

**DIRECTORATE OF EDUCATION**  
**Govt. of NCT, Delhi**

**SUPPORT MATERIAL**  
**(2021-2022)**

**SCIENCE**  
**Class : IX**  
**(English Medium)**

Under the Guidance of

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Pr. Secretary (Education)

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IAS**



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**MESSAGE**

I would like to congratulate the members of Core Academic Unit and the subject experts of the Directorate of Education, who inspite of dire situation due to Corona Pandemic, have provided their valuable contributions and support in preparing the Support Material for classes IX to XII.

The Support Material of different subjects, like previous years, have been reviewed/ updated in accordance with the latest changes made by CBSE so that the students of classes IX to XII can update and equip themselves with these changes. I feel that the consistent use of the Support Material will definitely help the students and teachers to enrich their potential and capabilities.

Department of Education has taken initiative to impart education to all its students through online mode, despite the emergency of Corona Pandemic which has led the world to an unprecedented health crises. This initiative has not only helped the students to overcome their stress and anxiety but also assisted them to continue their education in absence of formal education. The support material will ensure an uninterrupted learning while supplementing the Online Classes.

**(H. Rajesh Prasad)**

**UDIT PRAKASH RAI, IAS**  
Director, Education & Sports



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### **MESSAGE**

The main objective of the Directorate of Education is to provide quality education to all its students. Focusing on this objective, the Directorate is continuously in the endeavor to make available the best education material, for enriching and elevating the educational standard of its students. The expert faculty of various subjects undertook this responsibility and after deep discussions and persistent efforts, came up with Support Material to serve the purpose.

Every year the Support Material is revised/updated to incorporate the latest changes made by CBSE in the syllabus of classes IX to XII. The contents of each lesson/chapter are explained in such a way that the students can easily comprehend the concept and get their doubts solved.

I am sure, that the continuous and conscientious use of this Support Material will lead to enhancement in the educational standard of the students, which would definitely be reflected in their performance.

I would also like to commend the entire team members for their contributions in the preparation of this incomparable material.

I wish all the students a bright future.

(UDIT PRAKASH RAI)

**Dr. RITA SHARMA**  
Additional Director of Education  
(School/Exam)



Govt. of NCT of Delhi  
Directorate of Education  
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D.O. No. PA/Addl. DE/Sch/31

Dated: 29.06.2021

## MESSAGE

It gives me immense pleasure to present the revised edition of the Support Material. This material is the outcome of the tireless efforts of the subject experts, who have prepared it following profound study and extensive deliberations. It has been prepared keeping in mind the diverse educational level of the students and is in accordance with the most recent changes made by the Central Board of Secondary Education.

Each lesson/chapter, in the support material, has been explained in such a manner that students will not only be able to comprehend it on their own but also be able to find solution to their problems. At the end of each lesson/chapter, ample practice exercises have been given. The proper and consistent use of the support material will enable the students to attempt these exercises effectively and confidently. I am sure that students will take full advantage of this support material.

Before concluding my words, I would like to appreciate all the team members for their valuable contributions in preparing this unmatched material and also wish all the students a bright future.

(Rita Sharma)

# भारत का संविधान

## उद्देशिका

हम, भारत के लोग, भारत को एक <sup>1</sup>[संपूर्ण प्रभुत्व-संपन्न समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य] बनाने के लिए, तथा उसके समस्त नागरिकों को :

सामाजिक, आर्थिक और राजनैतिक न्याय,

विचार, अभिव्यक्ति, विश्वास, धर्म

और उपासना की स्वतंत्रता,

प्रतिष्ठा और अवसर की समता

प्राप्त कराने के लिए,

तथा उन सब में

व्यक्ति की गरिमा और <sup>2</sup>[राष्ट्र की एकता

और अखंडता] सुनिश्चित करने वाली बंधुता

बढ़ाने के लिए

दृढ़संकल्प होकर अपनी इस संविधान सभा में आज तारीख 26 नवम्बर, 1949 ई० (मिति मार्गशीर्ष शुक्ला सप्तमी, संवत् दो हजार छह विक्रमी) को एतद्वारा इस संविधान को अंगीकृत, अधिनियमित और आत्मार्पित करते हैं ।

- 
1. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3-1-1977 से) "प्रभुत्व-संपन्न लोकतंत्रात्मक गणराज्य" के स्थान पर प्रतिस्थापित ।
  2. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3-1-1977 से) "राष्ट्र की एकता" के स्थान पर प्रतिस्थापित ।

<sup>1</sup>[भाग 4क  
मूल कर्तव्य

51क. मूल कर्तव्य-भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह-

(क) संविधान का पालन करे और उसके आदर्शों, संस्थाओं, राष्ट्र ध्वज और राष्ट्रगान का आदर करे ;

(ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रेरित करने वाले उच्च आदर्शों को हृदय में संजोए रखे और उनका पालन करे ;

(ग) भारत की प्रभुता, एकता और अखंडता की रक्षा करे और उसे अक्षुण्ण रखे ;

(घ) देश की रक्षा करे और आह्वान किए जाने पर राष्ट्र की सेवा करे ;

(ङ) भारत के सभी लोगों में समरसता और समान भावना की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग पर आधारित सभी भेदभाव से परे हो, ऐसी प्रथाओं का त्याग करे जो स्त्रियों के सम्मान के विरुद्ध हैं ;

(च) हमारी सामासिक संस्कृति की गौरवशाली परंपरा का महत्व समझे और उसका परिरक्षण करे ;

(छ) प्राकृतिक पर्यावरण की, जिसके अंतर्गत वन, झील, नदी और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणि मात्र के प्रति दयाभाव रखे ;

(ज) वैज्ञानिक दृष्टिकोण, मानववाद और जानार्जन तथा सुधार की भावना का विकास करे ;

(झ) सार्वजनिक संपत्ति को सुरक्षित रखे और हिंसा से दूर रहे ;

(ञ) व्यक्तिगत और सामूहिक गतिविधियों के सभी क्षेत्रों में उत्कर्ष की ओर बढ़ने का सतत प्रयास करे जिससे राष्ट्र निरंतर बढ़ते हुए प्रयत्न और उपलब्धि की नई ऊंचाइयों को छू ले ;]

<sup>2</sup>[(ट) यदि माता-पिता या संरक्षक हैं, छह वर्ष से चौदह वर्ष तक की आयु वाले अपने, यथास्थिति, बालक या प्रतिपाल्य के लिए शिक्षा के अवसर प्रदान करे ।]

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<sup>1</sup> संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 11 द्वारा (3-1-1977 से) अंतःस्थापित ।

<sup>2</sup> संविधान (छियासीवां संशोधन) अधिनियम, 2002 की धारा 4 द्वारा (1-4-2010 से) अंतःस्थापित ।

## PART IV A

### FUNDAMENTAL DUTIES

**51A. Fundamental Duties** – It shall be the duty of every citizen of India.

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem.
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom.
- (c) to uphold and protect the sovereignty, unity and integrity of India.
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women.
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures.
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individuals and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;
- (k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

1. Ins. by the Constitution (Forty second Amendment Act, 1976, s 11 (w.e.f. 3-1-1977)

2. Ins. by the Constitution (Eighty Sixth Amendment) Act, 2002, s 4 (w.e.f. 1-4-2010)

# SCIENCE SUPPORT MATERIAL CLASS-IX

SESSION-(2021-22)

CLASS : IX

**Group Leader : Dr. Ravinder Kumar (Vice Principal)**  
**RPVV Civil Linex (1207113)**

Subject Experts	Designation	School/Branch
Mr. Ajay Kumar	TGT (N. Sci)	Core Academic Unit
Ms. Sadaf Faitma Merchant	TGT (N.Sci)	RPVV Sector-XI, Rohini, Delhi
Mr. Amit Kaushik	TGT (N.Sci)	RPVV B- Block, Yamuna Vihar, Delhi
Ms. Kiran	TGT (N.Sci)	GGSSS, B-1 Vasant Kunj, New Delhi
Ms. Richa Sakhuja Sethi	TGT (N.Sci)	SCSD SV Sec-9, Rohini, New Delhi
Mohd. Iftakhar Alam (Urdu Medium)	PGT (Bio.)	RPVV Link Road, Karol Bagh, N. Delhi-05



**Assessment Areas (Theory) 2020-21**  
**Science (086)**

**Time : 3hrs.**

**Maximum Marks : 80 Marks**

<b>Competencies</b>	
Demonstrate Knowledge and Understanding	46%
Application of Knowledge/Concepts	22%
Analyze, Evaluate and Create	32%

**Note:** • Typology of Questions:

- ❖ VSA including objective type questions, Assertion–Reasoning type questions: SA; LA;  
Source-based/Case-based/Passage-based/ Integrated assessment questions.
- ❖ An internal choice would be provided.

**Suggestive verbs for various competencies**

- Demonstrate Knowledge and Understanding  
State, name, list, identify, define, suggest, describe, outline, summarize, etc.
- Application of Knowledge/Concepts  
Calculate, illustrate, show, adapt, explain, distinguish, etc.
- Analyze, Evaluate and Create  
Interpret, analyze, compare, contrast, examine, evaluate, discuss, construct, etc.

<b>Internal Assessment (20 Marks) (Term I and Term II 10 marks each)</b>	
Periodic Assessment (PT + MA)	03
Subject Enrichment (Practical Work)	03
Portfolio	02
Multiple Assessment	02

(Note : Pl. follow instruction provided by CBSE for Assessment Area, Courses Structure and Question Paper Design)

# Course Structure (2021-22)

## Class – IX

EVALUATION SCHEME		
Theory		
Units	Term-I	Marks
<b>I</b>	Matter – Its Nature and Behaviors: Chapter-2	09
<b>II</b>	Organization in the Living World Chapter - 5 and 6	18
<b>III</b>	Motion, Force and Work : Chapter - 8 and 9	13
Units	Term-II	Marks
<b>I</b>	Matter – Its Nature & Behaviors: Chapter-3 and 4	18
<b>II</b>	Organization in the Living World: Chapter - 13	08
<b>III</b>	Motion, Force and Work : 10 and 11	14
<b>Total Theory (Term I + II)</b>		80
<b>Internal Assessment : Term I</b>		10
<b>Internal Assessment : Term II</b>		10
<b>Grand Total</b>		100

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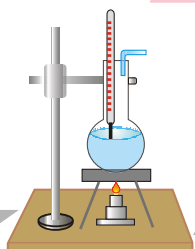
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## CONTENT

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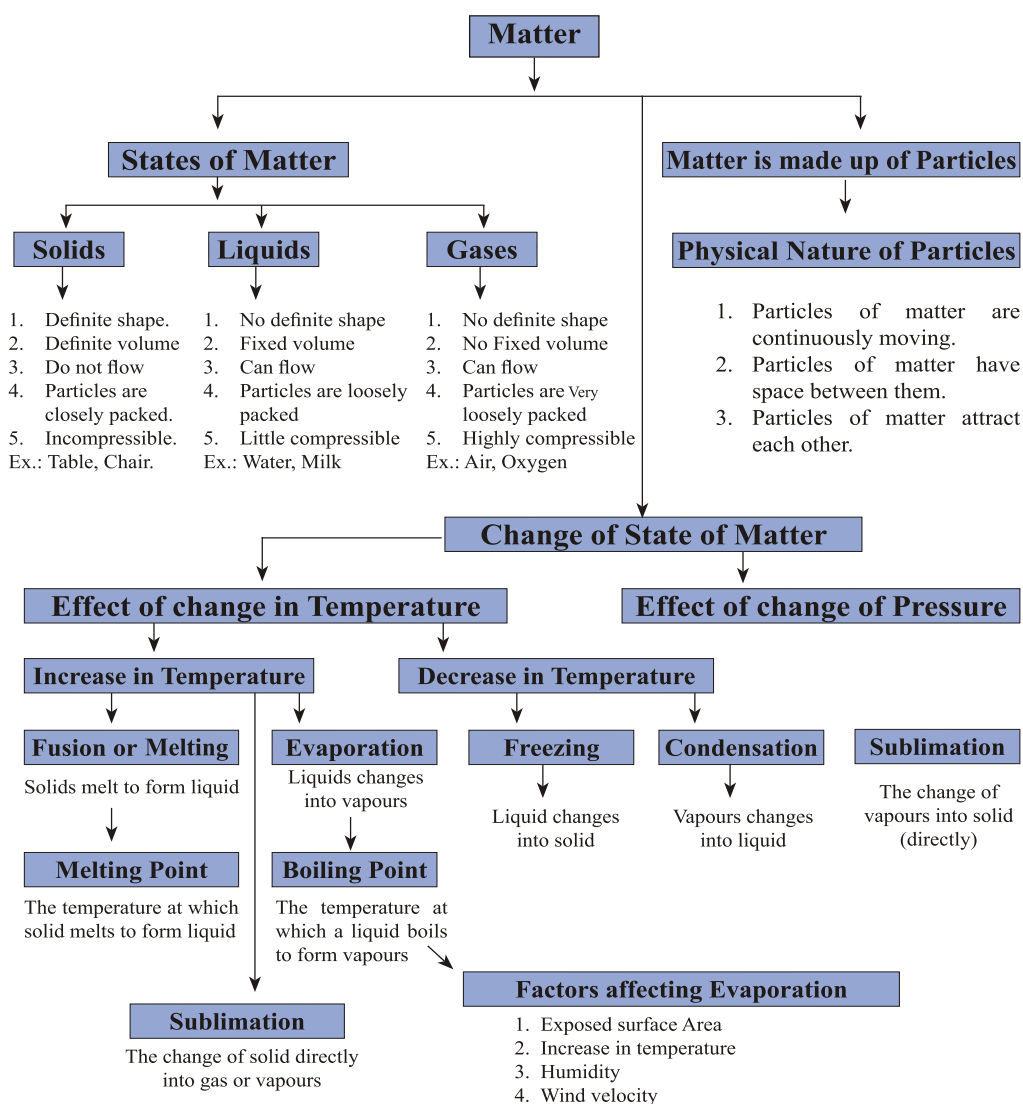
S. No.	Chapter Name	Pg. No.
1.	Matter in Our Surrounding	1-12
2.	Is Matter Around us Pure ?	13-28
3.	Atoms and Molecules	29-46
4.	Structure of the Atom	47-60
5.	The Fundamental Unit of Life	61-77
6.	Tissue	78-101
7.	Diversity in Living Organism	102-122
8.	Motion	123-141
9.	Force and Laws of Motion	142-159
10.	Gravitation	160-174
11.	Work and Energy	175-190
12.	Sound	191-209
13.	Why do we Fall Ill?	210-221
14.	Natural Resources	222-235
15.	Improvement in Food Resources	236-250
16.	Experiment	251-304
17.	Question Paper for Practice	305-324



## Chapter - 1

# Matter In Our Surrounding

## CONCEPT MAPPING



## Matter

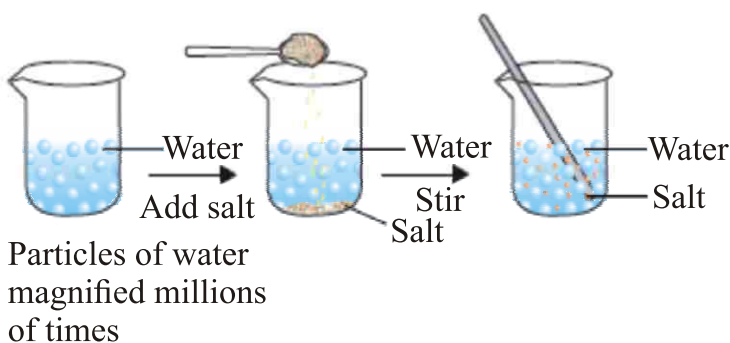
The matter is the material of which everything in this universe, (in and around us) is made up of. It is anything that occupies space and has mass and offers resistance to any applied force.

### *Physical Nature of Particles :*

Matter is made up of particles. The particles of matter are very-very small.

### *Characteristics of Particles :*

- (i) **Particles of matter are continuously moving** i.e., they possess kinetic energy. As the temperature rises, particles move faster because kinetic energy of the particles increases.
- (ii) **Particles of matter have space between them.** When we make tea, coffee or lemonade (nimbu pani), particles of one type of matter get into the space between particles of the other. This shows that there is enough space between particles of matter.



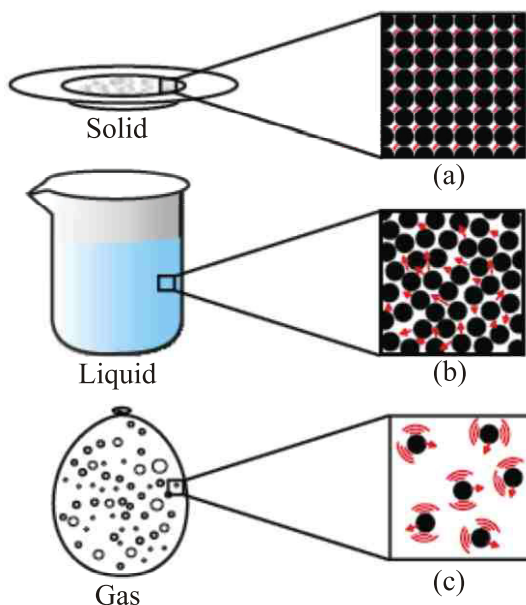
*When we dissolve salt in water, the particles of salt get into the space between particles of water.*

### **Particles are varying and have spaces between them**

- (iii) **Particles of matter attract each other.** When we open a water tap, try to break the stream of water with our fingers, can we do this? No, because the stream of water remains together. Particles of water are held together because of the force of attraction between them.

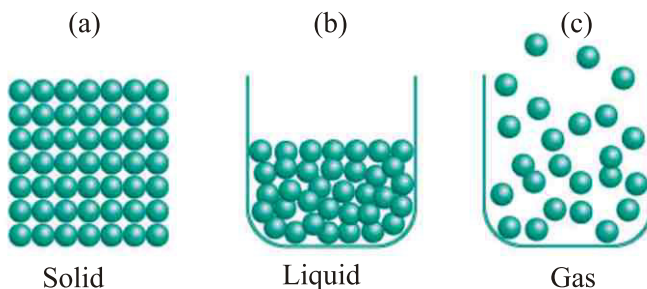
- *The space between the particles and kinetic energy of particles is minimum in solids, intermediate in liquids and maximum in gases.*
- *The force of attraction between the particles is strongest in solids, intermediate in liquids and weakest in gases.*

- *Movement of particles is minimum in solids, more in liquids and maximum in gases.*



*a, b and c show the magnified schematic pictures of the three states of matter. The motion of the particles can be seen and compared in the three states of matter.*

**Fig. Three states of matter**



### Arrangement of particles in three states of matter and their movements

#### States of Matter

The physical states of a matter are : (i) Solid, (ii) Liquid, (iii) Gas.

We can classify our body into three states of matter i.e.,

- (i) Bones and teeth are solids.
- (ii) Blood and water present in our body are liquids.
- (iii) Air in our lungs is gaseous.

**(i) Solid State:**

Characteristics of solid states are :

- (a) Have definite shape.
- (b) Have distinct boundaries.
- (c) Have rigidity and incompressibility.
- (d) Have definite volume.

**Some Exceptional Examples:** Rubber band is a solid but it can change its shape under force and regains its shape when force is removed. If excessive force is applied, it breaks.

The solids have fixed and rigid shape. The kinetic energy of the particles in the solid state is very less and therefore, solids have fixed and rigid shape.

- *We can compress sponge as its pores are filled with air but it is solid.*
- *Salt and sugar take the shape of the container in which they are placed but shape of their crystals do not change, so they are solids.*

**(ii) Liquid State :**

The characteristics of liquid state are :

- (a) Have fluidity i.e., they are not rigid.
- (b) Low compressibility.
- (c) No definite shape and boundaries. They take the shape of the vessels.
- (d) Have definite volume.
- *Force of attraction between the particles of liquid keeps its volume same.*
- *Liquids are substances having fixed (definite) volume and no fixed shape. They take the shape of the container in which they are stored.*
- *The gases (oxygen and carbon dioxide) from the atmosphere diffuse and dissolve in water. Due to these gases aquatic plants and animals are able to survive. Diffusion is much more in liquids than in solids due to free movement of particles of liquids.*

**(iii) Gaseous State :**

The characteristics of gaseous state are :

- (a) Have fluidity.
- (b) Have high compressibility.
- (c) Have no definite boundaries.
- (d) Have no definite shape.
- (e) Have no definite volume.
- *The particles in a gas are free to move in any direction hence gases can flow.*
- *Gases are substance that do not have fixed volume and occupy all the volume available to them.*

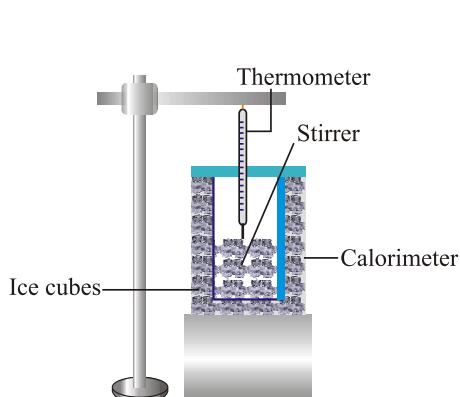
- *Pressure of gas is the force applied on the walls of vessel by the irregular moving gas particles.*

### Change of State of Matter

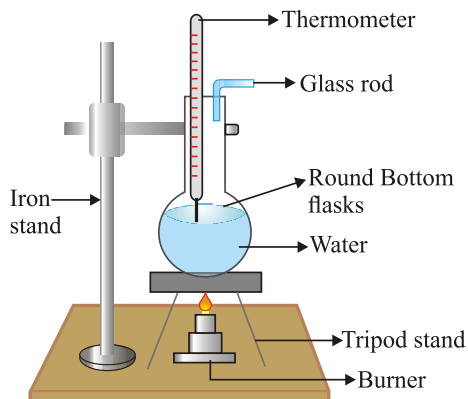
- Water can exist in three states of matter i.e., solid – ice, liquid – water, gas – water vapour.
- On heating ice melts into water and then converts into water vapours.

*Change in the physical state of matter can be done in two ways :*

#### (A) By Changing the Temperature :



(a) Melting of ice to form water



(b) Boiling of water to form water vapour

- (i) **Melting Point :** The temperature at which a solid melts to form liquid at atmospheric pressure is called its melting point. Melting point of ice is 273.16 K (0°C). During melting the temperature of ice does not rise even though heat is being supplied continuously because of latent heat of fusion. This latent heat of fusion is used up to overcome the forces of attraction between ice particles. At 0° C energy of water particles is much more than the energy of particles of ice at 0°C.

- **Latent Heat of Fusion :** *The amount of heat required to change 1 kg solid to its liquid state (at its melting point) at atmospheric pressure.*

(ii) **Boiling Point :** The temperature at which a liquid boils to form vapours at atmospheric pressure is called its boiling point. Boiling point of water is 373 K (100° C + 273 = 373 K).

- **Latent Heat of Vapourization :** *The amount of heat required to change 1 kg liquid to its gaseous state (at its boiling point) at atmospheric pressure.*
- *During boiling the temperature of water does not rise even though heat is being supplied continuously as this heat of vapourization is used up to overcome the forces of attraction between water particles.*



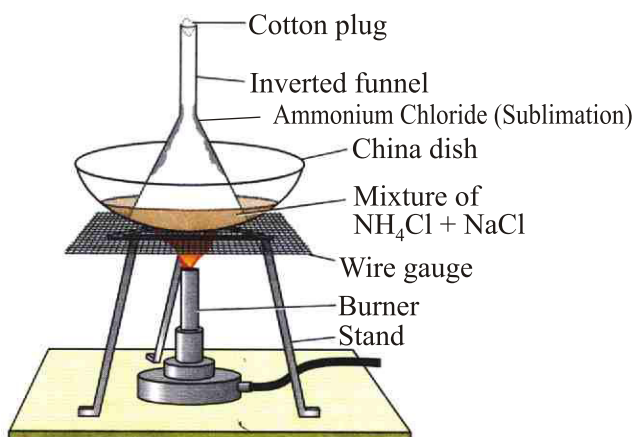
At 100°C, energy of water vapours is much more than the energy of water at 100°C. So, we can change one state of matter to another state by changing temperature.



- At 25°C, Water is liquid.
- At 0°C, Water is solid (ice).
- At 100°C, water is gaseous state (steam).

**(iii) Sublimation :** The change of solid directly into vapours on heating and of vapours into solid on cooling without passing through the intervening liquid state is called sublimation.

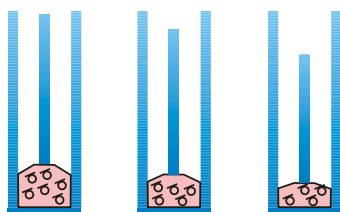
*Example :* When camphor or ammonium chloride is heated in a China dish covered by a inverted funnel (with cotton plug in its upper open end), the vapours of ammonium chloride are converted into solid ammonium chloride on coming in contact with the cold inner walls of the funnel.



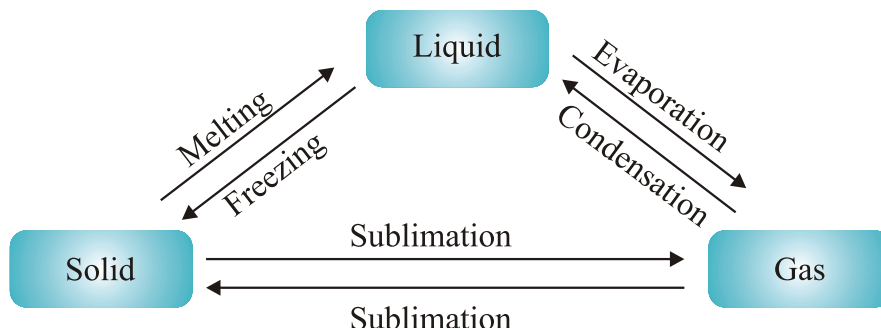
### Sublimation of Ammonium Chloride

#### (B) Effect of Change of Pressure :

If we compress a gas in a cylinder, the distance between the particles of gas is reduced and finally gas is liquefied on lowering temperature.



- *By applying high pressure, the particles of a gas can be brought close together.*
- *Solid carbon dioxide (dry ice) is changed into carbon dioxide gas directly without changing into liquid when pressure is reduced to one atmospheric pressure.*
- *Thus, states of matter i.e., solid, liquid and gas are determined by temperature & pressure.*



**Evaporation** : A surface phenomenon in which liquid changes into vapours at any temperature below its boiling point is called evaporation. Particles on the surface of a liquid have higher kinetic energy than others, so they break the forces of attraction between the particles & escape from the surface of liquid in the form of vapours.

**Factors affecting evaporation** : Rate of evaporation depends on :

- Exposed surface area** : On increasing surface area of liquid, rate of evaporation increases.
- Increase in temperature** : Increases kinetic energy of particles hence rate of evaporation increases.
- Humidity** : When the humidity of air (degree of dampness of air) is low, evaporation rate is increased. More humidity, less evaporation.
- Wind** : When wind speed increases, rate of evaporation also increases.

**Evaporation always causes cooling** : The cooling caused by evaporation is based on the fact that when a liquid evaporates, it takes latent heat of vaporization from surroundings which on losing heat get cooled.

### *Examples :*

- When we put acetone on our hand, it gets vapourized by taking heat from our hand and our hand feels cool.

- (ii) We should wear cotton clothes in summer to keep us cool and comfortable as cotton is good absorber of water, so it absorbs the sweat from our body and exposes it to air for evaporation of sweat thus cools our body.
- (iii) Often people sprinkle water on ground during summer. This water takes heat from ground and surrounding air to evaporate, thus making the place cool.

## QUESTIONS

### VERY SHORT QUESTIONS

1. Write different states of matter.
2. Which has more density – liquid or solid ?
3. What is the melting point of ice ?
4. Boiling point of alcohol is  $78^{\circ}\text{C}$ . Change it into Kelvin scale ?
5. Why do gas exert pressure ?
6. How do we liquefy the gases ?
7. What happens to particles when salt dissolves in water ?
8. What is the physical state of water at:  
(a)  $0^{\circ}\text{C}$  (b)  $25^{\circ}\text{C}$
9. What is the chemical name of dry ice ?
10. Why is heat energy needed to melt a solid ?

### SHORT QUESTIONS

1. Classify the matter on the basis of physical characteristics ?
2. Why solid carbon dioxide is called 'dry ice' ?
3. Why do we keep ether and acetone at cool places ?
4. Write two factors which will increase rate of evaporation ?
5. Which gas is supplied in the liquefied form at home and in hospitals ?
6. Compare the force of attraction between iron, rubber band and chalk ?
7. Arrange sugar, water and oxygen in the increasing order of force of attraction between their particles ?
8. Define boiling point, melting point and evaporation ?
9. What is sublimation? Name two substances which undergo sublimation.
10. Why does steam causes more severe burns than boiling water?
11. Change the temperature in celsius scale temperature :  
(a)  $293\text{ K}$  (b)  $470\text{ K}$ .

## LONG QUESTIONS

1. Describe the factors affecting evaporation ?
2. (a) Why do we wear cotton clothes in summers ?  
(b) Why do we feel cold, when we keep acetone or ether on our palm ?
3. Write three characteristics of particles of matter. Give one example of each ?
4. Write the characteristic responsible for :  
(a) Smell of perfume spreads in the room.  
(b) Water takes the shape of the container in which it is kept.
5. Name three states of matter. Give one example of each and state three characteristic properties of each.
6. Compare the properties of solids, liquids and gases in tabular form.
7. (a) Write full forms of (i) LPG (ii) CNG  
(b) Draw the 'states of matter triangle' to show the interconversion of states of matter.
8. (a) Why does a desert cooler cool better on a hot, dry day?  
(b) What is evaporation? How can the evaporation of a liquid be made faster?

## OBJECTIVE TYPE QUESTION:

1. A few substances are arranged in the increasing order of 'forces of attraction' between their particles. Which one of the following represents a correct arrangement ?  
(a) Water, air, wind  
(b) Air, sugar, oil  
(c) Oxygen, water, sugar  
(d) Salt, juice, air

2. Which one of the following sets of phenomena would increase on raising the temperature ?
- (a) Diffusion, evaporation, compression of gases.
  - (b) Evaporation, compression of gases, solubility
  - (c) Evaporation, diffusion, expansion of gases.
  - (d) Evaporation, solubility, diffusion, compression of gases.
3. The property to flow is unique to fluids. Which one of the following statements is correct?
- (a) Only gases behave like fluids
  - (b) Gases and solids behave like fluids
  - (c) Gases and liquids behave like fluids
  - (d) Only liquids are fluids
4. Choose the correct statement of the following:
- (a) conversion of solid into vapours without passing through the liquid state is called sublimation.
  - (b) conversion of vapours into solid without passing through liquid state is called vaporisation.
  - (c) conversion of vapours into solid without passing through the liquid state is called freezing.
  - (d) conversion of solid into liquid is called sublimation.
5. During summer, water kept in an earthen pot becomes cool because of the phenomenon of
- (a) diffusion.
  - (b) transpiration
  - (c) osmosis.
  - (d) evaporation

6. On converting 25°C, 38°C and 66°C to kelvin scale, the correct sequence of temperature will be
- 298K 311K and 339K
  - 298K, 300K and 338K
  - 273K, 278K and 543K
  - 298K, 310K, and 338K

$$[K=273+t^{\circ}C]$$

7. Fill in the blanks:
- The boiling points of, acetone is 329 K, its temperature in Celsius will be .....°C.
  - The arrangement of particles is ordered in the ..... state. However there is no order in the ..... state.
  - Evaporation of a liquid at room temperature leads to a ..... effect.
  - Osmosis is a special kind of .....
8. Match the physical quantities given in column A to their S. I. units given in column B :

Column A	Column B
Temperature	Pascal
Density	Cubic Metre
Volume	Kelvin
Pressure	Kilogram per cubic meter

9. Choose the correct option given in bracket.
- The amount of heat required to change 1 kg solid to its liquid state at atmospheric pressure is known as its .....
- (Latent heat of fusion / Latent heat of vaporisation)

**Assertion and reason type questions:-**

Two statements are given one labelled assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true but R is not the correct explanation fo A.
- (c) A is true but R is false.
- (d) A is false but R is true.

1. Assertion (A) : Steam causes severe burn than boiling water  
Reason (R) : Steam has latent heat.
2. Assertion (A) : A glass filled with ice has water droplets on its outer surface  
Reason (R) : Ice is liquid state of water.

**Answers:**

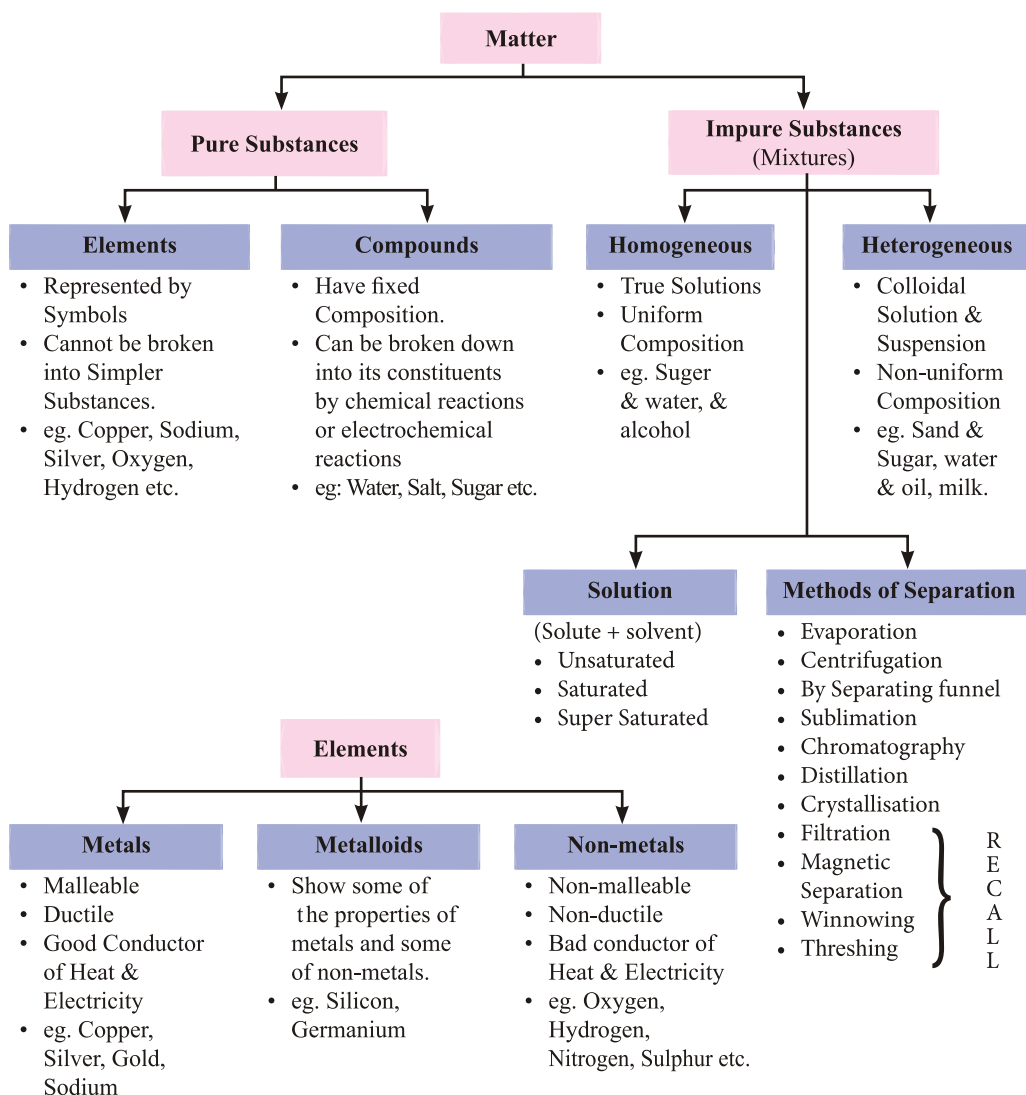
1. (a)
2. (c)



# Is Matter Around Us Pure ?

## Chapter - 2

### CONCEPT MAPPING





**'Pure'** word means that there is no mixing in a substance. But according to scientific language all things are mixture of so many substances, not of single one. That's why they are not pure.

E.g. Milk, water, fat, etc.

- *Pure substances means that all elements have same chemical properties.*
- *A pure substance is made up of same kind of elements.*

**Substance :** A substance is a kind of matter that cannot be separated into other kind of matter by any physical process. A pure substance is made up of same kind of elements.

### What is a mixture ?

It is a substance in which two or more substances (element or compound) are simply mixed together in any proportion. Examples : The air is a mixture of oxygen, nitrogen, carbon dioxide and water vapour.

**Types of Mixture : Mixture is of two types :**

- Homogenous mixture
- Heterogenous mixture

**Homogenous Mixture :** These types of mixtures have no visible boundaries of separation between the various constituents.

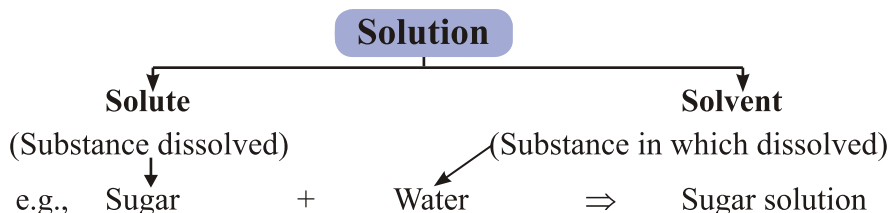
**Example :** Sugar in water. It has a uniform composition throughout its mass.

**Heterogenous Mixture :** These types of mixtures have visible boundaries of separation between the various constituents.

**Example :** Mixture of sugar and sand. It does not have a uniform composition throughout its mass.

**Solution :** A solution is a homogenous mixture of two or more substances. E.g., Nimboo pani, soda water.

**Solution :** A solution has a solvent and a solute as its components. The component of the solution that dissolves the other component in it is called the solvent. The component of the solution that is dissolved in the solvent is called the solute.



## Types of Mixtures

True	Colloidal	Suspension
1. Size of solute particles is smallest. $< 10^{-9}$ m.	1. Size of solute particles bigger than true but smaller than suspension. In between $10^{-9}$ to $10^{-6}$ m.	1. Size of particles biggest. $> 10^{-6}$ m.
2. Solute particles can't be seen with naked eye.	2. Solute particles can't be seen with Naked eye.	2. Can be seen with naked eye.
3. Homogenous mixture.	3. Seems homogenous but actually heterogenous mixture.	3. Heterogenous mixture.
4. Particles can't be separated by filtration.	4. Particles can't be separated by filtration.	4. Can be Separated by filtration.
5. Transparent	5. Translucent	5. Opaque
6. Stable solutions - i.e., solute particles do not settle on keeping.	6. Stable solutions.	6. Unstable solution – solute particles settle upon keeping.
7. Do not show tyndall effect.	7. Show tyndall effect.	7. May or may not show tyndall effect.
8. Solution diffuse rapidly through filter paper as well as parchment paper.	8. Colloid particles pass through filter paper but not through parchment paper.	8. Suspension particles do not pass through filter paper as well as parchment paper.
9. e.g., Sugar in water.	9. e.g., Milk, blood.	9. e.g., Sand/mud in water.

### Common examples of colloids :

	Dispersal Phase (Solute)	Dispersion Medium (Solvent)	Type	Example
1.	Liquid	Gas	Aerosol	Fog, cloud
2.	Solid	Gas	Aerosol	Smoke

3	Gas	Liquid	Foam	Shaving Cream
4.	Liquid	Liquid	Emulsion	Milk, face cream, emulsion paint
5.	Solid	Liquid	Sol	Mud, digene
6.	Gas	Solid	Foam	Foam, rubber sponge
7.	Liquid	Solid	Gel	Jelly, cheese
8.	Solid	Solid	Solid sol	Coloured gemstones, glass (milky, coloured)

• Gas in gas is not a colloidal solution – it is called a mixture.

### Concentration of Solution

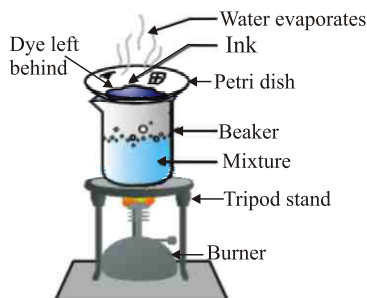
1. Mass by mass percentage  $= \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$
2. Mass by volume percentage  $= \frac{\text{mass of solute}}{\text{volume of solution}} \times 100$

### Methods of Separation of Mixtures :

#### (1) Evaporation :

Basic principal : Out of the two components of a mixture one can evaporate [i.e., has less boiling point] and other has higher boiling point.

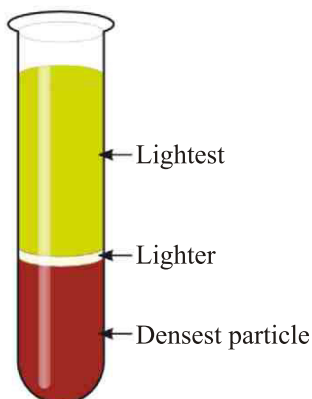
**Example :** Mixture of dye [higher boiling point] and water. Out of water and dye, water evaporates but dye is left behind in petri dish.



#### (2) Centrifugation :

Basic principle : Separation of Substances or particles on the basis of

their density, when mixture is rotated very fast, then denser particles are forced at the bottom and lighter particles stay above.



**Example :** Separating cream from milk.

Can you think what is toned and double toned milk ?

*Applications :*

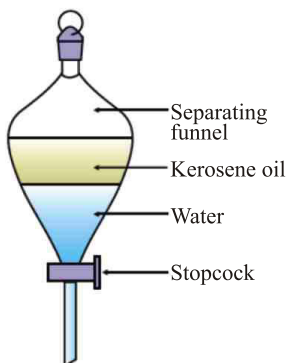
- (a) Used in diagnostic labs for blood and urine tests.
- (b) Used in dairies and home to separate butter from cream.
- (c) Used in washing machines dryers to squeeze out water from clothes.

Have you seen dust particles from our clothes settle at the bottom of washing tub.  
Do you know why now ?

### (3) By Separating Funnel:

**Basic principle :** Two immiscible liquids (which do not dissolve in each other) can be easily separated by putting in a separating funnel.

**Example :** Water from oil can be separated by first opening the stop cock till water is removed in one beaker, then afterwards oil can be collected in a separate beaker.



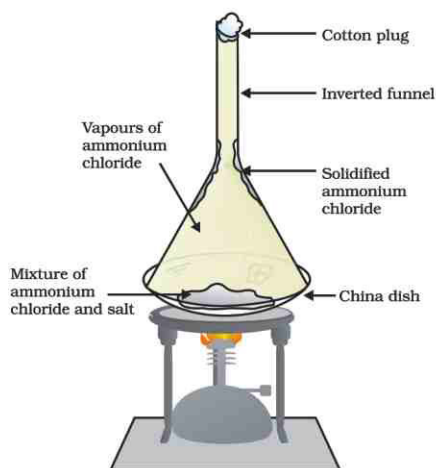
*Applications :*

- (a) Separation of oil from water.
- (b) Extraction of iron from its ore. Lighter slag is removed from above the molten iron.

#### (4) Sublimation :

**Basic principle :** Out of the two components, one will sublime (directly converts to gas from solid) and other will not.

**Example:**  $\text{NH}_4\text{Cl}$  (ammonium chloride) and  $\text{NaCl}$  common salt mixture can be easily separated by heating so the  $\text{NH}_4\text{Cl}$  sublimates but common salt remains behind.



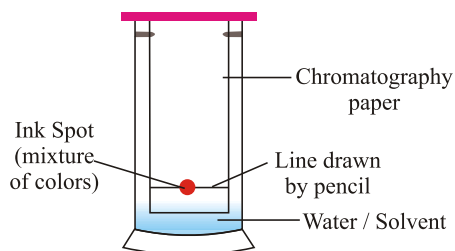
*Applications :*

- (a) Camphor, naphthalene, anthracene,  $\text{NH}_4\text{Cl}$  can sublime.

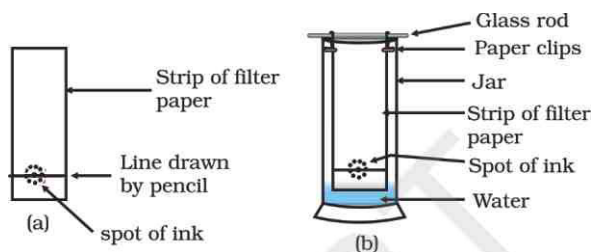
#### (5) Chromatography :

**Basic principle :** Coloured components of a mixture can be separated by using an Adsorbent on which they are adsorbed at different rates.

*(Adsorption is the process of surface absorption.)*



When water/any suitable solvent moves up the chromatography paper ink with two different colours separates because both colours are absorbed at different speeds.



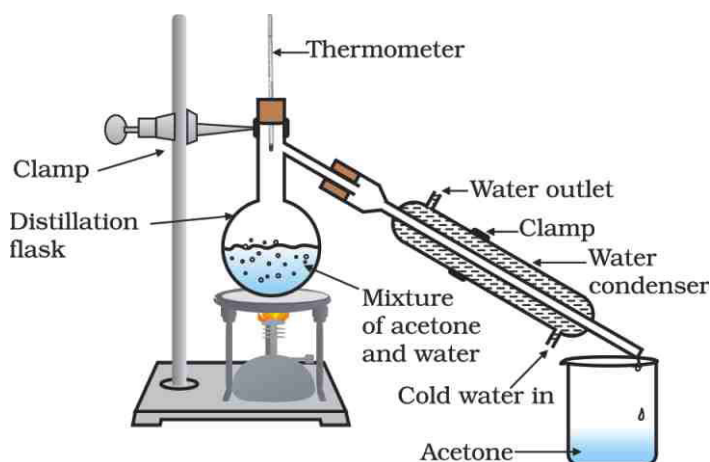
*Applications :*

- (a) To separate colours of a dye.
- (b) To separate pigments from natural colours like chlorophyll.
- (c) To separate drugs from blood.

*(Can you guess what is done when athletes undergo a doping test for their blood?)*

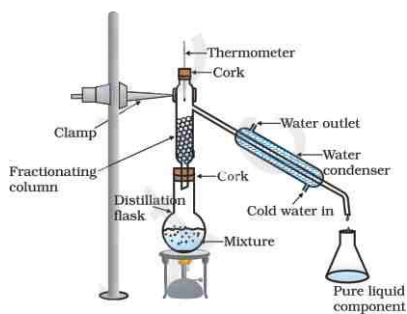
## (6) Distillation :

Basic principle : Based on Separating mixture of miscible liquids having different boiling points, followed by condensation. Out of the two components one has a lower boiling point and other has higher boiling point. This is used to separate two or more miscible liquids.



**Example :** When mixture of acetone and water is heated, acetone having lesser boiling point, boils and moves to delivery tube, within which it condenses back to liquid with the help of a condenser clamped to it. Thus, acetone is separated out in a beaker and water is left in the distillation flask.

**Note :** If there are more than two components (liquids) mixed (with different boiling points) then we use a fractionating column to separate all the components from each other. This process is done for air, petroleum etc.



*Petroleum is separated into paraffin wax, lubricating oil, diesel, kerosene, petrol and petrol gas by this method.*

### Fractional Distillation of Air :

Air is also separated by this method.

Air  $\xrightarrow[\text{cooled}]{\text{compressed and}}$  Liquid air  $\longrightarrow$  Allowed to warm  $\longrightarrow$  Gases separated  
up slowly in a fractionating column at different heights

Some of the applications of fractional distillation :

- In petroleum refineries, petrochemical and chemical plants, natural gas processing and cryogenic air separation plants.
- In oil refineries to separate crude oil into useful substances (or fractions).
- In the separation of oxygen, liquid nitrogen and argon from air.

### (7) Crystallisation :

**Basic principle :** To remove impurities from a mixture by first dissolving in a suitable solvent and then crystallising out one component.

*For example :* Copper sulphate crystals (impure) are first dissolved in sulphuric acid and then heated to saturated solution. Now, this solution is left overnight. So, only pure copper sulphate crystals on filter paper.

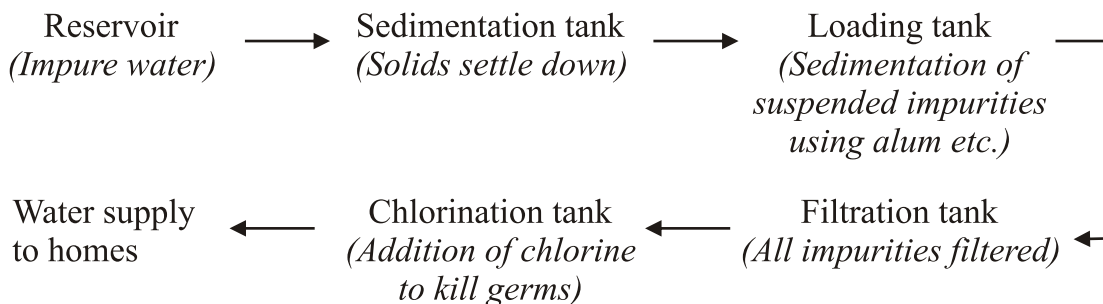
Why is crystallisation better than evaporation ?

- Some solids decompose or get charred upon heating to dryness during evaporation. e.g., sugar.
- Some impurities remain dissolved in solution after filtration. On evaporation, these impurities do not evaporate and remain with the mixture.

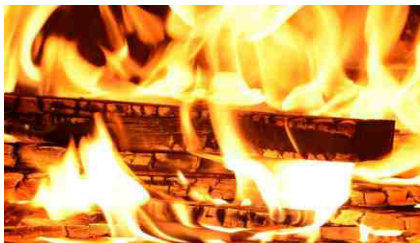

*Applications :*

- Purification of salt from sea water.
- Separation of crystals [e.g., alum (phitkari), copper sulphate] from their impure crystals.

## Water purification in water treatment plants



## Physical Vs Chemical Changes

Chemical	Physical
<ul style="list-style-type: none"> <li>• Not easily reversible</li> <li>• New Product(s) formed</li> <li>• Reactants used up</li> <li>• Often heat/light/sound/fizzing occurs</li> <li>• Electricity may be produced</li> <li>• A precipitate may form e.g., Wood burning</li> </ul>	<ul style="list-style-type: none"> <li>• Easily reversible</li> <li>• No new products</li> <li>• Often just a state change e.g., ice melting</li> </ul>
	

### Elements

Made of same type of atoms

S.No.	Metals	Non-metals	Metalloids
1.	Lustrous	Non-lustrous	Metalloids have intermediate properties between metals and non-metals.



2.	Malleable, ductile	Non-malleable, non-ductile	E.g., Boron, Germanium, Silicon
3.	Sonorous	Non-sonorous	
4.	Good conductors of heat & electricity	Bad conductors	
5.	e.g., Gold, iron etc.	e.g., Oxygen, Phosphorus	

Mixture	Compound
1. Elements or compounds are simply mixed so no new substance is formed.	1. Substances are reacted together with each other to make a new substance.
2. Elements do not combine in a fixed ratio.	2. Composition of the components is fixed i.e., they combine together in a fixed ratio according to their masses.
3. A mixture shows the properties of its components.	3. Compound doesn't show the properties of component elements.
4. Components can be easily separated by any mechanical method which is suitable.	4. Components can't be separated from each other by simple mechanical methods.
5. e.g., Mixture of iron and sulphur.	5. e.g., Iron and sulphur react to form iron sulphide.

# QUESTIONS

## VERY SHORT ANSWER TYPE QUESTIONS

- Classify the following into homogenous and heterogenous mixtures :
  - Ice
  - Soil
  - Wood
  - Air
- Name the type of mixture formed by mixing sulphur and carbon disulphide.
- Justify the statement that: 'Rusting of iron is corrosion and it is a chemical change'.
- Name the processes used for separation :
  - Miscible liquids
  - Immiscible liquids
  - Butter from milk
  - Sand from water-sand mix
  - Separation of colours in dyes.
  - Camphor from camphor, sand and salt
  - Alcohol from aqueous alcohol.
- Name the apparatus by which mixture of oil and water can be separated.
- A hard substance produces a tinkling sound when beaten. Is it metal or a non metal?
- What type of solution is an alloy?
- Classify the following as physical change or chemical change.
  - Burning of magnesium ribbon in air
  - Burning of sulphur in air
  - Electrolysis of water.
- Which component of the mixture (Iron & sulphur) reacts with dil HCL and gives hydrogen gas?
- Crystallization is a better technique than simple evaporation. Give one reason to justify the statement.

## SHORT ANSWER TYPE QUESTIONS

1. What is meant by concentration of a solution?
2. List the two conditions essential for using distillation as a method for separation of the components from a mixture.
3. Smoke and fog both are aerosols. In what ways are they different?
4. Salt can be recovered from its solution by evaporation can you suggest any other method also?
5. Can we separate alcohol dissolved in water by using a separating funnel?  
If yes, then describe the procedure. If not, explain.
6. Crystallization is a better method or technique than separation for separating substances from a mixture. Give one reason to justify the statement.
7. A solution is prepared by adding 40 gm of sugar in 100 gm of water. Calculate the concentration in terms of mass by mass percentage of solution.
8. What is chromatography? Mention its two applications.
9. Write down the processes in sequential order involved in to get the supply of drinking water to your home from the water works (Flow-chart).
10. How many litres of 15% (m/v) sugar solution would it take to get 75 gm of sugar ?  
[Hint : 15% of  $(75+x) = 75$ ]

## LONG ANSWER TYPE QUESTIONS

1. Why the interconversion of states of matter is considered as a physical change? Give three reasons to justify your answer.
2. During an experiment the students were asked to prepare a 20% (mass/mass) solution of sugar in water. Ram dissolved 20 gm of sugar in 100 gm of water while Sohan prepared it by dissolving 20 gm of sugar in water to make 100 gm of solution.
  - (a) Are the two solutions of the same concentration.
  - (b) Compare the mass% of the two solutions.
  - (c) Whose solution contain less amount of solute.
3. When a fine beam of light enters a room through a small hole, Tyndall effect is observed, Explain, why does this happen ? Give one more example where this effect can be observed.

4. With the help of flow diagram, show the process of obtaining or separating different gases from air. If the boiling points of oxygen, argon and nitrogen are  $-183^{\circ}\text{C}$ ,  $-186^{\circ}\text{C}$  and  $-196^{\circ}\text{C}$  respectively, which gas gets liquified first as the air is cooled?
5. You are provided with a mixture containing sand, iron fillings, ammonium chloride and sodium chloride. Describe the procedures you would use to separate these constituents from the mixture.
6. Sometimes the solid particles in a liquid are so small and pass through filter paper : Suggest a technique which is used to separate solid from liquid. What is the principal of this method? Explain the process with an example.

## OBJECTIVE TYPE QUESTIONS :

1. Complete the sentence by choosing the correct words given in the bracket:
  - a. Pure substances are ..... and have the same ..... throughout.
  - b. Mixture of sulphur and carbon disulphide is. .... and does not show ..... (homogenous, heterogeneous, Tyndall effect).
  - c. Tincture of iodine has antiseptic properties. This solution is made by dissolving ..... in ..... (potassium iodide, iodine, water, alcohol)
2. Which of the following are homogeneous in nature ?
 

(i) ice.	(ii) wood.	(iii) soil	(iv) air
(a). (i) and (iii)	(b). (ii) and (iv)		
(c). (i) and (iv)	(d) (iii) and iv)		
3. Which of the following are physical changes ?
 

(i) Melting of iron metal.	(ii) Rusting of iron
(iii) Bending of an iron rod.	(iv) Drawing a wire of iron metal

  - a. (i), (ii) and (iii),
  - b. (i), (ii) and (iv)
  - c. (i), (ii) and (iv)
  - d. (ii), (iii) and (iv)
4. Which of the following are chemical changes ?
 

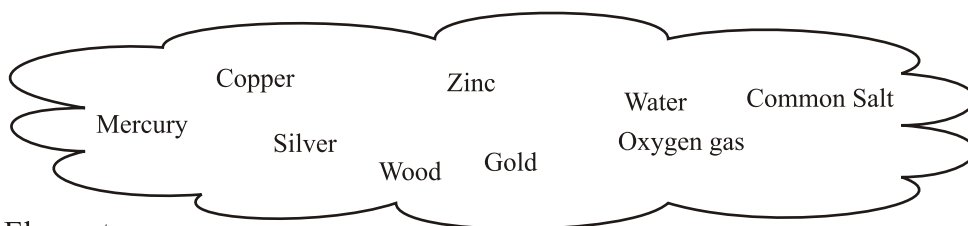
(i) Decaying of wood.	(ii) Burning of wood
(iii) Sawing of wood.	(iv) Hammering of a nail into a piece of wood

5. Give one word for the given sentences :
- Salt can be recovered from its solution by evaporation. Name another technique for the same .....
  - Technique by which Mercury and water can be separated .....
  - Technique by which water and sand can be separated .....
  - Technique by which cream can be separated from milk .....
6. Name the process associated with the following:
- Dry ice is kept at room temperature and at one atmospheric pressure.
  - A drop of ink placed on the surface of water contained in a glass spreads throughout the water.
  - A potassium permanganate crystal is in a beaker and water is poured into the beaker with stirring.
  - An acetone bottle is left open and the bottle becomes empty.
  - Settling of sand when a mixture of sand and water is left undisturbed for some time.
  - Fine beam of light entering through a small hole in a dark room, illuminates the particles in its paths.
7. Give an example each for the mixture having the following characteristics. Suggest a suitable method to separate the components of these mixtures
- A volatile and a non-volatile component .....
  - Two volatile components with appreciable difference in boiling points.....
  - Two immiscible liquids .....
  - One of the components changes directly from solid to gaseous state .....
  - Two or more coloured constituents soluble in some solvent .....

8. Which of the following are not compounds ?

- a. Chlorine gas
- b. Potassium chloride
- c. Iron.
- d. Iron sulphide
- e. Aluminum
- f. Iodine
- g. Carbon
- h. Carbon monoxide

9. Classify the substances given in the cloud into elements and compounds :



Elements :

Compounds :

10. Sugar crystals obtained from sugarcane and beetroot are mixed together. Will it be pure substance or a mixture ?  
Yes or No

### Assertion-Reason Type Questions:-

Two statements are give-one labelled assertion (A) and the other labelled Reason (R). Select the correct answer to the question from the codes (a), (b), (c), (d) as given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true but R is not the correct explanation fo A.
- (c) A is true but R is false.
- (d) A is false but R is true.

1. Assertion (A) : A mixture of Ammonium chloride and sodium chloride can be separated by sublimation.

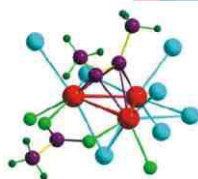
Reason (R) : Sodium chloride sublimes on heating.

2. Assertion (A) : A mixture of kerosene and water cannot be separated by a separating funnel.

Reason (R) : Kerosene oil and water have different densities and are insoluble

### Answers :

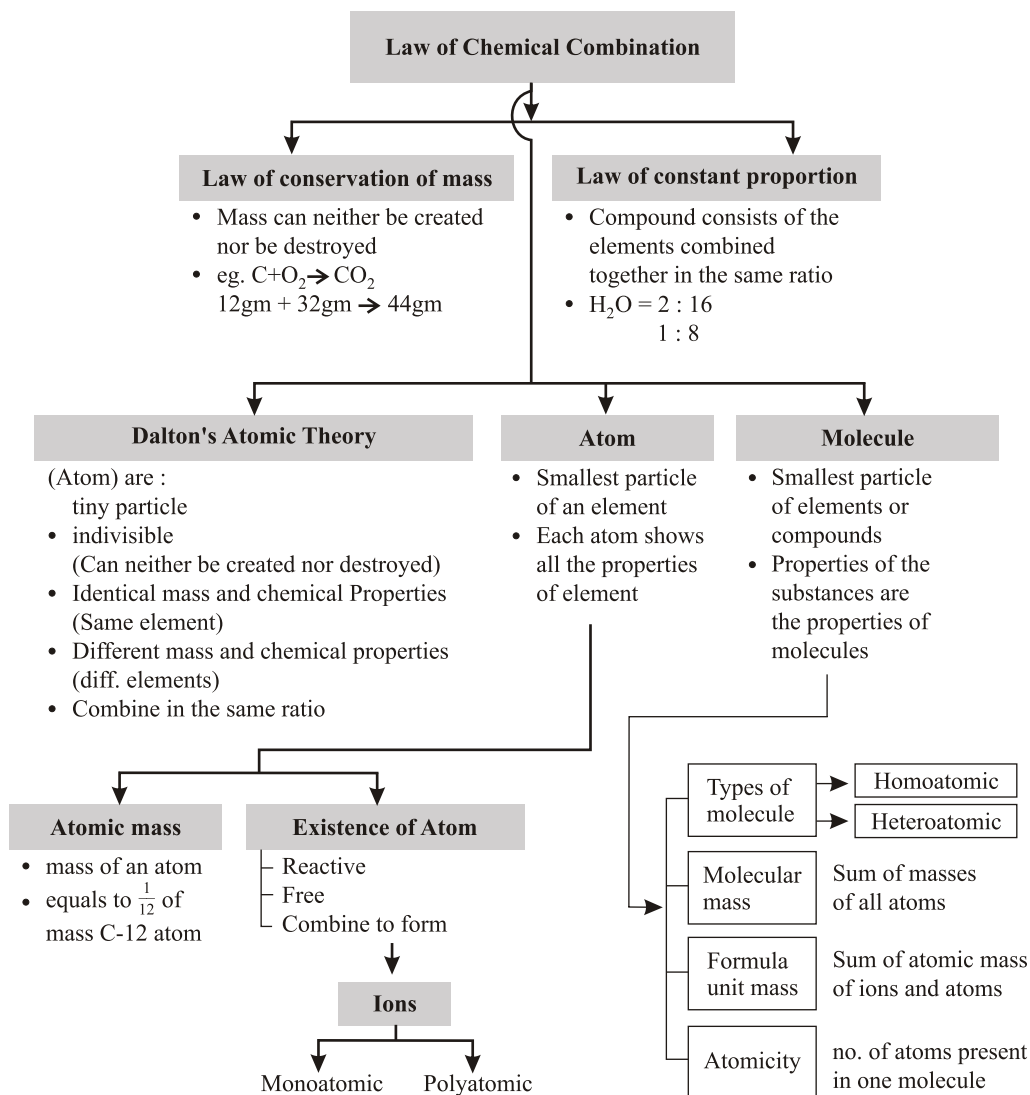
- 1. (a)
- 2. (d)



## Chapter - 3

# Atoms And Molecules

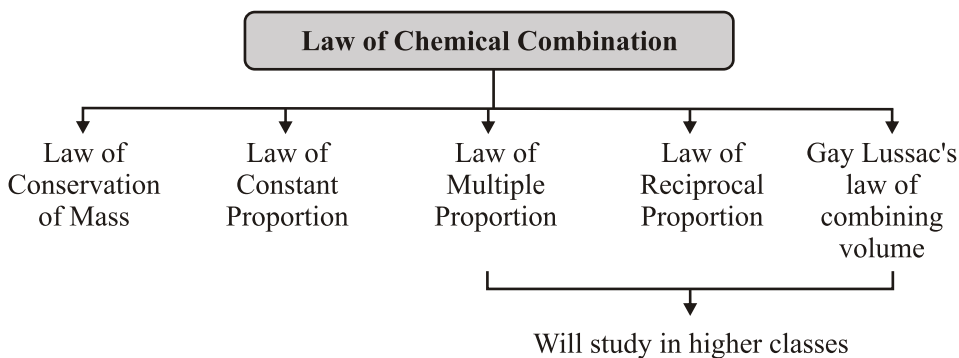
### CONCEPT MAPPING





### ***Laws of Chemical Combination :***

The chemical reaction between two or more substances giving rise to products is governed by certain laws. These laws are called 'Laws of Chemical Combination'.



### ***Law of Conservation of Mass***

According to this law, "Mass can neither be created nor destroyed."

In a chemical reaction, this law can be understood in the following way:

*" During a chemical reaction total mass of reactants will be equal to total mass of products."*

For example,



Reactant          Product

Then,

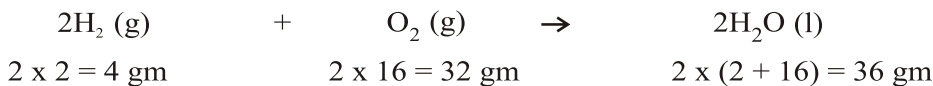
$$m_A + m_B = m_{AB}$$

where,

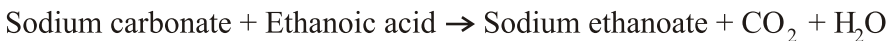
$$m_A = \text{Mass of A}$$

$$m_B = \text{Mass of B}$$

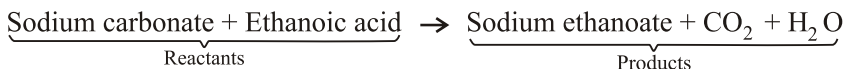
$$m_{AB} = \text{Mass of AB}$$



**Example :** In a reaction 5.3 gm of sodium carbonate reacted with 6 gm of ethanoic acid. The products were 2.2 gm of  $\text{CO}_2$ , 0.9 gm of  $\text{H}_2\text{O}$  and 8.2 gm of sodium ethanoate. Show that these observation are all in agreement with law of conservation of mass.



**Solution :**



Now, according to the law of conservation of mass :

**Mass of sodium carbonate + Mass of ethanoic acid = Mass of sodium ethanoate + Mass of CO<sub>2</sub> + Mass of H<sub>2</sub>O**

Putting values of masses from the equation :

$$5.3 \text{ gm} + 6.0 \text{ gm} = 8.2 \text{ gm} + 2.2 \text{ gm} + 0.9 \text{ gm}$$

$$\text{Or} \quad 11.3 \text{ gm} = 11.3 \text{ gm}$$

Since, LHS = RHS

∴ Law of conservation of mass is in agreement with the given values in equation.

### ***Law of Constant Proportion***

According to this law, "A pure chemical compound always contains the same elements combined together in the same proportion by mass irrespective of the fact from where the sample has been taken or from which procedure has it been produced."

*For example :*

18 gm of H<sub>2</sub>O ⇒ 16 gm of oxygen + 2 gm of hydrogen,

$$\text{i.e., } m_{\text{H}}/m_{\text{O}} = 2/16 = 1/8$$

36 gm of H<sub>2</sub>O ⇒ 32 gm of oxygen + 4 gm of hydrogen,

$$\text{i.e., } m_{\text{H}}/m_{\text{O}} = 4/32 = 1/8$$

09 gm of H<sub>2</sub>O ⇒ 08 gm of oxygen + 1 gm of hydrogen,

$$\text{i.e., } m_{\text{H}}/m_{\text{O}} = 1/8$$

From the above three cases, differently weighing H, O samples were taken but the ratio of masses of 'H' to mass of 'O' comes out to be '1/8' is same, proving law of constant proportion.

Likewise, if a sample of 'H, O' was taken from anywhere i.e., from well, pond, lake or anywhere the ratio of masses of 'H' to 'O' will come out to be same as '1/8'.

**Example :** Hydrogen and oxygen combine in the ratio 1 : 8 by mass to form water. What mass of oxygen gas would be required to react completely with 3.0 gm of hydrogen gas ?

**Solution :**  $\frac{m_H}{m_O} = \frac{1}{8}$       Given in equation (For  $H_2O$ )

But,  $m_H = 3.0 \text{ gm}$  (given)

Or  $\frac{3}{m_O} = \frac{1}{8}$

Or  $m_O = 24 \text{ gm}$

$\therefore$  Mass of oxygen will be 24 gm.

Or it will be a sample of 27 gm of  $H_2O$  where 3 gm of hydrogen is present with 24 gm of oxygen.

## Dalton's Atomic Theory

Based upon laws of chemical combination, Dalton's Atomic Theory provided an explanation for the Law of Conservation of Mass and Law of Constant Composition.

Postulates of Dalton's atomic theory are as follows :

- All matter is made up of very tiny particles called 'Atoms'.
- Atom are indivisible particles, which can't be created or destroyed in a chemical reaction. (Proves 'Law of Conservation of Mass')
- Atoms of an element have identical mass and chemical properties.
- Atoms of different elements have different mass and chemical properties.
- Atom combine in the ratio of small whole numbers to form compounds. (proves 'Law of Constant Proportion')
- The relative number and kinds of atoms are constant in a given compound.

## Atom

- According to modern atomic theory, an atom is the smallest particle of an element which takes part in chemical reaction such that during the chemical reaction, the atom maintain its identity, throughout the chemical or physical change.
- Atoms are very small and hence can't be seen even through very powerful microscope.
- Atomic radius of smallest atom in hydrogen is  $0.37 \times 10^{-10} \text{ m}$  or 0.037 nm.

Such that,

$$1 \text{ nm} = 10^{-9} \text{ m}$$

## IUPAC (International Union of Pure & Applied Chemistry) Symbols of Atoms of Different Elements

Element	Symbol	Element	Symbol
Aluminium	Al	Iodine	I
Argon	Ar	Iron	Fe
Barium	Ba	Lead	Pb
Calcium	Ca	Nitrogen	N
Carbon	C	Oxygen	O
Chlorine	Cl	Potassium	K
Cobalt	Co	Silicon	Si
Copper	Cu	Silver	Ag
Fluorine	F	Sulphur	S
Gold	Au	Zinc	Zn
Hydrogen	H		

### Atomic Mass

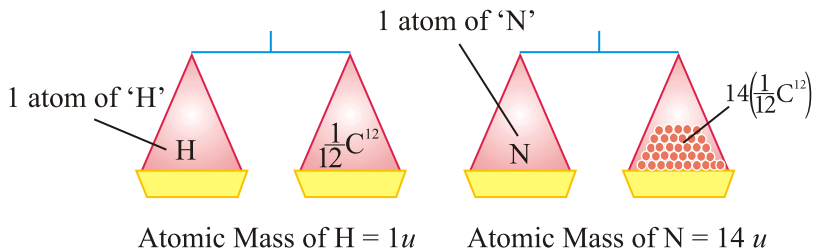
- The mass of an atom of an element is called its atomic mass.
- In 1961, IUPAC have accepted 'atomic mass unit' ( $u$ ) to express atomic and molecular mass of elements and compounds.

### Atomic Mass Unit

The atomic mass unit is defined as the quantity of mass equal to  $1/12$  of mass of an atom of carbon-12.

$$1 \text{ amu or } u = \frac{1}{12} \times \text{Mass of an atom of C}$$

$$1 u = 1.66 \times 10^{-27} \text{ kg}$$



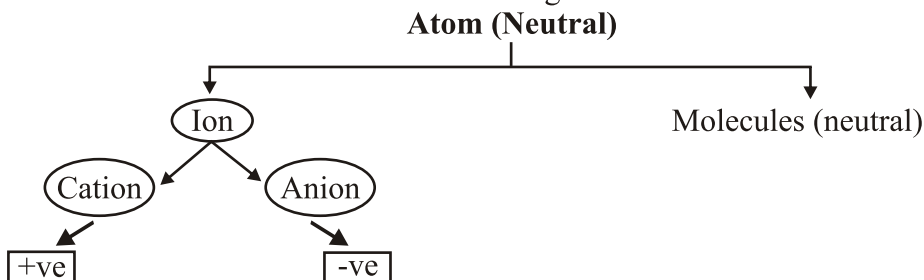
Likewise,

This means atomic mass unit  $\frac{1}{12}$ th of Carbon – 12

Atomic Mass of some elements					
Element	Symbol	Atomic Mass	Element	Symbol	Atomic Mass
Hydrogen	H	1u	Sodium	Na	23u
Helium	He	4u	Magnesium	Mg	24u
Lithium	Li	7u	Aluminium	Al	27u
Beryllium	Be	9u	Silicon	Si	28u
Boron	B	11u	Phosphorous	P	31u
Carbon	C	12u	Sulphur	S	32u
Nitrogen	N	14u	Chlorine	Cl	35u
Oxygen	O	16u	Potassium	K	39u
Fluorine	F	19u	Calcium	Ca	40u
Neon	Ne	20u	Iron	Fe	56

### How do atoms exist ?

- Atoms of most of the elements are very reactive and does not exist in free state.
- Only the atoms of noble gases (such as He, Ne, Ar, Kr, Xe and Rn) are chemically unreactive and can exist in the free state as single atom.
- Atoms of all other elements combine together to form molecules or ions.



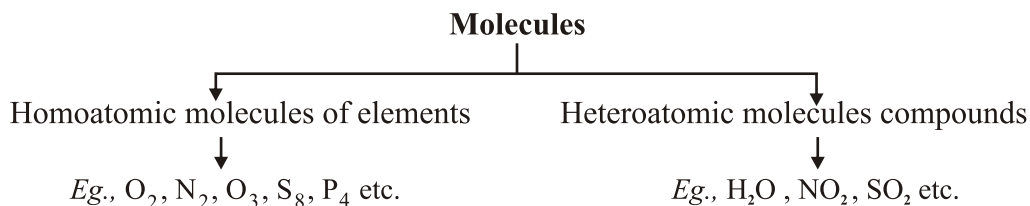
### Molecule

- A molecule is a group of two or more atoms which are chemically bonded with each other.
- A molecule is the smallest particle of matter (except element) which is capable of an independent existence and show all properties of that substance.

E.g., 'H, O' is the smallest particle of water which shows all the properties of water.

- A molecule may have atom of same or different elements, depending upon this, molecule can be categorized into two categories :

**Homoatomic molecules** (containing atom of same element) and **Heteroatomic molecules or compounds** (containing atoms of different elements)



Molecules of some compounds	
Compound	Combining Elements
Water (H <sub>2</sub> O)	Hydrogen, Oxygen
Ammonia (NH <sub>3</sub> )	Nitrogen, Hydrogen
Carbon Dioxide (CO <sub>2</sub> )	Carbon, Oxygen
Hydrogen Chloride (HCl)	Hydrogen, Chlorine
Methane (CH <sub>4</sub> )	Carbon, Hydrogen
Ethane (C <sub>2</sub> H <sub>6</sub> )	Carbon, Hydrogen
Sodium Chloride (NaCl)	Sodium, Chlorine
Copper Oxide (CuO)	Copper and Oxygen

## Atomicity

The number of atoms present in one molecule of an element is called its atomicity.

Name	Formula	Atomicity	
1. Argon	Ar	Monoatomic (1)	} Noble gasses constitute monoatomic molecules
2. Helium	He	Monoatomic (1)	
3. Oxygen	O <sub>2</sub>	Diatomic (2)	
4. Hydrogen	H <sub>2</sub>	Diatomic (2)	
5. Phosphorus	P <sub>4</sub>	Tetratomic (4)	
6. Sulphur	S <sub>8</sub>	Polyatomic (8)	
7. Ozone	O <sub>3</sub>	Triatomic (3)	

## Chemical formulae

It is the symbolic representation of the composition of a compound.

### Characteristics of chemical formulae

- The valencies or charges on ion must balance.
- When a compound is formed of metal and non-metal, symbol of metal comes first. *E.g.*, CaO, NaCl, CuO.
- When polyatomic ions are used, the ions are enclosed in brackets before writing the number to show the ratio. *E.g.*,  $\text{Ca}(\text{OH})_2$ ,  $(\text{NH}_4)_2\text{SO}_4$

### Molecular Mass

It is the sum of atomic masses of all the atoms in a molecule of that substance.  
*e.g.*, Molecular mass of  $\text{H}_2\text{O}$  = 2 x Atomic mass of Hydrogen + 1 x

Atomic mass of Oxygen

So, Molecular mass of  $\text{H}_2\text{O}$  = 2 x 1 + 1 x 16 = 18 u

### Formula Unit Mass

It is the sum of atomic mass of ions and atoms present in formula for a compound.

*e.g.*, In NaCl, Na = 23 a.m.u. , Cl = 35.5 a.m.u.

So, Formula unit mass = 1 x 23 + 1 x 35.5 = 58.5 u

*Examples:*

(i) Symbol : H S

Valencies : 1 2

$\text{H}_2\text{S}_1$  or  $\text{H}_2\text{S}$  (Hydrogensulphide)

(ii) Symbol : C O

Valencies : 4 2

*eg.*  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3$

$\text{C}_2\text{O}_4$  or  $\text{CO}_2$  (Carbon dioxide)

[Take 2 common and dividethe formula by 2]

(iii) For Hydrochloric acid (Hydrogen chloride)

H Cl

1 1

$\text{H}_1\text{Cl}$  or HCl

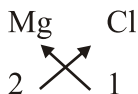
(iv) For Carbon tetrachloride

C Cl

4 1

$\text{C}_1\text{Cl}_4$  or  $\text{CCl}_4$

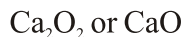
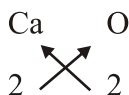
(v) For Magnesium chloride



(vi) For aluminium oxide

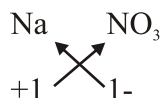


(vii) For Calcium oxide



[Take 2 common and divide the formula by 2]

(viii) For Sodium nitrate (For ions)

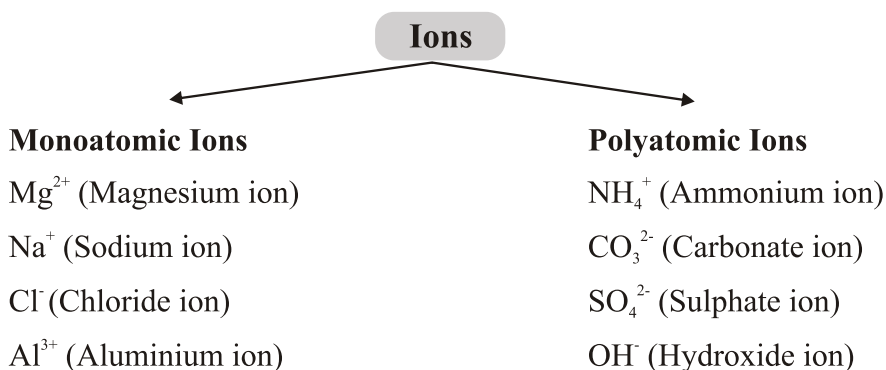


## Ions

An ion may be defined as an atom or group of atoms having positive or negative charge.

**Some positively charged ions :**  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Al}^{3+}$

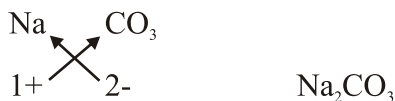
**Some negatively charged ions :**  $\text{Cl}^-$  (chloride ion),  $\text{S}^{2-}$  (sulphide ion),  $\text{OH}^-$  (hydroxide ion),  $\text{SO}_4^{2-}$  (sulphate ion)





## Chemical Formulae of Ionic Compounds (Polyatomic)

(i) Sodium carbonate



(ii) Aluminium sulphate



(iii) Calcium hydroxide



(iv) Ammonium sulphate



(v) Magnesium hydroxide



## Molar Mass

The molar mass of a substance is the mass of 1 mole of that substance.

It is equal to the  $6.022 \times 10^{23}$  atoms of that element/substance.

**Example :**

(a) Atomic mass of hydrogen (H) is 1 *u*. Its molar mass is 1 g/mol.

(b) Atomic mass of nitrogen is 14 *u*. So, molar mass of nitrogen (N) is 14 g/mol.

(c) Molar mass of  $\text{S}_8$  = Mass of S  $\times$  8 =  $32 \times 8 = 256$  g/mol

(d) Molar mass of HCl = Mass of H + Mass of Cl  
= 1 + 35.5 = 36.5 g/mol

## Mole concept

A group of  $6.022 \times 10^{23}$  Particles (atoms, molecules or ions) of a substance is called a mole of that substance.

$$1 \text{ mole of atoms} = 6.022 \times 10^{23} \text{ atoms}$$

$$1 \text{ mole of molecules} = 6.022 \times 10^{23} \text{ molecules}$$

*Example,*  $1 \text{ mole of oxygen} = 6.022 \times 10^{23} \text{ oxygen atoms}$

$6.022 \times 10^{23}$  is Avogadro Number

- 1 mole of atoms of an element has a mass equal to gram atomic mass of the element.

### Important Formulae

$$(i) \text{ Number of moles } (n) = \frac{\text{Given mass } m}{\text{Molar mass } M}$$

$$(ii) \text{ Number of moles } (n) = \frac{\text{Given number of particles}}{\text{Avogadro's number}}$$

$$n = \frac{N}{N_0}$$

$$(iii) \frac{m}{M} = \frac{N}{N_0}$$

$$m = \frac{M \times N}{N_0}$$

$$(iv) \text{ Percentage of any atom in given compound} = \frac{\text{Mass of element} \times 100}{\text{Mass of compound}}$$

**Example.** Calculate no. of iron atoms in a piece of iron weighing 2.8 gm (Atomic mass = 54 u).

**Solution :** 1 mole of iron = 56 gm (Gram atomic mass of iron)

1 mole of iron element contains  $6.022 \times 10^{23}$  atoms of iron.

So,  $56 \text{ gm of iron} = 6.022 \times 10^{23} \text{ atoms}$

$$\begin{aligned} 2.8 \text{ gm of iron} &= \frac{6.022 \times 10^{23} \times 2.8}{56} \\ &= 3.011 \times 10^{22} \text{ atoms} \end{aligned}$$

**Example.** Mass of one molecule of a substance is  $5.32 \times 10^{-23}$  g. What is its molecular mass ?

**Solution :** Mass of 1 molecule of substance  
 $= 5.32 \times 10^{-23} \text{ g}$

$$\begin{aligned}
 &\text{Mass of } 6.022 \times 10^{23} \text{ molecules of substance} \\
 &= 5.32 \times 10^{-23} \times 6.022 \times 10^{23} \\
 &= 32\text{g}
 \end{aligned}$$

**Example.** Calculate the mass of 0.5 mole of  $\text{N}_2$  gas.

**Solution:**

1 mole of $\text{N}_2$	= Gram molecular mass of $\text{N}_2$
Or 1 mole of $\text{N}_2$	= 28 gm
$\therefore$ 0.5 mole of $\text{N}_2$ gas	= $0.5 \times 28$
	= 14 gm of $\text{N}_2$

**Example.** Calculate the total number of  $\text{O}_2$  molecules present in 8 gm of  $\text{O}_2$

**Solution:** Gram molecular mass of  $\text{O}_2$

$$= 6.022 \times 10^{23} \text{ O}_2 \text{ molecules}$$

Or 32 gm of $\text{O}_2$	= $6.022 \times 10^{23} \text{ O}_2 \text{ molecules}$
Or 8 gm of $\text{O}_2$	= $6.022 \times 10^{23} \times 8/32 \text{ O}_2 \text{ molecules}$
	= $1.51 \times 10^{23} \text{ O}_2 \text{ molecules}$

# QUESTIONS

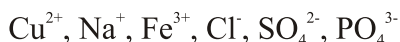
## VERY SHORT ANSWER TYPE QUESTIONS

1. What do you understand by valence electrons.
2. Name the anion and cation that constitute the molecule of calcium oxide.
3. An element 'X' has atomic number 13. Write the formula of its oxide.
4. Write the names of elements present in common salt.
5. If 'K' and 'L' shells of an atom are completely filled with electrons then what will be the total number of electrons in an atom.
6. Name two elements that exist as independent atoms.
7. How many atoms are there in 1g of hydrogen.
8. Identify poly atomic ion in  $\text{MgCO}_3$ .
9. State the law of definite proportion.

## SHORT ANSWER TYPE QUESTIONS

1. Write the chemical formulae of-

(a) Calcium chloride	(e) Lead Nitrate
(b) Magnesium bicarbonate	(f) Calcium Phosphate
(c) Aluminum sulphate	(g) Iron (II) sulphide
(d) Sodium carbonate	(h) Mercury (I) chloride.
2. Write the molecular formulae of all the compounds that can be formed by the combination of following ions.



3. Write the cations (Positively charged ions) and anions (negatively charged ions)

**Present** (If any) in the following compounds.

(a) NaCl

(c)  $\text{NH}_4\text{NO}_3$

(b)  $\text{H}_2$

(d)  $\text{Ca}(\text{HCO}_3)_2$

4. Give the formulae of the compounds formed from the following sets of elements

(a) Calcium and fluorine

(d) Sulphur and Oxygen

(b) Nitrogen and Hydrogen

(e) Carbon and Oxygen

(c) Nitrogen and Oxygen

(f) Carbon and Chlorine

5. Classify each of the following on the basis of their atomicity.

(a)  $\text{F}_2$

(b)  $\text{NO}_2$

(c)  $\text{CH}_4$

(d)  $\text{P}_4$

(e)  $\text{H}_2\text{O}_2$

(f)  $\text{P}_4\text{O}_{10}$

(g)  $\text{O}_3$

(h) HCl

(i) He

(j) Ag

6. Calculate the number of moles of magnesium present in a magnesium ribbon weighing 12 gm. Molar atomic mass of Magnesium is 24 gm/mol.

7. Write postulates of Dalton's atomic theory (atleast three).

8. What is the difference between the molecules of an element and the molecule of a compound? Give one example of each.

9. What is the difference between  $2\text{H}$  and  $\text{H}_2$ ? (atleast two differences)

10. (a) What would be gram atomic mass of 5 moles of chlorine?

(b) Calculate the gram atomic mass of one atom of oxygen.

(gm at. mass of oxygen = 16 gm.)

## LONG ANSWER TYPE QUESTIONS

1. Verify by calculating that 5 moles of  $\text{CO}_2$  and 5 moles of  $\text{H}_2\text{O}$  do not have the same mass.

[Hint : molar mass of  $\text{CO}_2$  = 44 g and molar mass of  $\text{H}_2\text{O}$  = 18 g]

2. If you take 5 moles of carbon atoms in a container and your friend take 5 moles of sodium atoms in another container of same weight.

[Hint : molar mass of carbon = 12 gm. molar mass of sodium = 23 gm]

- (a) Whose container will be heavier?  
(b) Whose container has more number of atoms?
3. Which has more number of atoms?  
100 gm of  $N_2$  or 100 gm of Ammonia  $NH_3$

$$\left[ \text{Hint : No. of atoms} = \frac{\text{mass}}{\text{molar mass}} \times 6.022 \times 10^{23} \right]$$

4. Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water, What mass of oxygen gas would be required to react completely with 3 gm of Hydrogen gas?
5. (a) Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?  
(b) Which postulate of Dalton's atomic theory can explain the law of constant proportion.?

### Objective Type Questions

1. Which of the following statements is not true about an atom?
- Atoms are not able to exist independently
  - Atoms are the basic units from which molecules and ions are formed
  - Atoms are always neutral in nature
  - Atoms aggregate in large numbers to form the matter that we can see, feel or touch
2. The chemical symbol for nitrogen gas is
- Ni
  - $N_2$
  - $N^+$
  - N

3. The Chemical symbol for sodium is
  - a. So
  - b. Sd
  - c. NA
  - d. Na
  
4. Which of the following correctly represents 360 g of water?
  - i. 2 moles of water.
  - ii. 20 moles of water
  - iii.  $6.022 \times 10^{23}$  molecules of water
  - iv.  $1.2044 \times 10^{25}$  molecules of water
  - a. i.
  - b. i.and iv
  - c. ii and iii
  - d. ii and iv
  
5. Give the formulae of the formed from the following sets of elements
  - a. Calcium and fluorine
  - b. Hydrogen and sulphur
  - c. Nitrogen and hydrogen
  - d. Carbon and chlorine
  - e. Sodium and oxygen
  - f. Carbon and oxygen
  
6. Write the molecular formulae for the following compounds
  - a. Copper (II) Bromide. ....
  - b. Aluminium (III) nitrate. ....
  - c. Calcium (II) phoshate .....  
 (Note: 'phoshate' is misspelled in the original text)
  - d. Iron (III) sulphide .....  
 (Note: 'sulphide' is misspelled in the original text)
  - e. Mercury (II) chloride .....  
 (Note: 'chloride' is misspelled in the original text)
  - f. Magnesium (II) chloride .....

7. An element 'X' form an oxide  $X_2O_3$
- State the valency of X
  - Write the formula for chloride of X.
8. Write the molecular formulae of the compounds that can be formed by the combination of following ions
- $Cu^{2+}$  and  $Cl^-$  .....
  - $Na^+$  and  $NO_3^-$  .....
  - $Fe^{3+}$  and  $SO_4^{2-}$  .....
  - $Fe^{3+}$  and  $Cl^-$  .....
9. Classify each of the following on the basis of their atomicity.

Elements	Atomicity
$F_2$	
$NO_3$	
$N_2O$	
$P_4$	
$H_2O_2$	
He	
Ag	
$CH_4$	
$P_4O_{10}$	

10. Fill in the blanks
- In a chemical reaction, the sum of the masses of the reactants and product remains unchanged. This is called .....
  - A group of atoms carrying a fixed charge on them is called .....
  - The formula unit mass of  $Ca_3(PO_4)_2$  is .....
  - Formula of sodium carbonate is ..... and that of ammonium sulphate is .....



### Assertion and reason type questions:-

Two statements are given one labelled assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true but R is not the correct explanation fo A.
- (c) A is true but R is false.
- (d) A is false but R is true.

1. Assertion (A) : Sulphates are poly atomic ions.

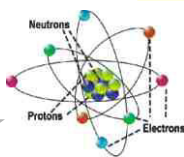
Reason (R) : The sulphate ion consists of one sulphur atom and four oxygen atom and corries an overall charge of 2-

**Answer:** (a) The Sulphate ion is  $\text{SO}_4^{2-}$ . The atoms of a poly atomic ion are tightly bonded together and so the entire ion behaves as a s unit.

2. Assertion (A) : Atomicity of oxygen is 2.

Reason (R) : 1 Mole of an element contain  $6.023 \times 10^{23}$  atom

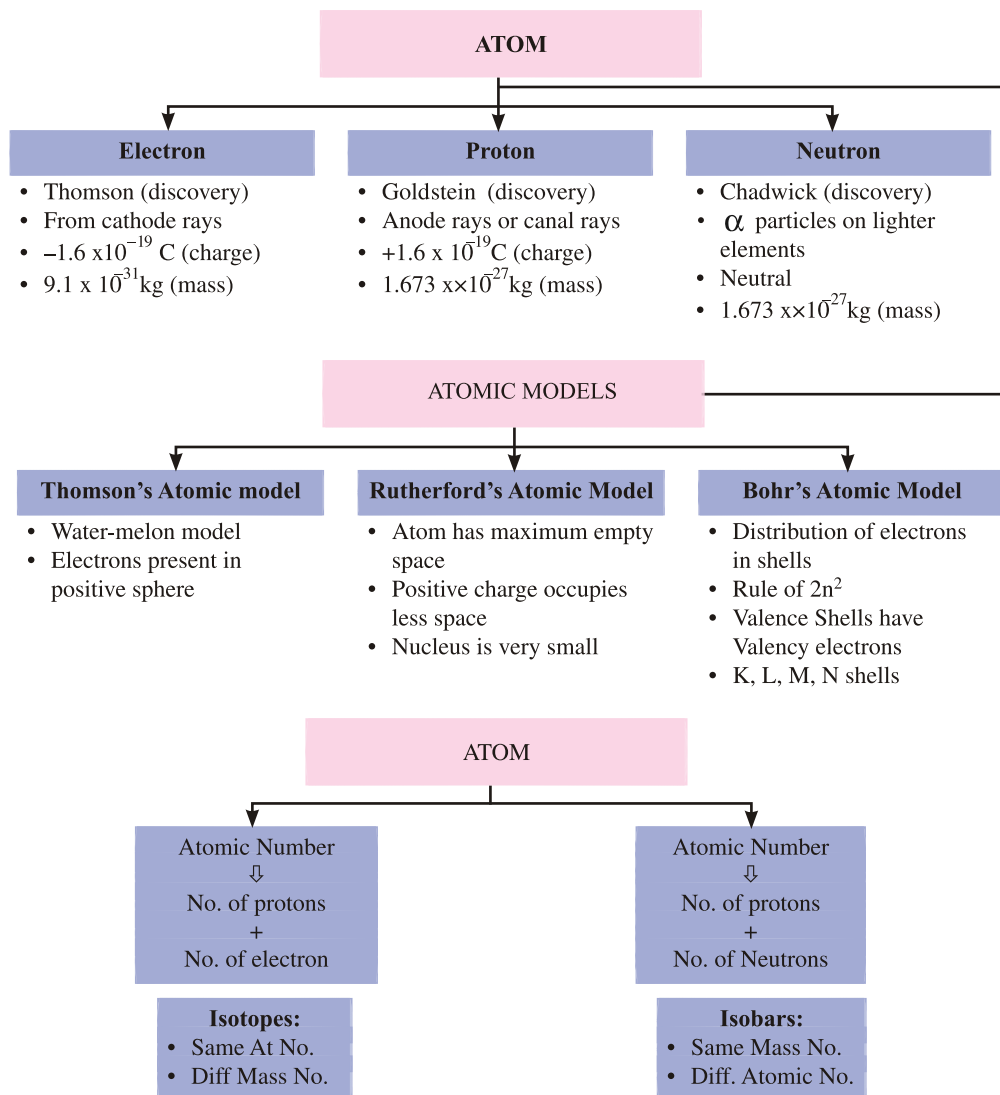
**Answer:** (b) Number of atoms present in a molecule of a gaseous element is called atomicity e.g.  $\text{O}_2$  has two atoms and hence, its atomicity is 2.



## Chapter - 4

# Structure of Atom

## CONCEPT MAPPING STRUCTURE OF ATOM



*John Dalton considered atom to be an indivisible entity, but his concept had to be discarded at the end of nineteenth century, when scientists through experiments were able to find existence of charged (electrons and protons) and neutral particles (neutrons) in the atom. These particles were called the 'Sub-atomic particles'.*

## **Discovery of Electrons - Cathode Rays (By J.J. Thomson)**

Thomson explained presence of electrons by cathode rays experiment.

### **Facts about Electrons**

- Charge on electron =  $-1.6 \times 10^{-19} \text{ C}$  (C = Coloumb)  
(As calculated by Robert E. Millikan)
- Mass of electron =  $9.1 \times 10^{-31} \text{ kg}$

## **Discovery of Protons - Anode Rays/Canal Rays (By E. Goldstein)**

E. Goldstein by his famous anode rays/canal rays experiment was able to detect presence of positively charged particles called protons in the atom.

### **Facts about Protons**

- Charge on proton =  $+1.6 \times 10^{-19} \text{ C}$
- Mass of proton =  $1.673 \times 10^{-27} \text{ kg}$   
*i.e.*, Mass of proton = 1840 x Mass of electron

## **Discovery of Neutrons (By J. Chadwick)**

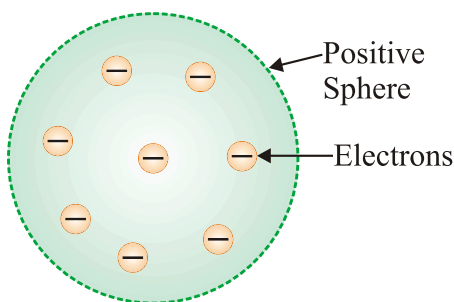
- J. Chadwick bombarded lighter elements (like lithium, boron etc.) with  $\alpha$ -particles and observed emission of new particles having zero charge but having mass equal to that of proton.
- These particles were called 'Neutron' *i.e.*, neutral particle of the atom.
- Neutrons are absent in Protium isotope of hydrogen atom. ( ${}_1\text{H}^1$ )
- Since, mass of electrons are negligible as compared to that of proton and neutrons hence, sum of masses of protons and neutrons in an atom will compose its atomic mass.

## Atomic Models

- From the knowledge of existence of subatomic particles viz., electron, proton and neutron in an atom, various atomic models were proposed by different scientists.
- Following are some of the atomic models :
  - (a) Thomson's Model of Atom
  - (b) Rutherford's Model of Atom
  - (c) Bohr's Model of Atom
- The most trusted and scientifically established model of atom which is adopted these days is 'Quantum Mechanical Model of Atom'. It will be dealt in higher classes.

### Thomson's Atomic Model

- This model is often called the 'Water Melon Model'.
- In this model, Thomson predicted the presence of electrons inside positive sphere (made up of protons), just same as seeds of watermelon are embedded in red edible part of watermelon.

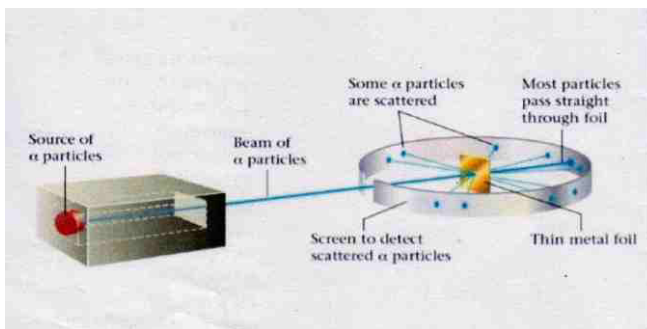


### J. J. Thomson's Model of Atom

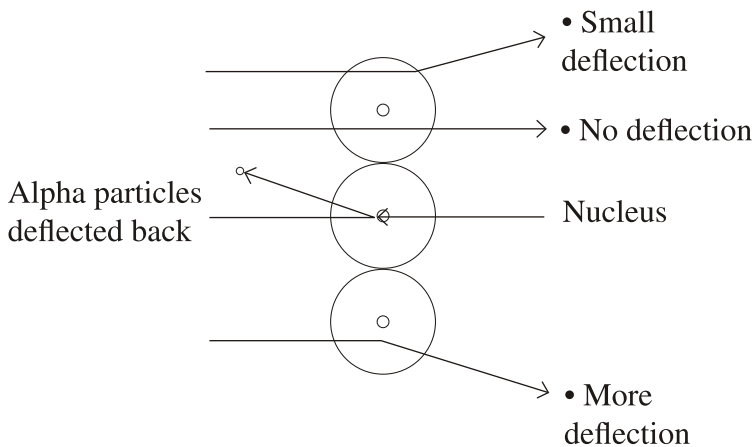
- Although this model explained neutrality of atom but couldn't able to explain other scientific experiments conducted on atom. Hence it was discarded.

## Rutherford's Atomic Model

- In his famous ' $\alpha$ -ray Scattering Experiment', Rutherford bombarded  $\alpha$ -ray (Helium nucleus,  $\text{He}^4$ ) upon thin gold foil.
- Rutherford made following observations from this experiment:
  - (i) Most of  $\alpha$ -particles passed through gold foil undeflected.
  - (ii) Some of the  $\alpha$ -particles deflected by foil by small angles.



- (iii) One out of every 12000 particles appeared to rebound.



### Rutherford $\alpha$ -ray Scattering Experiment

- From his observation, Rutherford draw following conclusions :
  - (i) Atom consists of predominantly empty space as most of  $\alpha$ -particles passed through gold foil undeflected.
  - (ii) Atom contains centrally placed positively charged nucleus (carrying positively charged particles), because few alpha particles were deflected and very few *i.e.*, one in 12000 bounced back.

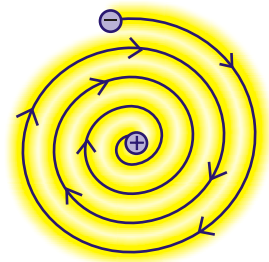
- (iii) Since a minute fraction of  $\alpha$ -particles suffered deflections and very few bounced back, this led to the conclusion that most of the space an atom is empty and the space occupied by nucleus is negligible compared to this empty space.

Size of nucleus was about  $10^{-5}$  times that of size of atom.

- (iv) Whole of the atomic mass is concentrated in the nucleus.
- On the basis of his experiment, Rutherford proposed model of atom having following features :
  - (i) There is positively placed nucleus in an atom. Nearly all the mass resides in nucleus (Proton + Neutron).
  - (ii) Electrons revolve round the nucleus in well defined orbits.
  - (iii) Size of nucleus is very small compared to the size of atom.

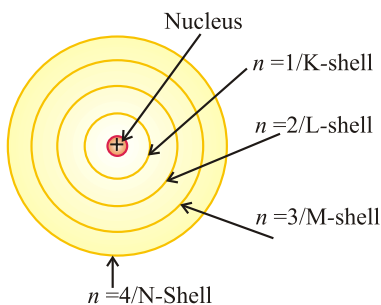
### Drawbacks of Rutherford's Model (Unstability of Atom)

- According to Rutherford, electrons revolve round the nucleus in well-defined orbits, but electrons being charged particles will lose their energy and finally will fall into the nucleus. This will make atom highly unstable.
- This was the major drawback of Rutherford which was unexplained by him.

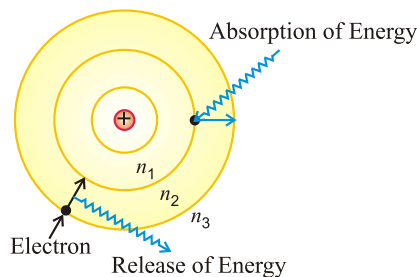


### Bohr's Atomic Model

- To overcome drawbacks of Rutherford's Model, Neil Bohr in 1912 proposed modified model of structure of atom. He made following assumptions :
  - (i) Only certain special orbits known as discrete orbits of electrons are allowed inside the atom.
  - (ii) While revolving in discrete orbits, the electrons do not radiate energy.
  - (iii) Energy is emitted or absorbed by an atom only when an electron moves from one orbit to another.



Energy levels in Atom  
Bohr's Model



"Electron's Energy Change"

## Atomic Number

The total number of proton lying in the nucleus of any atom is called the atomic number.

- An atomic number is the identity of an atom, changing atomic number means changing the atom.
- Atomic number is denoted by 'Z'. (Z=no. of Proton)
- For a neutral atom, no. of protons and electrons are equal.

## Mass Number

It is the sum of total number of protons and neutrons lying in the nucleus of an atom.

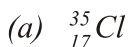
Mass Number = **Number of Proton** + **Number of Neutron**

It is denoted by 'A'. ( $A = n_p + n_N$ )

**Representation of Atom :**  ${}^A_Z E$  (E = Symbol of element)

E.g.,  ${}^{27}_{13} Al$  (z) Atomic No. of Aluminium (Al) = 13 ( $z = n_p$ )  
 (A) Mass No. of Aluminium (Al) = 27 ( $A = n_p + n_N$ )  
 $\downarrow \quad \downarrow$   
 (A=13+14)

**Example.** Calculate number of protons, electrons and neutrons for :



**Solution : (a)**  $^{35}_{17}\text{Cl}$

**(b)**  $^{23}_{11}\text{Na}$

$${}_Z\text{Cl} = 17 (n_p)$$

Here, since Cl is neutral, so  $n_e = n_p = 17$ .

Now,  ${}^A\text{Cl} = 35$

Or  $35 = n_p + n_N$

Or  $35 = 17 + n_N$

Or  $n_N = 35 - 17 = 18$

$${}_Z\text{Na} = 11$$

$${}_A\text{Na} = 23$$

$$23 = n_p + n_N$$

$$23 = 11 + n_N$$

$$n_N = 23 - 11 = 12$$

## Distribution Of Electrons In Various Shells

The distribution of electrons in various shells is done in accordance to 'Bohr-Burry Scheme'.

### Bohr-Burry Scheme

This scheme can be summarized as follows :

- (i) The filling of electrons in an atom is done in accordance to ' $2n^2$ ', where ' $n$ ' is the number of shell and ' $2n^2$ ' represents the total number of electrons that can be accommodated in that particular shell.

If $n = 1, i.e., K = \text{shell}, 2n^2 = 2 \times (2)^1 = 2$ electrons	<i>Maximum number number of electrons that can be filled in particular shell.</i>
If $n = 2, i.e., L = \text{shell}, 2n^2 = 2 \times (2)^2 = 8$ electrons	
If $n = 3, i.e., M = \text{shell}, 2n^2 = 2 \times (2)^3 = 18$ electrons	
If $n = 4, i.e., N = \text{shell}, 2n^2 = 2 \times (2)^4 = 32$ electrons	

- (ii) The outermost shell can't hold more than 8 electrons, while second last shell can't have more than 18 electrons, even though they may have capacity to hold more electrons.

For example, in ' $\text{Ca}_{20}$ ', the electron distribution will be :

	K	L	M	N
$\text{Ca}_{20} =$	2	8	8	2

But  $\text{Ca}_{20} = 2, 8, 10$  is wrong although 'M' shell can contain upto 18 electrons.

- (iii) The outermost shell can't hold more than 2 electrons and the penultimate shell can't hold more than 8 electrons unless the preceding inner shell (antepenultimate shell) is filled completely obeying ' $2n^2$ ' rule

*Some examples :*



- (a)  $K_{19} = 2, 8, 8, 1$   
 (b)  $Al_{13} = 2, 8, 3$   
 (c)  $F_9 = 2, 7$   
 (d)  $Ne_{10} = 2, 8$   
 (e)  $Na_{11} = 2, 8, 1$

"Fundamental Particles in Atom"

Name of Elements	Symbol	Atomic Number	Number of Electrons	Number of Protons	No. of Neutrons	Atomic Mass	Electronic Configuration				Valency
							K	L	M	N	
Hydrogen	H	1	1	1	-	1	1	-	-	-	1+, -
Helium	He	2	2	2	2	4	2	-	-	-	0
Lithium	Li	3	3	3	4	7	2	1	-	-	1+
Beryllium	Be	4	4	4	5	9	2	2	-	-	2+
Boron	B	5	5	5	6	11	2	3	-	-	3+
Carbon	C	6	6	6	6	12	2	4	-	-	4+
Nitrogen	N	7	7	7	7	14	2	5	-	-	3-
Oxygen	O	8	8	8	8	16	2	6	-	-	2-
Fluorine	F	9	9	9	10	19	2	7	-	-	1-
Neon	Ne	10	10	10	10	20	2	8	-	-	0
Sodium	Na	11	11	11	12	23	2	8	1	-	1+
Magnesium	Mg	12	12	12	12	24	2	8	2	-	2+
Aluminium	Al	13	13	13	14	27	2	8	3	-	3+
Silicon	Si	14	14	14	14	28	2	8	4	-	4
Phosphorus	P	15	15	15	16	31	2	8	5	-	3-
Sulphur	S	16	16	16	16	32	2	8	6	-	2-
Chlorine	Cl	17	17	17	18	35.5	2	8	7	-	1-
Argon	Ar	18	18	18	22	40	2	8	8	-	0
Potassium	K	19	19	19	20	39	2	8	8	1	1+
Calcium	Ca	20	20	20	20	40	2	8	8	2	2+

## Valence shell and valence Electrons

- From Bohr-Bury sequence, we know that maximum number of electrons which can be accommodated in outermost shell is 8.
- Every element tend to have 8 electrons in its outermost shell, in achieving 8 electrons, an atom can either gain electrons or loose electrons.
- The number of electrons lost or gained by an element in achieving 8 (octet) determine its valency.

Electrons in the outermost shell will be called its Valence electron.

*For example,*

S. No.	Element	Electron distribution	Valency
1.	C <sub>6</sub>	2, 4	4
2.	N <sub>7</sub>	2, 5	3
3.	O <sub>8</sub>	2, 6	2
4.	F <sub>9</sub>	2, 7	1
5.	Ne <sub>10</sub>	2, 8	0
6.	Na <sub>11</sub>	2, 8, 1	1
7.	Mg <sub>12</sub>	2, 8, 2	2
8.	Ca <sub>20</sub>	2, 8, 8, 2	2

- For elements like H, He, Li, Be and B, these elements lose their outermost electron to achieve 2 electrons in their outermost shell. These elements will have valence in accordance to this act.

S. No.	Element	Electron distribution	Valence
1.	H <sub>1</sub>	1	1
2.	He <sub>2</sub>	2	0
3.	Li <sub>3</sub>	2, 1	1
4.	Be <sub>4</sub>	2, 2	2
5.	B <sub>5</sub>	2, 3	3

## Isotopes :

Isotopes are atoms of same elements having same atomic number and different mass numbers e.g. Isotope of Hydrogen.  ${}^1_1\text{H}$ ,  ${}^2_1\text{H}$ ,  ${}^3_1\text{H}$

E.g., Chlorine has two isotopes of mass number 35 and 37 respectively.

${}^{35}_{17}\text{Cl}$  and  ${}^{37}_{17}\text{Cl}$ .

### Uses of isotopes

- (i) Uranium isotope is used as fuel in nuclear reactor.
- (ii) Isotope of cobalt is useful in treatment of cancer.
- (iii) An isotope of iodine is used in the treatment of goiter.
- (iv) Carbon -14 is used in carbon dating.

**Relative atomic mass** is an average of the masses of all the isotopes of the element.

In any mixture of pure chlorine, 75% of  $\text{Cl}^{35}$  and 25% of  $\text{Cl}^{37}$  is present.

∴ Relative atomic mass = 75% of  $\text{Cl}^{35}$  + 25%  $\text{Cl}^{37}$

Relative atomic mass of chlorine

$$\begin{aligned} &= \frac{75}{100} \times 35 + \frac{25}{100} \times 37 \\ &= \frac{35 \times 3}{4} + \frac{37}{4} \\ &= \frac{1}{4} (105 + 37) \\ &= \frac{1}{4} \times 142 = 35.5\text{u} \end{aligned}$$

## Isobars

Isobars are the atoms of those elements which have the same mass number but different atomic numbers are called isobars.  ${}^{40}_{20}\text{Ca}$  and  ${}^{40}_{18}\text{Ar}$  have same mass number and different atomic number.  ${}^{24}_{11}\text{Na}$  and  ${}^{24}_{12}\text{Mg}$  are another examples.

# QUESTIONS

## VERY SHORT ANSWER TYPE QUESTIONS

1. What will happen to an element 'X' if its atoms gain three electrons.
2. If the electronic configuration of an atom is 2, 8, 2. Calculate the total number of electrons and write the name of the atom.
3. Write any two observation which support the fact that atoms are divisible.
4. Name the particles which determine the mass of an atom.
5. What is the charge on canal rays?
6. What is the difference between Na and  $\text{Na}^+$  in terms of electron.
7. An atom of an element is represented as  ${}^{\text{X}}\text{X}$ . How many electrons and neutrons are present in this atom.
8. An atom of an element has 7 electron in its L shell. What is its atomic number and valency.
9. Which of the following are isotopes and which are isobars.  
Argon, Calcium, Deuterium, Protium.
10. Which subatomic particle has no charge on it.

## SHORT ANSWER TYPE QUESTIONS

1. Why is an atom neutral inspite of the presence of charged particles in it?
2. How does a proton differ from an electron?
3. Why do isotopes show similar chemical properties.
4. Differentiate between isotopes and isobars.
5. Draw the electronic configuration of  $\text{Mg}^{++}$ . [at- no. = 12]
6. Describe Thomson's model of atom. Which subatomic particle was not present in Thomson's model of atom?
7. Draw the electron distribution of following elements - (dot structure)  
(a) Na (at no. = 11)                      (c) Cl (at no. = 17)  
(b) Al (at no. = 13)                      (d) O (at no. = 8)
8. Is it possible for the atom of an element to have one electron, one proton and no neutron. If so, name the element.
9. Write down the electron distribution of Chlorine atom. How many electrons are there in L-shell? (At no. of chlorine = 17)
10. In the atom of an element x, 6 electrons are present in the outermost shell. If this atom acquires noble gas configuration by accepting requisite number of electrons, then what would be the charge on the ion so formed?

### LONG ANSWER TYPE QUESTIONS

1. On the basis of Thomson's atomic model of an atom, explain how the atom is neutral as a whole.
2. What do you think would be the observation, if the  $\alpha$  particle scattering experiment is carried out using a foil of metal other than gold?
3. (a) Helium atom has an atomic mass of  $u$ . It has two protons in its nucleus. How many neutrons does it have?  
(b) What are the limitations of Rutherford's model of an atom.
6. Define valency by taking examples of sodium and chlorine.
7.  $Mg^{+2}$  has completely filled K and L shells. Explain what do you understand by this statement.
8. Why do Helium, Neon and Argon have zero valency?
9. Enlist the conclusion drawn by Rutherford from his  $\alpha$ -scattering experiment.
10. What are the postulates of Bohr's model of an atom?

## Ch-4 Structure of the Atom

### Objective Type Questions :

1. Which of the following correctly represent the electronic distribution in the Mg atom ?  
a) 3, 8, 1      b) 2, 8, 2      c) 1, 8, 3      d) 8, 2, 2
2. Rutherford's 'alpha ( $\alpha$ ) particles scattering experiment' resulted in to discovery of  
a) Electron      (b) Proton      c) Nucleus in the atom      d) Atomic mass
3. The number of electrons in an element X is 15 and the number of neutrons is 16. Which of the following is the correct representation of the element?  
a.  ${}_{15}^{31}\text{X}$   
b.  ${}_{16}^{31}\text{X}$   
c.  ${}_{16}^{15}\text{X}$   
d.  ${}_{15}^{16}\text{X}$

Dalton's atomic theory succesfully explained

- i. Law of conservation of mass
  - ii. Law of constant composition
  - iii. Law of radioactivity
  - iv. Law of multiple proportion
- a. i, ii and iii      b. i, iii and iv
  - c. ii, iii and iv      d. i, ii and iv
5. Which of the following statements about Rutherford's model of atom are correct?
  - i. considered the nucleus as positively charged
  - ii. established that the  $\alpha$ -particles are four times as heavy as a hydrogen atom
  - iii. can be compared to solar system
  - iv. was in agreement with Thomson's model
  - a. i and iii.      b. ii and iiiii
  - c. i and iv.      d. only i
6. Which of the following are true for an element?
  - i. Atomic number = number of protons + number of electrons
  - ii. Mass number = number of protons + number of neutrons
  - iii. Atomic mass = number of protons = number of neutrons
  - iv. Atomic number = number of protons = number of electrons
  - a. i and ii
  - b. i and iii
  - c. ii and iii
  - d. ii and iv
7. The ion of an element has 3 positive charges. Mass number of the atom is 27 and the number of neutrons is 14. What is the number of electrons in the ion?
  - a. 13
  - b. 10
  - c. 14
  - d. 16

8. An atom with 3 protons and 4 neutrons will have a valency of  
a. 3      b. 7      c. 1      d. 4
9. The electron distribution in an aluminium atom is  
a. 2, 8, 3.      b. 2, 8, 2      c. 8, 2, 3      d. 2, 3, 8
10. Fill in the blanks in the following statements
  - a. Rutherford's  $\alpha$ -particle scattering experiment led to the discovery of the .....
  - b. Isotopes have same.....but different.....
  - c. Neon and chlorine have atomic numbers 10 and 17 respectively. Their valencies will be.....and.....respectively.
  - d. The electronic configuration of silicon is.....and that of sulphur is .....
11. Read the following passage and answer the following questions:  
In order to overcome the objections raised against Rutherford's model of an atom, Neil Bohr put forward the following postulates about the model of an atom.
  - (i) Only certain special orbits known as discrete orbits of electrons are allowed inside the atom.
  - (ii) While revolving in discrete orbits the electrons do not radiate energy.
 Now complete the following statement
  - (a) Atom are made up of \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_
  - (b) \_\_\_\_\_ amended Rutherford's shortcomings
  - (c) Electrons do not radiate energy while revolving in \_\_\_\_\_ orbits.
  - (d) Discrete orbits are also known as \_\_\_\_\_
  - (e) K, Shell can accommodate \_\_\_\_\_ electrons.

### Assertion and Reason type Questions :

Directions : In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Mark the correct choice as :

- (a) Both assertion (A) and reason (R) are true but reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

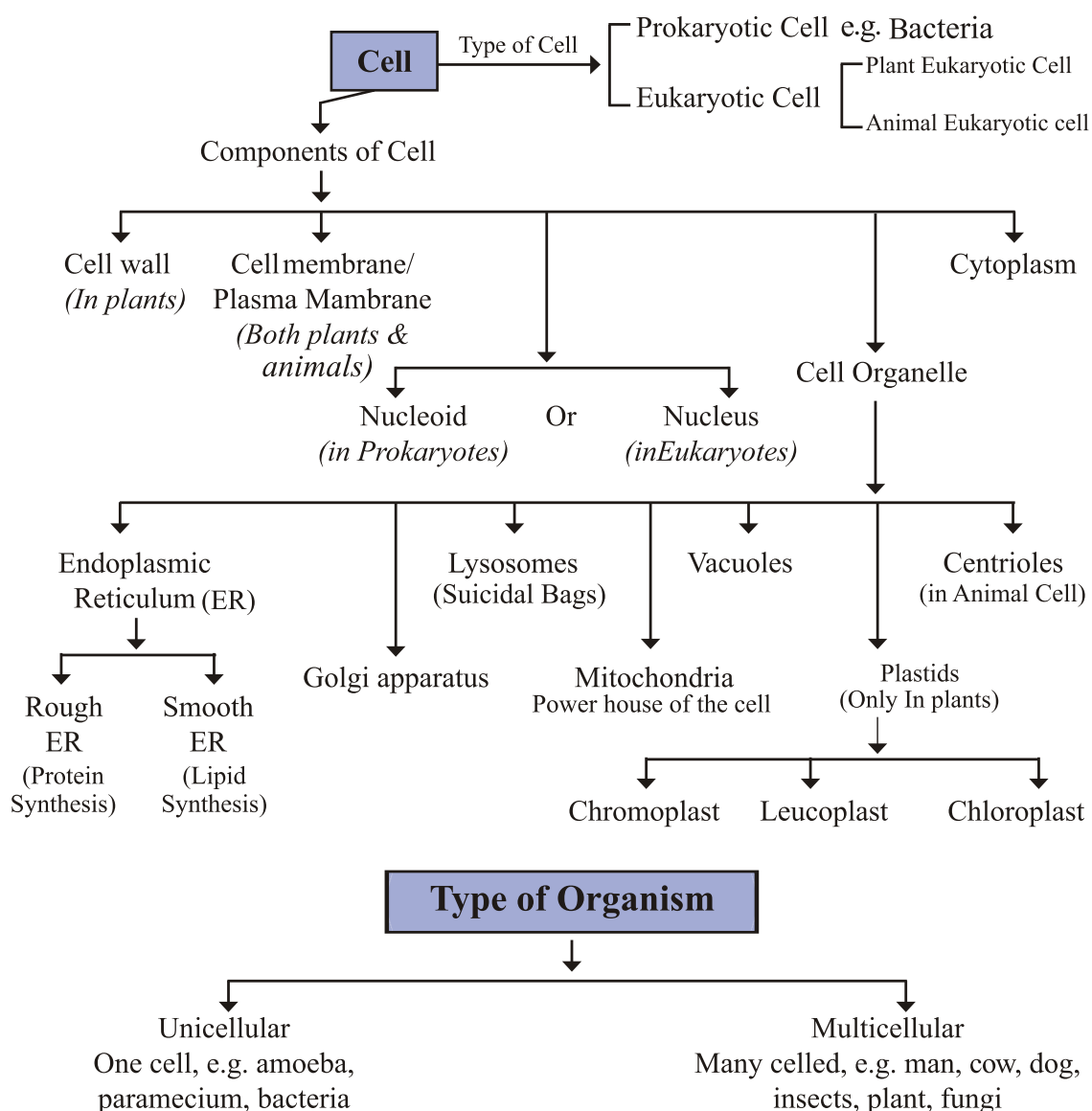
- Q1. Assertion : For noble gases, valency is zero.  
Reason : Noble gases have 8 valence electrons.  
Answer : (a) Noble gases have valency zero because their shell has 8 valence electrons.
- Q2. Assertion : A few positively charged  $\alpha$  – particles are deflected in Rutherford's experiment.  
Reason : Most of the space in the atom is empty.  
Answer : (b) The positive charge has to be concentrated in a very small volume (nucleus) that repelled and deflected the positively charged  $\alpha$  – particles.



## Chapter - 5

# Fundamental Unit Of Life: Cell

### CONCEPT MAPPING





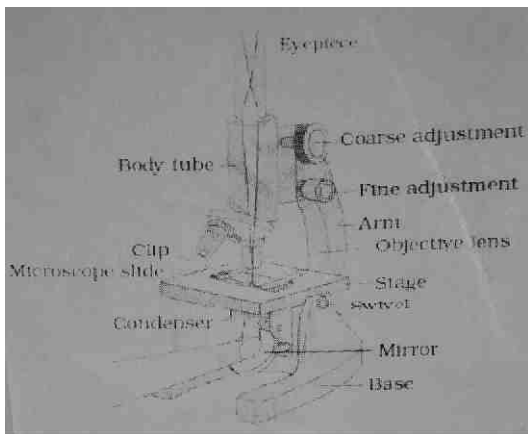
## Cell

- All living forms are composed of microscopic units called as 'Cells'.
- A cell is the basic structural and functional unit of all life forms.
- Study of structure and composition of cell is called Cytology'.
- Cell was first discovered and observed by Robert Hooke in a thin dead slice of cork in the year 1665.
- First free living cell was discovered by A. V. Leeuwenhoek. in 1674.
- Protoplasm is an aggregate of various chemicals such as water, ions, salts and other organic molecules like proteins, carbohydrates, fats, nucleic acids, vitamins etc. along with cell organelles & nucleus that constitute a cell.
- It exists in sol-gel states.

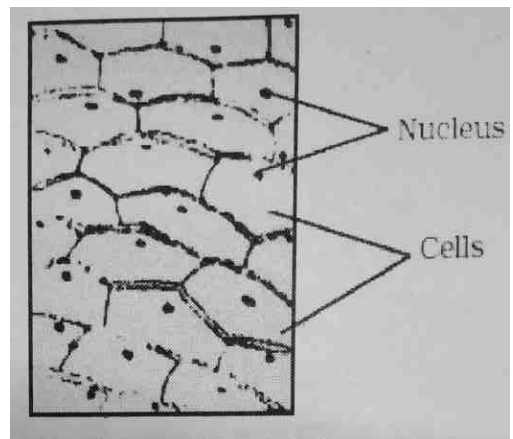
### Cell Theory:

Two biologists, Schleiden and Schwann (1838) gave the Cell theory which states that :

- (i) All plants and animals are composed of cells.
  - (ii) Cell is the basic unit of life.
  - (iii) All cell arise from pre-existing cells.
- Viruses are the exceptions of cell theory.

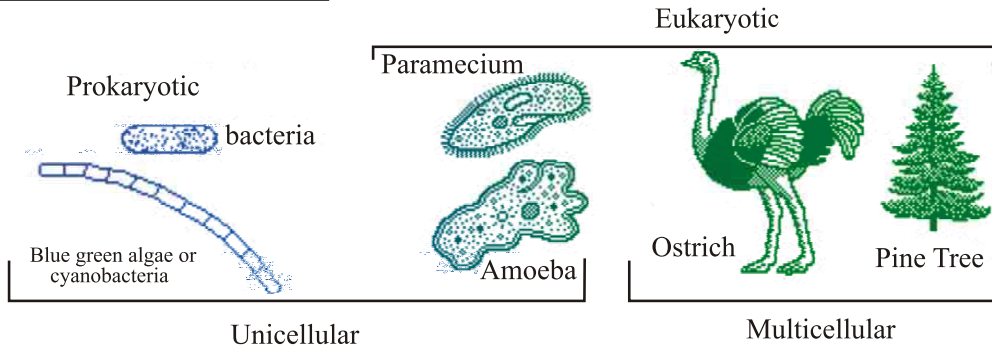


Compound microscope



Onion Peel Cells

## Types of Cell & Organism :

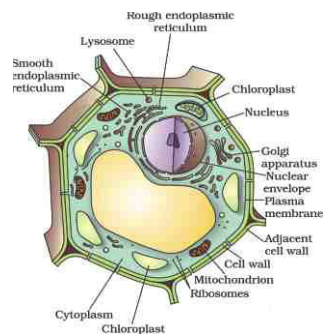
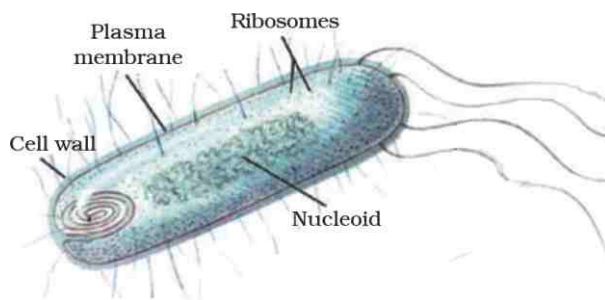


### ***On the Basis of Type of Organization Cells are of two kind***

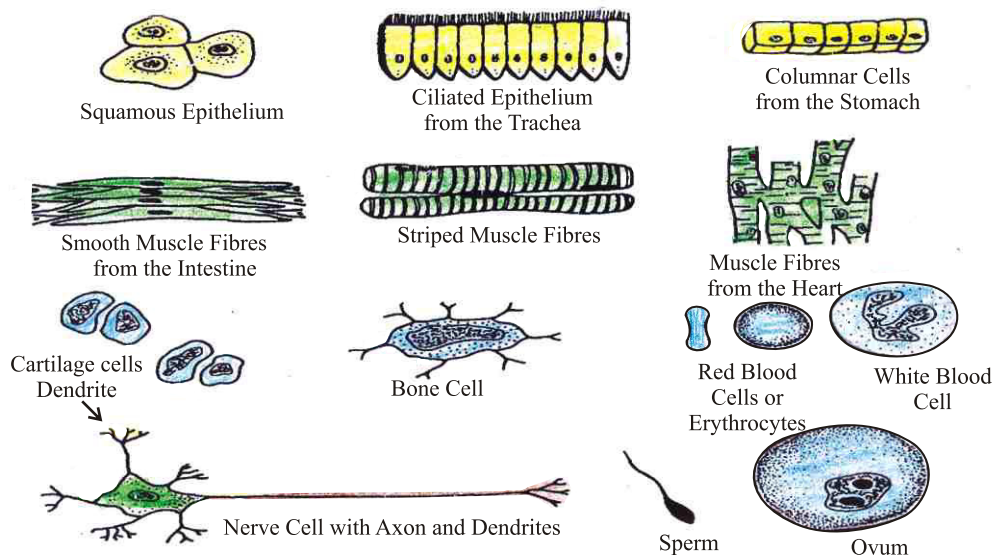
Prokaryotic Cells	Eukaryotic Cells
<ul style="list-style-type: none"> <li>• Very minute in size. (1 to <math>10^{-6}</math> m)</li> <li>• Nuclear region (nucleoid) not surrounded by a nuclear membrane.</li> <li>• Always Unicellular</li> <li>• Single Chromosome present.</li> <li>• Nucleolus absent.</li> <li>• Cell division by fission or budding</li> <li>• Membrane bound cell organelles are absent.</li> </ul> <p>Ex. Bacteria</p>	<ul style="list-style-type: none"> <li>• Fairly large in size. (5-100 <math>\mu</math>m)</li> <li>• Nuclear material surrounded by a nuclear membrane.</li> <li>• May be unicellular or multicellular</li> <li>• More than one chromosome present.</li> <li>• Nucleolus present.</li> <li>• Cell division by mitosis or meiosis.</li> <li>• Membrane bound cell organelles are present.</li> </ul> <p>Ex. All Plants, Animals, Amoeba etc.</p>

### ***Organism are of Two Type :***

Characteristics	Unicellular organism	Multicellular organism
Cell number	Single cell, Simple	Large number of cells, Complex
Function	All functions are performed by single cell	Different cells perform different specific functions.
Division of labour	Not performed / Required	Cells specified to perform different functions.
Reproduction	Involves the same single cell	Specialised cells, (germ cells) take part in reproduction.
Life span	Short	Long
Examples :	Amoeba, Paramecium bacteria etc.	Plant, Fungi & Animals



**Cell Shape :** Cells are of variable shapes and sizes. That varies according to their function position. Generally cells are spherical but they may be elongated (nerve cell), branched (pigmented), discoidal (RBC). Spindle- shaped (muscle cell) etc.



### *Different kinds of cell found in the human body*

**Cell Size :** Size of cell is variable depending upon its position & function. Some are microscopic while some are visible with naked eyes. Their size may vary from 0.2  $\mu\text{m}$  to 18 cm.

- Size of typical cell in a multicellular organism ranges from 2-120 micron.
- The largest cell is ostrich egg (15 cm long, 13 cm wide & weight 1.4 kg)
- The longest cell is nerve cell (upto 1m).
- Smallest cells so far known are PPLOs e.g., mycoplasma

## ***Components of Cell***

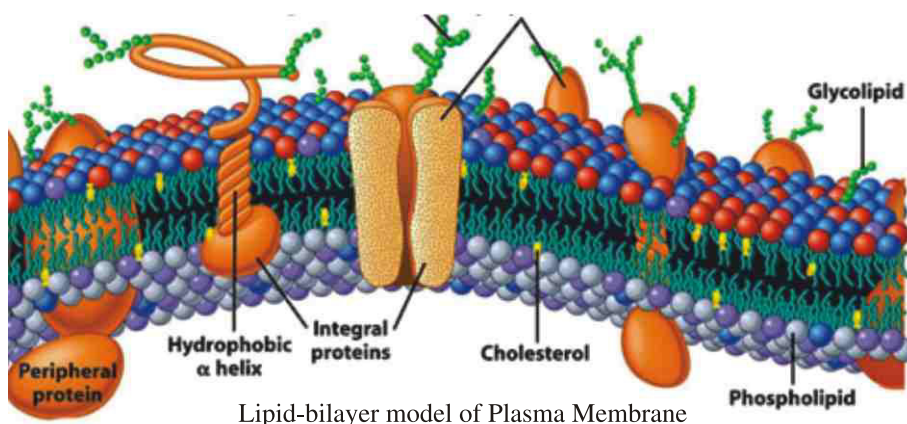
There is an occurrence of division of labour within a Eukaryotic cell as they all got certain specific components called 'Cell organelles'. Each of them perform a specific function.

The three basic components of all the cells are :

- (i) Plasma membrane
- (ii) Nucleus
- (iii) Cytoplasm

### ***Cell Membrane/Plasma Membrane :***

- (a) Plasma membrane is selectively permeable in nature, means it allows or permits the entry and exit of some materials in and out of the cell.
- (b) Cell membrane is also called plasma membrane or plasma lemma.
- (c) It is the limiting boundary of each cell which separates cytoplasm from its surroundings.
- (d) It is found in both plant as well as animal cells.
- (e) It is the outermost covering of a cell in case of animals and lies below the cell wall in case of plants.
- (f) As per the liquid model of plasma membrane. It is made up of proteins and lipids where proteins are sandwiched between bilayer of lipids.
- (g) Singer and Nicholson gave the fluid mosaic model or liquid - bilayer model of plasma membrane.
- (h) It is flexible and can be folded, broken and reunited.

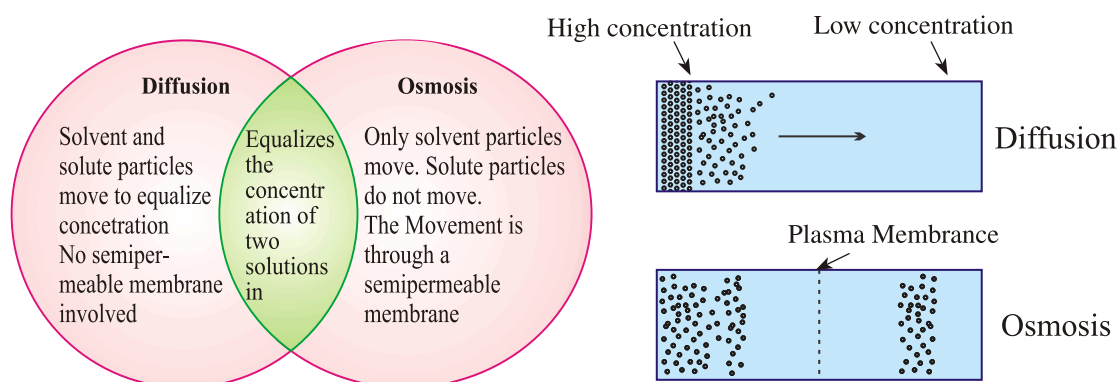


(i) **Functions of Plasma Membrane :**

- (a) It regulates the movement of molecules inside and outside the cell.
- (b) It helps in maintaining the distinct composition of the cell.

(ii) **Transportation of molecules across the Plasma Membrane :**

This can be done by following ways :



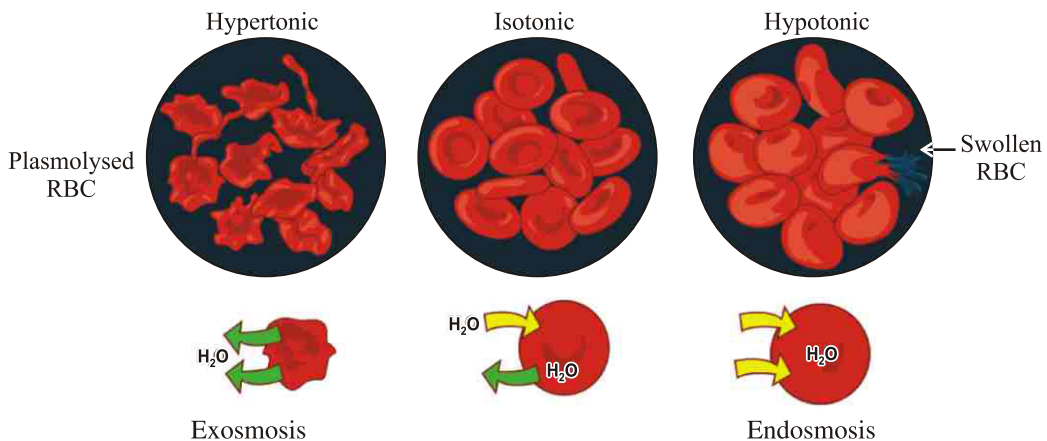
- **Diffusion :** Movement of solutes or ions from a region of higher concentration to a region of lower concentration is called as diffusion. It does not require energy therefore, it is called as passive transport.
- **Osmosis :** The movement of solvent or water from its higher concentration (solvent) to lower concentration (solvent) through a semipermeable membrane is called as osmosis.

**Or**

The movement of solvent or water from lower concentration to higher concentration (of solution) through a semipermeable membrane is called as osmosis.

- **Osmosis can also be called as 'Diffusion of solvents'.**
- **Endomosis :** Movement of solvent into the cell is called Endomosis.
- **Exosmosis :** Movement of solvent outside the cell is called Exosmosis.

**Types of Solutions on the Basis of Concentration and its effect on cell :**

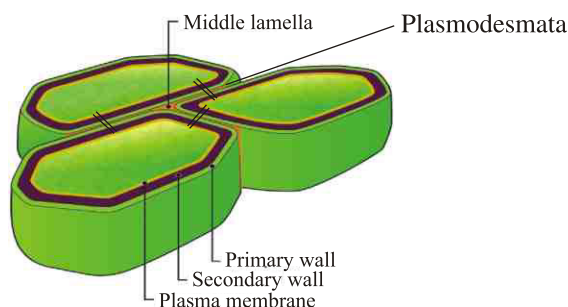


**Fig. : Effect of different types of solution on RBC's placed in them.**

- (a) **Isotonic Solution :** When concentration of a solution outside the cell is equal to the concentration of cytoplasm of the cell, it is called as isotonic solution.
- (b) **Hypertonic Solution :** When concentration of a solution outside the cell is more than inside of the cell. Due to this, cell loses water and becomes plasmolysed. **Plasmolysis:**– Shrinking of the protoplasm away from the cell wall due to Excessive loss of water (Exosmosis)
- (c) **Hypotonic Solutions :** When the concentration of the solutions outside the cell is lesser than that of cytoplasm of cell, due to excessive endosmosis cell swells up and may bursts.

### Cell Wall

- It is the outermost covering of the plant cells and cells of fungi.
- It is absent in animal cells.
- Cell wall is rigid, strong, thick porous and non-living structure. In plant it is made up of cellulose and hemicelluloses. In fungi it is primarily made up of Chitin. Cell walls of two adjacent cells are joined by a layer called middle lamellae and microscopic channels called plasmodesmata for transport.

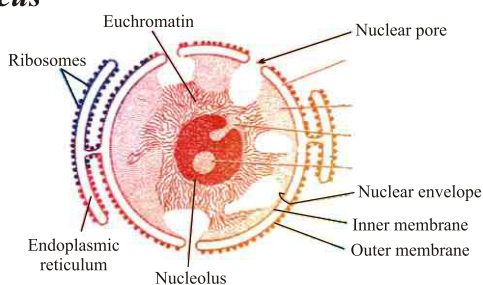




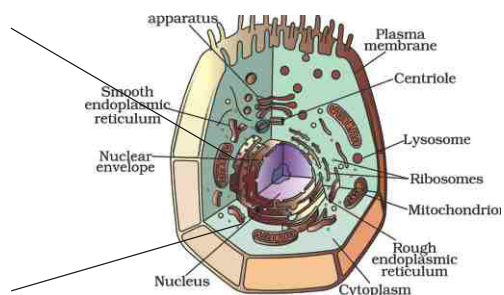
### ***Functions of Cell Wall :***

- (a) It provides definite shape, structure, support and protection to the cell.
- (b) It provides strength to the cell.
- (c) It is permeable and allows entry of molecules of different sizes & thus control intercellular Transport.

### ***Nucleus***



Enlarged view of Nucleus



Eukaryotic Cell

- Nucleus is the most important cell organelle which directs and controls all its cellular activities.
- It is called as 'Headquarter of the cell'/controller of cell.
- It was discovered by Robert Brown in 1831.
- In Eukaryotes, a well-defined nucleus is present while in Prokaryotes, a well-defined nucleus is absent.
- Prokaryotes contain a primitive nucleus called Nucleoid.
- It has double layered covering called as nuclear membrane.
- Nuclear membrane has pores which regulate the movement of materials in & out of the Nucleus.
- Besides nuclear membrane, nucleus also contains nucleolus and chromatin material. Chromatin is made up of DNA and Protein, that ultimately condense and forms chromosome.
- Chromosomes or chromatin material consists of DNA which stores and transmits hereditary information for the cell to function, grow and reproduce.

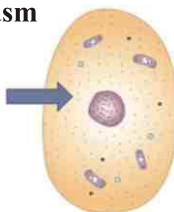
### ***Functions of Nucleus :***

- (a) It controls all the metabolic activities of the cell and regulates the cell cycle.
- (b) It helps in transmission of hereditary characters from parents to their offsprings.

## Cytoplasm

### Cytoplasm

Cytoplasm is the part in which the other organelles exist.



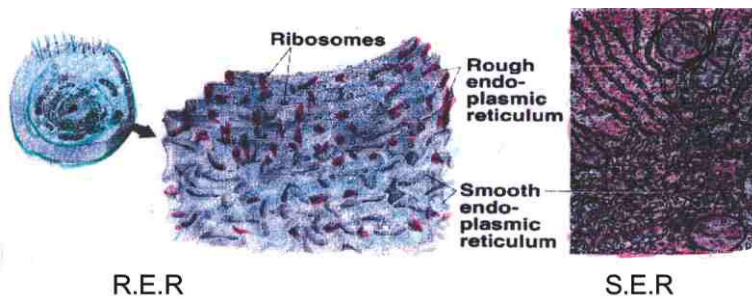
- Cytoplasm was discovered by Kolliker in 1862.
- It is the site of both biosynthetic and catabolic pathways (Metabolic activities)
- It can be divided into two parts :
  - (i) Cytosol :** Aqueous soluble part contain various fibrous proteins forming cytoskeleton. It contain about 90% water, 7% Protein 2% carbohydrates & 1% etc.
  - (ii) Cell organelles :** Living part of the cells having definite shape, structure and function bounded by plasma membrane. There are single membrane bound, double membrane bound and non membrane bound Cell organelles.

Single Membrane bound cell organelles	Double Membrane bound cell organelles	Non Membrane bound cell organelles
eg. ER, Lysosomes, Golgibodies & Vacuoles Peroxisomes	eg. Mitochondria, Plastids These 2 also have their OWN DNA material	eg. Ribosome, Centrosomes, Microtubules

### Endoplasmic Reticulum

- It is the network of membrane bound tubules and sheet present in the cytoplasm.
- It was discovered by Porter, Claude and Fullam.
- These are present in all cells except prokaryotes and mammalian erythrocytes.





*Endoplasmic reticulum is of two types :*

### Smooth ER

- Made of tubules mainly.
- Helps in steroid, lipids and Polysaccharide synthesis.
- Ribosomes are absent.

### Rough ER

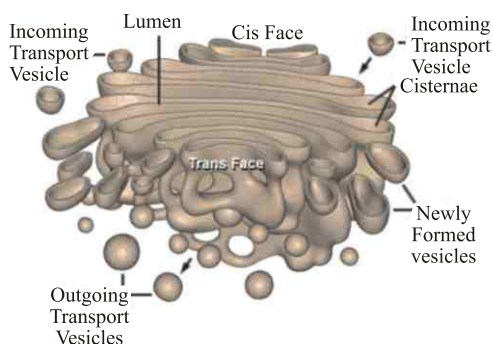
- Made of Cisternae and vesicles.
- Helps in protein synthesis.
- Contains ribosome on its surface.

### **Function of ER :**

- It is the only organelle which serves as a channel for the transport of materials between various regions of cytoplasm and between cytoplasm and nucleus.
- It also functions as a cytoplasmic framework to provide surface for some of the biochemical activities. It forms endoskeleton of cell.
- It helps in synthesis of fats, protien, steroids, cholesterol etc.
- SER plays a crucial role in detoxification of drugs and poisonous by products.
- Membrane biogenesis: Protein & Lipids produced by ER are used to produce cell membrane.

Golgi apparatus consists of a system of membrane bounded fluid filled vesicles arranged parallel to each other in stacks called Cisternae along with some large and spherical vesicles. It was discovered by Camillo Golgi. It is absent in prokaryotes, mammalian RBC's & sieve cells.

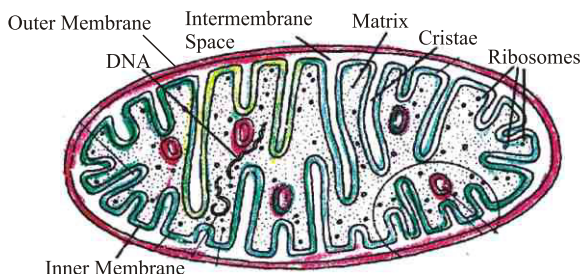
### *The Golgi Apparatus*



### ***Functions of Golgi apparatus :***

- (a) Its function include the storage, modification, Packaging & secretion of products in vesicles.
- (b) It involved in the formation of lysosomes.
- (c) It is secretory in nature.
- (d) It helps in melanin synthesis.
- (e) It also involved in the synthesis of cell wall & plasma membrane.

### ***Mitochondria***



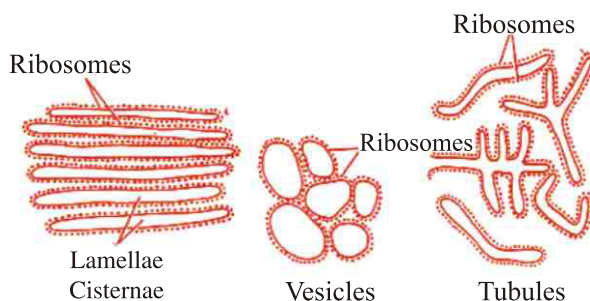
It is a rod shaped structure found in cytoplasm of all eukaryotic cells except mammalian RBC's.

- These are also absent in prokaryotes.
- It was first seen by Kolliker in insect cells in 1880.
- It is also called as 'Power House of the Cell' or the 'Storage Battery'.
- It is double membranous structure where outer membrane has specific proteins while inner membrane is folded inside to form chambers called Cristae.
- Mitochondria has its own DNA & Ribosomes

### ***Functions of Mitochondria :***

- (a) Its main function is to produce, store and release the energy in the form of ATP (Adenosine Triphosphate) The energy currency of the cell.
- (b) It is the site for cellular respiration (Kreb cycle) in which ATP are produced.

### ***Ribosomes***



(Ribosomes located on different cell organelles and their parts)

- Ribosomes are the sites of protein synthesis.
- All structural and functional proteins (enzymes) coded by the nuclear DNA are synthesized upon cytoplasmic ribosomes. The DNA codes are transcribed into messenger RNA (mRNA) molecules, Which comes out of the Nucleolus and translated (Protein synthesis) by ribosomes attached to RER in the form of proteins.

### ***Functions of Ribosomes :***

Ribosomes are the main site of protein synthesis. Synthesized proteins is transported by endoplasmic reticulum.

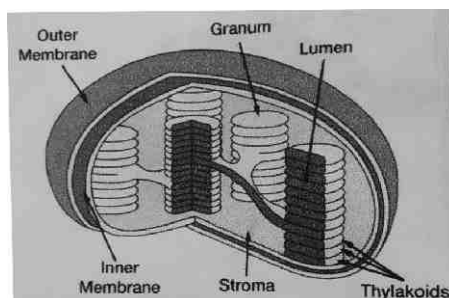
### ***Plastids***

- It is double membranous, discoidal structure, found mainly in algae and plant cells.
- Besides being discoidal or rhombic in plant cells, they occur in variable shapes like in (algae.) They can be 'U' - shaped, spiral, coiled, ribbon- shaped etc.

### ***Depending upon the type of pigment present in them, they are of following three types :***

- (i) Leucoplast – These are white or colourless and found in non- photosynthesis tissue of plant such as Root, bulb, seeds, etc. They can change into other type of plastids. The primary functions is storage of starch, oil, proteins.
- (ii) Chromoplast – These are coloured plastids except green, these impart colour to fruits & flowers.
- (iii) Chloroplast – It contain chlorophyll which impart green, these colour to leaves and, found in aerial parts of plants. It helps in the process of photosynthesis so it is called the 'Kitchen of cell in plant.

### ***Chloroplast :***



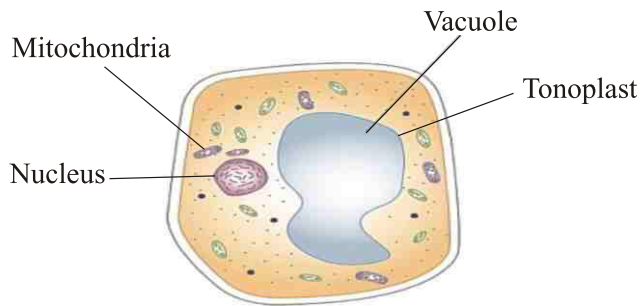
### ***Chloroplast have following two parts:***

- (i) **Grana :** It constitutes the lamellar system. These are found layered on top of each other. These stacks are called Grana. Each granum of the chloroplast is formed by superimposed closed compartments called Thylakoids.

**Function :** They are the sites of light reaction of photosynthesis as they contain photosynthetic pigment chlorophyll, photosynthetic units.

- (ii) **Stroma :** It is a granular transparent substance also called as matrix. Grana are embedded in it. Besides Grana they also contain lipid droplets, starch grains, ribosomes etc.

## Vacuoles

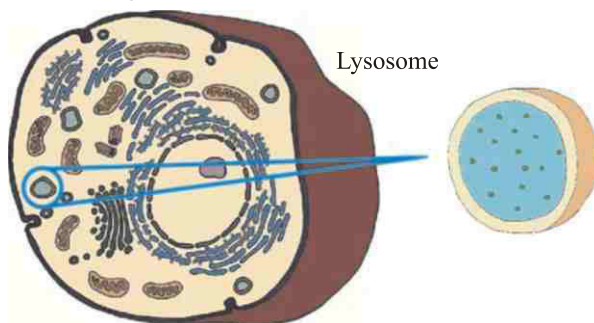


- These are membrane bounded regions in the cytoplasm containing water and other substances.
- They are bounded by a single membrane called Tonoplast.
- In animal cells vacuoles are absent or smaller in size. In plant cells a single large vacuole is found which occupies about 90% of the volume of cell.

### Functions :

It helps in maintaining osmotic pressure in a cell & stores toxic metabolic products (Waste product, water, sugar, protein etc.) of plant cell.

## Lysosome (Suicidal Bag)



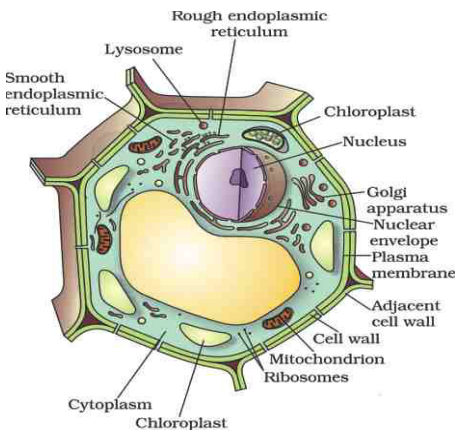
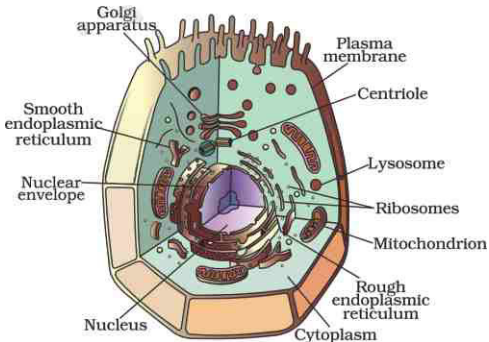
- They are tiny membrane bound cell organelle containing powerful digestive enzymes for intracellular digestion.
- Lysosome absent in RBC's
- Lysosomes are synthesised by golgi body & enzymes present in it are synthesised by RER.

### Functions :-

- (a) Their main function is phagy (digestion). Means they breakdown worn out cell parts.
- (b) They are kind of waste disposal system of the cell.
- (c) They help in digesting foreign materials like invading viruses and bacteria in the cell.

**Suicidal Bag :** During disturbances in cellular metabolism (i.e., in case of cell damage), lysosomes burst and their enzymes are released into the cytoplasm which digest their own cell. So they are also called 'Suicidal Bags'.

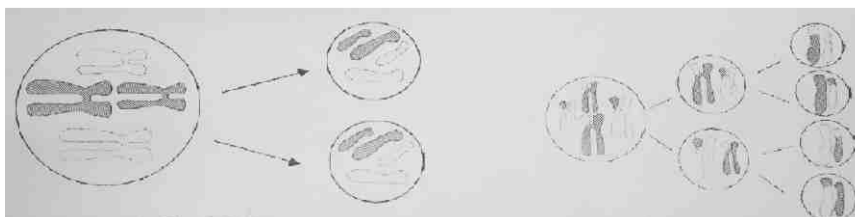
## Difference between Animal cell and Plant cell

Plant Cell	Animal Cell
<ul style="list-style-type: none"> <li>• Contain chloroplasts for photosynthesis.</li> <li>• Have a cell wall to maintain structure and rigidity.</li> <li>• Usually do not contain lysosomes and Peroxisomes.</li> <li>• Cells are square and rigid or geometric shaped.</li> <li>• Limited movement.</li> <li>• Have one large central vacuole.</li> </ul>	<ul style="list-style-type: none"> <li>• No chloroplasts</li> <li>• No cell wall</li> <li>• May Contain cilia and/or flagella</li> <li>• Cells are fluidic and flexible, many shapes.</li> <li>• Cells can move around.</li> <li>• Has small or no vacuoles.</li> <li>• Have lysosome</li> </ul>
	

**Cell Division :** New cells are formed in organisms in order to grow, to replace old, dead and injured cells, and to form gametes required for reproduction. The process by which new cells are made is called cell division.

There are two main types of cell division:

- i) **Mitosis :** The process of cell division by which most of the cells divide for growth is called mitosis. In this process, each cell called mother cell divides to form two identical daughter cells. The daughter cells have the same number of chromosomes as mother cell. It helps in growth and repair of tissues in organisms.
- ii) **Meiosis :** Specific cells of reproductive organs or tissues in animals and plants divide to form gametes, which after fertilisation give rise to offspring. They divide by a different process called meiosis which involves two consecutive divisions. When a cell divides by meiosis it produces four new cells instead of just two. The new cells have only half the number of chromosomes than that of the mother cells.



Mitosis

Meiosis

# QUESTIONS

## VERY SHORT ANSWER TYPE QUESTIONS

1. Name the largest cell of living world ?
2. Who gave the fluid mosaic model of plasma membrane ?
3. Which cell organelle is called as the 'Head quarter of cell' ?
4. Where are chromosoms present and what are their functions?
5. Which cell organelle contains enzymes for ATP production ?
6. Which cell organelle is called as 'Digestive bag' ?
7. Which organelle controls osmotic pressure in a plant cell?

## SHORT ANSWER TYPE QUESTIONS

1. What is the composition of protoplasm ?
2. Define cell ?
3. What is the difference between diffusion and osmosis ?
4. Why plasma membrane is called as selectively permeable membrane ?
5. What happen if we remove mitochondria from a animal cell justify ?
6. State any two function of Golgi body ?
7. Name various type of plastids present in a plant cell ?
8. State the main function of lysosome ?
9. Which cell organelle is known as powerhouse of cell and why ?
10. What is the function of SER ?
11. How Mitosis is different from meiosis.

## LONG ANSWER TYPE QUESTIONS

1. Draw a neat and labelled diagram of mitochondria.
2. Differentiate between plant and animals cell with suitable diagram.
3. Write a short note on nucleus and chromosomes.
4. Explain the effect of concentration of solution on the cell ?
5. Who proposed cell theory. What are its postulates ?
6. Draw a neat labelled diagram of plant cell ?
7. How does unicellular organism differ from Multicellular organism ?
8. What are plastids? Explain its structure and types ?
9. What are the functions of vacuoles ?
10. Expand the following : ATP, DNA, RNA alongwith its function.
11. What happens if we give too much fertilizer to the root of a plant.

## OBJECTIVE TYPE QUESTIONS

### Fill in the Blanks :

1. .... and ..... proposed the cell theory.
2. Nucleus in the cell is discovered by .....
3. A Human cell have ..... pairs of chromosome.
4. A ..... can be made into crystal. (bacterium, virus, amoeba)
5. The main constituent of cell-wall in plant is .....
6. .... organelle is the power house of the cells.
7. Chromosomes are made up of nucleic acid and .....



**MCQ:**

1. **Which of the following is an example of a single cell that does not function as a full fledged organism ?**  
(a) White blood cells (WBC) (b) Amoeba  
(c) Euglena (d) Paramecium
2. **Who discovered the first living cell ?**  
(a) Robert Hooke (b) Leeuwenhoek  
(c) Purkinje (d) Robert Brown
3. **Who used the word 'protoplasm first time for living cells ?**  
(a) Robert Hooke (b) Leeuwenhoek  
(c) WBC and Amoeba (d) Robert Brown
4. **Which organelle is considered as a suicide bag ?**  
(a) Centrosome (b) Mesosomes  
(c) Lysosomes (d) Chromosome
5. **Which of the following organelle is present in onion cells but not in human cheek cells ?**  
(a) Cell wall (b) cytoplasm  
(c) nucleus (d) plasma membrane
6. **Which cell organelle plays a crucial role in detoxifying many poisons and drugs ?**  
(a) Golgi Apparatus (b) Lysosomes  
(c) Smooth Endoplasmic Reticulum (d) Vacuoles
7. **Function of centriole is**  
(a) formation of spindle fibre (b) nucleolus formation  
(c) cell wall formation (d) cell division initiation
8. **viruses are**  
(a) Uni cellular micro-organisms (b) Bi-Cellular micro-organisms  
(c) Multi-cellular micro-organisms (d) Non-cellular micro-organisms
9. **Which of the following often distinguishes plant cells from animal cells ?**  
(a) centrioles (b) nucleus  
(c) Chromatin (d) rough ER

**Match the following :**

**C1**

- A. Smooth Endoplasmic reticulum
- B. Nucleoid
- C. Food Vacuole
- E. Mitochondria
- D. Plastids

**C2**

- 1. Amoeba
- 2. ATP
- 3. Bacteria
- 4. Detoxification
- 5. Leucoplast
- 6. Suicidal Bags.

**Assertion & Reasoning Questions :**

- Assertion A : Meiosis is also called reduction division.  
Reason (R) : The number of chromosomes in the resulting cells are reduced to half.
- Assertion (A) : Mitosis cell division is responsible for the growth of the organisms.  
Reasoning (R) : The cell divided into two daughter cell.
- Assertion (A) : Mitochondria is known as the power house of the cell.  
Reasoning (R) : Mitochondria contain powerful hydrolysing enzymes.
- Assertion : Cell is the functional and structural unit of life.  
Reason : Cells perform all the life processes and form the structure of the living beings.

**True and False :**

1. Plant cell will plasmolysed when placed in a hypotonic solution.
2. Animal cell will shrink in a hypotonic solution.
3. Mitochondria is known as suicidal bag of a cell of all.
4. Cell wall is present in plant cell.

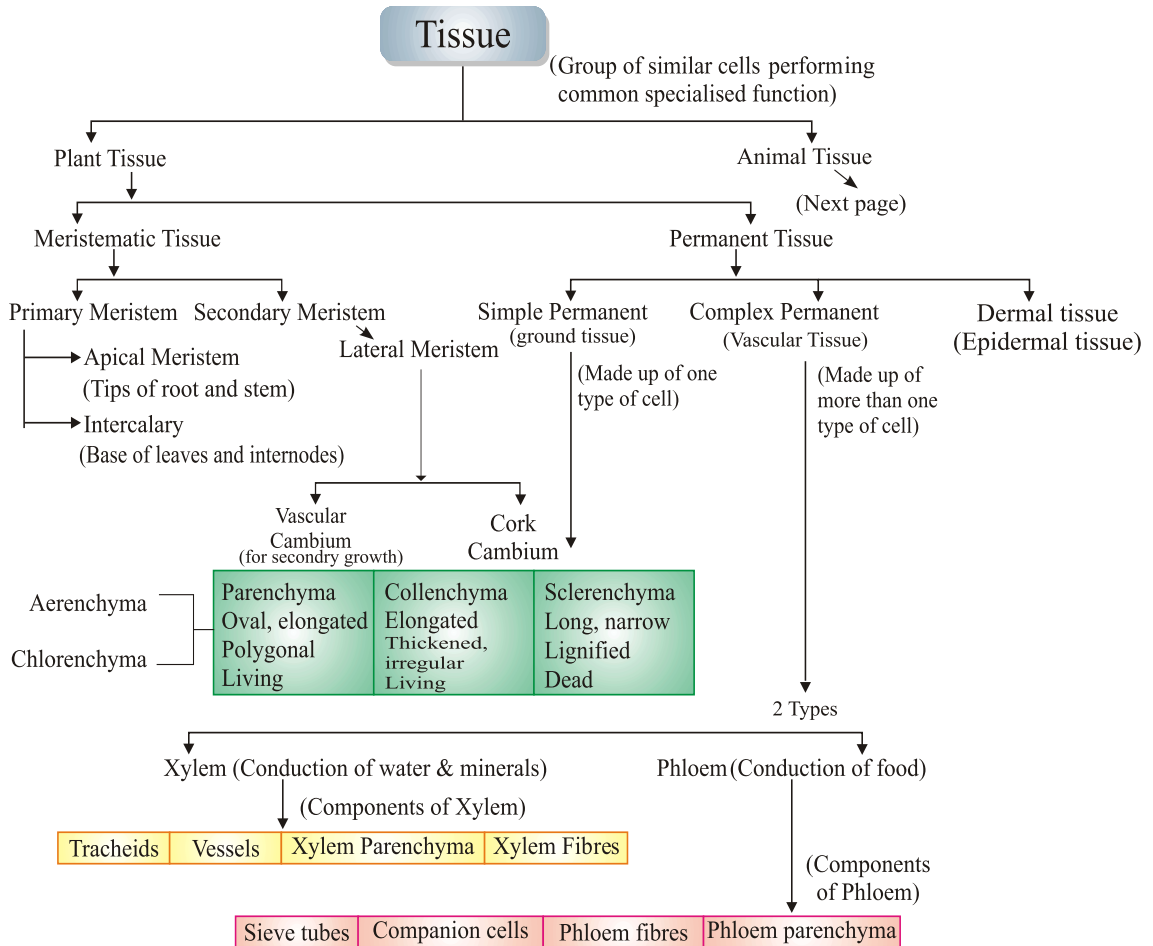




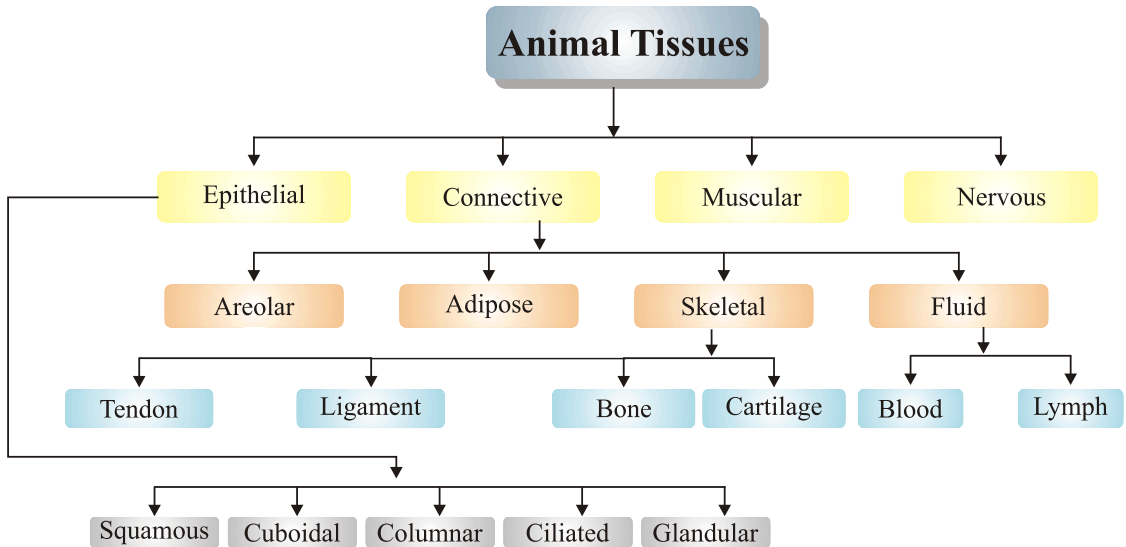
## Chapter - 6

# Tissue

### CONCEPT MAPPING



## ANIMAL TISSUE



**Tissue :** A group of cell that are similar in structure and work together to achieve a particular function is called Tissue.

**Histology :** The microscopic study of tissue is called Histology.

## PLANT TISSUE- Meristematic & Permanent Tissues

### ***Meristematic Tissue (growth tissue)***

These are simple living tissues having thin walled compactly arranged immature cells which are capable of division and formation of new cells.

Main features of Meristematic tissues are :

- Thin primary cell wall (cellulosic).
- Intercellular spaces are absent (compact tissue).
- Generally vacuoles are absent, dense cytoplasm & prominent nuclei are present.
- Actively dividing cells are present in growing regions of plants e.g., root & shoot tips.

### ***Classification on the Basis of Origin***

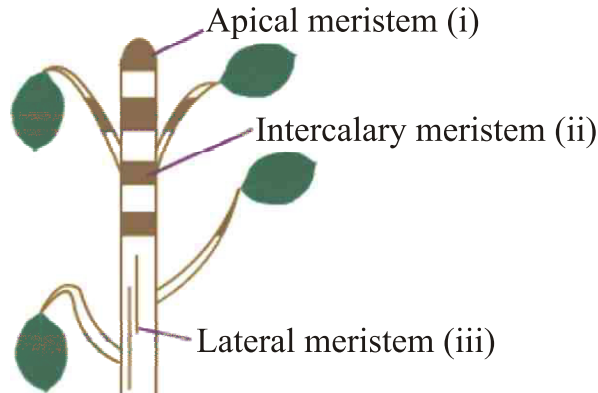
#### ***(A) Primary Meristem (Promeristem)***

- Derived directly from the meristems of embryo.
- They consist of cells derived from primary meristem.
- They add to primary growth of plants.

(B) *Secondary meristem*

- These are having cells derived from primary permanent tissue.
- They usually add to the diameter of plants.

***Classification on the Basis of Location***



(A) *Apical Meristem*

- It is present at the growing tips of stems and roots.
- Cell division in this tissue leads to the elongation of stem & root, thus it is involved in primary growth of the plant.

(B) *Intercalary Meristem*

- It is present behind the apex. It helps in longitudinal growth.
- It is the part of apical meristem which is left behind during growth period.
- These are present at the base of leaf and internode region.
- These lead to the increase in the length of leaf (Primary) eg., in grass stem, bamboo stem, mint stem etc.

(c) *Lateral Meristem (Cambium)*

- It is also called as secondary meristem.
- It occurs along the side of longitudinal axis of the plant.
- It gives rise to the vascular tissues.
- Causes growth in girth of stem and root.
- They are responsible for secondary growth by increasing the girth.

**PERMANENT TISSUE**

- The permanent tissues are formed from those meristematic cells which are left behind and have lost their capability to divide.
- The division and differentiation of the cells of meristematic tissues give rise to permanent tissues.
- They have definite shape, size and thickness. The permanent tissue may be dead or living.

- As a result of cell differentiation the meristematic tissues tend to form different type of permanent tissues.
- In cell differentiation, developing tissues changes from simple to more complex forms to perform various specialized functions.

Depending upon the stucture and composition the permanent tissue are classfied into two types :

**(A) Simple Permanent Tissues (Supporting tissue and protective tissue)**

**(B) Complex Permanent Tissue**

**(C) Dermal (Protective) Tissue**

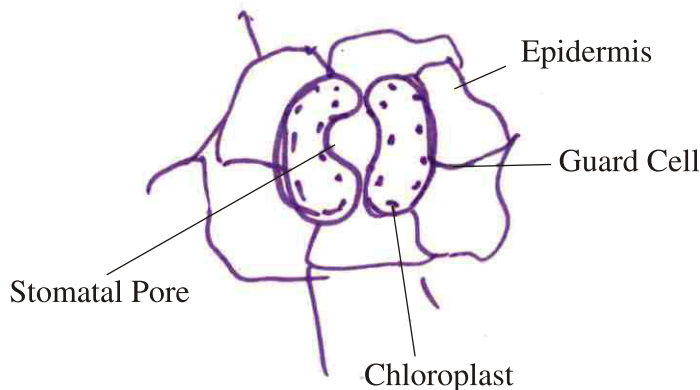
**(A) Simple Permanent Tissues :**

- These are made up of one type of cells which are similar structurally and functionally.

*Protective Tissues:* These tissues are primarily protective in function. They consist of:

(i) Epidermis

- Epidermis forms one cell thick outermost layer of various body organs of plants such as leaves, flowers, stems and roots.
- Epidermis is covered outside by cuticle. Cuticle is a water proof layer of waxy substance called as cutin which is secreted by the epidermal cells and provide protection against provide protection against loss of water and also invasion by microbes.
- Cells of epidermis of leaves are not continuous at some places due to the presence of small pores called as stomata.
- Each stomata is guarded by a pair of bean-shaped cells called as guard cells. These are the only epidermal cells which possess chloroplasts, the rest being colourless.



STOMATA

### Functions of Epidermis

- The main function of epidermis is to protect the plant from desiccation and infection.
- Cuticle of epidermis cuts the rate of transpiration and evaporation of water and prevents wilting.
- Function of Stomata : It allows gaseous exchange to occur during photosynthesis, respiration and also helps in transpiration.

### (ii) **Cork or Phellem**

- In older roots and stems, tissues at the periphery become cork cells or phellem cells.
- Cork is made up of dead cells with thick walls and do not have any intercellular spaces.
- The cell wall in cork deposits waxy substance called as suberin.
- The cells of cork become impermeable to water and gases due to the deposition of suberin.
- The cork cells are without any protoplasm but are filled with resins or tannins.

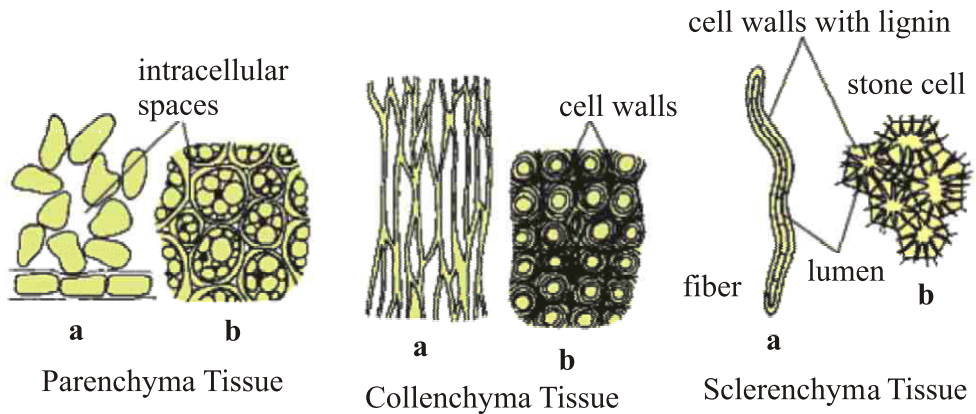


### Functions of Cork :

- Cork is protective in function. Cork cells prevent desiccation, infection and mechanical injury.
- Imperviousness, lightness, toughness, compressibility and elasticity make the cork commercially valuable.

(iii) **Simple Permanent:** These are supportive in function and are of three types :

## The Three Basic Types of Plant Tissue (Supporting Tissue)

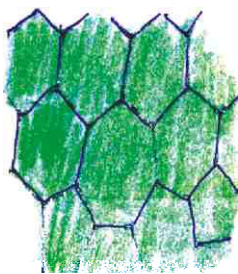


[a. longitudinal section (LS)]

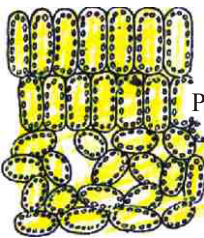
c. Transverse Section (TS)]

(i) Parenchyma : It is the fundamental backing tissue.

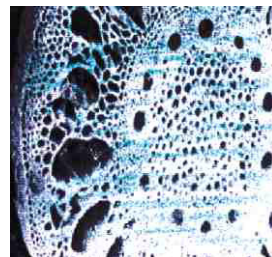
- Loosely packed thin walled cells, oval or spherical in structure with large space between cells
- Cell wall mainly composed of cellulose & pectin.
- Large central vacuole for food & water storage.
- Primary function is food storage and packing.



Parenchyma



Chlorenchyma



Aerenchyma

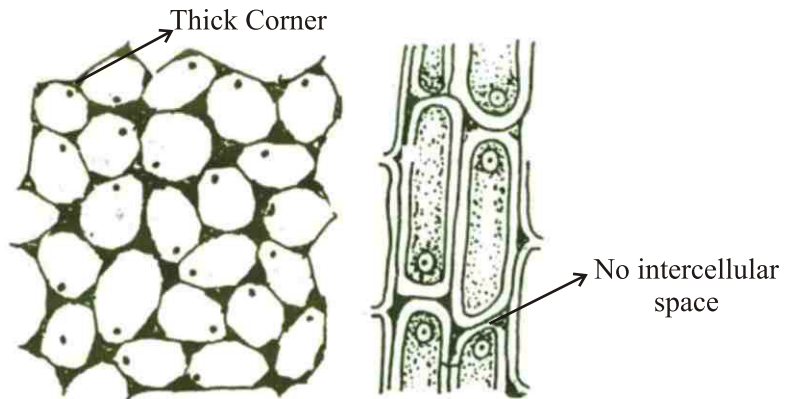
Parenchyma and its type :

**Idioblast :** Some parenchyma involved in storage of excretory substances such as resin, tannin, gum and oils called as idioblast.  
 • In typical parenchyma chlorophyll is absent.

**Chlorenchyma :** Chloroplast containing parenchyma tissues are called as chlorenchyma which perform photosynthesis e.g., mesophyll of leaves.

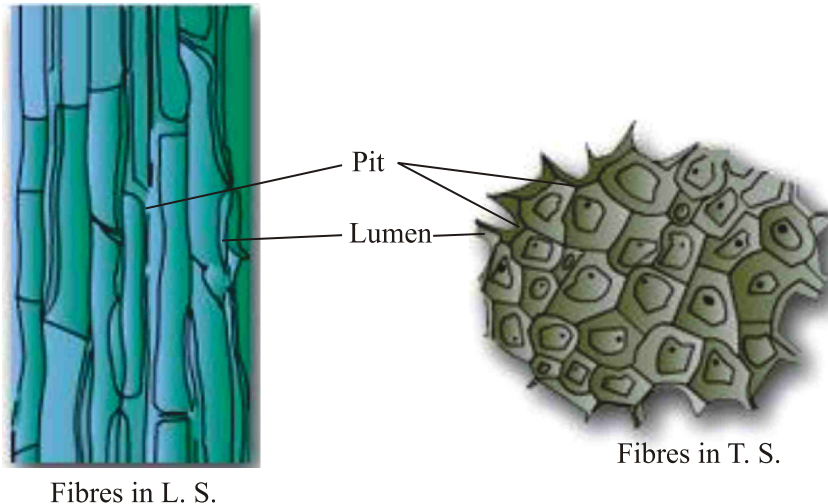
**Aerenchyma :** In hydrophytic plants aerenchyma (a type of parenchyma containing air spaces) provides buoyancy.

(ii) Collenchyma : It is the living mechanical tissue.



### Collenchyma

- Elongated cells with thick corners.
- Localized cellulose and pectin thickening.
- Provides flexibility to plant parts & easy bending of various parts of plant.
- Few chloroplasts may be present.
- Give mechanical strength elasticity to the growing stems.
- They have no or very little intercellular spaces.



#### Fibres in L.S.

- Composed of extremely thick walled cells with little or no protoplasm.
- Cells are dead & possess very thick lignified walls.
- Lignin is water-proof material.
- Intercellular spaces are absent.

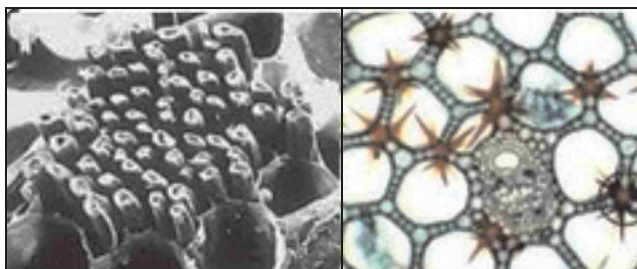


### (iii) Sclerenchyma

**Cells of sclerenchyma are of two types :**

**Sclereids :**

- These are also called grit cells or stone cells.
- These are small cells, where lumen is so small due to higher thickening of cell wall, as present in drupe fruit (mango, coconut, walnut) legume seeds (Macrosclereid)



**Fibres :**


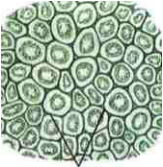

- They are very long, narrow, thick, lignified cells. Lumen is large as compared to sclereids. Generally 1-3 mm long.
- In the thick walls of both the fibres and sclereids are present thin areas called as pits.

**Uses of Sclerenchyma Fibres**

- These are used in the manufacture of ropes, mats & certain textile fibres.
- Jute and coir are obtained from the thick bundle of fibres.



### ***Difference between Parenchyma, Collenchyma and Sclerenchyma***

Features	Parenchyma	Collenchyma	Sclerenchyma
	 thin primary cell wall	 irregularly thickened primary cell wall	 thick secondary primary cell wall



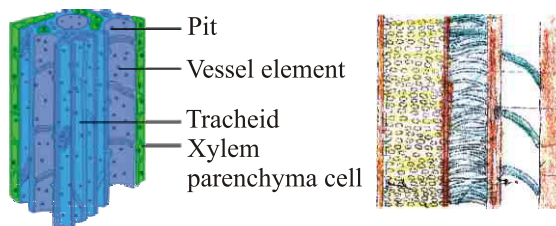
1. Cell shape	Isodiametric cells which are oval, spherical or polygonal in shape.	Circular, oval or polyhedral.	Variable in shape. Fibres and sclereids.
2. Cell Wall	Thin cellulosic cell wall.	Uneven thickening on their cell wall.	Lignified secondary cell wall present.
3. Cytoplasm	Abundant	Present	Absent
4. Nucleus	Present (Living tissue)	Present (Living tissue)	Absent (Dead tissue)
5. Vacuoles	Large vacuole	Vacuolated	Absent
6. Intercellular spaces	Present	Absent	Absent
7. Occurrence	Basically packing tissue, all soft part of plant-pith, cortex, medullary rays.	Dicot stems, petiole and beneath the epidermis. Absent in monocot and roots.	Dicot hypodermis, bundle sheath, pericycle, seed, pulp of fruits.
8. Functions	Food storage, photosynthesis, provide buoyancy to hydrophytes	Provide tensile strength, mechanical support, photosynthesis	Protection from stress and strain, mechanical strength.

### (B) *Complex permanent Tissues*

- It consists of more than one type of cells which work together as a unit.
- It helps in transportation of organic materials, water and minerals.
- It is also known as conducting or vascular tissue.
- Xylem and phloem together form vascular bundles.

**Xylem:** Also known as wood and is a vascular and mechanical tissue.

Xylem help in Transportation of water and minerals from soil to plant.



***Xylem consists of four types of cells called as components or elements :***

(i) Tracheids :

- They are elongated dead cells (primitive elements) mainly involved in conduction of water and minerals in gymnosperms.

(ii) Vessels :

They are advance element (generally found in angiosperms).

- Vessels are cylindrical tube like structures placed one above the other end to end which form a continuous channel for efficient conduction of water.

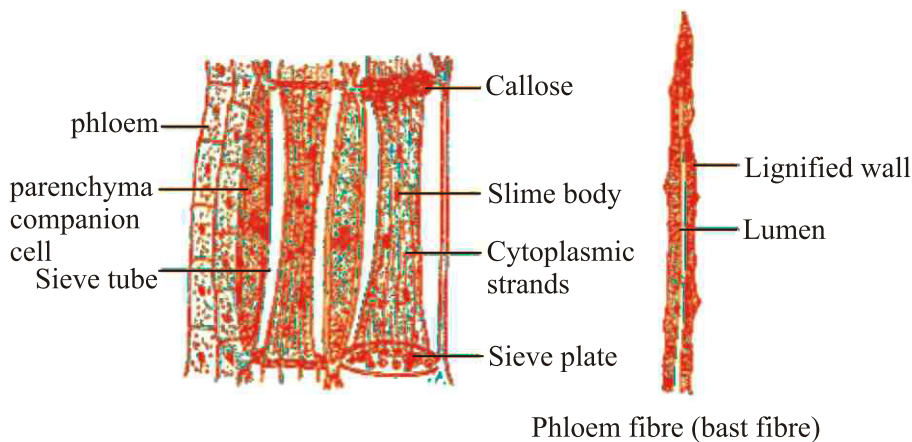
(iii) Xylem parenchyma :

- They are small and thick walled parenchymatous cells designed for storage of starch (food).

(iv) Xylem sclerenchyma (fibres)

- They are non-living fibers with thick walls and narrow cavities which provide mechanical support.
- Except xylem parenchyma all other xylem elements are dead.
- The annual rings present in the trunk of a tree are xylem rings.
- By counting the number of annual rings, we can determine the age of a tree.

**Phloem :** It transport (translocation) food from leaves to other parts of the plant. All phloem cells are living except phloem fibres.



Phloem consist of four types of components/elements :

(i) Sieve tubes :

- Sieve tubes are tubular structures made up of elongated, thin walled cells placed end to end.
- The end walls of sieve tube cells are perforated by numerous pores, called as sieve plates.

- Nucleus of sieve cell degenerates at maturity. However, cytoplasm persists, because of protoplasmic continuation of sieve tube with companion cell through plasmodesmata.

**(ii) Companion cells :**

- Companion cells have dense cytoplasm and prominent nuclei.
- Sieve tubes & companion cells are also called sister cells because they originate from single mother cell.

**(iii) Phloem fibre/Phloem Sclerenchyma :**

- They give mechanical support to sieve tubes and are dead.

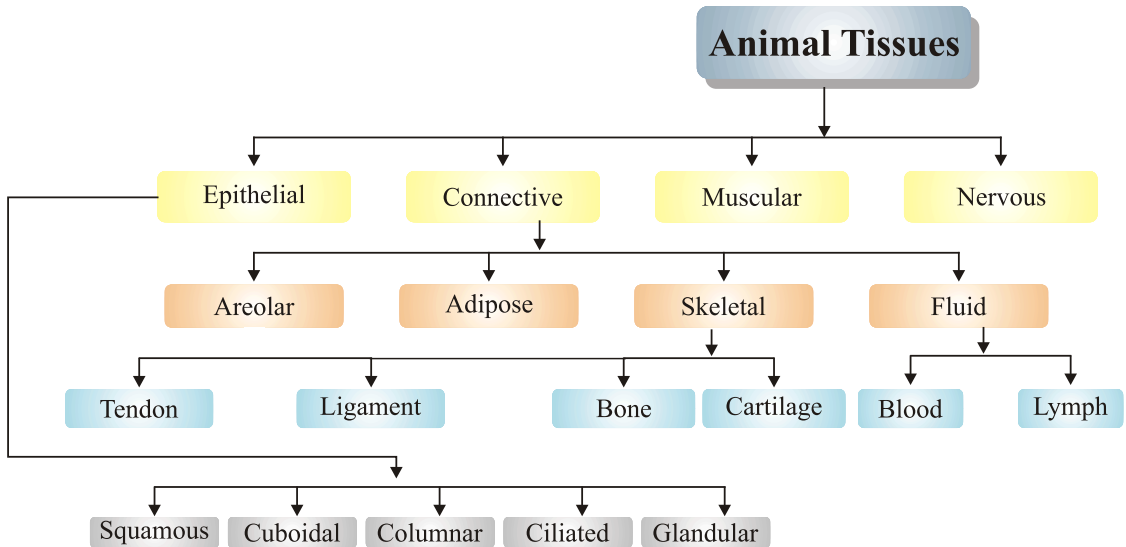
**(iv) Phloem parenchyma :**

- They store food and help in radial conduction of food.

## ***Difference Between Xylem and Phloem***

<b>Features</b>	<b>Xylem</b>	<b>Phloem</b>
Cells : Living/dead	Dead	Living
Cells :	(Except-xylem parenchyma)	(Except phloem fibre)
Thickness	Thick	Thin
Material	Lignin	Cellulose
Permeability	Impermeable	Permeable
Cross walls	None	Sieve plates
Cytoplasm	None	Yes
Function	Carries water and minerals	Carries sugars (Food)
Direction of flow	Upwards (Unidirectional)	Down and up (bidirectional)
Special features	Fibres	Companion cells

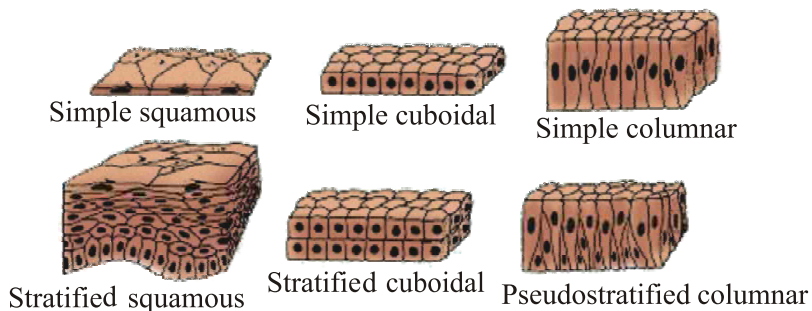
# ANIMAL TISSUE



## EPITHELIAL TISSUE

- Cells of epithelium are set very close to each other tightly packed and the tissue rests on a non-cellular basement membrane & consists of single layer of cells.
- It covers all the organs and line the cavities of hollow organs like stomach.
- It is primarily protective in function.

### Type of Epithelium



### Epithelium tissues are classified as :

(a) *Squamous epithelium* : Also called pavement epithelium.

- Cells arranged end to end like tiles on a floor.
- Cells are polygonal in surface view.
- It forms the delicate lining of cavities (mouth, oesophagus, nose, pericardium, alveoli etc.) blood vessels and covering of the tongue and skin.

- Epithelial cells are arranged in many layers (stratum) to prevent wear and tear in skin. This pattern is stratified squamous epithelium.

(b) *Cuboidal epithelium* :

- They are cube like cells that fit closely, cells look like squares in section, but free surface appears hexagonal.
- It is found in kidney tubules, thyroid vesicles and in glands (salivary glands, sweat glands).
- It forms germinal epithelium of gonads (testes and ovaries).
- It is involved in absorption, excretion and secretion. It also provides mechanical support.

(c) *Columnar epithelium* :

- Columnar means 'pillar-like' epithelium. It forms lining of stomach.
- Small intestine and colon, forming mucous membranes.
- Border of micro villi is present at the free surface end of each cell which increases absorption efficiency in small intestine.

(d) *Ciliated epithelium* :

- Cells may be cuboidal or columnar.
- Found in respiratory tract, lining of spermduct, oviduct & kidney tubules etc.
- On its free surface are present protoplasmic outgrowths called cilia.
- It helps in the movement of ova in the fallopian tube.

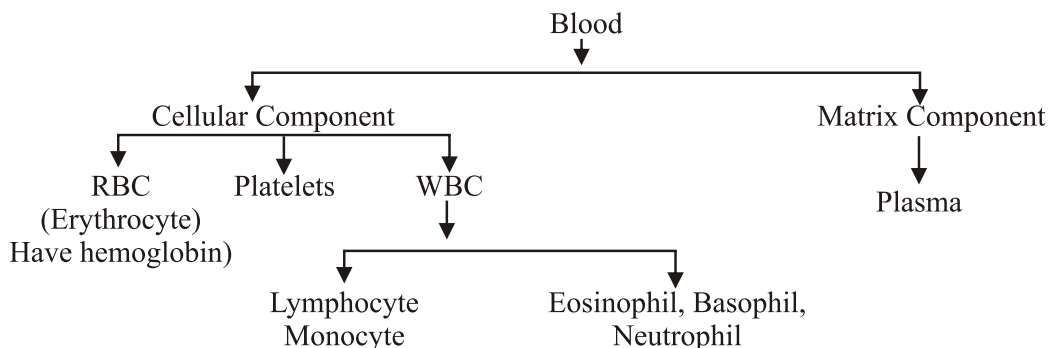
(e) *Glandular epithelium* :

- Gland cells secrete substances at the epithelial surface.
- Sometimes position of epithelial tissue folds inward and form multicellular gland it is called Glandular epithelium.

## CONNECTIVE TISSUE

- The cells of the connective tissue are widely spaced and embedded in an intercellular matrix.
- Their basic function is to provide support to different organs and keeping them in place.
- Connective tissue have two components : matrix and cellular part.

(a) *Fluid or vascular tissue* :



## Blood and lymph

- Blood is a connective tissue, fluid matrix of blood is plasma having wandering or floating cells, called corpuscles, blood helps in the transportation of various materials such as nutritive substances, gases, excretory products, hormones etc.

### (a) Plasma

- Form 55% part of blood. Constitution : 90-92% : water, 7% : Protein (Albumin, fibrinogen, globulin), 0.9% : inorganic salt etc.

### (b) Corpuscles

- Forms 45% part of blood.

#### (i) RBCs

- They are also called as erythrocytes, containing red coloured respiratory pigment called haemoglobin that helps in transportation of oxygen.

#### (ii) WBCs (Leucocytes : They are also called as 'Soldiers of the body'.) Provide immunity.

- They are irregular, amoeboid, phagocyte cells that protect our body by engulfing bacterial & other foreign particles. they are of five types : Monocytes, Lymphocytes, Basophils, Neutrophils, Eosinophils.

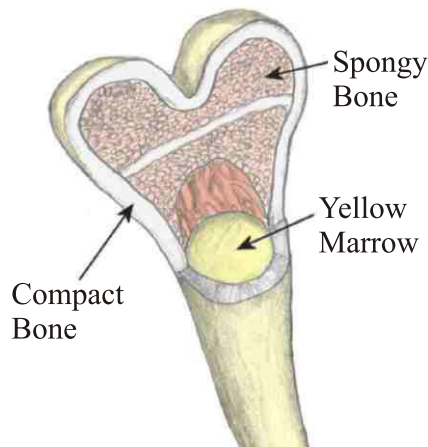
#### (iii) Blood platelets or thrombocytes

- They are spindle shaped cells which are involved in clotting of blood.

## (b) Skeletal Tissue

### BONE :

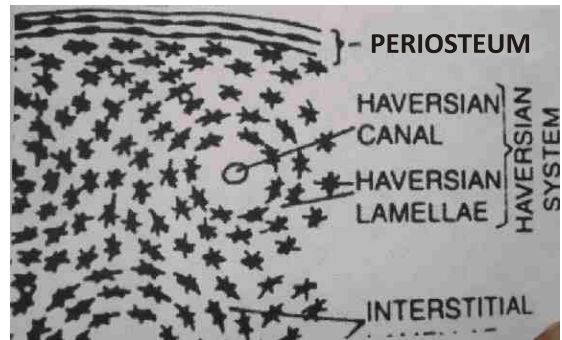
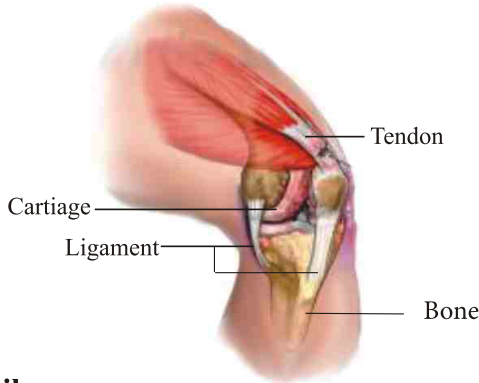
*It is hard connective tissue that forms supportive framework i.e. skeleton of the body. It is of two types :*



Structure of bone

## Bone

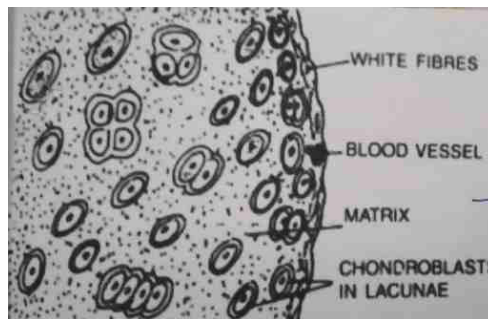
- Matrix of bone is very hard because of salts such as calcium phosphate,  $\text{CaCO}_3$  (60-70%) etc. and a protein ossein.
- Bone cells (osteoblasts) are embedded in this hard matrix.
- Matrix is deposited in the form of concentric layers of lamellae formed around a central canal, the bone cells occupy small spaces between the concentric layers of matrix.



## T.S. of Bone

## Cartilage

- This tissue is elastic, less harder as compared to bones.
- Elasticity is due to presence of chondrin (protein). Cells are called as chondrocytes which are widely spaced and matrix is reinforced by fibres.
- It is found at joint of bones, in the nose, ear, trachea and larynx.
- It provides flexibility and great tensile strength.



## T.S. of Cartilage

(c) *Dense regular connective Tissue (Fibrous Tissue)*

(i) Ligament
(ii) Tendon

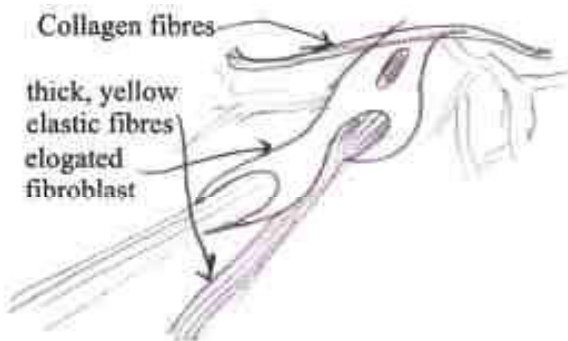
It is most abundant type of connective tissue. It is further divided into following types :

- (i) Yellow fibrous connective tissue (Ligament)
  - They are very elastic due to the presence of a network of yellow fibres in its matrix called as ligament which attaches bone to bone.
- (ii) White fibrous connective tissue (Tendon)
  - They have very little matrix containing abundant white fibres forming layers and non-elastic in nature.
  - Bundles of this tissue are called as tendons, which attaches muscles to the bones.



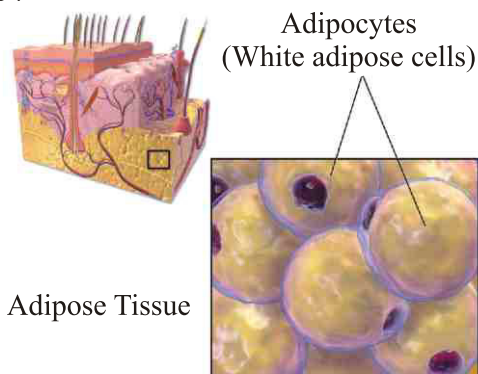
Tendons	Ligaments
<ol style="list-style-type: none"> <li>1. Inelastic</li> <li>2. Join muscles to bone.</li> <li>3. Made up of white collagen fibres.</li> </ol>	<ol style="list-style-type: none"> <li>1. Elastic</li> <li>2. Connect bones to bones.</li> <li>3. Made up of white collagen as well as yellow elastin fibres</li> </ol>
Bone	Cartilage
<ol style="list-style-type: none"> <li>1. Hard and inflexible</li> <li>2. Porous.</li> <li>3. Blood vessels present.</li> <li>4. Matrix made up of protein and mineral salts (e.g., calcium phosphate)</li> </ol>	<ol style="list-style-type: none"> <li>1. Flexible</li> <li>2. Non-porous</li> <li>3. Blood vessels absent.</li> <li>4. Matrix made up of protein.</li> </ol>

(d) *Areolar tissue :*



- This tissue fills spaces inside organs and is found between the skin & muscles, around blood vessels, nerves and in the bone marrow.
- It is a supporting and packing tissue.
- It also helps in repair of tissues after injury.

(e) *Adipose tissue :*





- These are oval and round cells, filled with fat globules called adipocytes.
- It is found in subcutaneous layer below the skin, around the heart, brain and below the eyeballs. It acts as an insulator and prevents loss of heat from the body.
- It serves as a fat reservoir and keeps visceral organs in position.

## MUSCULAR TISSUE

- Movements are brought about in our body with the help of muscular tissue.
- They are long fibre-like cells called muscle fibres.
- They are capable of contraction or relaxation because they are made up of contractile proteins. (actin and myosin)

### Skeletal Muscle

#### *Types of Muscu*



### Cardiac Muscle



### Smooth Muscle



(a) *Striated muscles*

- These muscles show alternate light and dark bands hence the name is striped or skeletal muscles.
- They are also called as voluntary muscles because these are under the control of one's will.
- Muscle fibers or cells are multinucleated and unbranched.
- Each fibre is enclosed by thin membrane which is called as sarcolemma. Cytoplasm is called as sarcoplasm.
- These muscles get tired and need rest.

(b) *Cardiac muscle fibres*

- They are involuntary muscles.
- Only found in the walls of heart.
- They are uninucleated and branched. Branches are united by intercalated disc.
- In these muscles rhythmic contraction and relaxation occurs throughout the life and never get tired.

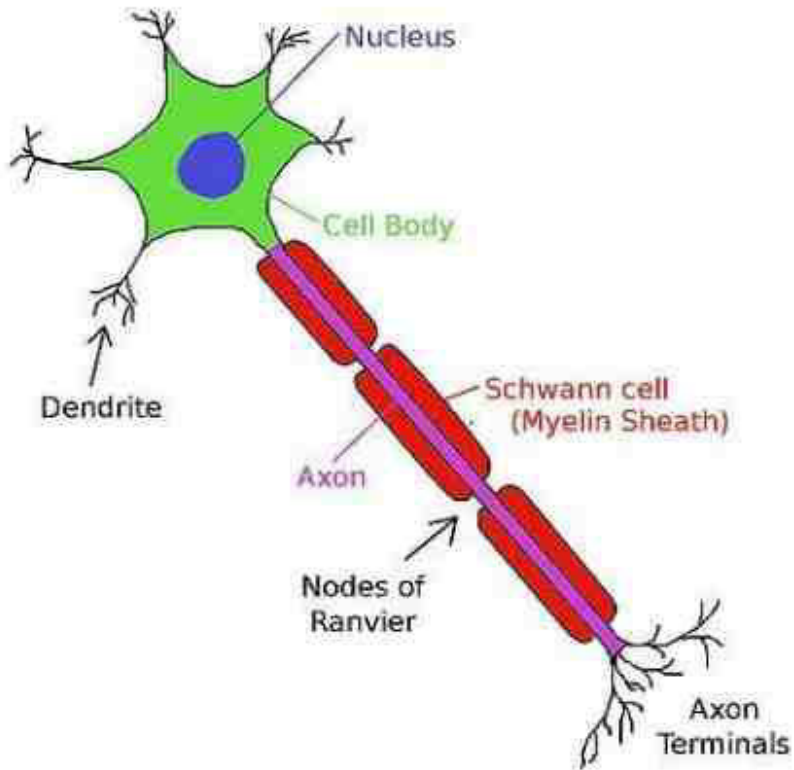
(c) *Non-striated muscles or smooth muscle*

- They are involuntary muscles also called as smooth muscles.
- These muscle fibres are uninucleated and spindle shaped.
- They are not enclosed by membrane but many fibres are joined together in bundles. They constitute internal organs.
- Such muscles are found in the walls of stomach, intestine, urinary bladder, bronchi, iris of eye etc.
- Peristaltic movements in alimentary canal are brought about by smooth muscles.

<b>Striated</b>	<b>Non-striated</b>	<b>Cardiac</b>
1. They are present in the limbs, body walls, tongue, pharynx and beginning of oesophagus.	1. They are present in the oesophagus (posterior part only), urino-genital tract, urinary bladder, vessels, iris of eye, dermis of skin, and arrector pili muscles of hair.	1. They are present in the wall of the heart, pulmonary veins and superior vena cava.
2. Cylindrical	2. Spindle shaped.	2. Cylindrical.
3. Fibres unbranched.	3. Fibres unbranched	3. Fibres branched.
4. Multinucleate.	4. Uninucleate	4. Uninucleate.
5. Bounded by sarcolemma.	5. Bounded by plasmalemma.	5. Bounded by sarcolemma
6. Light and dark bands present	6. Light and dark bands absent	6. Faint light and dark bands present.
7. No oblique bridges and intercalated discs	7. No oblique bridges and intercalated discs.	7. Oblique bridges and intercalated discs present.
8. Nerve supply from central nervous system.	8. Nerve supply from autonomic nervous system.	8. Nerve supply from the brain and autonomic nervous system.
9. Blood supply is abundant.	9. Blood supply is scanty.	9. Blood supply is abundant.
10. Very rapid contraction.	10. Slow contraction.	10. Rapid contraction.
11. They soon get fatigued.	11. They do not get fatigued.	11. They never get fatigued.
12. Voluntary	12. Involuntary	12. Involuntary

## NERVOUS TISSUE

- They are highly specialized tissues due to which the animals are able to perceive and respond to the stimuli.
- Their functional unit is called as nerve cell or neuron.
- Cell body is cyton covered by plasma membrane.
- Short hair like extensions rising from cyton are dendrons which are further subdivided into dendrites.
- Axon is long, tail like cylindrical structure with fine branches at the end Axon is covered by a sheath, which is known as myelin sheath.
- Nerve ending of one neuron is very closely placed to the dendrons of another neuron to carry impulses from one neuron to another neuron in the form of electrochemical waves. This close proximity is called as synapse.



**Structure of Neuron**

## **OBJECTIVE TYPE QUESTIONS**

### **VERY SHORT ANSWER TYPE QUESTIONS**

1. The tissue derived directly from the meristem of embryo is called as .....
2. A group of cells with similar structure organized to do a common function is called as .....
3. Which plant tissue remains in active metabolic state always ?
4. Sieve tubes and companion cells are found in ..... tissue. (Xylem/ phloem/ collenchyma)
5. Long, narrow, dead cells having a thick deposition of lignin in the cell wall are called ..... cells.
6. Which tissue is responsible for transport of water in plants ?
7. The special property of muscle fibres to contract forcefully and return to relaxed state is called ..... (excitability / contractibility / flexibility)
8. A branch of science dealing with the study of bones is called..... (Ornithology/ physiology/ osteology)
9. The fluid matrix of blood is called .....
10. Spindle-shaped, non-striated, involuntary muscle fibres present in hollow internal organs like urinary bladder are called ..... (smooth muscle fibres/ striated muscle fibres/ cardiac muscle fibres. )

### Q3. MCQ

1. In plants which of the following have the capability of cell division ?  
(a) Parenchyma (b) Sclerenchyma  
(c) Xylem (d) Apical Meistem
2. The growth in plants is  
(a) limited to certain regions (b) uniform in all parts  
(c) limited to top region (d) limited to roots only.
3. Intercalary meristems are found  
(a) at internodes and base of leaves (b) at growing tips of roots  
(c) beneath the bark (d) at the tips of stem
4. Cells of the tissue have dense cytoplasm, thin cellulose walls and prominent nuclei. Identify the tissue.  
(a) Collenchyma (b) Sclerenchyma  
(c) Meristem (d) Parenchyma
5. Dead long and narrow cells in a plant belong to which tissue ?  
(a) Parenchyma (b) Scclrenchyma  
(c) Collenchyma (d) Phloem
6. Bone is an example of \_\_\_\_\_  
(a) Muscular tissue (b) Connective tissue  
(c) Epithelial tissue (d) Nervous tissue
7. Which animal tissue is usually separated from the underlying tissue by an extracellular fibrous basement membrane ?  
(a) Muscular tissue (b) Connective tissue  
(c) Epithelial tissue (d) Nervous tissue
8. Oesophagus and the lining of the mouth are also covered with which tissue ?  
(a) Squamous epithelium (b) Ciliated epithelium  
(c) Areolar connective (d) Striated muscle tissues
9. Husk of a coconut is made of which tissue ?  
(a) Parenchyma tissue (b) Sclerenchymatous tissue  
(c) Collenchyma (d) Xylem
10. Muscles contain special proteins called \_\_\_\_\_ that help in muscle movement.  
(a) receptor proteins (b) enzymes  
(c) nucleo proteins (DNA, RNA) (d) contractile proteins (actin and myosin)

## **VERY SHORT ANSWER TYPE QUESTIONS**

1. Which meristem increases the girth of the plant ?
2. Name the epidermal tissue which helps in movement of ova in the oviduct.
3. Suggest a term for " The signal which passes along the nerve fibre :-
4. Which tissue helps in buoyancy in aquatic plants ?
5. "I am an animal tissue which fills the space inside the body organs and also supports them". Identify me and write my name.
6. Blood has a fluid matrix. Name thin matrix.
7. Name the tissues which enables animals to move rapidly in response to stimuli.

## **SHORT ANSWER TYPE QUESTION (2 MARKS)**

1. Name the outermost layer of cells in plants. State any two functions of this layer.
2. What is cutin ? Where is it found ?
3. What is the speciality of ciliated columnar epithelium tissue ?
4. Which animal tissue is responsible for transportation of various materials in body ? Name various components / Cells of this tissue.
5. Where is suberin found in plants ? What is its function ?

## **SHORT ANSWER TYPE QUESTION (3 MARKS)**

1. Draw a well labelled diagram of small pores present in epidermis of a leaf. State any two functions of these pores.
2. Broadly classify animal tissues.
3. Write the composition of mammalian blood. State any two main functions of blood.
4. Write down the identifying features of connective tissue. State any one major difference between ligament and tendon.
5. With the help of diagram explain the structure of neuron.
6. Name the cells of adipose tissue. Where is adipose tissue found in an animal body ? State its function also.

### LONG ANSWER TYPE QUESTION (5 MARKS)

1. What is meristematic plant tissue ? Categorise and explain various meristematic tissues. Also show the location of these meristematic tissues with help of a well labelled diagram.
2.
  - (i) Write characteristic features of complex permanent tissues.
  - (ii) Name two complex permanent tissues found in plants.
  - (iii) What do these two complex permanent tissues constitute together ?
  - (iv) Write the composition and function of these complex permanent tissues.
3. Differentiate between three types of muscles on the basis of their structure and function. Draw a neat well labelled diagram of these three types of muscles.
4. What are different kind of connective tissues ? State their functions.
5. Differentiate between parenchyma, collenchyma and sclerenchyma tissue on the basis of following :-
  - (i) Cell Wall
  - (ii) Cytoplasm
  - (iii) Nucleus
  - (iv) Occurance
  - (v) Function

### ASSERTION AND REASON BASED QUESTION

Directions – In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Mark the correct choice as :

- (a) Both assertion (A) and reason (R) true and reason (R) is the correct explanation of assertion (A)
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

Q1. Assertion - Water Hyacinth floats on water surface.

Reason - Inter-cellular spaces are absent in between the cells of sclerenchyma.

Ans. (b) Water Hyacinth floats on water surface because it has spongy petioles that enclose a lot of air in its aerenchyma. This air makes the plant lighter than water so that it is able to float on the water surface.

Q2. Assertion – Blood is considered to be 'connective tissue'.

Reason – During circulation, blood passes through all the organs of the body.

Ans. (a) Blood is circulated through all the organs of the body and therefore connects different tissues and organs of the body.



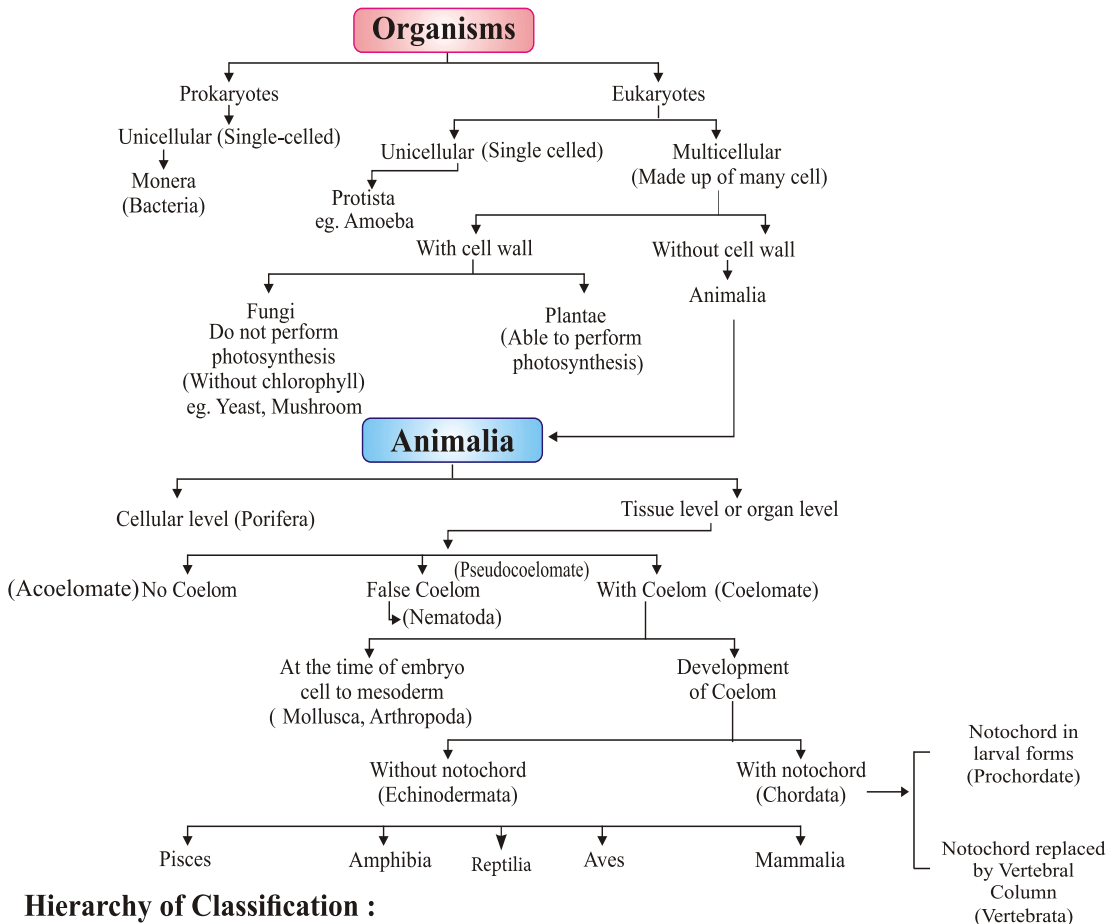


## Chapter - 7

# Diversity in Living Organism

## CONCEPT MAPPING

All living organism are grouped on the basis of their similarities and increasing complexities into different category.



### Hierarchy of Classification :



**Biodiversity** means the variety of living organisms present in a particular region. There are about 20 lac organisms known on the earth which differ from one another in external form, internal structure, mode of nutrition, Habitat, etc.

**Taxonomy** : It is a branch of biology which deals with identification, nomenclature and classification of organisms. Carolus Linnaeus is called the father of taxonomy.

**Nomenclature** : It is a system of assigning scientific names to the organisms. An organism can have different names in different languages. This creates confusion in naming organism. A scientific name is needed which is same in all languages. Binomial nomenclature system given by Carolus Linnaeus is used naming different organisms

***Following are some (rules and norms) conventions to be followed in writing the scientific name of an organisms:***

The Name consist of two part : genus and species.

- (1) Genus should be written first followed by the species.
- (2) First letter of the genus should be capital and that of the species should be in small letter.
- (3) When printed the scientific name should be written in italics and when written with hands genus and species should be underlined separately.

*Example : Homo sapiens for Human and Panthera tigris for Tiger.*

**Classification** : The method of arranging organisms into groups or sets on the basis of similarities and differences in called classification.

**Evolution** : Evolution is a slow and continuous process during which early organism on earth emerged, adapted and diversified into various form.

Charles Darwin first described the idea of evolution in 1859 in his book 'The origin of species'.

### ***Importance of Classification***

- It makes the study of wide variety of organisms easy and in systematic manner.
- It helps to understand how the different organisms have evolved with time.
- It forms a base for the study of other biological sciences, like biogeography.

### ***Basis of Classification***

- There are certain features or properties used for the classification of living organisms which are known as characteristics. Organisms with same characteristics are placed in same groups.

**Hierarchy of classification :** Linnaeus proposed a classification system by arranging organisms into taxonomic groups at different levels according to the characteristics they have. The groups or the levels from top to bottom are :

Kingom —→ Phylum (in Animal) Division (in plant) —→ Class —→ Order  
—→ Family —→ Genus —→ Species.

### ***Classification System***

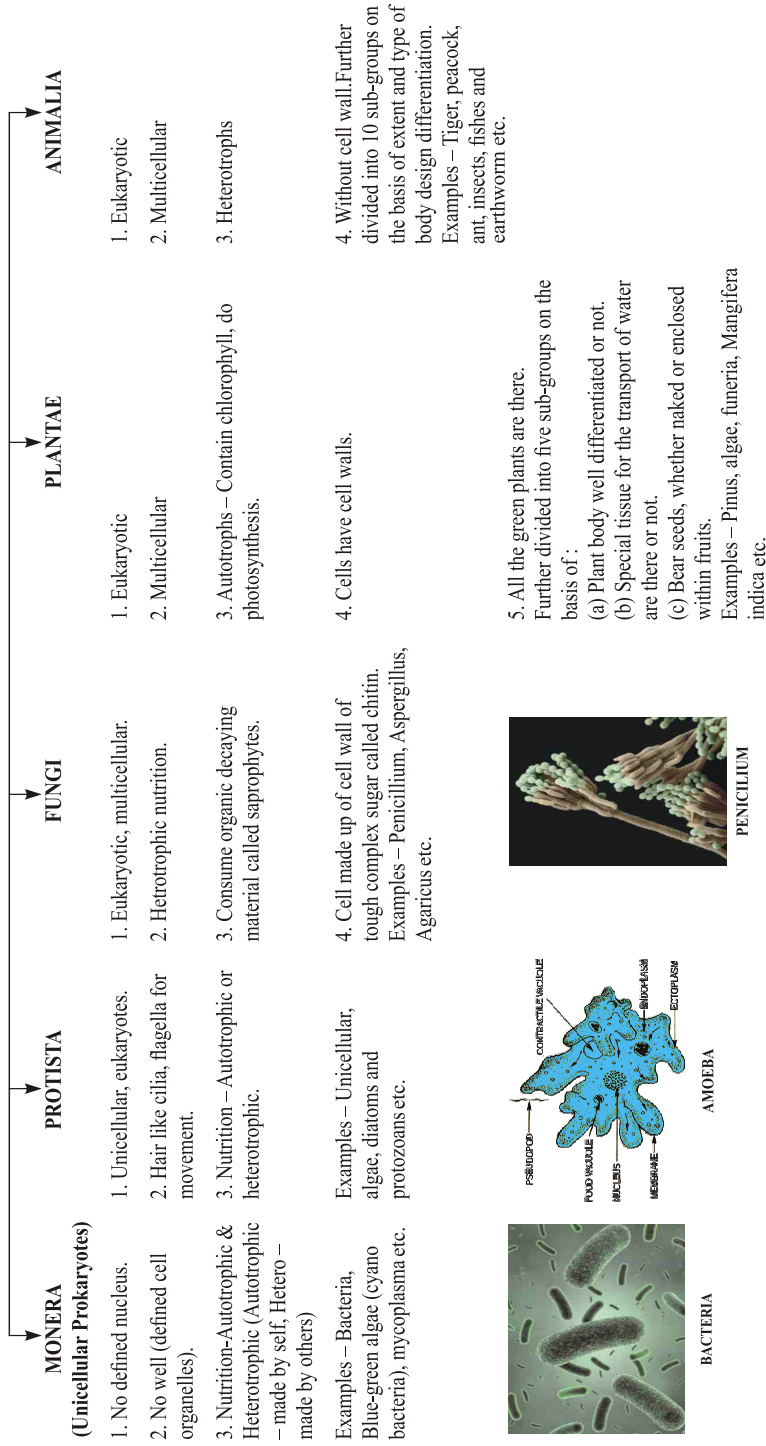
- **1. Two kingdom classification :** Carolus Linnaeus in 1758 classified the living organisms into two groups as plants and animals.
- **2. Five kingdom classificatoin :** R. Whittaker in 1959 further classified the organisms into five kingdoms as Fungi, Plantae, Animalia, Monera, Kingdom Protista.

**Note :** *Carl Woese in 1977 further divided kingdom Monera into archaebacteria (or Archae) and Eubacteria (or Bacteria).*

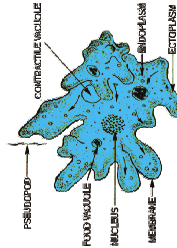
### **Basis of classification :**

- **Type of cellular structure**
  - (a) **Prokaryotic cells :** These are primitive and incomplete cells without well-defined nucleus.
  - (b) **Eukaryotic cells :** These are advanced and complete cells with well-defined nucleus
- **Level of organisation**
  - (a) **Cellular Level :** All living things are made up of cells. These are structural and functional unit of life.
  - (b) **Tissue level :** The cells organised to form tissue. A tissue is a group of cells which are similar in structure and perform a specific function.
  - (c) **Organ level :** Many tissues combine to form an organ, which performs a particular function.
  - (d) **Organ system level :** Group of organs work together to perform life activities. e.g., the organs of digestive system work together to digest food.
- **Body Structure**
  - (a) **Unicellular organisms :** These are organisms made up of single cell with all activities performed by the single cell.
  - (b) **Multicellular organisms :** These are organisms made up of large number of cells with different functions performed by different cells.
- **Mode of Nutrition (obtaining food)**
  - (a) **Autotrophs :** These are the organisms that make their own food by photosynthesis.
  - (b) **Heterotrophs :** These are the organisms which depend on other organisms for food.

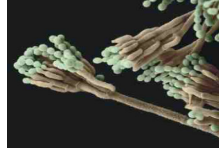
## FIVE KINGDOM CLASSIFICATIONS



**BACTERIA**



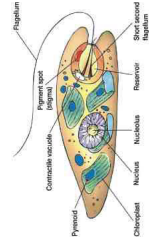
**AMOEBA**



**PENICILLIUM**



**ANABAENA**



**EUGLENA**



**AGARICUS**

## Kindom I : MONERA

- (i) Prokaryotic, unicellular, autotrophic or heterotrophic
- (ii) May or may not have cell wall which is rigid and made up of peptidoglycan.
- (iii) *Examples* : Anabaena, Bacteria, Cyano-bacteria or Blue-green algae (autotrophic).



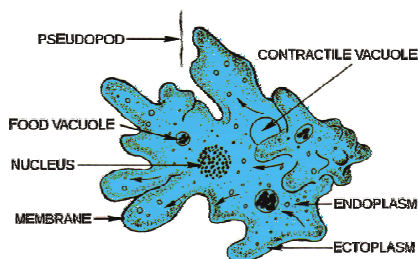
BACTERIA



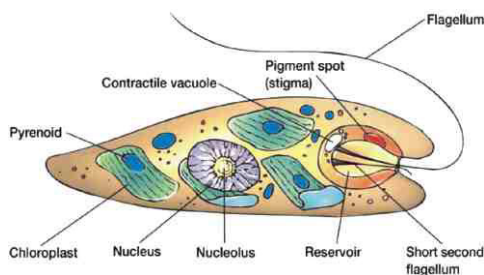
ANABAENA

## Kingdom II : PROTISTA

- (i) Eukaryotic, unicellular.
- (ii) Can be autotrophic or heterotrophic.
- (iii) May have cilia, flagella or pseudopodia for locomotion.
- (iv) *Examples* : Plants like unicellular algae, diatoms; animals like protozoans (Amoeba, Paramecium, Euglena); fungi like slime molds and water moulds.



AMOEBIA



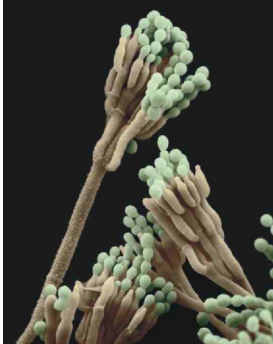
EUGLENA

## Kingdom III : FUNGI

- (i) Eukaryotic, cell wall is made up of chitin.
- (ii) Mostly multicellular but sometimes unicellular (yeast).
- (iii) Mode of nutrition :
  - (a) **Mostly saprophytes** : These organisms use dead and decaying organic material for food.
  - (b) **Some parasitic** : These organisms live inside or outside the body of other living organism to have food and can be disease causing.
  - (c) **Symbiotic relation** : These are relations between two organisms in

Which they live together for benefit of one or both. Lichens are a symbiotic relation between a fungi and cyanobacteria/algae. Here fungi gets food from cyanobacteria and in return cyanobacteria gets water mineral and protection from fungi.

- (iv) *Examples* : Mushrooms (*Agaricus*), green mould (*Penicillium*), smut (*Aspergillus*), yeast



PENICILLIUM



AGARICUS

#### Kingdom IV : PLANTAE

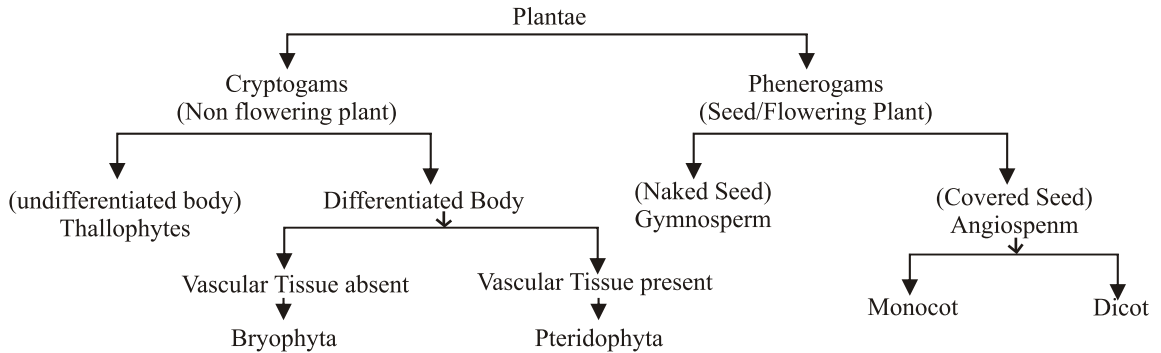
- (i) Eukaryotic, multicellular.
- (ii) Autotrophs. Some maybe heterotrophs also
- (iii) Cell wall is made up of cellulose and hemicellulose.

**Kingdom Plantae further classified into 5 division based on following (features) basis**

- (a) **Differentiated body parts** : Body is differentiated into leaves stems, roots, flowers, etc.
- (b) **Presence of vascular tissue** : There are two types of vascular tissues present in the plants :
  - **Xylem** : Helps in transport of water & Minerals.
  - **Phloem** : Helps in transport of food.
- (c) **Reproduction through seeds or spores** :
  - **Phanerogam** : Plants with seeds are called phanerogam. They contains embryo with stored food and are multicellular.
  - **Cryptogam** : Plants reproduce by spores, without flower and seeds. They contains only naked embryo.

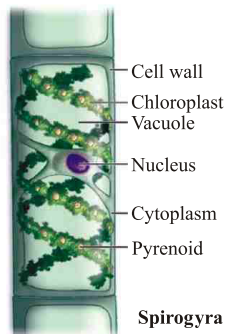
**(d) Seeds are naked or covered (fruit) :**

- **Angiospermae** : These are plants with seeds inside the fruit and bears flowers.
- **Gymnospermae** : These are plants with naked seeds and do not bear flowers or fruit.



**Division 1 : Thallophyta**

- Basic and elementary plants with undifferentiated body parts.
- Generally called algae.
- No vascular tissue present.
- Reproduce through spores.
- Mainly found in water (aquatic)
- Example : Ulva, Spirogyra, Ulothrix, Cladophora, Chara.



**Division 2 : Bryophyta**

- Body structure differentiated but not fully developed.
- No vascular tissues present.
- Reproduce through spores.
- Found on both land and water therefore known as '**Amphibians of Plantae Kingdom**'.



- (v) *Example* : Liverwort (Marchantia, Riccia), Mosses (Funaria), Hornwort (Dendrocerous).



**FUNARIA**



**RICCIA**

### **Division 3 : Pteridophyta**

- (i) Differentiated body structure - leaves, stems, roots, etc.
- (ii) Vascular tissues present are incomplete.
- (iii) Reproduce through spores.
- (iv) *Examples* : Marsilea, fern, horsetails.



**MARSILEA**



**FERN**

### **Division 4 : Gymnosperms**

- (i) Differentiated body parts i.e. leaves, stem and root etc.
- (ii) Vascular tissues present (incomplete)
- (iii) Naked seeds without fruits or flowers.
- (iv) Perennial, evergreen and woody.
- (v) *Examples* : Pines (deodar), Cycas, Ginkgo.



**PINUS**



**CYCAS**



## Division 5 : Angiosperms

- (i) Also known as flower-bearing plants.
- (ii) Later on flower becomes fruit after fertilisation
- (iii) Seeds are inside the fruit.
- (iv) Plant Embryos in seeds have structure called cotyledons. They are also called seed leaves because in many plants they emerge and become green when they germinate.
- (v) Vascular Tissue present (Complete)

Angiosperms are further divided on the basis of number of cotyledons into two kind :

- (a) Monocot      (b) Dicots.

S. No.	Features	Monocots	Dicots
1.	Seed	One cotyledon	Two cotyledons
2.	Root	Fibrous root	Prominent primary root
3.	Stem	False or hollow	Strong
4.	Leaf	Parallel venation	Reticulate venation
5.	Flower (petals)	Three or multiple of three (Trimerous)	Five or multiple of five (pentamerous)
6.	Example	Wheat, Rice etc.	Potato, Sunflower. Peanuts, Beans, Mango etc.

## Kingdom V : ANIMALIA

Basis of classification of Animalia kingdom :

- (i) **Symmetry :**
  - (a) **Bilateral symmetry :** It is when an organism can be divided into right and left equal halves, identical but mirror images, by a single vertical plane.
  - (b) **Radial symmetry :** It is when an organism is equally spaced around a central point, like spokes on a bicycle wheel.
- (ii) **Germ layers :** In embryonic stages there are different layers of cells called germ layer. The three different types of germ layer are :
  - **Ectoderm :** It is the outermost layer which forms nail, hair, epidermis, etc.
  - **Endoderm :** It is the innermost layer which forms stomach, colon, urinary, bladder, etc.
  - **Mesoderm :** It is the middle layer between ectoderm and endoderm which forms bones, cartilage, etc.

So, according to the number of germ layers present in embryonic stage, animal could be :

- **Diploblastic :** Organisms which are derived from two embryonic germ layers (ecto and endo).
- **Triploblastic :** Organisms which are derived from all the three embryonic germ layers. (ectoderm, mesoderm and endoderm)

(iii) **Coelom :** Body cavity or coelom is important for proper functioning of various organs. For example heart which has to contract & expand needs some cavity or empty space, which is provided by the coelom. (Coelom is the empty space occupied by different organ system in complex organism).

On the basis of presence or absence of coelom, organisms are divided into :

- **Acoelomates :** These are the simple organisms having no body cavity. e.g., Coelentrata, Platyhelminthes
- **Coelomates :** These are complex organisms having true cavity lined by mesoderm from all sides. e.g., Annelida, Mollusca, Arthropoda etc.
- **Pseudo coelomate :** These are organisms having false coelom. They have pouches of mesoderm scattered between endoderm and ectoderm. e.g., Nematoda

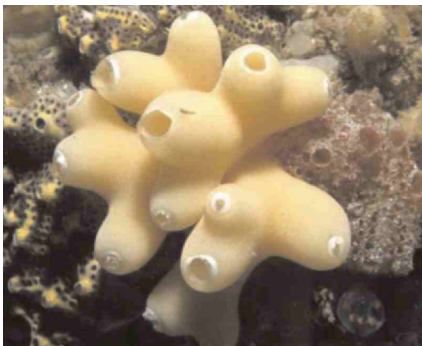
(iv) **Notochord :** It is a long rod like structure, which runs along the body between nervous, tissue and gut and provides place muscle to attach for ease of movement.

Organisms could be :

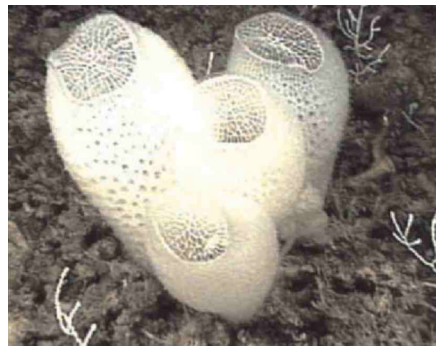
- Without notochord – Non Chordate
- with notochord – Protochordate
- with notochord in initial embryonic stages and vertebral column in adult phase – Vertebrates

### Phylum 1 : Porifera or Sponges

- Cellular level of organization. (They have porous body).
- Non-motile animals (sessile)
- Holes on body which led to a cannal system for circulation of water and food
- Hard outside layer called as skeletons
- Examples: Sycon, Spongilla, Euplectelia



**SYCON**



**EUPLECTELIA**

## Phylum 2 : Coelenterata

- (i) Tissue level of organization
- (ii) No coelom (acoelomates)
- (iii) Radial symmetry, diploblastic
- (iv) Hollow gut
- (v) Can move from one place to another
- (vi) Examples : Hydra, sea anemone, jelly fish (solitary), corals (colonies)



SEA ANEMON



CORALS

## Phylum 3 : Platyhelminthes

- (i) Also called flat worms
- (ii) No coelom present
- (iii) Bilateral symmetry, triploblastic
- (iv) Free living or parasitic
- (v) Digestive cavity has one opening for both ingestion and egestion
- (vi) Examples : Planaria (free living), liver fluke (parasitic)



PLANARIA



LIVER FLUKE

## Phylum 4 : Nematoda

- (i) No true coelom (Pseudocoelomate)
- (ii) Triploblastic, bilateral symmetry
- (iii) They are Parasitic worm.
- (iv) Male and female distinct from each other eg. Ascaris, Hookworm, Pinworm etc.

## Phylum 5 : Annelida

- (i) Second largest phylum
- (ii) Coelom present
- (iii) Bilateral Symmetry, Triploblastic
- (iv) The body is Metamerically Segmented (segments specialized for different functions)
- (v) Water or land (aquatic or Terrestrial habitat)
- (vi) Extensive organ differentiation
- (vii) *Examples* : Earthworm, Leech, Nereis



**EARTHWORM**



**NEREIS**

## Phylum 6 : Arthropoda (Jointed legs)

- (i) Largest phylum (consist of 80% of species)
- (ii) Generally Known as insects
- (iii) True Coelom present, Body is divided into 3 Region - head, thorax & Abdomen.
- (iv) Bilateral symmetry, triploblastic
- (v) Tough exo-skeleton made up of chitin
- (vi) Jointed appendages like feet, antenna
- (vii) *Examples* : Prawn, scorpion, cockroach, housefly, butterfly, spider



**Spider**



**Ant**



**Prawn**

## Phylum 7 : Mollusca

- (i) Coelom present
- (ii) Triploblastic, bilateral symmetry
- (iii) soft bodies, sometimes covered with hard shell
- (iv) Generally not segmented
- (v) Muscular foot for movement
- (vi) Kidney like organ for excretion
- (vii) *Examples:* Chiton, octopus, pila, unio



**CHITON**



**OCTOPUS**

## Phylum 8 : Echinodermata (Spiny skin)

- (i) Spiny skin, marine
- (ii) No notochord
- (iii) Coelom present, triploblastic, bilateral symmetry or radial symmetry
- (iv) Endoskeleton of calcium carbonate
- (v) Water vascular system for locomotion
- (vi) *Examples :* Antedon, sea cucumber, star fish, echinus



**SEA CUCUMBER**

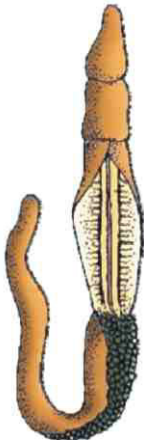


**STARFISH**

**Earlier it was placed under phylum chordata but now it is placed as a separate phylum under non chordata.**

**Phylum 9 : Hemichordata**

- (i) Small group of marine animals
- (ii) Cylindrical, bilateral symmetry, triploblastic
- (iii) Coelom present
- (iv) Gills for respiration
- (v) *Examples* : Balanoglossus



**BALANOGLLOSSUS**

**Phylum 10 : Chordata**

- (i) Bilateral symmetry, triploblastic
- (ii) Coelom present with organ system level of organisation
- (iii) Notochord present
- (iv) Gills present at some phase of life
- (v) Dorsal nerve chord present
- (vi) Post anal tail present at some stage of life, for example, in humans in embryonic stages.

Sub-divided into two :

**(a) Protochordata**

- Notochord at some stage of life.
- Marine
- Examples : Herdmania, amphioxus

**(b) Vertebrata**

- Notochord converted to vertebral column

- Organs like kidney for excretion and osmoregulation
- Paired appendages (eg. fins or limbs)
- 2, 3, 4 chambered heart examples : Humans (4-chambered), frog (3-chambered), fishes (2-chambered)

**Vertebrates** are divided into five classes namely Pisces, Amphibia, Reptilia, Aves and Mammalia.

- **Warm blooded organisms :** These are organisms which maintain same body temperature irrespective of outside temperature. *Example:* Humans beings. Human's body temperature is approximately 37°C.
- **Cold blooded organisms :** These are organisms which change their body temperature as per surrounding temperature. *Example :* Frog.

**(i) Pisces (Fishes)**

- Their skin is covered with scales or plates.
- They respire using gills.
- They have streamlined body and fins which help them to move in water.
- They are cold blooded and their heart has only two chambers.
- They lay eggs from which the young ones hatch out (oviparous) but some may be viviparous.
- Fishes with cartilage skeleton called **cartilaginous fishes**  
*Example :* Shark, sting Ray.
- Fishes with bony skeleton are called bony fishes.  
Example – Rohu



STING RAY



SHARK



TUNA



ROHU



**(iii) Amphibia (Amphibians)**

- They are found in land and water. They need water for completion of life cycle.
- They do not have scales but have mucous glands on their skin.
- They are cold blooded and the heart is three chambered.
- Respiration is through gills or lungs. They lay eggs in water.
- Frogs, Toads, Salamanders etc.



**FROGS**



**TOADS**



**SALAMANDER**

**(iv) Reptilia (Reptiles)**

- They have scales as exoskeleton and breathe through lungs.
- They are cold blooded.
- Most of them have three chambered heart but crocodiles have four chambered heart.
- They lay eggs with hard covering, on Land.
- Example :- Snakes, Turtles, Lizards, Crocodiles etc.



**SNAKE**



**CROCODILE**

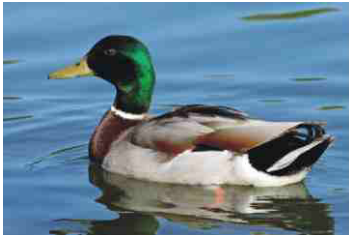


**LIZARD**

**(v) Aves (Birds)**

- They are warm blooded animals.
- They have four chambered heart.
- They breathe through lungs. Have hollow Bones (Pneumatic bones) that help in flying.
- They have an outer covering of feathers (Exoskeleton)
- Their two fore limbs are modified into wings for flying. They lay eggs.
- Example :- Crow, Sparrow, Pigeon, Duck, Stork , Ostrich etc.





**DUCK**



**PIGEON**



**OSTRICH**

**(vi) Mammalia (Mammals)**

- They are warm blooded animals.
- They have four chambered heart.
- They have mammary glands for production of milk to nourish their young ones.
- The skin has hairs and sweat glands. Most of them give birth to their young ones.
- Some of them lay eggs (like Platypus and Echidna).
- *Example : Cat, Rat, Dog, Lion, Tiger, Whale, Bat, Humans etc.*



**Cat**



**Lion**



**Human beings**



**bat**

Sr. No.	Features	Pisces	Amphibian	Reptilia	Aves	Mammalia
1.	Habitat	Water	Water and Land	Water and land	Water, land and air	Land or water
2.	Respiratory organs	Gills	Gills, lungs	Lungs	Lungs	Lungs
3.	Heart	2-chambered	3-chambered	3-chambered	4-chambered	4-chambered
4.	Maintenance of body temperature	Cold blooded	Cold blooded	Cold blooded	Warm blooded	Warm blooded

5.	Young ones	Eggs	Eggs in water	Eggs with tough coating, on land	Eggs	Young babies except Platypus and echidna.
6.	Skin	Skin covered with scales	Mucus glands in skin	Skins covered with scales	Skin covered with feathers	Hair, oil and sweat glands are present on the skin
7.	Special features	Streamlined body	Need water for completion of life cycle		Hollow Bones	Mammary glands which produces milk for children
8.	<i>Example :</i>	Anabas, Dog fish, Angler fish, Mandarin fish, Electric ray, Sting fish, Sea horse, Flying fish	Salamander, Common frog, Toad, Hyla (tree frog)	Trutle, Snakes, Lizard, Flying lizard, Crocodile, Chameleon	Ostrich, Sparrow, Crow, Pigeon, Tufted Duck, White Stock	Humans, Lion, Tiger, Cat, Bat, Whale

## Salient Features of Different Phyla of the Animal Kingdom

Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features
Portifera	Cellular	Various	Absent	Absent	Absent	Absent	Absent	Body with Pores and canals in walls.
Coelenterata (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.
Platyhelminthes	Organ & Organ-System	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.
Aschelminthes	Organ-System	Bilateral	Pseudo coelomate	Absent	Complete	Absent	Absent	Often worm-shaped, elongated.
Annelida	Organ-System	Bilateral	coelomate	Present	Complete	Present	Absent	Body segmentation like rings.
Arthropoda	Organ-System	Bilateral	coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.

Mollusca	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton of shell usually present.
Echinodermata	Organ-system	Radial	Coelomate	Absent	Complete	Present	Present	Water vascular system. radial symmetry.
Hemichordata	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	Worm-like with proboscis, collar and trunk.
Chordata	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Notochord, dorsal hollow nerve cord, gill slits with limbs or fins.

## QUESTIONS

### VERY SHORT ANSWER TYPE QUESTIONS

1. Define biodiversity.
2. Who wrote the book 'Origin of Species'.
3. What do you mean by primitive organism and advanced organism ?
4. Who is 'known as the father of taxonomy'?
5. List out the range of variation that you see around you among living organisms.
6. In Five kingdom classification, write the correct sequence of five kingdom classificatoin.
7. Write the examples of Archaeobacteria and Eubacteria.
8. What are resting spore and heterocyst ?
9. Who is the father of Evolution?
10. Give two examples belonging to members of nematoda.

### SHORT ANSWER TYPE QUESTION

1. What are the most striking features of phylum arthropoda ? Explain with example.
2. List the differences between annelids and arthropods.
3. Give two examples from phylum protochordata. Why they are placed in this Phylum.
4. Bats and whales are classified as mammals. Why ?
5. What do you understand by Nomenclature. What conventions are followed during Nomenclature of an organism. Write the biological name of Human, Housefly and Cockroach.

## LONG ANSWER TYPE QUESTION

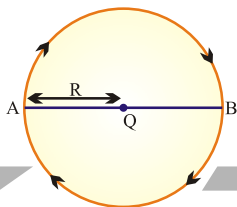
1. Define : (a) Evolution (b) Species (c) Viviparous  
(d) Oviparous (e) Coelom (f) Bilateral Symmetry.
2. Who proposed Hierarchical Classification. Give a brief account of Taxons used in Hierarchical classification.
3. Who proposed five Kingdom classification. Explain 5 kingdom classification in detail ?
4. Differentiate Between -  
(a) Angiosperms and Gymnosperms  
(b) Monocot and Dicots  
(c) Prokaryotes and Eukaryotes.

## OBJECTIVE TYPE QUESTIONS

### MCQ

1. **Chloroplast in Spirogyra is :**  
(a) spirally arranged and ribbon shaped with pyrenoids  
(b) spirally arranged without pyrenoids  
(c) circular  
(d) cup-shaped
2. **Needle shaped structure in Pinus plant is :**  
(a) leaf (b) root  
(c) stem (d) reproductive part
3. **Which among the following produce seeds ?**  
(a) Thallophyta (b) Bryophyta  
(c) Pteridophyta (d) Gymnosperms
4. **Which of the following are called "Amphibians of Plant Kingdom" ?**  
(a) bryophytes (b) algae  
(c) pteridophytes (d) gymnosperms
5. **A plant has woody stem and its leaves show reticulate venation ?**  
(a) gymnosperm (b) monocot  
(c) dicot (d) pteridophyte
6. **Some students want to prepare a temporary mount of Spirogyra. Where should they search for fresh specimen ?**  
(a) In a pond and salty water (b) in a stream of fresh water  
(c) in a stream of salty water (d) in a pond with stagnant water
7. **Pneumatic bones is an important characteristic of :**

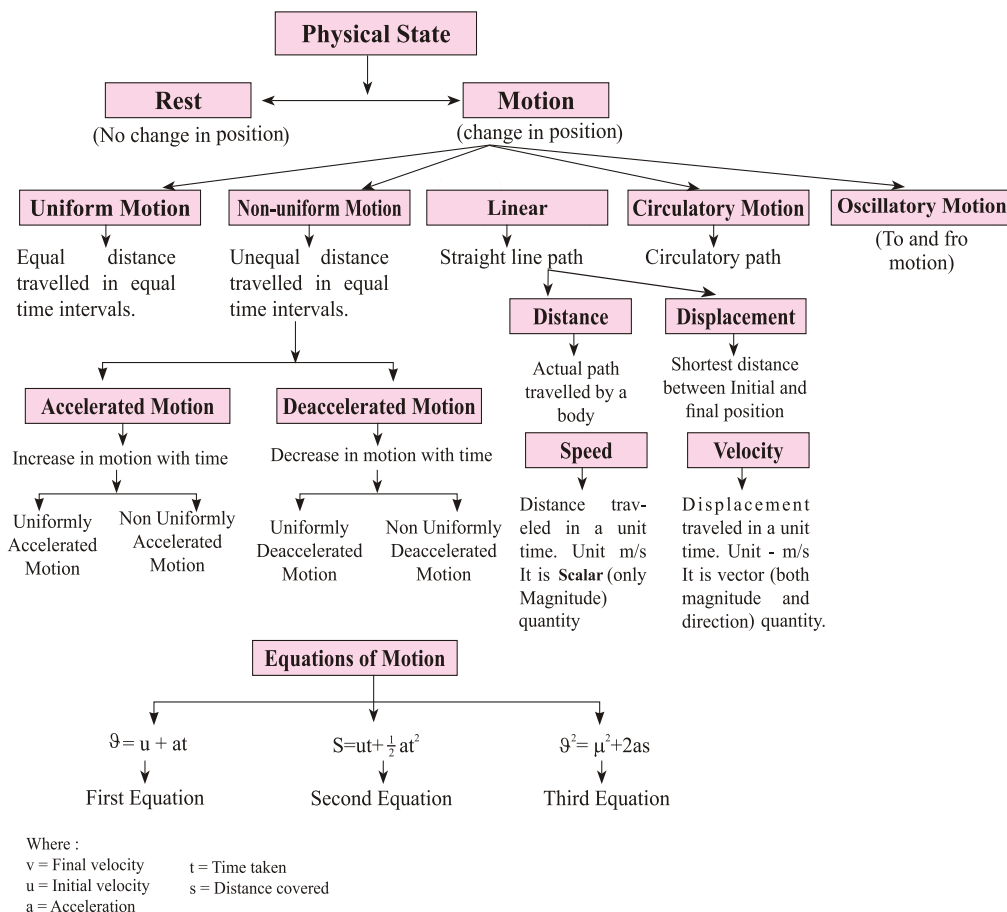
- (a) reptiles (b) amphibians  
(c) aves (d) mammals
8. **Earthworm is :**  
(a) bisexual with self fertilization (b) bisexual with cross-fertilization  
(c) unisexual with cross-fertilization (d) none of these
9. **Which one is a true fish ?**  
(a) Jellyfish (b) starfish  
(c) Dogfish (d) Silverfish
10. **Which of the following is not an aerial adaptation of a bird ?**  
(a) Presence of strong flight muscles (b) Presence of vertebral columns  
(c) Streamlined body (d) Forelimbs modified into wings
1. Assertion (A) : Bryophytes are called amphibians of plant kingdoms  
Reason (R) : In bryophytes water is required for fertilization.
2. Assertion (A) : Organisms named according to binomial Nomenclature.  
Reason (R) : Names consist of two words one scientific and other vernacular.
3. Assertion (A) : Platyhelminthes are commonly called flatworms  
Reason (R) : Platyhelminthes are elongated, dorsoventrally flattened animals.
4. Assertion (A) : Lichens are examples of bryophyta.  
Reason (R) : Lichen is a symbiotic relation between a Fungi and Algae.
5. Assertion (A) : Vascular and mechanical tissue is absent in thallophyta  
Reason (R) : Thallophyta are usually aquatic organisms.



## Chapter - 8

# Motion

### CONCEPT MAPPING



**Rest :** A body is said to be in a state of rest when its position does not change with respect to a reference point.

**Motion :** A body is said to be in a state of motion when its position change continuously with reference to a point.

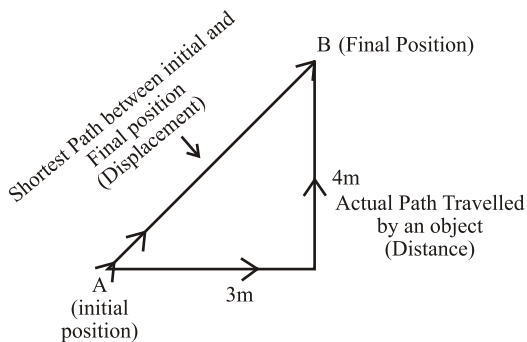
Motion can be of different types depending upon the type of path by which the object is going through.

- Physical quantity :— There are seven basic physical quantity. Every quantity is written in two parts : first write the magnitude of the physical quantity and then write the unit of the quantity, i.e. magnitude 4 Unit.

Quantity Name	SI Unit	
	Name	Symbol
Length	Metre	m
Time	Second	s
Mass	Kilogram	Kg
Absolute Temperature	Kelvin	K
Amount of Substance	Mole	mol
Electric Current	Ampere	A
Luminous Intensity	Candela	cd

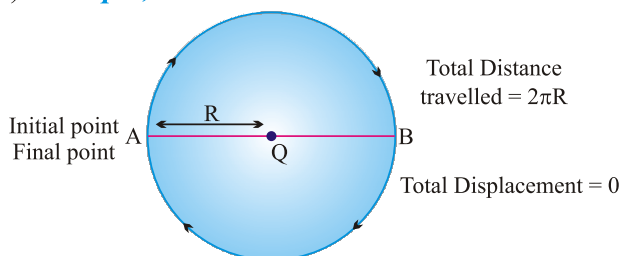
i) Scalar quantities : Those Physical quantities that has only magnitude but no direction. i.e. speed, distance, mass, volume, time, temperature, work, electric current.

ii) Vector quantities : Those physical quantities that has both magnitude as well as direction. i.e. velocity, force, momentum, displays etc.



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- Displacement can be zero (when initial point and final point of motion are same) *Example*, circular motion.



- Distance and displacement are denoted by 'S'.

### Difference between Distance and Displacement

Distance	Displacement
1. Length of actual path travelled by an object.	1. Shortest length between initial point and final point of an object.
2. It is scalar quantity.	2. It is vector quantity.
3. It remains positive, can't be '0' or negative.	3. It can be positive (+ve), negative (-ve) or zero.
4. Distance can be equal to displacement (in linear path).	4. Displacement can be equal to distance in linear path or it is lesser than distance.

**Example 1.** A body travels in a semicircular path of radius 10 m starting its motion from point 'A' to point 'B'. Calculate the distance and displacement.

**Solution :** Total distance travelled by body,  $S = ?$

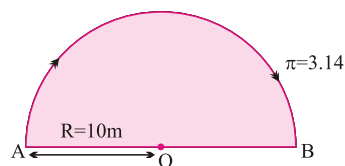
Given,

$$\pi = 3.14, R = 10 \text{ m}$$

$$S = \pi R$$

$$S = 3.14 \times 10 \text{ m}$$

$$= 31.4 \text{ m}$$



Total displacement of body,  $S = ?$

Given,

$$R = 10 \text{ m}$$

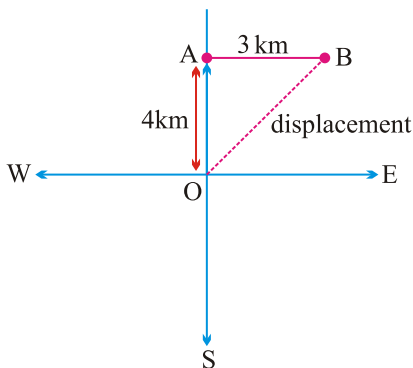
$$S = 2 \times R$$

$$= 2 \times 10 \text{ m} = 20 \text{ m}$$



**Example 2.** A body travels 4 km towards North then he turn to his right and travels another 3 km before coming to rest. Calculate (i) total distance travelled, (ii) total displacement.

**Solution :**



$$\begin{aligned}\text{Total distance travelled} &= OA + AB \\ &= 4 \text{ km} + 3 \text{ km} \\ &= 7 \text{ km}\end{aligned}$$

**Ans.**

$$\begin{aligned}\text{Total displacement} &= OB \\ OB &= \sqrt{OA^2 + AB^2} \\ &= \sqrt{(4)^2 + (3)^2} \\ &= \sqrt{16 + 9} \\ &= \sqrt{25} \\ &= 5 \text{ km}\end{aligned}$$

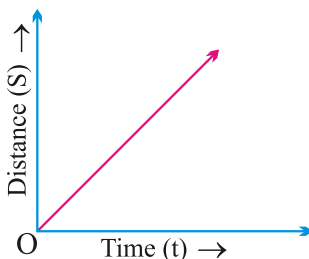
**Ans**

**Uniform and Non-uniform Motions :**

- Uniform Motion :**

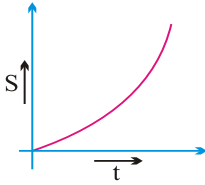
When a body travels equal distance in equal interval of time, then the motion is said to be uniform motion.

eg. movements of hands of a clock rotation and revolution of the earth.

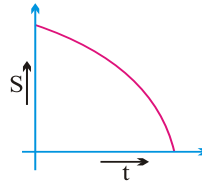


- **Non-uniform Motion :**

In this type of motion, the body will travel unequal distances in equal intervals of time. eg. motion of a car on busy road.



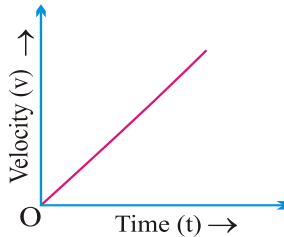
Continuous increase in slope of curve indicates accelerated non-uniform motion.



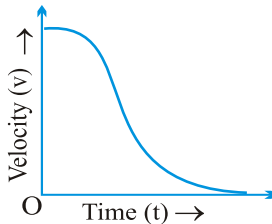
Continuous decrease in slope of curve indicates decelerate non-uniform motion.

Non-uniform motion is of two types :

- (i) **Accelerated Motion :** When motion of a body increases with unequal time.



- (ii) **De-accelerated Motion or Non uniform Retardation :** When motion of a body decreases with unequal interval of time.



Continuous decrease in slope of curve indicates deaccelerated non-uniform motion.

**Speed :** The measurement of distance travelled by a body per unit time is called speed. It is denoted by  $v$ .

$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

$$v = \frac{s}{t}$$

- SI unit = m/s (meter/second)
- If a body is executing uniform motion, then there will be a constant speed or uniform motion.
- If a body is travelling with non-uniform motion, then the speed will not remain uniform but have different values throughout the motion of such body.
- For non-uniform motion, average speed will describe one single value of speed throughout the motion of the body.

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

- It is necessary to write the The unit of every quantity in the answer of numerical questions :

**Example :** *What will be the speed of body in m/s and km/hr if it travels 40 kms in 5 hrs ?*

**Solution :**

$$\text{Distance (s)} = 40 \text{ km}$$

$$\text{Time (t)} = 5 \text{ hrs.}$$

$$\text{Speed (in km / hr)} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{40 \text{ km}}{5 \text{ hrs}}$$

$$= 8 \text{ km/hr}$$

**Ans.**

$$\text{Speed (in m/s)} = ?$$

$$40 \text{ km} = 40 \times 1000 \text{ m} = 40,000 \text{ m}$$

$$5 \text{ hrs} = 5 \times 60 \times 60 \text{ sec.}$$

$$= \frac{40 \times 1000 \text{ m}}{5 \times 60 \times 60 \text{ s}}$$

$$= \frac{80 \text{ m}}{36 \text{ s}}$$

$$= 2.22 \text{ m/s}$$

**Ans.**

**Velocity** : It is the speed of a body in given direction.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

- Velocity is a vector quantity. Its value changes when either its magnitude or direction changes. It is also denoted by  $v$
- For non-uniform motion in a given line, average velocity will be calculated in the same way as done in average speed.

$$\text{Average velocity} = \frac{\text{Total displacement}}{\text{Total time}}$$

- For uniformly changing velocity, the average velocity can be calculated as follows :

$$\text{Avg velocity} = \frac{\text{Initial velocity} + \text{Final velocity}}{2}$$

$$V_{(avg)} = \frac{u + v}{2}$$

where,  $u$  = initial velocity,  $v$  = final velocity

SI unit of velocity =  $\text{ms}^{-1}$

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

$\therefore$

- It can be positive (+ve), negative (-ve) or zero.

**Example 1** : During first half of a journey by a body it travel with a speed of 40 km/hr and in the next half it travels with a speed of 20 km/hr. Calculate the average speed of the whole journey.

**Solution :** Speed during first half ( $v_1$ ) = 40 km/hr  
 Speed during second half ( $v_2$ ) = 20 km/hr

$$\begin{aligned}\text{Average speed} &= \frac{v_1 + v_2}{2} \\ &= \frac{40 + 20}{2} = \frac{60}{2} \\ &= 30 \text{ km/hr}\end{aligned}$$

Average speed by an object (body) = 30 km/hr. **Ans.**

**Example 2 :** A car travels 20 km in first hour, 40 km in second hour and 30 km in third hour. Calculate the average speed of the train.

**Solution :** Speed in Ist hour = 20 km/hr, Distance travelled during 1st hr =  $1 \times 20 = 20 \text{ km}$

Speed in IInd hour = 40 km/hr, Distance travelled during 2nd hr =  $1 \times 40 = 40 \text{ km}$

Speed in IIIrd hour = 30 km/hr, Distance travelled during 3rd hr =  $1 \times 30 = 30 \text{ km}$

$$\begin{aligned}\text{Average speed} &= \frac{\text{Total distance travelled}}{\text{Total time taken}} \\ &= \frac{20 + 40 + 30}{1 + 1 + 1} = \frac{90}{3} \\ &= 30 \text{ km/hr}\end{aligned}$$

**Ans.**

**Acceleration**: Acceleration is seen in uniform motion and it can be defined as the rate of change of velocity with time.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time}}$$

$$\Rightarrow \text{Acceleration} = \frac{\text{Final Velocity} - \text{Initial Velocity}}{\text{Time}} \quad a = \frac{v - u}{t}$$

where,  $v$  = final velocity,  $u$  = initial velocity

If  $v > u$ , then 'a' will be positive (+ve).

**Retardation/Deacceleration**: Deacceleration is seen in uniform motion during decrease in velocity with time. It has same definition as acceleration.

$$\begin{aligned}&= \frac{\text{Change in velocity}}{\text{time}} \\ a &= \frac{v - u}{t}\end{aligned}$$

Here  $v < u$ , ' $a$ ' = negative (-ve).

Unit of Acceleration and deacceleration is  $\text{m/s}^2$  or  $\text{ms}^{-2}$

**Example 1 :** *A car speed increases from 40 km/hr to 60 km/hr in 5 sec. Calculate the acceleration of car.*

**Solution :**  $u = \frac{40 \text{ km}}{\text{hr}} = \frac{40 \times 1000}{60 \times 60} = \frac{40 \times 5}{18} = \frac{200}{18} = 11.11 \text{ ms}^{-1}$

$$v = \frac{60 \text{ km}}{\text{hr}} = \frac{60 \times 5}{18} = \frac{150}{9} = 16.66 \text{ ms}^{-1}$$

$$a = ?$$

$$t = 5 \text{ sec.}$$

$$a = \frac{v - u}{t}$$

$$= \frac{16.66 - 11.11}{5}$$

$$= \frac{5.55}{5}$$

$$= 1.11 \text{ ms}^{-2}$$

**Ans.**

**Example 2.** *A car travelling with a speed of 20 km/hr comes into rest in 0.5 hrs. What will be the value of its retardation ?*

**Solution :**

$$v = 0 \text{ km/hr}$$

$$u = 20 \text{ km/hr}$$

$$t = 0.5 \text{ hrs}$$

Retardation,  $a' = ?$

$$a' = \frac{v - u}{t}$$

$$= \frac{0 - 20}{0.5}$$

$$= -\frac{200}{5}$$

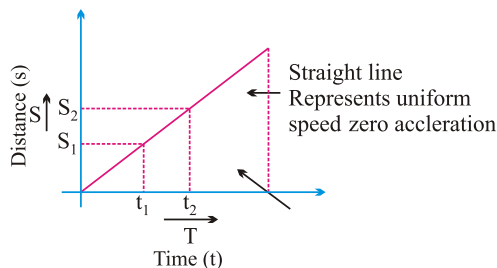
$$= -40 \text{ km/hr}$$

**Ans.**

## Graphical Representation of Equation :-

### (i) Distance-Time Graph : (s-t graph)

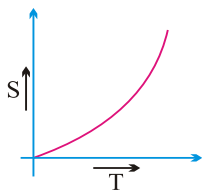
#### (a) s/t graph for uniform motion :



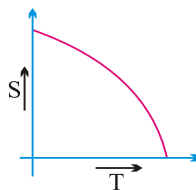
The slope of a distance - time graph represent speed of an object  
 speed of an object moving with uniform speed can be determined by :

$$v = \frac{s_2 - s_1}{t_2 - t_1}$$

#### (b) s/t graph for non-uniform motion :

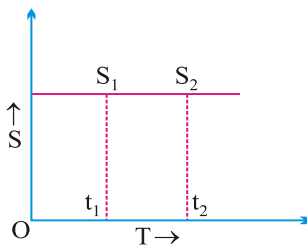


Continuous increase in slope of curve indicates accelerated non-uniform motion.



Continuous decrease in slope of curve indicates decelerated non-uniform motion.

#### (c) s/t graph for a body at rest :



$$v = \frac{s_2 - s_1}{t_2 - t_1}$$

But,  $s_2 = s_1$

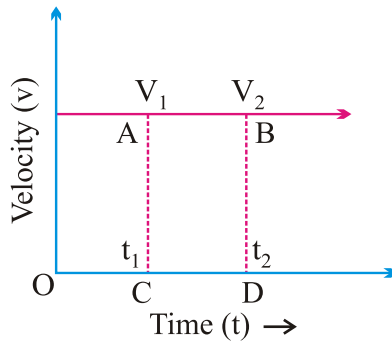
$$v = \frac{0}{t_2 - t_1}$$

∴

Or  $v = 0$

**(ii) Velocity-Time Graph : ( $v/t$  graph)**

**(a)  $v/t$  graph for uniform motion :**



$$a = \frac{v_2 - v_1}{t_2 - t_1}$$

But,  $v_2 = v_1$

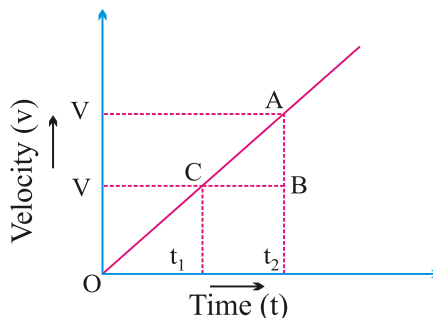
$$\therefore a = \frac{0}{t_2 - t_1} \quad \text{Or} \quad a = 0$$

Distance covered by the object in time  $t_1$  or  $t_2$  is :-

$$\begin{aligned} \text{distance (s)} &= AC \times CD \\ &= \text{area of rectangle} \\ &\quad ABCD \end{aligned}$$

**(b)  $v/t$  graph for non-uniform motion :**

**(A)  $v/t$  graph for accelerated (uniform) motion :**

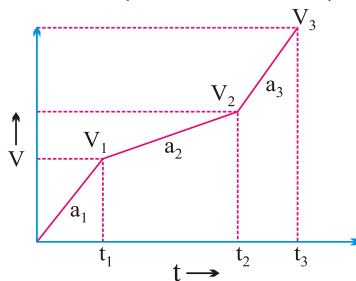


$$a = \frac{\text{change in velocity}}{\text{time taken}} \Rightarrow a = \frac{v - u}{t_2 - t_1} = \frac{\text{Final velocity (v) - Initial Velocity (u)}}{t_2 - t_1}$$

In uniformly accelerated motion, there will be equal increase in velocity in equal interval of time throughout the motion of body.



**(B)  $v/t$  graph for accelerated (non-uniform) motion :**



Here if,

$$t_2 - t_1 = t_2 - t_3$$

Then,

$$v_2 - v_1 \neq v_3 - v_2$$

$$\frac{v_2 - v_1}{t_2 - t_1} \neq \frac{v_3 - v_2}{t_3 - t_2}$$

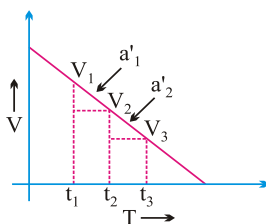
Or

Or

$$a_2 \neq a_3$$

**(C)**

**$v/t$  graph for deaccelerated (uniform) motion :**



Here,

$$v_2 - v_1 = v_3 - v_2$$

If

$$t_2 - t_1 = t_3 - t_2$$

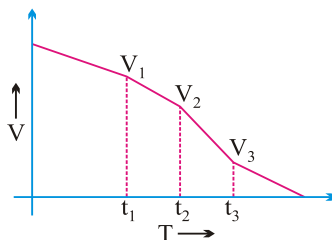
$$\frac{v_2 - v_1}{t_2 - t_1} = \frac{v_3 - v_2}{t_3 - t_2}$$

Then,

Or

$$a'_1 = a'_2$$

**(D)  $v/t$  graph for deaccelerated (non-uniform) motion :**



Here,

$$v_2 - v_1 \neq v_3 - v_2$$

If

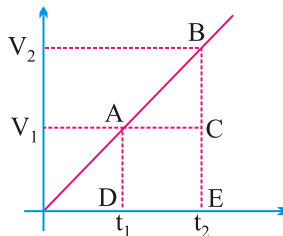
$$t_2 - t_1 = t_3 - t_2$$

$$\frac{v_2 - v_1}{t_2 - t_1} \neq \frac{v_3 - v_2}{t_3 - t_2}$$

Then,

Or  $a'_1 \neq a'_2$

**Note :** The area enclosed between any two time intervals is ' $t_2 - t_1$ ' in  $v/t$  graph will represent the total displacement by that body.



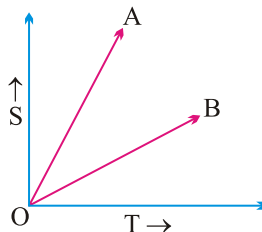
Total distance covered/travelled by body between  $t_2$  and  $t_1$ , time intervals

$$= \frac{1}{2} \times (CE - BE) \times (OE - OD) + AD \times (DE)$$

$$= \text{Area of } \triangle ABC + \text{Area of rectangle } ACED$$

$$= \frac{1}{2} \times (v_2 - v_1) \times (t_2 - t_1) + v_1 \times (t_2 - t_1)$$

**Example :** From the information given in  $s/t$  graph, which of the following body 'A' or 'B' will be more faster ?



**Solution :**  $V_A > V_B$  (Steeper The slope of line in distance-Time graph the greater the speed)

**Equation of Motion (For Uniformly Accelerated Motion) By graphical method:**

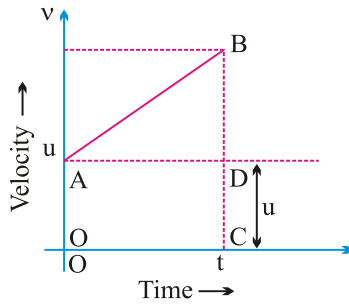
(i) **First Equation of motion:**

$$v = u + at$$

Or Final velocity = Initial velocity + Acceleration  $\times$  Time

**Graphical Derivation :**

Suppose a body has initial velocity ' $u$ ' (i.e., velocity at time  $t = 0$  sec.) at point 'A' and this velocity changes to ' $v$ ' at point 'B' in ' $t$ ' i.e., final velocity will be ' $v$ '.



For such a body there will be an acceleration.

$$a = \frac{\text{Change in velocity}}{\text{Change in time}}$$

$$a = \frac{OB - OA}{OC - 0} = \frac{v - u}{t - 0}$$

$$a = \frac{v - u}{t} \Rightarrow at = v - u$$

Or

Or

$$v = u + at$$

### (ii) Second Equation of motion :-

$$s = ut + \frac{1}{2}at^2$$

$$\begin{aligned} \text{Distance travelled by The object} &= \text{Area of OABC (trapezium)} \\ &= \text{Area of OADC (rectangle)} + \text{Area of } \triangle ABD \\ &= OA \times AD + \frac{1}{2} \times AD \times BD \\ &= u \times t + \frac{1}{2} \times t \times (v - u) \\ &\left( \because \frac{v - u}{t} = a \right) \text{ so } [v - u = at] \\ &= ut + \frac{1}{2} \times t \times at \end{aligned}$$

### (iii) Third Equation of motion :- $s = ut + \frac{1}{2}at^2$

$$v^2 = u^2 + 2as$$

$$s = \text{Area of trapezium OABC}$$

$$s = \frac{(OA + BC) \times OC}{2}$$

$$s = \frac{(u + v) \times t}{2}$$

Or

$$s = \left( \frac{u + v}{2} \right) \times \left( \frac{v - u}{a} \right) \quad \left( \because \frac{v - u}{t} = a \right)$$

$$s = \frac{v^2 - u^2}{2a}$$

$\therefore$

Or

$$v^2 = u^2 + 2as$$

**Example 1.** A car starting from rest moves with uniform acceleration of  $0.1 \text{ ms}^{-2}$  for 4 mins. Find the speed and distance travelled.

**Solution :**

$$u = 0 \text{ ms}^{-1} \quad \because \text{car is at rest.}$$

$$a = 0.1 \text{ ms}^{-2}$$

$$t = 4 \times 60 = 240 \text{ sec.}$$

$$v = ?$$

From,

$$v = u + at$$

$$v = 0 + 0.1 \times 240$$

Or

$$v = 24 \text{ ms}^{-1}$$

**Ans.**

Distance travelled

$$\begin{aligned} s &= ut + \frac{1}{2} at^2 \\ &= 0 \times 240 + \frac{1}{2} \times 0.1 \times (240)^2 \\ &= 2880 \text{ m or} \end{aligned}$$

$$s = 2.88 \text{ km}$$

**Example 2.** The brakes applied to a car produces deceleration of  $6 \text{ ms}^{-2}$  in opposite direction to the motion. If car requires 2 sec. to stop after application of brakes, calculate distance travelled by the car during this time.

**Solution :** Deceleration,  $a = -6 \text{ ms}^{-2}$

Time,  $t = 2 \text{ sec.}$

Distance,  $s = ?$

Final velocity,  $v = 0 \text{ ms}^{-1} \quad \because \text{car comes to rest.}$

Now,

$$v = u + at$$

Or

$$u = v - at$$

Or

$$u = 0 - (-6) \times 2 = 12 \text{ ms}^{-1}$$

And,

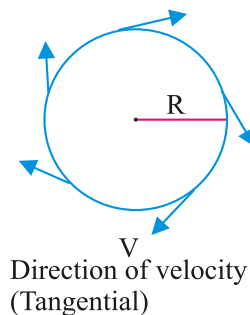
$$\begin{aligned} s &= ut + \frac{1}{2} at^2 \\ &= 12 \times 2 + \frac{1}{2} \times (-6) \times (2)^2 \\ &= 24 - 12 = 12 \text{ m} \end{aligned}$$

**Ans.**

## Uniform Circular Motion

If a body is moving in a circular path with uniform speed, It is motion is called uniform circular motion.

In such a motion the speed may be same throughout the motion but its velocity (which is tangential) is different at each and every point of its motion due to continuous change in direction. Thus, uniform circular motion is an accelerated motion.



so, velocity of an object in a circular motion is :

$$v = \frac{2\pi r}{t}$$

## QUESTIONS

### VERY SHORT ANSWER TYPE QUESTIONS

1. Change the speed 6 m/s into km/hr.
2. Why do speedometer and odometer provided in a motor vehicle ?
3. What is the other name of negative acceleration ?
4. What does the slope of distance-time graph indicate ?
5. What can you say about the motion of a body if its speed-time graph is  
a) straight line parallel to the time axis b) Straight line
6. Define Motion and speed
7. Is distance is a scalar or vector quantity? Why?
8. Is displacement a scalar quantity? Why?
9. Define average speed. How we calculate it ?
10. What is difference between speed and velocity?

### SHORT ANSWER TYPE QUESTIONS

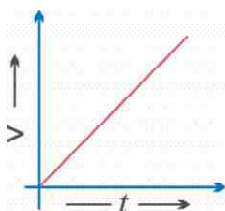
1. A tortoise moves a distance of 100 m in 15 minutes. What is its speed in km/hr ?
2. If a bus travelling at 20 m/s is subjected to a steady deceleration of  $5 \text{ m/s}^2$ , how long will it take to come to rest ?
3. What is the difference between uniform linear motion and uniform circular motion ?
4. Explain why the motion of a body which is moving with constant speed in a circular path is said to be accelerated.
5. Define velocity. What is SI unit of velocity?
6. What is meant by the term acceleration? Write its SI unit.
7. Write difference between 'distance' and 'displacement'.
8. Under what conditions can a body travel a certain distance and yet its resultant displacement be zero.
9. Is a uniform circular motion accelerated? Explain.
10. What type of motion is exhibited by a free falling body & why?

### LONG ANSWER TYPE QUESTIONS

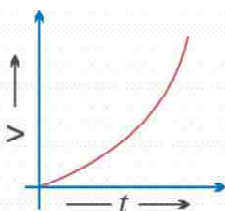
1. Derive the equations  $v = u + at$ ,  $s = ut + \frac{1}{2}at^2$  and  $v^2 = u^2 + 2as$  graphically.
2. A car travels 30 kilometers at a uniform speed of 40 km/hr and next 30 km at a uniform speed of 20 km/hr. Find its average speed.
3.
  - (a) Convert a speed of 54 km/hr into m/s.
  - (b) Change the speed of 6 m/s into km/hr.
  - (c) A driver decreases the speed of a car from 25 m/s to 10 m/s in 5 seconds. Find the acceleration of car.
4. A scooter acquires a velocity of 36 km/hr in 10 seconds just after the start. Calculate the acceleration of the scooter. Also calculate The distance covered upto this time.

[Hint : change speed in m/s,  $v = u + at$ ].

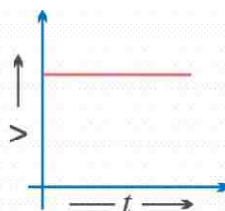
6. A car increase its speed from 20 km/hr to 50 km/min 10 seconds. Find its acceleration. [Hint : convert km/hr to m/s.  $v = u + at$ ].
7. A cyclist goes around a circular path once every 2 minutes. If the radius of the track is 105 metres. Calculate his speed.  $\left[ v = \frac{2\pi r}{t}, \pi \frac{22}{7} \right]$ .
8. Which type of motion is represented by each one of the following graphs?



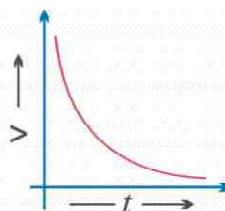
(a)



(b)



(c)



(d)

### Answer of Long Questions :

3. 26.6 km/hr.
4. (a) 15 m/s      (b) 21.6 km/hr      (c)  $a = -3 \text{ m/s}^2$
5.  $a = 1 \text{ m/s}^2$
6.  $a = 0.83 \text{ m/s}^2$
7.  $v = 5.5 \text{ m/s}$

## OBJECTIVE TYPES QUESTIONS

### MCQ

1. The numerical ratio of displacement to distance for a moving object is
  - (a) equal to or less than 1
  - (b) always equals to 1
  - (c) always less than 1
  - (d) always more than 1
2. Retardation of a body is expressed in
  - (a) m
  - (b)  $\text{ms}^{-1}$
  - (c)  $-\text{ms}^{-2}$
  - (d)  $\text{ms}^{-2}$
3. If the displacement time graph of a particle is parallel to the time axis, the velocity of the particle is
  - (a) Unity
  - (b) Infinity
  - (c) Zero
  - (d) None of these

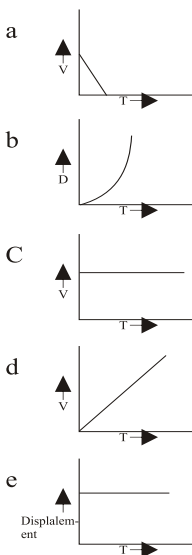
## OBJECTIVE TYPES QUESTIONS

4. **The slope of velocity-time graph gives**  
 (a) the displacement (b) the distance  
 (c) the acceleration (d) the speed
5. **The distance covered by a bus moving with a speed of 36Km/hr in 15 min. is**  
 (a) 0.9Km (b) 9 Km  
 (c) 90Km (d) 900Km
6. **A body is thrown vertically upward with velocity 'u' the greatest height 'h' to which it will rise is,**

(a)  $\frac{u}{g}$       (b)  $\frac{u^2}{2g}$       (c)  $\frac{u^2}{g}$       (d)  $\frac{u}{2g}$

7. **Match the following :**

### Column I



### Column II

p. Constant velocity

q. Non-uniform speed

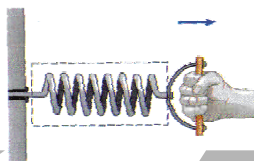
r. Body at rest

t. uniform retardation

- Q. **Assertion Reasoning based questions :-**

- A) Displacement of an object may be zero but distance covered by it is not zero  
 Displacement is the shortest distance between initial and final position of the object.
- B) Assertion (A) – Motion with uniform velocity is always along a straight line path.  
 Reason (R) – Uniform velocity means that speed and direction remain unchanged.
- C) Assertion (A) – Slope of Distance time graph represent the speed.  
 Reason (R) – Steeper the slope of the line greater will be the speed of an object.

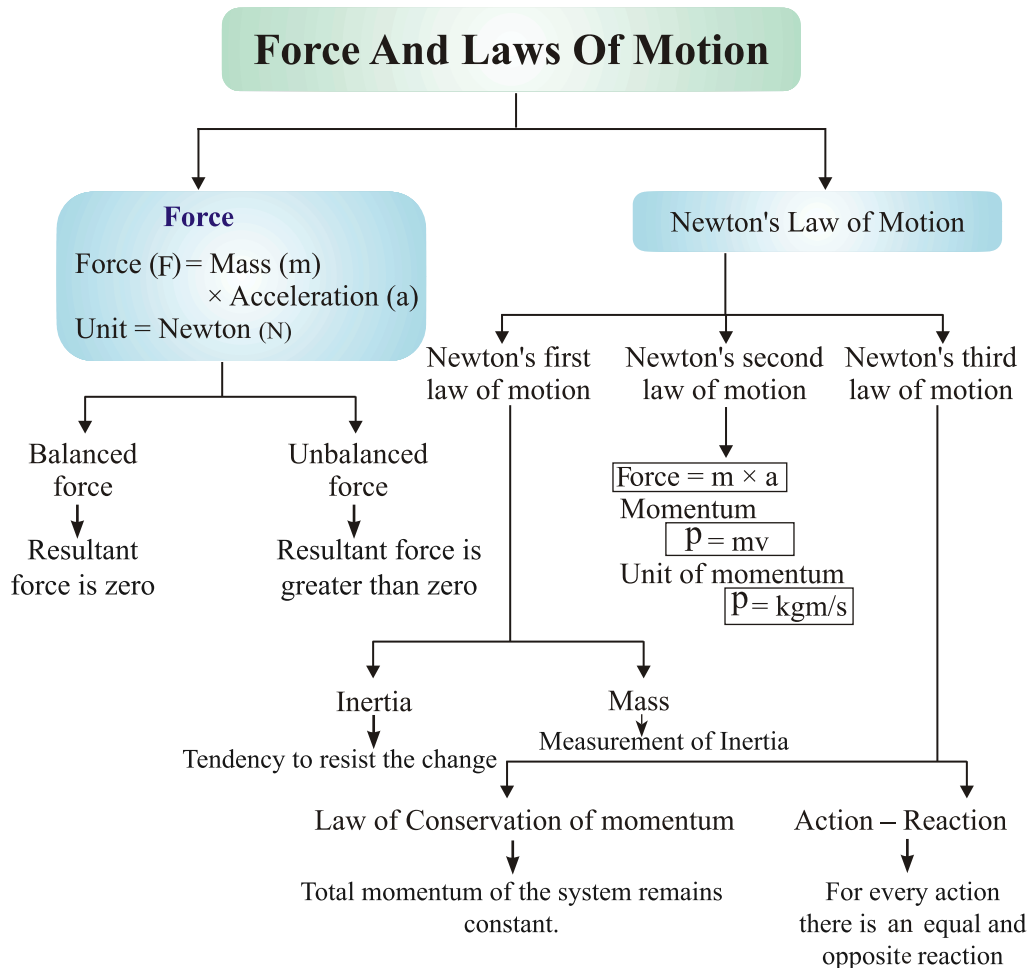




## Chapter - 9

# Force And Laws Of Motion

## CONCEPT MAPPING



### Forces and Laws of Motion :

**Force :** It is the force that enables us to do any work. To do anything, either we pull or push the object. Therefore, pull or push is called force.

*Example*, to open a door, either we push or pull it. A drawer is pulled to open and pushed to close.

### **Effect of Force**

- (i) Force can move a stationary body or object. For example, a football can be set to move by kicking it, *i.e.*, by applying a force.
- (ii) Force can stop a moving body. For example, by applying brakes, a running cycle or a running vehicle can be stopped.
- (iii) Force can change the direction of a moving object. For example, by applying force, *i.e.*, by moving handle, the direction of a running bicycle can be changed. Similarly by moving steering, the direction of a running vehicle is changed.
- (iv) Force can change the speed of a moving body. By accelerating, the speed of a running vehicle can be increased or by applying brakes the speed of a running vehicle can be decreased.
- (v) Force can change the shape and size of an object. For example, by hammering, a block of metal can be turned into a thin sheet. By hammering, a stone can be broken into pieces.

***Forces are mainly of two types :***

- (A) Balanced forces
- (B) Unbalanced forces

#### **(A) Balanced Forces**

- If the resultant of applied forces is equal to zero, it is called balanced forces.      an

*Example*, In the tug of war if both the team apply similar magnitude of forces in opposite directions, rope does not move in either side. This happens because of balanced forces in which resultant of applied forces become zero.

- Balanced forces do not cause any change of state of an object. Balanced forces are equal in magnitude and opposite in direction.
- Balanced forces can change the shape and size of an object. For example, when forces are applied from both sides over a balloon, the size and shape of balloon is changed.

## **(B) Unbalanced Forces**

- If the resultant of applied forces are greater than zero, the forces are called unbalanced forces. An object in rest can be moved because of applying Unbalanced forces.
- Unbalanced forces can do the following :
  - \* Move a stationary object
  - \* Increase the speed of a moving object
  - \* Decrease the speed of a moving object
  - \* Stop a moving object
  - \* Change the shape and size of an object

## **Laws of Motion :**

**Galileo Galilei :** Galileo first of all said that object move with a constant speed when no forces act on them. This means if an object is moving on a frictionless path and no other force is acting upon it, the object would be moving forever. That is, there is no unbalanced force working on the object.

- But practically it is not possible for any object. Because to attain the condition of zero, unbalanced force is impossible. Force of friction, force of air and many other forces are always acting upon an object.

## **Newton's Laws of Motion :**

Newton studied the ideas of Galileo and gave the three laws of motion. These laws are known as Newton's laws of motion.

### **Newton's First Law of Motion (Law of Inertia) :**

Any object remains in the state of rest or in uniform motion along a straight line, until it is compelled to change the state by applying external force.

**Explanation :** If any object is in the state of rest, then it will remain in rest until an external force is applied to change its state. Similarly, an object will remain in motion until any external force is applied over it to change its state. This means all objects resist to in changing their state. The state of any object can be changed by applying external forces only.

## Newton's First Law of Motion in Everyday Life :

- (a) A person standing in a bus falls backward when bus starts moving suddenly. This happens because the person and bus both are in rest while bus is not moving, but as the bus starts moving, the legs of the person start moving along with bus but rest portion of his body has the tendency to remain in rest. Because of this, the person falls backward; if he is not alert.
- (b) A person standing in a moving bus falls forward if driver applies brakes suddenly. This happens because when bus is moving, the person standing in it is also in motion along with bus. But when driver applies brakes the speed of bus decreases suddenly or bus comes in the state of rest suddenly in this condition the legs of the person which are in contact with the bus come in rest while the rest part of his/her body have the tendency to remain in motion. Because of this person falls forward if he / She is not alert.
- (c) Before hanging the wet clothes over laundry line, usually many jerks are given to the clothes to get them dried quickly. Because of jerks, droplets of water from the pores of the cloth falls on the ground and reduced amount of water in clothes dries them quickly. This happens because when suddenly clothes are made in motion by giving jerks, the water droplets in it have the tendency to remain in rest and they are separated from clothes and fall on the ground.
- (d) When the pile of coin on the carom-board is hit by a striker, only the coin at the bottom moves away leaving rest of the pile of coin at same place. This happens because when the pile is struck with a striker, the coin at the bottom comes in motion while rest of the coin in the pile has the tendency to remain in the rest and they vertically falls on the carom-board and remain at same place.

## Mass and Inertia

- The property of an object because of which it resists to get disturb <sup>the</sup> its state is called inertia. Inertia of an object is measured by its mass. Inertia is directly proportional to the mass. This means inertia increases with increase in mass and decreases with decrease in mass. A heavy object will have more inertia than the lighter one.
- In other words, the natural tendency of an object that resists the change in state of motion or rest of the object is called inertia.

- Since a heavy object has more inertia, thus it is difficult to push or pull a heavy box over the ground than the lighter one.

## **Momentum**

- Momentum is the power of motion of an object.
- The product of velocity and mass is called the momentum. Momentum is denoted by 'p'.

Therefore, Momentum of the object = Mass  $\times$  Velocity

Or, 
$$p = m \times v$$

Where,  $p$  = momentum,  $m$  = mass of the object and  $v$  = velocity of the object.

Consider the following explanations to understand the momentum :

- A person get injured in the case of hitting by a moving object, such as stone, pebbles or anything because of momentum of the object.
- Even a small bullet is able to kill a person when it is fired from a gun because of its momentum due to great velocity.
- A person get injured severely when hit by a moving vehicle because of momentum of vehicle due to mass and velocity.

## **Momentum and Mass and Velocity**

- Since momentum is the product of mass and velocity ( $p = m \times v$ ) of an object. This means momentum is directly proportional to mass and velocity. Momentum increases with increase of either mass or velocity of an object.
- This means if a lighter and a heavier object is moving with same velocity, then heavier object will have more momentum than the lighter one.
- If a small object is moving with great velocity, it has tremendous momentum. And because of momentum, it can harm an object more severely. For example, a small bullet having a little mass even kills a person when it is fired from a gun.
- Usually, road accidents prove more fatal because of high speed than in slower speed. This happens because vehicles running with high speed have greater momentum compared to a vehicle running with slower speed.

## **Momentum of an object which is in the state of rest :**

Let an object with mass ' $m$ ' is in the rest.

Since, object is in rest, therefore, its velocity,  $v = 0$

Now, we know that

$$\text{Momentum} = \text{mass} \times \text{velocity}$$

Or

$$p = m \times 0 = 0$$

Thus, the momentum of an object in the rest *i.e.*, non-moving, is equal to zero.

### Unit of momentum :

$$\text{SI unit of mass} = \text{kg}$$

$$\text{SI unit of velocity} = \text{meter per second } i.e., \text{ m/s}$$

We know that

$$\text{Momentum } (p) = m \times v$$

Therefore,

$$p = \text{kg} \times \text{m/s}$$

Or

$$p = \text{kg m/s}$$

Therefore, SI unit of momentum

$$= \text{kg m/s}$$

## Numerical Problems Based on Momentum

### Type I. Calculation of Momentum

**Example 1.** *What will be the momentum of a stone having mass of 10 kg when it is thrown with a velocity of 2 m/s ?*

**Solution :**

$$\text{Mass } (m) = 10 \text{ kg}$$

$$\text{Velocity } (v) = 2 \text{ m/s}$$

$$\text{Momentum } (p) = ?$$

We know that,

$$\text{Momentum } (p) = \text{Mass } (m) \times \text{Velocity } (v)$$

Therefore,

$$p = 10 \text{ kg} \times 2 \text{ m/s} = 20 \text{ kg m/s}$$

Thus, the momentum of the stone

$$= 20 \text{ kg m/s.}$$

**Ans.**

**Example 2.** *The mass of a goods lorry is 4000 kg and the mass of goods loaded on it is 20000 kg. If the lorry is moving with a velocity of 2 m/s, what will be its momentum ?*

**Solution :** Given,      Velocity ( $v$ ) = 2 m/s

Mass of lorry = 4000 kg, Mass of goods on the lorry = 20000 kg

Therefore,      Total mass ( $m$ ) on the lorry = 4000 kg + 20000 kg = 24000 kg

Momentum ( $p$ ) = ?

We know that,      Momentum ( $p$ ) = Mass ( $m$ )  $\times$  Velocity ( $v$ )

Therefore,       $p = 24000 \text{ kg} \times 2 \text{ m/s}$

Or       $p = 48000 \text{ kg m/s}$

Thus, the momentum of the lorry      = 48000 kg m/s. **Ans.**

**Example 3.** *A car having mass of 1000 kg is moving with a velocity of 0.5 m/s. What will be its momentum ?*

**Solution :** Given,      Velocity of the car ( $v$ ) = 0.5 m/s

Mass of the car ( $m$ )      = 1000 kg

Momentum ( $p$ ) = ?

We know that,      Momentum ( $p$ ) = Mass ( $m$ )  $\times$  Velocity ( $v$ )

Therefore,       $p = 1000 \text{ kg} \times 0.5 \text{ m/s} = 500 \text{ kg m/s}$

Thus, momentum of the car      = 500 kg m/s. **Ans.**

### Statement of Second Law

Rate of change of momentum of an object is proportional to applied unbalanced force in the direction of force.

### Mathematical expression

Suppose,      Mass of an object =  $m$  kg

Initial velocity of an object =  $u$  m/s

Final velocity of an object =  $v$  m/s

So, Initial momentum,  $p_1 = mu$ , Final momentum,  $p_2 = mv$

$$\begin{aligned}\therefore \text{Change in momentum} &= \text{Final momentum} - \text{Initial momentum} \\ &= mv - mu \\ &= m(v - u)\end{aligned}$$

$$\begin{aligned}\therefore \text{Rate of change of momentum} &= \frac{\text{Change in momentum}}{\text{Time taken}} \\ &= \frac{m(v - u)}{t}\end{aligned}$$

- According to IInd law, this rate of change of momentum is directly proportional to force.

$$\therefore F \propto \frac{m(v - u)}{t}$$

We know that,  $\frac{v - u}{t} = a$  (From 1st equation of motion)

So,  $F = kma$

Where  $k$  is a constant. Its value = 1.

$$\therefore F = 1 \times m \times a = ma$$

SI unit  $= \text{kg m/s}^2$  or Newton

### Q. Define 1 Newton.

**Ans.** When an acceleration of  $1 \text{ m/s}^2$  is seen in a body of mass  $1 \text{ kg}$ , then the force applied on the body is said to be  $1 \text{ Newton}$ .

### Proof of Newton's First Law of Motion from Second Law

First law states that if external force  $F = 0$ , then a moving body keeps moving with the same velocity, or a body at rest continues to be at rest.



So,

$$F = 0$$

We know

$$F = \frac{m(v - u)}{t}$$

(a) A body is moving with initial velocity  $u$ , then

$$0 = \frac{m(v - u)}{t} \quad \Rightarrow \quad v - u = 0$$

So,

$$v = u$$

Thus, final velocity is also same.

(b) A body is at rest *i.e.*,  $u = 0$ .

Therefore, from above  $u = v = 0$

So, the body will continue to be at rest.

### Third Law of Motion

To every action there is an equal and opposite reaction.

#### Applications :

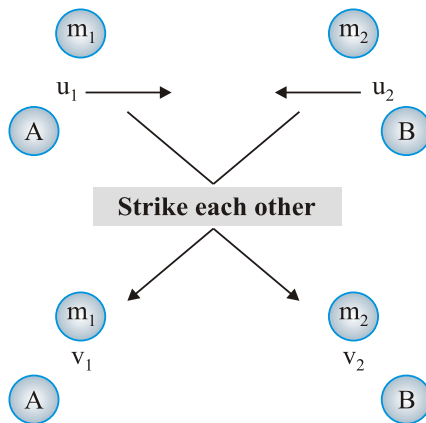
- (i) Walking is enabled by IIIrd law.
- (ii) A boat moves back when we deboard it.
- (iii) A gun recoils.
- (iv) Rowing of a boat.

### Law of Conservation of Momentum

When two (or more) bodies act upon one another, their total momentum remains constant (or conserved) provided no external forces are acting.

$$\text{Initial momentum} = \text{Final momentum}$$

Suppose, two objects A and B each of mass  $m_1$  and mass  $m_2$  are moving initially with velocities  $u_1$  and  $u_2$ , strike each other after time  $t$  and start moving with velocities  $v_1$  and  $v_2$  respectively.



Now,

Initial momentum of object A =  $m_1 u_1$

Initial momentum of object B =  $m_2 u_2$

Final momentum of object A =  $m_1 v_1$

Final momentum of object B =  $m_2 v_2$

So,

$$\begin{aligned} \text{Rate of change of momentum in A, } F_1 &= \frac{m_1 v_1 - m_1 u_1}{t} \\ &= \frac{m_1 (v_1 - u_1)}{t} \quad \dots(i) \end{aligned}$$

And

$$\begin{aligned} \text{Rate of change of momentum in B, } F_2 &= \frac{m_2 v_2 - m_2 u_2}{t} \\ &= \frac{m_2 (v_2 - u_2)}{t} \quad \dots(ii) \end{aligned}$$

We know from IIIrd law of motion,

$$F_1 = -F_2$$

So,

$$\frac{m_1 (v_1 - u_1)}{t} = -\frac{m_2 (v_2 - u_2)}{t} \quad [\text{From equations (i) \& (ii)}]$$

Or

$$m_1 v_1 - m_1 u_1 = -m_2 v_2 + m_2 u_2$$

So

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

Thus,

Initial momentum = Final momentum

**Example 1.** A bullet of mass 20 g is fired horizontally with a velocity of 150 m/s from a pistol of mass 2 kg. Find the recoil velocity of the pistol.

**Solution :** Given,

$$\text{Mass } (m_1) \text{ of bullet} = 20 \text{ g} = 0.02 \text{ kg}$$

$$\text{Mass } (m_2) \text{ of pistol} = 2 \text{ kg}$$

Initially bullet is inside the gun and it is not moving.

$$\text{So,} \quad \text{Mass} = m_1 + m_2 = (0.02 + 2) \text{ kg} = 2.02 \text{ kg}$$

$$\text{And} \quad u_1 = 0$$

$$\text{So,} \quad \text{Initial momentum} = 2.02 \times 0 = 0 \quad \dots(i)$$

Finally let the velocity of pistol be  $v_2$  and  $v_1$  for bullet = 150

$$\begin{aligned} \text{So,} \quad \text{Final momentum} &= m_1 v_1 + m_2 v_2 \\ &= 0.02 \times 150 + 2v_2 \quad \dots(ii) \end{aligned}$$

$$\text{We know that} \quad \text{Initial momentum} = \text{Final momentum}$$

$$\text{So,} \quad 0 = \frac{0.02 \times 150}{100} + 2v_2 \quad [\text{From equations (i) and (ii)}]$$

$$\Rightarrow \quad 3 + 2v_2 = 0$$

$$\text{Or} \quad 2v_2 = -3$$

$$\text{Or} \quad v_2 = -1.5 \text{ m/s} \quad \textbf{Ans.}$$

(-ve sign indicates that gun recoils in direction opposite to that of the bullet.

**Example 2.** Two hockey players viz A of mass 50 kg is moving with a velocity of 4 m/s and another one B belonging to opposite team with mass 60 kg is moving with 3 m/s, get entangled while chasing and fall down. Find the velocity with which they fall down and in which direction ?

**Solution :** Given,  $m_A = 50 \text{ kg}$ ,  $u_A = 4 \text{ m/s}$

$$m_B = 60 \text{ kg}, u_B = 3 \text{ m/s}$$

$$\begin{aligned}\text{Initial momentum}_A &= m_A u_A \\ &= 50 \times 4 = 200 \text{ kg m/s}\end{aligned}$$

$$\begin{aligned}\text{Initial momentum}_B &= m_B u_B \\ &= 60 \times 3 = 180 \text{ kg m/s}\end{aligned}$$

$$\text{So, Total initial momentum} = 200 + 180 = 380 \text{ kg m/s} \quad \dots(i)$$

$$\begin{aligned}\text{Final momentum} &= (m_A + m_B)v = (50 + 60)v \\ &= 110v \quad \dots(ii)\end{aligned}$$

According to the law of conservation of momentum,

$$380 = 110v$$

$$\text{Or} \quad v = \frac{380}{110} = 3.454 \text{ m/s} \quad \textbf{Ans.}$$

# QUESTIONS

## VERY SHORT ANSWER TYPE QUESTIONS

1. Can force be (-)ve ? When ?
  2. What is the tendency of a body to resist its change of state called ?
  3. Inertia is also measured by.....of an object.
  4. Higher the mass of an object, higher is its..... .
- Force
5. Acceleration is determined by.....which is also mass of the object.
  6. Why does the load from the cage above the seats in a bus falls down when suddenly brakes are applied ?
  7. When a tree is shaken, its fruits and leaves fall down. Why?
  8. Define Momentum of a body.
  9. On what factors does the momentum of a body depend?
  10. Why it is difficult to walk on a slippery road?

## SHORT ANSWER TYPE QUESTIONS

1. Quantity of motion contained in a body is..... .
2. Unit of momentum is..... .
3. Define 1 Newton.
4. Although we know that a moving body keeps moving indefinitely until an external force is applied on it, then why does a ball stops when we slide it on ground (without stopping it) ?
5. Why is it difficult to stop a truck suddenly than a motorbike ?
6. When a metro suddenly stops all the passengers fell forward on its floor. Why do this happen ?

7. We have a huge atmosphere above us that exerts a huge pressure on our shoulders, head and whole body. Why don't we get crushed under it ?
8. A coin of mass 1 kg and a stone of mass 5 kg are thrown down the Eiffel Tower with an acceleration of  $10 \text{ m/s}^2$ . Which one would reach the ground early and why ?
9. Give applications of 1st law of motion i.e., inertia.
10. (a) Friction is measured in.....  
(b) Distinguish between balanced and unbalanced forces.

### LONG ANSWER TYPE QUESTIONS

1. (a) Derive first law of Newton from second law.  
(b) Find the force required to stop a car of mass 100 kg with two passengers each of 50 kg sitting inside, if it is moving at 60 km/hr speed and takes 5 s to stop.
2. Two balls A and B of masses 40 g and 50 g are moving at speeds of 40 m/s and 30 m/s respectively. If after colliding, B starts moving with a velocity of 25 m/s, what is the velocity of A ?
3. A girl of mass 30 kg jumps on a cart of mass 5 kg with a velocity of 10 m/s. Find the velocity with which she and cart start moving after she jumps on it.
4. (a) Why does a gunman get a jerk on firing a bullet?  
(b) Calculate the momentum of a toy car of mass 200 gm moving with a speed of 5 m/s. [Hint - convert mass into kg].  
(c) State the law of conservation of momentum.
5. For how long should a force of 100 N acts on a body of 20 kg so that it acquires a velocity of 100 ms? [Hint - using formula  $f = ma$ .  $V = u + at$ ]
6. (a) Find the acceleration produced by a force of 5 N acting on a mass of 10 kg.

- (b) Which would require a greater force : (a) accelerating a 10 gm mass of  $5 \text{ m/s}^2$  or (b) a 20 gm mass at  $2 \text{ m/s}^2$ ?  
[convert mass into kg].
7. The velocity of a body of mass 10 kg increases from 4 m/s to 8 m/s when a force acts on it for 2s.
- (a) What is the momentum before the force acts?
- (b) What is the momentum after the force acts?
- (c) What is the gain in momentum per second?
- (d) What is the value of force?

$$\left[ \text{Hint} - a = \frac{v-u}{t} \text{ and } f = ma \right]$$

### Answers to Long Answer Type Questions

1. (b) - 2000/3 N
2. 46.25 m/s
3. 8.57 m/s
4. (b) 1 kg/ms
5. 20 sec.
6. (a)  $0.5 \text{ m/s}^2$   
(b) A greater force of 0.05 N is required for accelerating a 10 gm mass.
7. (a) 40 kg.m/s  
(b) 80 kg.m/s  
(c)  $20 \text{ kg.m/s}^2$   
(d) 20 N.

## OBJECTIVE TYPE QUESTIONS :

### MCQ.

1. **A truck and a car are moving with equal velocity, on applying brakes, both will stop after certain distance and then :**
  - (a) Truck will cover less distance before stopping.
  - (b) Car will cover less distance before stopping.
  - (c) Both will cover equal distance.
  - (d) None of the above.
2. **In which of the following cases, the net force is not zero ?**
  - (a) An object floating in air
  - (b) A ball freely falling from a certain height.
  - (c) A cork floating on the surface of water
  - (d) All the cases.
3. **A force acts on a body of mass 3kg such that its velocity changes from  $4\text{ms}^{-1}$  to  $10\text{ms}^{-1}$ . The change in momentum of the body is :**
  - (a)  $42\text{Kgms}^{-1}$
  - (b)  $2\text{Kgms}^{-1}$
  - (c)  $18\text{Kgms}^{-1}$
  - (d)  $14\text{Kgms}^{-1}$
4. **While opening a top with two fingers, the force applied are:**
  - (a) equal in magnitude
  - (b) Parallel to each other
  - (c) opposite in direction
  - (d) All of the above



5. The engine of a car produces an acceleration of  $4\text{ms}^{-2}$  in a car, if this Car pulls another car of same mass, what is the acceleration produces ?
- (a)  $8\text{ms}^{-2}$                       (b)  $2\text{ms}^{-2}$                       (c)  $4\text{ms}^{-2}$                       (d)  $0.5\text{ms}^{-2}$
6. A force 100N acts in a body mass 2kg for 10 sec. The change in the velocity of the body is.
- (a)  $100\text{ms}^{-1}$                       (b)  $250\text{ms}^{-1}$                       (c)  $500\text{ms}^{-1}$                       (d)  $1000\text{ms}^{-1}$

**Assertion and Reason type questions :**

**Choose the appropriate answer from the following choices :**

• **Assertion Reasoning Questions :-**

Read the Assertion (A) and Reason (R) statements carefully and mark the correct option out of the following :

- a) Both Assertion (A) and Reason (R) are true, and (R) is correct explanation of the assertion (A)
- b) Both (A) and (R) are true, but (R) is not current explanation of the (A).
- c) (A) is True but (R) is false.
- d) (A) is False but (R) is true.

1. **Assestion (A) :** If the external force on the body is Zero, then its accelerations is Zero.

**Reason (B) :** Acceleration does not depend on force.

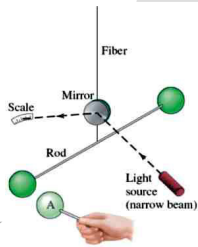
2. **Assertion (A) :** If two objects of different masses have same momentum, the lighter

body possess greater velocity.

**Reason (B) :** For all bodies momentum always remains same.

3. **Assertion (A) :** Newton's third law of motion is applicable only when bodies are in motion.

**Reason (B) :** Newton's third law applies to all types of forces eg., gravitaional, electric or magnetic force etc.



## Chapter - 10

# Gravitation

## CONCEPT MAPPING

### Gravitation

Newton's Universal  
law of gravitation

$$\text{Force (F)} = \frac{GM_1M_2}{R^2}$$

G = Gravitational Constant

$M_1$  = Mass of object 1

$M_2$  = Mass of object 2

R = distance between object

$$W = m \times g$$

Weight = Mass  $\times$   
Gravity

Buoyant force  
'f'

Thrust  $\rightarrow$  Pressure

$$P = F/A$$

P = Pressure

F = Force

A = Area

Acceleration due to  
gravity ( $g$ ) =  $9.8 \text{ m/s}^2$

$$g = \frac{GM}{R^2}$$

R = Radius of Earth

M = Mass of Earth

G = Gravitational  
constant

$$\text{Value of G} = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

## Gravitational Force of Earth



If we release a small stone without pushing it from a height, it accelerates towards earth. The stone is when accelerated towards earth, means some force is acting on it.



Earth

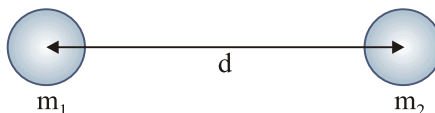
The force which pulls the objects towards the centre of the earth is known as gravitational force of the earth.

Here, stone also attracts earth. It means every object in universe attracts every other object.

## Newton's Universal Law of Gravitation

(Imp.)

Sir Isaac Newton in 1687 proposed a law about the force of attraction between the two objects in the universe which is known as Newton's law of gravitation.



According to this law :

Every mass in this universe attracts every other mass with a force which is directly proportional to the product of two masses and inversely proportional to the square of the distance between them.

Let masses ( $m_1$ ) and ( $m_2$ ) of two objects are distance ( $d$ ) apart, then force of attraction ( $F$ ) between them

$$F \propto m_1 \times m_2$$

$$F \propto \frac{1}{d^2}$$

$$F \propto \frac{m_1 \times m_2}{d^2}$$

$$F = \frac{Gm_1 \times m_2}{d^2}$$

where  $G$  is a constant and is known as Gravitational constant.

$$\text{Value of } G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

$G$  is called universal gravitational constant.

If unit of  $F$  is in Newton,  $m$  is in kg,  $d$  is in metre, then unit of  $G$  can be calculated as :

$$G = \frac{F \times d^2}{m_1 \times m_2} \text{ so unit be } \frac{\text{Nm}^2}{\text{kg}^2} \text{ or } \text{Nm}^2/\text{kg}^2$$

## Relation between Newton's third law of motion and Newton's law of gravitation

According to Newton's third law of motion, **“Every object exerts equal and opposite force on other object but in opposite direction.”**

According to Newton's law of gravitation, “Every mass in the universe attracts the every other mass.”

In case of freely falling stone and earth, stone is attracted towards earth means earth attracts the stone but according to Newton's third law of motion, the stone should also attract the earth and really it is true that stone also attracts the earth with the same force  $F = m \times a$  but due to very less mass of the stone, the acceleration ( $a$ ) in its velocity is  $9.8 \text{ m/s}^2$  and acceleration ( $a$ ) of earth towards stone is  $1.65 \times 10^{-24} \text{ m/s}^2$  which is negligible and we cannot feel it.

### ***Importance of universal law of gravitation***

- (i) The force that binds us to the earth.
- (ii) The motion of moon around the earth.
- (iii) The motion of earth around the sun.
- (iv) The tides due to moon in the sea.

### ***Free fall of an object and acceleration during free fall***

When an object is thrown upward, it reaches certain height, then it starts falling down towards earth. It is because the earth's gravitational force exerts on it.

This fall under the influence of earth is called ‘free fall of an object’.

During this free fall direction do not change but velocity continuously changes which is called acceleration due to gravity.

It is denoted by ‘ $g$ ’.

Its unit is same as acceleration  $\text{m/s}^2$ .

## Gravitational Acceleration and its value at the surface of earth

The uniform acceleration produced in a freely falling object due to the gravitational force of earth, is called acceleration due to gravity. It is represented by ‘ $g$ ’ and it always acts towards the centre of the earth.

### **Value of ‘ $g$ ’ on the surface of earth**

The force acting on an object is

$$F = \frac{GM_e m}{R^2} \quad \dots(i)$$

Where  $M_e$  = Mass of earth

$m$  = Mass of an object

$R$  = Radius of earth

and if acceleration due to gravity is 'g' due to force F then,

$$F = m \times g \quad \dots(ii)$$

Equating (i) and (ii), we get  $m \times g = \frac{GM_e m}{R^2}$

Or  $g = \frac{GM_e}{R^2}$

If  $G = 6.673 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$ ,  $M_e = 6 \times 10^{24} \text{ kg}$ ,  $R^2 = (6.37 \times 10^6)^2 \text{ m}^2$

Then,  $g = \frac{6.6734 \times 10^{-11} \times 6 \times 10^{24}}{(6.37 \times 10^6)^2}$

$$g = 9.8 \text{ m/s}^2$$

### ***Relationship and difference between 'G' and 'g'***

$G$  = Gravitational constant

$g$  = Acceleration due to gravity

$$g = \frac{GM}{R^2}$$

### **Difference between G (Gravitational constant) and g (Acceleration due to gravity)**

Gravitation Constant (G)	Gravitational acceleration (g)
1. Its value is $6.6734 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$ .	1. Its value is $9.8 \text{ m/s}^2$ .
2. Its value remains constant always and everywhere.	2. Its value varies at various places.
3. Its unit is $\text{Nm}^2/\text{kg}^2$ .	3. Its unit is $\text{m/s}^2$ .
4. It is a scalar quantity.	4. It is a vector quantity.

**Example.** If two stones of 150 gm and 500 gm are dropped from a height, which stone will reach the surface of earth first and why ? Explain your answer. (Imp.)

**Ans.** It was Galileo, who first time demonstrated and depicted that the acceleration of an object falling freely towards earth does not depend on the mass of the object.

It can be verified by universal law of gravitation. Let an object of mass  $m$ , is allowed to fall from a distance of  $R$ , from the centre of the earth.

Then, the gravitational force,  $F = \frac{GM_e m}{R^2}$  ( $M_e$  = Mass of the earth)

The force acting on the stone is  $F = m \times a$

So,  $m \times a = \frac{GM_e m}{R^2}$

Or  $a = \frac{GM_e}{R^2}$

So, acceleration in an object falling freely towards earth depends on the mass of earth and height of the object from the centre of the earth. So stones of mass 150 gm and 500 gm will reach the earth surface together.

***Equation of motion when an object is falling freely towards earth or thrown vertically upwards :***

**Case 1.** When an object is falling towards earth with initial velocity ( $u$ ), then

Velocity ( $v$ ) after  $t$  seconds,  $v = u + gt$

Height covered in  $t$  seconds,  $h = ut + \frac{1}{2}gt^2$

Relation between  $v$  and  $u$  when  $t$  is not mentioned :

$$v^2 = u^2 + 2gh$$

**Case 2.** When object is falling from rest position means initial velocity  $u = 0$  (zero), then

Velocity ( $v$ ) after  $t$  seconds,  $v = gt$

Height covered in  $t$  seconds,  $h = \frac{1}{2}gt^2$

Relation between  $v$  and  $u$  when  $t$  is not mentioned :

$$v^2 = 2gh$$

**Case 3.** When an object is thrown vertically upwards with initial velocity  $u$ , the gravitational acceleration will be negative ( $-g$ ), then

Velocity ( $v$ ) after  $t$  seconds,  $v = u - gt$

Height covered in  $t$  seconds,  $h = ut - \frac{1}{2}gt^2$

Relation between  $v$  and  $u$  when  $t$  is not mentioned :

$$v^2 = u^2 - 2gh$$

## Mass

The mass of a body is the quantity of matter contained in it. Mass is a scalar quantity which has only magnitude but no direction.

SI unit of mass is kilogram which is written in short form as kg.

- Mass of a body is constant and does not change from place to place.
- Mass of a body is usually denoted by the small 'm'.
- Mass of a body cannot be zero.

### Weight

The force with which an object is attracted towards the centre of the earth, is called the weight of the object.

$$\text{Force} = m \times a$$

In case of earth,

$$a = g$$

So,

$$F = m \times g$$

But the force of attraction of earth on an object is called its weight (W). So,

$$W = m \times g$$

So, weight is the force and its SI unit is Newton (N). It depends on 'g' and is a vector quantity.

### Relation between 1 kg wt and express it into Newton :

We know that

$$W = m \times g$$

If mass ( $m$ ) = 1 kg,  $g = 9.8 \text{ m/s}^2$ , then

$$W = 1 \text{ kg} \times 9.8 \text{ m/s}^2$$

Or

$$1 \text{ kg wt} = 9.8 \text{ N}$$

So, the gravitational force of earth that acts on an object of mass 1 kg is called as 1 kg wt.

### Distinguish between Mass and Weight

Mass	Weight
1. We can measure mass of an object by its inertia.	1. Weight = mass $\times$ acceleration or $m \times g$ .
2. The total quantity of matter contained in an object is called mass of an object.	2. The gravitational force by which earth attracts an object is called weight of the object.
3. Mass of the object remains constant at all the places.	3. Weight of the object is different at different places.
4. Measurement of mass is done by using a pan or beam balance.	4. Measurement of weight is done by using a spring balance.
5. Mass does not change even value of $g$ is zero at any place.	5. Weight of the object becomes zero if $g$ is zero.



### Factors affecting value of $g$

Earth is not a perfect sphere. The radius of earth increases when we go from pole to equator. Therefore, in most of the calculation, we can take  $g$  as constant at the surface of earth or closer to it. But, as we move away from earth, we can use equation  $g = \frac{GM}{d^2}$  for solving problems.

**Example.** Calculate the value of ' $g$ ' at a height of 12800 km from the centre of the earth (radius of earth is 6400 km). Draw its interpretation.

**Solution :** We know that  $g_1 = \frac{GM_e}{(2R_e)^2}$ ,  $R_e = 6400$  km

Weight of the object from the centre of earth = 12800 km =  $2R_e$

$$\therefore g_2 = \frac{GM_e}{(2R_e)^2}$$

Or 
$$\frac{g_1}{g_2} = \frac{G \cdot M_e}{(R_e)^2} \times \frac{(2R_e)^2}{G \cdot M_e}$$

$$\frac{g_1}{g_2} = \frac{4}{1} \quad \text{Or} \quad 4g_2 = g_1$$

So, the value of gravitational acceleration ' $g$ ' at a distance of 12800 km from the centre of the earth is  $\frac{1}{4}$ .

The value of gravitational acceleration ' $g$ ' decreases with increasing height.

***The weight of an object on moon is one-sixth of the weight on earth.***

Let mass of an object be  $m$ , its weight on earth means the force by which earth attracts it towards the centre.

Now, 
$$F_e = \frac{GM_e m}{R_e^2} \quad \dots(i)$$

where  $G$  = Gravitational constant,  $M_e$  = Mass of the earth,  $m$  = Mass of object,  $R_e$  = Radius of the earth

Weight of an object on moon,

$$F_m = \frac{GM_m m}{R_m^2} \quad \dots(ii)$$

where  $M_m$  = Mass of the moon,  $R_m$  = Radius of the moon

Dividing equation (i) by equation (ii), we get

$$\frac{F_e}{F_m} = \frac{GM_e \cdot m}{R_e^2} \times \frac{R_m^2}{GM_m \cdot m}$$

$$\frac{F_e}{F_m} = \frac{M_e}{M_m} \times \left( \frac{R_m}{R_e} \right)^2$$

We know that mass of earth is 100 times the mass of the moon.

So,  $M_e = 100M_m$

And radius of earth is 4 times the radius of moon.

So,  $R_e = 4R_m$

$$\frac{F_e}{F_m} = \frac{100M_m}{M_m} \times \left( \frac{R_m}{4R_m} \right)^2$$

Then,

$$\frac{F_e}{F_m} = \frac{100}{1} \times \frac{1}{16}$$

$$\frac{F_e}{F_m} = 6 \text{ times (approx.)}$$

Hence,

$$F_e = 6F_m$$

### Thrust and Pressure

**Thrust :** The force acting on an object perpendicular to the surface is called thrust.

**Pressure :** The effect of thrust per unit area is called pressure.

$$\text{Pressure (P)} = \frac{\text{Force (F)}}{\text{Area (A)}} = \frac{\text{Newton}}{\text{meter}^2} = \text{N/m}^2$$

SI unit is N/m<sup>2</sup> or Nm<sup>-2</sup>.

SI unit of pressure is Pascal (Pa).

### Factors on which pressure depends

Pressure depends on two factors :

- (i) Force applied
- (ii) Area of surface over which force acts

*Examples :*

*(Imp.)*

- The base of high buildings is made wider so that weight of walls act over a large surface area and pressure is less.
- School bags are having broad strap so that the weight of school bags fall over a larger area of the shoulder and produce less pressure and becomes less painful.
- The blades of knives are made sharp so very small surface area and on applying force, it produces large pressure and cuts the object easily.
- All liquids and gases are fluids and they exert pressure in all directions.

### **Buoyancy**

The upward force experienced by an object when it is immersed into a fluid is called force of buoyancy. It acts in upward direction and it depends on the density of the fluid.

- Force of gravitational attraction of the earth on the surface of the object  $\leq$  buoyant force exerted by fluid on the surface of the object.

**Result :** The object floats.

- Force of gravitational attraction of the earth on the surface of the object  $>$  buoyant force exerted by fluid on the surface of the object.

**Result :** The object sinks.

That is why, all pin sinks and boat/ship floats on the surface of water. (Archimedes' principle)

### **Density**

The mass per unit volume is called density of an object. If M is the mass and V is the volume, then density ( $d$ ) is

$$\text{Density } (d) = \frac{\text{Mass } (M)}{\text{Volume } (V)}$$

SI unit =  $\text{kg/m}^3$

### **Archimedes' Principle**

*(Imp.)*

It states, when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.

### **Applications of Archimedes' Principle :**

- (i) It is used in determining relative density of substances.

(ii) It is used in designing ships and submarines.

(iii) Hydrometers and lactometers are made on this principle.

It is because of this ship made of iron and steel floats in water whereas a small piece of iron sinks in it.

### Relative density

The ratio of the density of a substance to that of the density of water is called relative density.

$$\text{Relative density} = \frac{\text{Density of a substance}}{\text{Density of water}}$$

It has no unit.

### Solved Numericals

(Imp.)

**Example 1.** *Relative density of gold is 19.3. The density of water is  $10^3 \text{ kg/m}^3$ . What is the density of gold in  $\text{kg/m}^3$  ?*

**Solution :** Given, Relative density of gold = 19.3

Density of water =  $10^3 \text{ kg/m}^3$

So, Density of gold = Relative density of gold

× Density of water

$$= 19.3 \times 10^3$$

Hence, density of gold

$$= 19.3 \times 10^3 \text{ kg/m}^3.$$

**Ans.**

**Example 2.** *Mass of  $0.025 \text{ m}^3$  of aluminium is 67 kg. Calculate the density of aluminium.*

**Solution :** Given, Mass of aluminium = 67 kg

Volume of aluminium =  $0.025 \text{ m}^3$

So, Density  $= \frac{M}{V} = \frac{67}{0.025}$

$$= 2680 \text{ kg/m}^3$$

**Ans.**

**Example 3.** *The mass of brick is 2.5 kg and its dimensions are  $20 \text{ cm} \times 10 \text{ cm} \times 5 \text{ cm}$ . Find the pressure exerted on the ground when it is placed on the ground with different faces.*

**Solution :** Given, Mass of the brick = 2.5 kg

Dimensions of the brick =  $20 \text{ cm} \times 10 \text{ cm} \times 5 \text{ cm}$

So, Weight of the brick (Thrust/Force)

$$= F = mg = 2.5 \times 9.8 = 24.5 \text{ N}$$

- (i) When the surface area  $10 \text{ cm} \times 5 \text{ cm}$  is in contact with the ground, then

$$\begin{aligned}\text{Area} &= 10 \times 5 = 50 \text{ cm}^2 \\ &= \frac{50}{10000} = 0.005 \text{ m}^2\end{aligned}$$

So, 
$$P = \frac{F}{A} = \frac{24.5}{0.0050}$$

$$= 4900 \text{ N/m}^2 \quad \text{Ans.}$$

- (ii) When the surface area  $20 \text{ cm} \times 5 \text{ cm}$  is in contact with the ground, then

$$\begin{aligned}\text{Area} &= 20 \times 5 = 100 \text{ cm}^2 \\ &= \frac{100}{10000} = 0.01 \text{ m}^2\end{aligned}$$

So, 
$$P = \frac{F}{A} = \frac{24.5}{0.01}$$

$$= 2450 \text{ N/m}^2 \quad \text{Ans.}$$

- (iii) When the surface area  $20 \text{ cm} \times 10 \text{ cm}$  is in contact with the ground, then

$$\begin{aligned}\text{Area} &= 20 \times 10 = 200 \text{ cm}^2 \\ &= \frac{200}{10000} = 0.02 \text{ m}^2\end{aligned}$$

So, 
$$P = \frac{F}{A} = \frac{24.5}{0.02}$$

$$= 1225 \text{ N/m}^2 \quad \text{Ans.}$$

**Example 4.** A force of  $20\text{N}$  acts upon a body whose weight is  $9.8\text{N}$ . What is the mass of the body and how much is its acceleration ?

**Solution :** Given, Force =  $20\text{N}$ , Weight  $W = 9.8\text{N}$

We know, 
$$W = mg$$

So, 
$$9.8 = m \times 9.8$$

Or 
$$m = 1 \text{ kg} \quad \text{Ans.}$$

And, 
$$F = ma$$

So, 
$$20 = 1 \times a$$

Or 
$$a = 20 \text{ m/s}^2 \quad \text{Ans.}$$

**Example 5.** A man weighs  $1200\text{N}$  on the earth. What is his mass (take  $g = 10 \text{ m/s}^2$ ) ? If he was taken to the moon, his weight would be  $200\text{N}$ . What is his mass on moon ? What is his acceleration due to gravity on moon ?

**Solution :** Given,      Weight of man on earth  $W_1 = 1200 \text{ N}$   
                                  Weight of man on moon  $W_2 = 200 \text{ N}$   
                                  Gravitational acceleration of earth  $= 10 \text{ m/s}^2$

Now,  $W = mg$   
 Or  $m = W/g$   
           $= 120 \text{ kg}$

*So, mass on moon will be 120 kg as it is constant everywhere so mass of man on moon* **Ans.**

Now,  $W_2 = mg_2$   
 Or  $200 = 120 \times g$   
 Or  $g = \frac{200}{120} = \frac{10}{6} = \frac{5}{3}$   
           $= 1.66 \text{ m/s}^2$  **Ans.**

**Example 6.** *An object is thrown vertically upwards and reaches a height of 78.4 m. Calculate the velocity at which the object was thrown ? ( $g = 9.8 \text{ m/s}^2$ )*

**Solution :** Given,       $h = 78.4 \text{ m}$ ,  $v = 0$ ,  $g = 9.8 \text{ m/s}^2$ ,  $u = ?$   
                                   $v^2 = u^2 - 2gh$   
 Or  $0 = u^2 - 2 \times 9.8 \times 78.4$   
 Or  $u^2 = \frac{2 \times 98 \times 784}{10 \times 10}$   
 Or  $u = \sqrt{\frac{2 \times 2 \times 49 \times 784}{10 \times 10}}$   
           $u = \frac{2 \times 7}{10} \sqrt{784}$   
 Or  $u = 39.2 \text{ m/s}^2$  **Ans.**

**Example 7.** *What is the mass of an object whose weight is 49 Newton ?*

**Solution :** Given,      Weight of object  $W = 49 \text{ N}$   
                                   $g = 9.8 \text{ m/s}^2$   
 Now,  $W = mg$   
 Or  $m = \frac{W}{g} = \frac{49}{9.8}$   
           $= 5 \text{ kg}$  **Ans.**

# QUESTIONS

## VERY SHORT ANSWERS QUESTION

1. State the universal law of gravitation.
2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.
3. Is value of  $G$  constant at all the places ?
4. What is the weight of an object of mass 1 kg ? **Ans : 9.8N**
5. A body has weight of 10 kg on the surface of earth. What will be its weight when taken to the centre of the earth ? **Ans : 0**
6. What is the value of gravitational acceleration acting on a free falling object ?

## SHORT ANSWERS QUESTION

1. What is the value of universal constant  $G$  and its unit ?
2. Why do pins sink in water ?
3. Name a factor on which  $g$  depends.
4. Name the balance used to measure weight of an object.
5. Mass of an object is 1600 gm on the earth. What is its mass on the moon? Why ? **Ans : 1600 gm**
6. Two objects placed in a room, are not pulling each other. Why ?
7. Name the force responsible for the motion of moon around the earth. How can some objects move around the earth ?

## LONG ANSWERS QUESTION

14. State Archimedes' Principle and explain it with example.
15. State two factors on which buoyant force depends.
16. Density of aluminium is  $2700 \text{ kg m}^{-3}$ . What is its relative density ? Density of water is  $1000 \text{ kg m}^{-3}$ . Define relative density. **Ans : 2.7**
17. A ball is released from a height of 1 metre. What time it will take to reach the surface of the earth ? **Ans : 0.45 s**
18. A ball thrown up, vertically returns to the thrower after 6 s. Find :
  - (a) the velocity with which it was thrown up. **Ans : 29.4 m/s**
  - (b) the maximum height it reaches and **Ans : 4.9 m**
  - (c) its position after 4 s. **Ans : 39.2 m**

## OBJECTIVE TYPE QUESTIONS

### MCQ.

1. **A weightless balloon contains 200g of water. Its weight in water will be.**  
 (a) 100g.                      (b) 200g.                      (c) 400g.                      (d) Zero.
2. **Archimedes Principle holds for**  
 (a) liquids only                      (b) Gases only  
 (c) liquids and gases both                      (d) may go anywhere.
3. **The unit of relative density is**  
 (a)  $\text{Kgm}^{-3}$                       (b)  $\text{gcm}^{-3}$                       (c)  $\text{gl}^{-1}$                       (d) no unit
4. **The relative density of a solid is 0.6. It floats in water with.**  
 (a) 40% of its volume inside water                      (b) 60% of its volume  
 (c) whole of its volume inside water                      (d) any fraction of its volume inside a water
5. **The pressase exerted by man on earth is minimum when he**  
 (a) Site                      (b) Stands on one foot  
 (c) Stands M both feet                      (d) lies on ground.
6. **If mass of a body is M on the earth surface, then the mass of the somebody on the moon's surface is:**  
 (a)  $M/6$                       (b) Zero                      (c) M                      (d) None
7. **If a planet existed whose mass and radius were both half to these of the earth, the acceleration due to gravity at its surface would be.**  
 (a)  $19.6\text{ms}^{-2}$                       (b)  $4.9\text{ms}^{-1}$                       (c)  $2.45\text{ms}^{-2}$                       (d)  $9.8\text{ms}^{-2}$
8. **The gravitational force between two bodies does not depend on**  
 (a) Their Separation                      (b) Their masses  
 (c) The product of their masses.                      (d) The medium between the two bodies.

### 9. Match the coloumn

Column I	Column II
(a) Gravitational Const.)	(i) $F = \frac{mg}{2}$
(b) Acceleration due to gravity at earth's surgace (g).	(ii) $F = \frac{mg}{4}$
(c) Acceleration due to gravity at depth Centre	(iii) $6.67 \times 10^{-11} \text{Nm}^2\text{kg}^{-2}$
(d) Force on a particle of mass 'm' placed at depth $r/2$ inside the earth	(iv) Zero
(e) Force on a particle of mass 'm' placed at height equal to radius of earth.	(v) $9.8\text{ms}^{-2}$



- **Assertion Reasoning Questions :-**

Read the Assertion (A) and Reason (R) statements carefully and mark the correct option out of the following :

- a) Both Assertion (A) and Reason (R) are true, and (R) is correct explanation of the assertion (A)
- b) Both (A) and (R) are true, but (R) is not correct explanation of the (A).
- c) (A) is True but (R) is false.
- d) (A) is False but (R) is true.

Q1 Assertion (A) : The value of acceleration due to gravity is maximum at the poles and minimum at the equator.

Reason (R) : Radius of earth is least along poles and maximum along the equatorial plane.

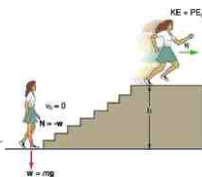
Ans. A, [R pole is minimum, hence R pole is maximum]

Q2. Assertion (A) : Although mass of an object has a constant value but its weight changes from place to place

Reason (R) :  $\text{Weight} = \text{Mass} \times \text{Acceleration due to gravity}$

Ans. A, [g changes from place to place hence

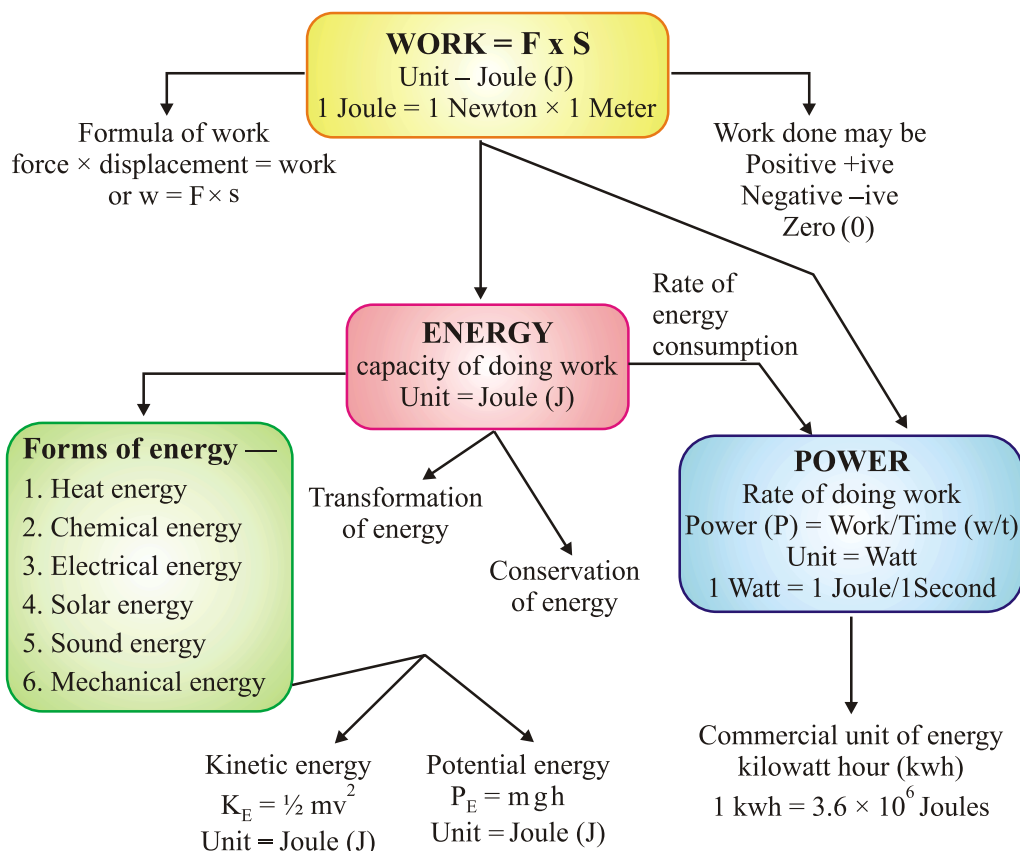
Weight of an object also changes.]



## Chapter - 11

# Work And Energy

### CONCEPT MAPPING



### Work

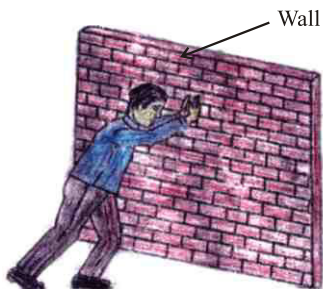
For doing work, energy is required.

- In animals, energy is supplied by the food they eat.
- In machine, energy is supplied by fuel.

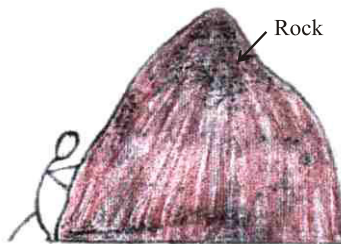
**Not much work inspite of working hard :** Reading, writing, drawing, thinking,

and analysing are all energy consuming. But in scientific manner, no work is done in above cases.

- *Example :* A man is completely exhausted in trying to push a rock (wall), but work done is zero as the wall is stationary.
- A man standing still with heavy suitcase may be tired soon but he does no work in this situation as he is stationary.



**When a force is applied on the wall, the wall does not move. So work is not done**



**When a force is applied on the rock, the rock does not move. So work is not done**

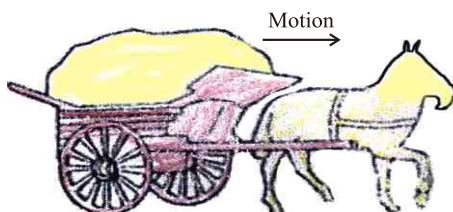
Work is said to be done when :

- a moving object comes to rest.
- an object at rest starts moving.
- velocity of an object changes.
- shape of an object changes.

**Scientific Conception of Work is done when force is applied on a body and when that force produces motion under its influence.**

**Condition of Work done**

- Force should be applied on the body.
- Body should be displaced.



*Examples :* Work is done when :

- (i) A cyclist is pedalling the cycle.
- (ii) A man is lifting load in upward or downward direction.

Work is not done when :

- (i) A coolie carrying some load on his head stands stationary.
- (ii) A man is applying force on a big rock.

### Work Done by a Fixed Force

Work done in moving a body is equal to the product of force and displacement of body in the direction of force.

$$\text{Work} = \text{Force} \times \text{Displacement}$$

$$W = F \times S$$

**Work is a scalar quantity.**

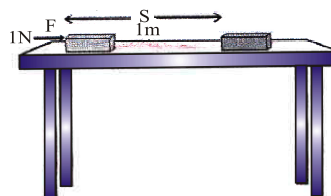
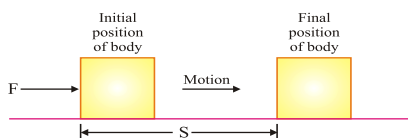
### Unit of Work

Unit of work is **Newton metre or Joule**.

When a force of 1 Newton moves a body through a distance of 1 metre in its own direction, then the work done is known as 1 Joule.

$$1 \text{ Joule} = 1 \text{ Newton} \times 1 \text{ metre}$$

$$1 \text{ J} = 1 \text{ Nm}$$



$$1 \text{ J} = 1 \text{ N} \times 1 \text{ m}$$

Whenever work is done against gravity, the amount of work done is equal to the product of weight of the body and the vertical distance through which the body is lifted.

$W = \text{Weight of body} \times \text{vertical distance}.$

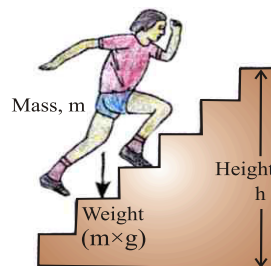
$$W = m \times g \times h$$

$m$  - mass of the body

$g$  - acceleration due to gravity

$h$  - height through which the body is lifted.

Note : Here, force required to lift the body is equal to its weight.



**During climbing work is done against gravity**

The amount of work done depends on the following factors :

- (i) **Magnitude of force** : Greater the force, greater is the amount of work & vice-versa.
- (ii) **Displacement** : Greater the displacement, greater is the amount of work & vice-versa.

## Negative, Positive and Zero Work

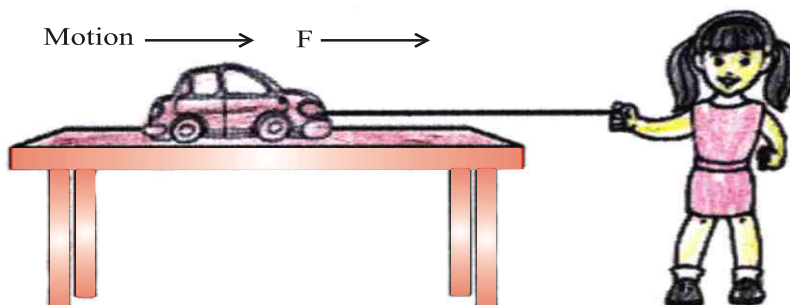
Work done by a force can be positive, negative or zero.

- (i) Work done is **positive** when a force acts in the direction of motion of the body. [ Fig. (a)] ( $\theta = 0^\circ$ ).

$\theta$  = angle between direction of force applied & the motion of body.

*Example :* A child pulls a toy car with a string horizontally on the ground. Here work done is positive.

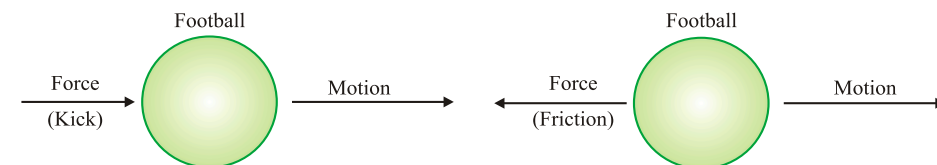
$$W = F \times S$$



### Positive work

- (ii) Work done is **negative** when a force acts opposite to the direction of motion of the body. ( $\theta = 180^\circ$ )

*Example :* When we kick a football lying on the ground, the force of our kick moves the football. Here direction of force applied & motion of football is same so work done is positive. But the football moving on the ground slows down gradually and ultimately stops. This is because a force due to friction (of ground) acts on the football. This force of friction acts in a direction opposite to the direction of motion of football. So, in this case, the work done by the force of friction on the football is negative (and it decrease the speed of the football).

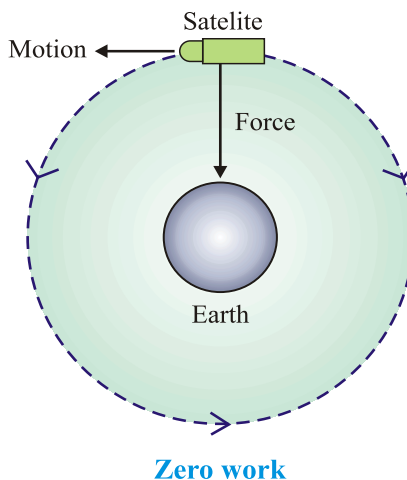


### Positive work

### Negative work

- (iii) Work done is **zero** when a force acts at right angles to the direction of motion. ( $\theta = 90^\circ$ )

*Example :* The moon moves around the earth in circular path. Here force of gravitation acts on the moon at right angles to the direction of motion of the moon. So work done is zero.



- -ve (negative) sign indicates that work is done against gravity.

*Note that if work is done against the direction of motion (gravity), then it is taken –ve.*

**Example.** A coolie lifts a luggage of 15 kg from the ground and put it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.

**Solution :** Mass of luggage ( $m$ ) = 15 kg

Displacement ( $S$ ) = 1.5 m

So, Work done,  $W$  =  $F \times S$

$$= mg \times S \quad [F = mg]$$

$$= 15 \times 10 \times 1.5 \quad [g = 10 \text{ m/s}^2]$$

[ $g$  = force of gravity]

$$= 225.0 \text{ kg m/s}^2$$

$$= 225 \text{ Nm} = 225 \text{ J}$$

Hence, work done = 225 J.

## Energy

- The sun is the biggest source of energy.
- Most of the energy sources are derived from the Sun.
- Some energy is received from nucleus of atoms, interior of the earth and the tides.

**Definition :** The capacity of doing work is known as energy.

The amount of energy possessed by a body is equal to the amount of work it can do. Working body loses energy, body on which work is done gains energy.

Energy is a scalar quantity.

**Unit :** The SI unit of energy is Joule (J) and its bigger unit is kilo joule (kJ).

$$1 \text{ kJ} = 1000 \text{ J}$$

The energy required to do 1 Joule of work is called 1 Joule energy.

### Forms of Energy

Main forms of energy are :

- |                       |                       |
|-----------------------|-----------------------|
| (i) Kinetic energy    | (ii) Potential energy |
| (iii) Heat energy     | (iv) Chemical energy  |
| (v) Electrical energy | (vi) Light energy     |
| (vii) Sound energy    | (viii) Nuclear energy |

- Sum of kinetic energy & potential energy of a body is called mechanical energy.

### Mechanical energy

The energy possessed by a body on account of its motion or position is called mechanical energy.

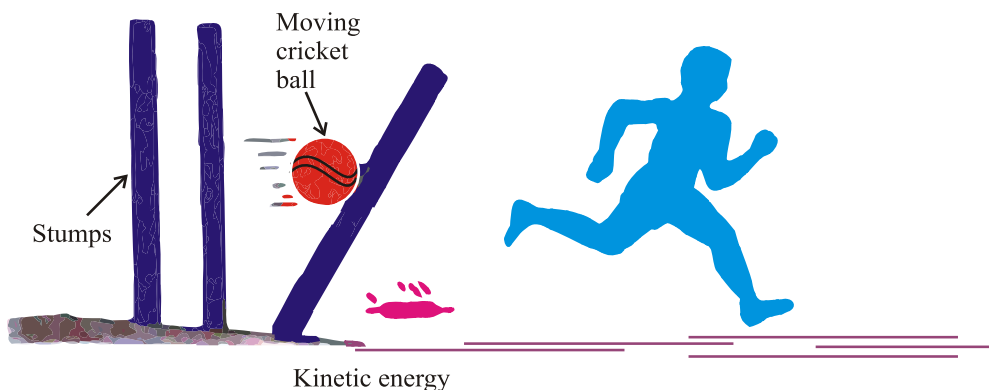
### Kinetic Energy

The energy of a body due to its motion is called kinetic energy.

Examples of kinetic energy :

- A moving cricket ball
- Running water
- A moving bullet
- Flowing wind
- A moving car
- A running athlete
- A rolling stone

- Flying aircraft



Kinetic energy is directly proportional to mass and the square of velocity.

### Formula for Kinetic Energy

The kinetic energy of a moving body is measured by the amount of work it can do before coming to rest. If an object of mass ' $m$ ' moving with uniform velocity ' $u$ ', it is displaced through a distance ' $s$ ', Constant force ' $F$ ' acts on it in the direction of displacement velocity changes from ' $u$ ' to ' $v$ '. Then acceleration is ' $a$ '.

$$\text{Work done, } W = F \times s \quad \dots(i)$$

$$\text{and} \quad F = ma \quad \dots(ii)$$

According to third equation of motion, relationship between  $u$ ,  $v$ ,  $s$  and  $a$  is as follows :

$$v^2 - u^2 = 2as$$

$$s = \frac{v^2 - u^2}{2a}$$

$$\text{So,} \quad \dots(iii)$$

Now putting the value of  $f$  and  $s$  from (ii) and (iii) in equation (i),

$$\begin{aligned} W &= ma \times \frac{v^2 - u^2}{2a} \\ &= \frac{m}{2} \times v^2 - u^2 = \frac{1}{2} m (v^2 - u^2) \end{aligned}$$

If  $u = 0$  (when body starts moving from rest)

$$W = \frac{1}{2}mv^2$$

$$\text{Or} \quad E_K = \frac{1}{2}mv^2$$

**Example.** An object of mass 15 kg is moving with uniform velocity of 4 m/sec. What is the kinetic energy possessed by it ?



**Solution :** Mass of the object,  $m = 15 \text{ kg}$

Velocity of the object,  $v = 4 \text{ m/s}$

$$\begin{aligned}E_K &= \frac{1}{2}mv^2 \\&= \frac{1}{2} \times 15 \text{ kg} \times 4 \text{ ms}^{-1} \times 4 \text{ ms}^{-1} \\&= 120 \text{ J}\end{aligned}$$

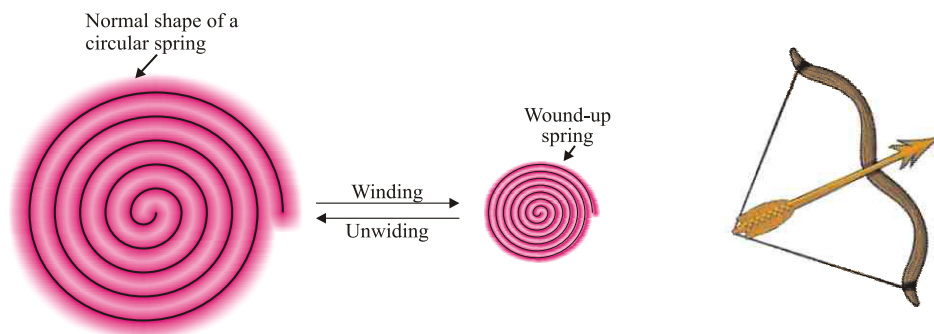
The kinetic energy of the object is 120 J.

### Potential Energy

The energy of a body due to its position or change in shape is known as potential energy.

Examples :

- (i) **Water kept in dam :** It can rotate turbine to generate electricity due to its position above the ground.
- (ii) **Wound up spring of a toy car :** It possess potential energy which is released during unwinding of spring. So toy car moves.
- (iii) **Bent string of bow :** Potential energy due to change of its shape (deformation) released in the form of kinetic energy while shooting an arrow.



### Factors affecting Potential Energy

- (i) **Mass :**  $\text{P. E.} \propto m$

More the mass of body, greater is the potential energy and vice-versa.

- (ii) **Height above the ground :**

$$\text{P. E.} \propto h \quad (\text{does not depend on the path it follows})$$

Greater the height above the ground, greater is the P.E. and vice-versa.

- (iii) **Change in shape :** Greater the stretching, twisting or bending, more is the potential energy.

## Potential Energy of an Object on a Height

If a body of mass ' $m$ ' is raised to a height ' $h$ ' above the surface of the earth, the gravitational pull of the earth ( $m \times g$ ) acts in downward direction. To lift the body, we have to do work against the force of gravity.

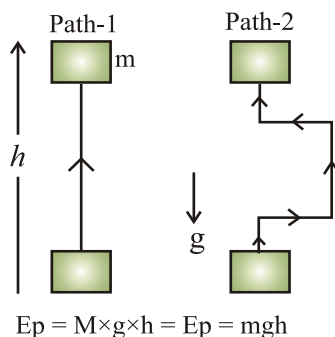
Thus, Work done,  $W = \text{Force} \times \text{Displacement}$

Or  $W = m \times g \times h = mgh$

This work is stored in the body as potential energy (gravitational potential energy).

Thus, Potential energy,  $E_p = m \times g \times h$

where  $g = \text{acceleration due to gravity.}$



**Example.** If a body of mass 10 kg is raised to a height of 6 m above the earth, calculate its potential energy.

**Solution :** Potential energy of the body  $= mgh$

Mass of body  $= 10 \text{ kg}$

Height above the earth  $= 6 \text{ m}$

Acceleration due to gravity  $= 10 \text{ m/s}^2$

So,  $E_p = 10 \times 10 \times 6$   
 $= 600 \text{ J}$

Thus, potential energy of the body is 600 Joules.

## Transformation of Energy

The change of one form of energy to another form of energy is known as transformation of energy.

### Example :

- (i) A stone on a certain height has entire potential energy. But when it starts moving downward, potential energy of stone goes on decreasing as height goes on decreasing but its kinetic energy goes on increasing as velocity of stone goes on increasing. At the time stone reaches the ground, potential energy becomes zero and kinetic energy is maximum.

Thus, its entire potential energy is transformed into kinetic energy.

- (ii) At hydroelectric power house, the potential energy of water is transformed into kinetic energy and then into electrical energy.
- (iii) At thermal power house, chemical energy of coal is changed into heat energy, which is further converted into kinetic energy and electrical energy.
- (iv) Plants use solar energy to make chemical energy in food by the process of photosynthesis.

### Law of Conservation of Energy






- Whenever energy changes from one form to another form, the total amount of energy remains constant.
- “Energy can neither be created nor be destroyed.”
- Although some energy may be wasted during conversion, but the total energy of the system remains the same.

### Conservation of Energy during Free Fall of a Body

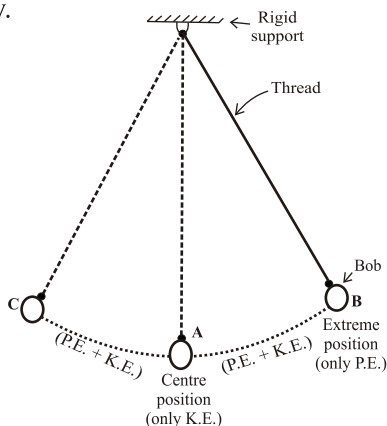
- A ball of mass ‘ $m$ ’ at a height ‘ $h$ ’ has potential energy =  $mgh$ .
- As ball falls downwards, height ‘ $h$ ’ decreases, so the potential energy also decreases.
- Kinetic energy at ‘ $h$ ’ is zero but it is increasing during falling of ball.
- The sum of potential energy & kinetic energy of the ball remains the same at every point during its fall.

$$\frac{1}{2}mv^2 + mgh = \text{Constant}$$

$$\text{Kinetic energy} + \text{Potential energy} = \text{Constant}$$

	Ball		P.E. of Ball	K.E. of Ball	Total Energy of Ball (P.E. + K.E.)
Ball at rest ↓		A	20J	0J	$20 + 0 = 20\text{J}$
Falling ball ↓		B	15J	5J	$15 + 5 = 20\text{J}$
Falling ball ↓		C	10J	10J	$10 + 10 = 20\text{J}$
Falling ball ↓		D	5J	15J	$5 + 15 = 20\text{J}$
Just before hitting the ground ↓		E	0J	20J	$0 + 20 = 20\text{J}$

Conservation of energy is a simple Pendulum A swinging pendulum is an example of conservation of energy.



A swinging (or oscillating) simple pendulum

A simple pendulum consists of small metal ball (called bob) suspended by a long thread from a rigid support, such that the bob is free to swing back and forth when displaced. Its energy is continuously transformed (or converted) from potential energy to kinetic energy and vice-versa.

The total energy of the swinging pendulum at any instant remains the same (or conserved).

The body which does work loses energy and the body on which work is done gains energy.

## Rate of Doing Work – Power

“Power is defined as the rate of energy consumption.”

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}} \quad \text{Or} \quad P = \frac{W}{t}$$

where  $P$  = Power  
 $W$  = Work done  
 $t$  = Time taken

### Unit of Power

SI unit of Power is Watt (W) = 1 Joule/second.

$$1 \text{ Watt} = \frac{1 \text{ Joule}}{1 \text{ second}} \quad \text{Or} \quad 1 \text{ W} = \frac{1 \text{ J}}{1 \text{ s}}$$

Power is one Watt when one Joule work is done in one second.

$$\text{Average Power} = \frac{\text{Total work done or total energy used}}{\text{Total time taken}}$$

### Power of Electrical Gadget

The power of an electrical appliance tells us the rate at which electrical energy is consumed by it. Here, when work is done, an equal amount of energy is consumed.

**Bigger unit of Power :** Bigger unit of power is called Kilowatt or KW.

$$1 \text{ Kilowatt (KW)} = 1000 \text{ Watt} = 1000 \text{ W or } 1000 \text{ J/s}$$

**Example.** A body does 20 Joules of work in 5 seconds. What is its power ?

**Solution :**

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}}$$

$$\text{Work done} = 20 \text{ Joules}$$

$$\text{Time taken} = 5 \text{ sec.}$$

$$P = \frac{20 \text{ J}}{5 \text{ s}}$$

$$\text{So, Power} = 4 \text{ J/s} = 4 \text{ W}$$

Thus, power of the body is 4 Watts.

**Commercial Unit of Energy :** Joule is very small unit of energy and it is inconvenient to use it where a large quantity of energy is involved.

For commercial purpose, bigger unit of energy is Kilotwatt hour (KWh).

**1 KWh :** 1 KWh is the amount of energy consumed when an electric appliance having a power rating of 1 Kilowatt is used for 1 hour.

### Relation between Kilowatt hour and Joule

1 Kilowatt hour is the amount of energy consumed at the rate of 1 Kilowatt for 1 hour.

$$\begin{aligned}
 1 \text{ Kilowatt hour} &= 1 \text{ Kilowatt for 1 hour} \\
 &= 1000 \text{ Watt for 1 hour} \\
 &= 1000 \text{ Watt} \times 3600 \text{ seconds} \quad (60 \times 60 \text{ seconds} = 1 \text{ hour}) \\
 &= 36,00,000 \text{ Joules}
 \end{aligned}$$

So,

$$1 \text{ KWh} = 3.6 \times 10^6 \text{ J} = 1 \text{ unit}$$

**Example.** A bulb of 60 Watt is used for 6 hrs. daily. How many units (KWh) of electrical energy are consumed ?

**Solution :**

Power of bulb	= 60 W =	$\frac{60}{1000}$ KW =	0.06 KW
t	= 6 hours		
	Energy	= Power × Time taken =	0.06 × 6 h
t		= 0.36 KWh =	0.36 units

# QUESTIONS

## VERY SHORT ANSWERS QUESTIONS

1. Define the term 'work'.
2. Define 1 Joule of work.
3. Give an example in which a force does positive work.
4. Give an example in which a force does negative work.
5. Define the term energy of a body.
6. Write the units of: (a) Work, (b) Energy.
7. Define power
8. Define 1 Watt energy
9. Define 1 Kilo Watt hour.

## SHORT ANSWERS QUESTIONS

1. What is conservation of energy ? Explain with an example.
2. What do you understand by kinetic energy ? Write its formula.
3. On what factors does the kinetic energy of a body depends ?
4. What happens to potential energy of a body when its height is doubled ?  
(Ans. Doubled)
5. How many joules are there in 1 Kilowatt hour ?

## LONG ANSWERS QUESTIONS

1. What are the quantities on which the amount of work done depend ? How are they related to work ?
2. A load of 100 kg is pulled up to 5 m. Calculate the work done.  
( $g = 10 \text{ m/s}^2$ ) (Ans. 5000 J)
3. A body of mass  $m$  is moving with a velocity  $5 \text{ ms}^{-1}$ . Its kinetic energy is 25 J. If its velocity is doubled, what is its kinetic energy ? (Ans. 100 J)
4. A boy weighing 50 kg climbs up a vertical height of 100 m. Calculate the amount of work done by him. How much potential energy he gains ?  
(Given  $g = 9.8 \text{ m/s}^2$ ) (Ans.  $4.9 \times 10^4 \text{ J}$ )
5. Five electric fans of 120 watts each are used for 4 hours. Calculate the electrical energy consumed in kilowatt hours. (Ans. 2.4 KWh)
6. The power of an electric heater is 1500 Watt. How much energy it consumes in 10 hours ? [Ans. 15 KWh (units)]

# OBJECTIVE TYPE QUESTIONS

## I. Objective Type Questions.

1. **If Ramesh has done the same amount of work in less time as compared to Rohan then**  
(a) Ramesh has more power (b) Rohan has more power  
(c) both have equal power
2. **A flying kite possesses**  
(a) only potential energy (b) Only kinetic energy  
(c) both P.E. and K.E. (d) neither P.E. nor K.E.
3. **The work done on an object does not depend upon the**  
(a) Displacement (b) force applied  
(c) angle between force (d) initial velocity of the object
4. **If a force  $F$  applied on a body gives its velocity  $V$ , its power will be.**  
(a)  $Fv$  (b)  $F/v$   
(c)  $Fv^2$  (d)  $F/v^2$
5. **Two particles of masses 1g and 4g have equal kinetic energies. what is the ratio between their momenta?**  
(a) 1:4 (b) 1:8  
(c) 1:2 (d) 1:16
6. **Moon revolves around the earth due to gravitational force ( $F$ ) of earth on moon. The work done by the gravitational force is ( $r$ =radius of circular orbit of moon).**  
(a)  $F \cdot 2\pi r$  (b)  $F \cdot \pi r$   
(c) Zero (d) negative work

## II. Fill in the blanks :

7. A 20 Kg. mass object is being lifted through a height of \_\_\_\_\_ m when 784 J of work is done on it.
8. In a heat engine, heat energy is converted into \_\_\_\_\_
9. If the velocity of a body is tripled, then the K.E. of the body becomes \_\_\_\_\_ times that of its initial values.
10. If a proton and an electron are brought towards each other, the \_\_\_\_\_ will decrease.



## Work & Energy

Directions : In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Mark the correct choice as :

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

Q1. Assertion - As a ball falls downwards, potential energy keeps decreasing but kinetic energy keeps increasing.

Reason - Energy can neither be created nor be destroyed.

Ans. option (a) Law of conservation of energy implies that the sum of potential energy and kinetic energy of the ball remains same at every point during its fall.

Q2. Assertion - Work done by the gravitational force of a revolving satellite, around the Earth, in a circular motion is zero.

Reason - Force of gravitation acts on the satellite, opposite to the direction of motion of the satellite.

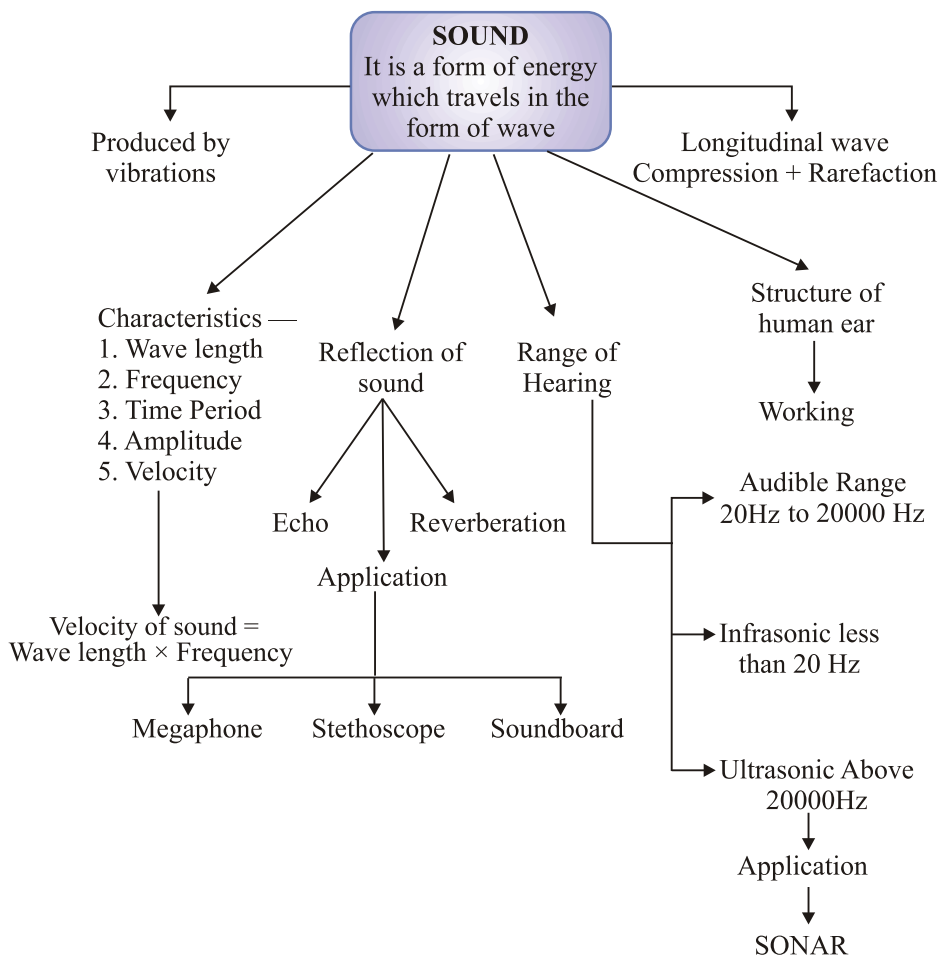
Ans. option (c) Force of gravitation acts on the satellite at right angles to the direction of motion of the satellite, therefore work done is zero therefore Assertion (A) is true but Reason (R) is false.



## Chapter - 12

# Sound

### CONCEPT MAPPING



### Sound

- The sensation felt by our ears is called sound.
- Sound is a form of energy which makes us hear.

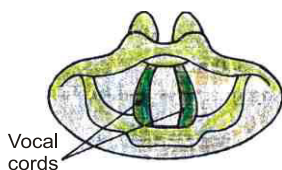
(iii) Law of conservation of energy is also applicable to sound.

(iv) Sound travels in form of wave.

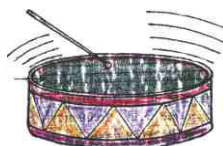
### Production of Sound

Sound is produced when object vibrates or sound is produced by vibrating objects.

- The energy required to make an object vibrate and produce sound is provided by some outside source (like our hand, wind etc.).
- *Example :* Sound of our voice is produced by vibration of two vocal cords in our throat [Fig. (a)].
- Sound of a drum or tabla is produced by vibration of its membrane when struck [Fig. (b)].

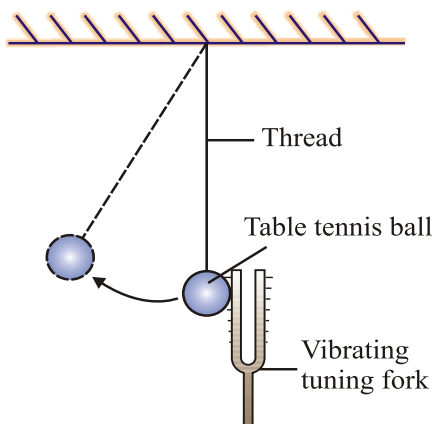


(a) Sound is produced when our vocal cords vibrate



(b) Sound is produced when the skin of a drum vibrates

- In laboratory experiments, sound is produced by vibrating tuning fork. The vibrations of tuning fork can be shown by touching a small suspended pith ball (cork ball) with a prong of the sounding tuning fork. The pith ball is pushed away with a great force.



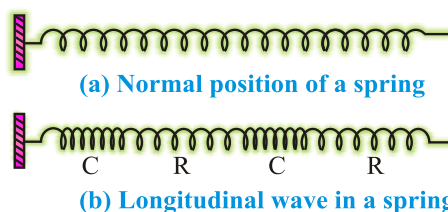
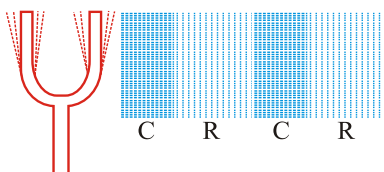
Sound can be produced by following methods :

- (i) By vibrating string (sitar)
- (ii) By vibrating air (flute)

- (iii) By vibrating membrane (table, drum)
- (iv) By vibrating plates (bicycle bell)
- (v) By friction in objects
- (vi) By scratching or scrubbing the objects etc.

### Propagation of Sound

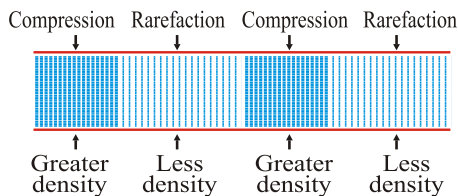
- The substance through which sound travels is called a **medium**.
- The **medium** may be **solid**, **liquid** or **gas**.
- When an object vibrates, then the air particles around it also start vibrating in exactly the same way and displaced from their stable position.
- These vibrating air particles exert a force on nearby air particles so they are also displaced from their rest position and start to vibrate.
- This process is continued in the medium till sound reaches our ears.
- The disturbance produced by sound travels through the medium (not the particles of the medium).
- Wave is a disturbance which travels through a medium and carries energy.
- So sound travels in wave form known as mechanical waves.



### Sound Waves are Longitudinal Waves

- When a body vibrates then it compresses the air surrounding it and form a area of high density called compression (C).
- Compression is the part of wave in which particles of the medium are closer to one another forming high pressure.
- This compression move away from the vibrating body.
- When vibrating body vibrates back a area of low pressure is formed called rarefaction (R).
- Rarefaction is the area of wave in which particles of the medium are further apart from one another forming a low pressure or low density area.

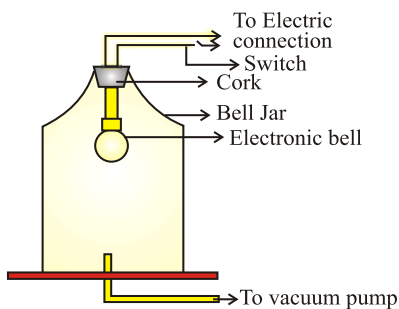
- When body vibrates back and forth, a series of compression and rarefaction is formed in air resulting in sound wave.
- Propagation of sound wave is propagation of density change.



### Sound needs Medium for Propagation

- Sound waves are mechanical waves.
- It needs material medium for propagation like air, water, steel etc.
- It cannot travel in vacuum.
- An electric bell is suspended in airtight bell jar connected with vacuum pump.
- When bell jar is full of air, we hear the sound but when air is pumped out from the bell jar by vacuum pump and we ring the bell, no sound is heard.
- So medium is necessary for propagation of sound.
- 

So, sound can not be heard directly on the surface of moon/in outer space as there is no air/atmosphere at moon or in outer space. The astronauts who land on moon (or walk in outer space) talk to one another through wireless sets using radio waves.



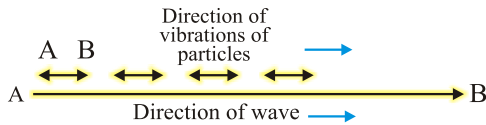
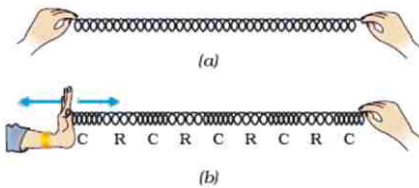
### Experiment to show that sound cannot travel through vacuum

(Imp.)

#### Sound Waves are Longitudinal Waves

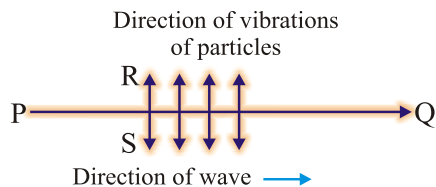
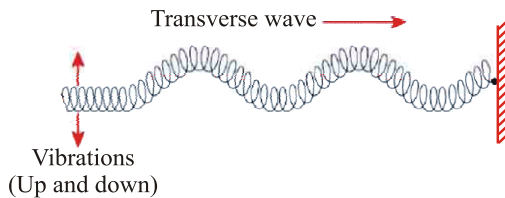
- A wave in which the particles of the medium vibrate back and forth in the same direction in which the wave is moving, is called a **longitudinal wave**.
  - When we push and pull the slinky compression (number of turns are more or closer) and rarefaction (number of turns are less or farther) are formed.

- When a wave travels along with slinky, its each turn moves back and forth by only a small distance in the direction of wave. So the wave is longitudinal.
- The direction of vibrations of the particles is parallel to the direction of wave.



(ii) When one end of a slinky is moved up and down rapidly whose other end is fixed, it produces **transverse wave**.

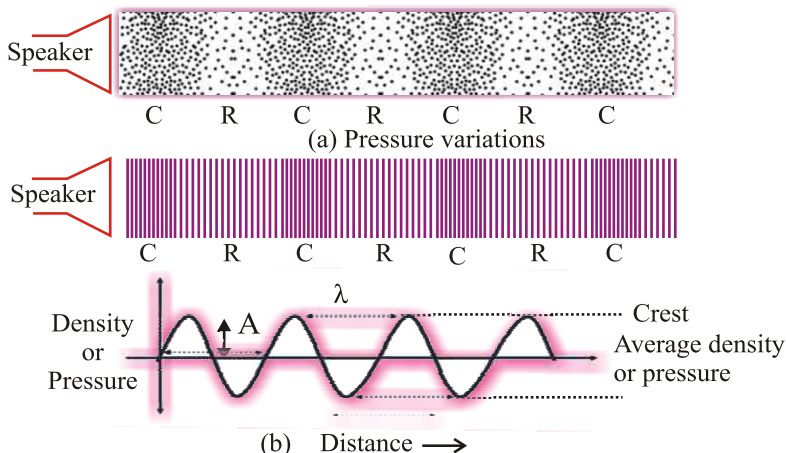
- This wave possess along the slinky in horizontal direction, while turns of slinky (particles) vibrate up and down at right angle to the direction of wave.
- Thus in transverse wave particles of the medium vibrate up and down at right angles to the direction of wave.
- Light waves are transverse waves but they don't need a material medium for propagation.



## Characteristics of Sound Wave

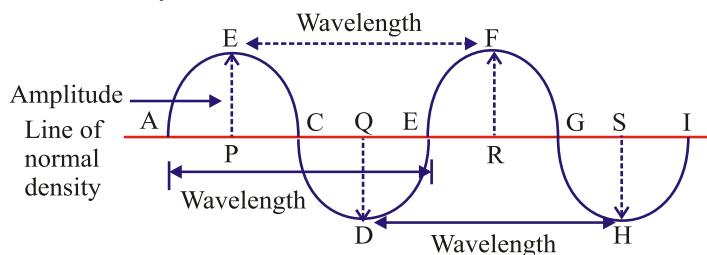
The characteristics of sound waves are : wavelength, frequency, amplitude, time period and velocity.

- When a wave travel in air the density and pressure of air changes from their mean position.
- Compression is shown by crest while rarefaction is shown by trough.
- Compression is the region of maximum density or pressure.
- Rarefaction is the region of minimum density or pressure.



### (i) Wavelength :

- In sound waves the combined length of a compression and an adjacent rarefaction is called its wavelength.
- The distance between the centres of two consecutive compressions or two consecutive rarefactions is also called its wavelength.
- So, we can say that the minimum distance in which a sound wave repeats itself.
- It is denoted by the Greek letter lamda  $\lambda$ . Its SI unit is metre.



### (ii) Frequency :

- No. of complete waves produced in one second or number of vibrations per second is called frequency.
- Number of compressions or rarefactions passed in one second is also frequency.
  - Frequency of wave is same as the frequency of the vibrating body which produces the wave.
  - The SI unit of frequency is hertz (Hz). The symbol of frequency is  $\nu$  (nu).
  - 1 Hertz** : One Hz is equal to 1 vibration per second.
  - Bigger unit of frequency is kilohertz kHz = 1000 Hz.

**(iii) Time Period :**

- (a) Time taken to complete one vibration is called time period.
- (b) Time required to pass two consecutive compressions or rarefactions through a point is called time period.
  - SI unit of time period is second (s). Time period is denoted by T.
  - The frequency of a wave is the reciprocal of the time period.

$$v = \frac{1}{T}$$

**(iv) Amplitude :**

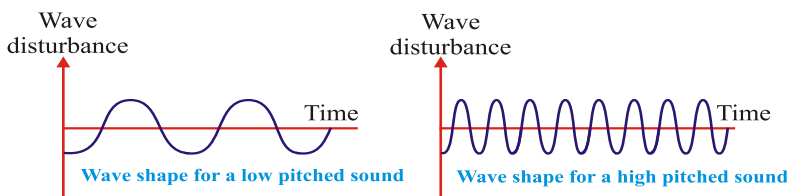
The maximum displacement of the particle of the medium from their original undisturbed position is called amplitude of the wave.

- Amplitude is denoted by A and its SI unit is metre (m).

Sound have characteristics like pitch and loudness and timbre.

**Pitch :** The pitch of sound depends on the frequency of sound (vibration). It is directly proportional to its frequency. Greater the frequency, higher is the pitch and lesser the frequency, lower is the pitch.

- A woman's voice is shrill a having a high pitch while a man's voice is flat having low pitch. This is because women have shorter vocal cords, which vibrate more quickly and produce a higher pitch. On the other hand, men have longer vocal cords that vibrate with low frequencies giving then a flat deep voice.
- High pitch sound has large number of compressions and rarefactions passing a fixed point per unit time.



**Loudness :** The loudness depends on the amplitude of the sound wave.

- Loudness is the measure of the sound energy reaching the ear per sec.
- Greater the amplitude of sound wave, greater is the energy, louder the sound; short is the amplitude, less is the energy, soft is the sound.
- Loudness is measured in decibel 'dB'.

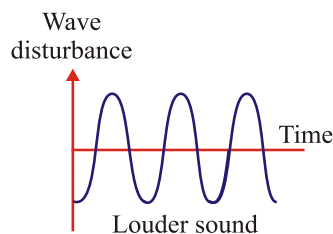
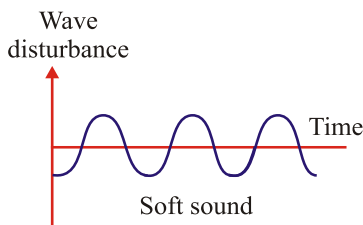


- Mathematically, Loudness of sound is proportional to the square of the amplitude of the vibration producing the sound.

$$\text{Loudness} \propto \text{Amplitude}^2$$

eg.:- if amplitude becomes twice, the loudness increases by a factor of 4

- Anything above 80dB, the sound is considered as 'noise'.



**Quality or Timbre :** The timbre of a sound depends on the shape of sound wave produced by it. It is the characteristic of musical sound.

- It helps us to distinguish between two sounds of same pitch & loudness.
- Sound of single (same) frequency is called **tone** while a mixture of different frequencies is called **note**. Noise is unpleasant to hear while music is pleasant to hear and it is of good quality.
- Tone - sound of single frequency is called tone
- Note - A sound that is produced when several frequencies are mixed, is called a note
- Music - An art of sound that has elements of rhythm, melody and harmony and is pleasant to hear.

#### (v) Velocity :

The distance travelled by a wave in one second is called velocity of the wave. Its SI unit is metre per second ( $\text{ms}^{-1}$ ).

$$\text{Velocity} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

$$V = \frac{\lambda}{T}$$

( $\lambda$  is the wavelength of the waves travelled in one time period T)

$$V = \lambda \nu \quad \left( \frac{1}{T} = \nu \right)$$

So, Velocity = Wavelength  $\times$  Frequency

This is the wave equation.

**Example.** What is the frequency of sound wave whose time period is 0.05 second ?

**Solution :** Frequency,  $\nu = \frac{1}{T}$

Given  $T = 0.05 \text{ s}$

$$\nu = \frac{1}{0.05} = \frac{100}{5} = 20 \text{ Hz}$$

So,

Hence frequency = 20 Hz.

### Speed of Sound in Various Mediums

- (i) Speed of sound depends on the nature of material through which it travels. It is slowest in gases, faster in liquids and fastest in solids.
- (ii) Speed of sound increases with the rise in temperature.
- (iii) Speed of sound increases as humidity of air increases.
- (iv) Speed of light is faster than speed of sound flash of light is seen first, followed by sound of thunder.
- (v) In air, speed of sound is  $344 \text{ ms}^{-1}$  at  $22^\circ\text{C}$ .

### Sonic Boom

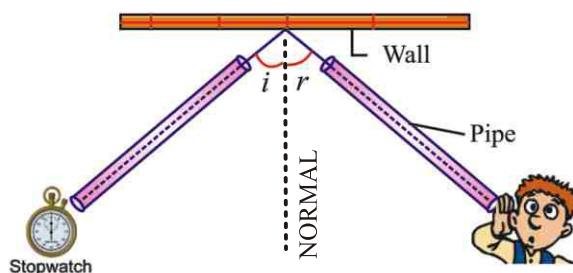
Some aircrafts, bullets, rockets etc. have ‘supersonic speed’.

- Supersonic refers to the speed of an object which is greater than the speed of sound and it produces extremely loud sound waves called ‘shock waves’ in air.
- Sonic boom is an explosive noise caused by shock waves.
- It emits tremendous sound energy which can shatter the glass panes of windows.

## Reflection of Sound

Like light, sound also bounces back when it falls on a hard surface. It is called reflection of sound. The laws of reflection of light are obeyed during reflection of sound.

- (i) The incident sound wave, the reflected sound wave and normal at the point of incidence lie in the same plane.
- (ii) Angle of reflection of sound is always equal to the angle of incidence of sound.



## Reflection of Sound

### Echo

The repetition of sound caused by the reflection of sound waves is called an echo.

- We can hear echo when there is a time gap of 0.1 second in original sound and echo (reflected sound).
  - Echo is produced when sound reflected from a hard surface (*i.e.*, brick wall, mountain etc.) as soft surface tends to absorb sound.
- v To calculate the minimum distance to hear an echo :

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Here Speed of sound in air =  $344 \text{ ms}^{-1}$  at  $22^\circ\text{C}$

Time = 0.1 second

$$344 = \frac{\text{Distance}}{0.1 \text{ sec}}$$

So,

Or Distance =  $344 \times 0.1 = 34.4 \text{ m}$

So, distance between reflecting surface and audience =  $\frac{34.4}{2} = 17.2$  m (at 22°C).

- So, the minimum distance the source of sound and the reflecting surface should be 17.2m to be able to hear an echo.
- Rolling of thunder is due to multiple reflection of sound of thunder from a number of reflecting surfaces such as clouds and the earth.

### Reverberation

- The persistence of sound in a big hall due to repeated or multiple reflections of sound from the walls, ceiling and floor of the hall is called reverberation.
- If it is too long, sound becomes blurred, distorted and confusing.

### Methods to reduce reverberation in big halls or auditoriums

- Panels made of felt or compressed fibre board are put on walls and ceiling to absorb sound.
- Heavy curtains are put on doors and windows.
- Carpets are put on the floor.
- Seats are made of material having sound absorbing properties.

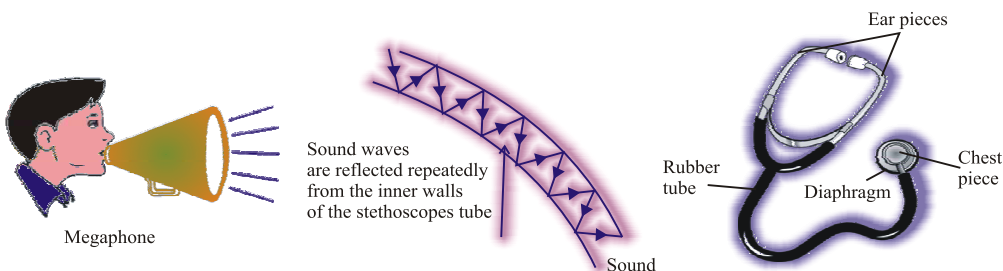
### Difference between Echo and Reverberation

Echo	Reverberation
1. The repetition of sound caused by reflection of sound wave is called echo.	1. The persistence of sound in a big hall due to repeated or multiple reflections of sound from the walls, ceiling and floor of the hall is called reverberation.
2. Echo is produced in a big empty hall. Here is no multiple reflections of sound. Sound is not persistent.	2. If reverberation is too long, sound becomes blurred, distorted and confusing due to overlapping of different sound.

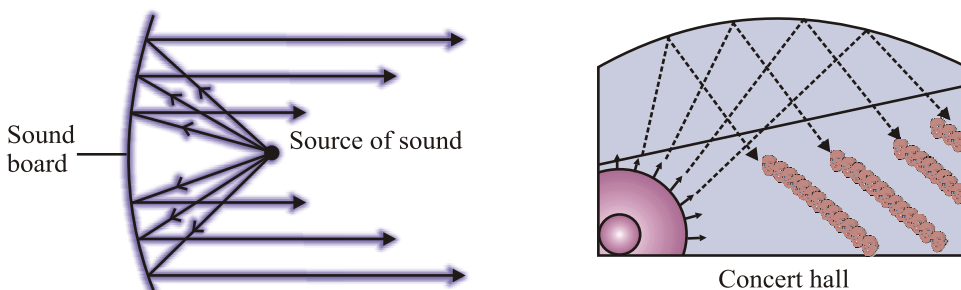
### Applications of Reflection of Sound

- Megaphone, loudspeakers, bulb horns and trumpets, shehnai etc. are designed to send sound in a particular direction without spreading all around. All these instruments have funnel tube which reflects sound waves repeatedly towards audience. In this amplitude of sound waves adds up to increase loudness of sound.

- (ii) **Stethoscope** : It is a medical instrument used for listening the sounds produced in human body mainly in heart and lungs. The sound of the heartbeats reaches the doctor's ears by the multiple reflection of the sound waves in the rubber tube of stethoscope.



- (iii) **Sound Board** : In big halls or auditoriums sound is absorbed by walls, ceiling, seats etc. So a curved board (sound board) is placed behind the speakers so that his speech can be heard easily by audiences. The soundboard works on the multiple reflection of sound.
- (iv) The ceiling of concert halls are made curved, so that sound after reflection from ceiling reaches all the parts of the hall .



### Range of Hearing

- (i) Range of hearing in human is 20 Hz to 20000 Hz.
  - Children younger than 5 years and dogs can hear upto 25 KHz.
- (ii) The sounds of frequencies lower than 20 Hz are known as 'infrasonic sounds'.
  - A vibrating simple pendulum produces infrasonic sounds.
  - Rhinoceroses communicate with each other using frequencies as low as 5 Hz.

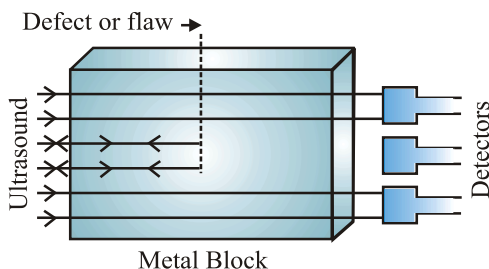
- Elephants and whales produce infrasonic waves.
  - Earthquakes produce infrasonic waves (before shock waves) which some animals can hear and get disturbed.
- (iii) The sounds of frequencies higher than 20 KHz are known as ‘ultrasonic waves’.
- Dogs, porpoises, dolphins, bats and rats can hear ultrasonic sounds.
  - Bats and rats can produce ultrasonic sounds.

## Hearing Aid

It is a battery-operated electronic device used by persons who are hard of hearing. A microphone converts sound into electrical signals, then those are amplified by an amplifier. Amplified signals are sent to the speaker of the hearing aid. The speaker converts the amplified signal to sound and sends it to the ear for clear hearing.

## Applications of Ultrasound

- (i) It is used to detect cracks in metal blocks in industries without damaging them.

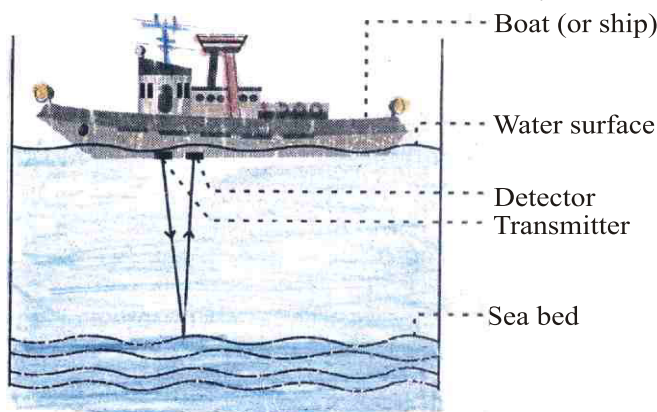


- (ii) It is used in industries to clean ‘hard to reach’ parts of objects such as spiral tubes, odd shaped machines etc.
- (iii) It is used to investigate the internal organs of the human body such as liver, gall bladder, kidneys, uterus and heart.
- (iv) **Echocardiography** : These waves are used to reflect the action of the heart and its images are formed. This technique is called echocardiography.
- (v) **Ultrasonography** : The technique of obtaining pictures of internal organs of the body by using echoes of ultrasound waves is called ultrasonography.
- (vi) Ultrasound is used to split tiny stones in kidneys into fine grains. Which then get flushed out with urine.

## SONAR

‘SONAR’ (Sound Navigation And Ranging).

- SONAR is a device which is used to find distance, direction and speed of underwater objects.
- SONAR consists of a transmitter and a receptor or detector that is installed at the bottom of a ship.
- The transmitter produces and transmits ultrasonic waves.
- These waves travel through water and after striking the objects on the bottom of sea, are reflected back and received by detector.



## SONAR

- These reflected waves are converted into electric signals by detector.
- The sonar device measures the time taken by ultrasound waves to travel from ship to bottom of sea and back to ship.

Half of this time gives the time taken by the ultrasound waves from ship to bottom.

Let the time interval between transmission and reception of ultrasound signal is  $t$ . Speed of sound through sea water is  $v$ , total distance travelled by waves =  $2d$ . Then,  $2d = v \times t$ . This is called echo ranging. i.e, using echo to range (find out)

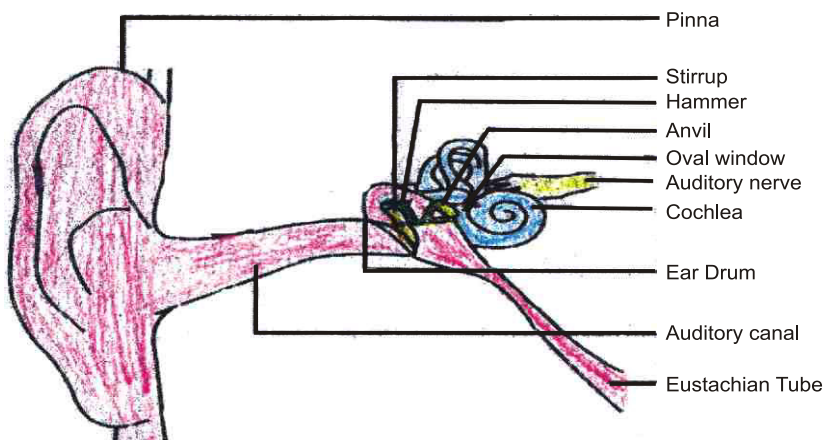
what is around you.

The sonar is used to find the depth of sea, to locate underwater hills, valleys, submarines, icebergs and sunken ships etc.

- Bats fly in the dark night by emitting high pitched ultrasound waves which are reflected from the obstacle or prey and returned to bats ear. The nature of reflection tells the bat where the obstacle or prey is and what it is like. This is also known as BIO SONAR. Whales and Dolphins also use this in sea.

### Structure of Human Ear

- The ear consists of three parts : outer ear, middle ear and inner ear.
- The ears are the sense organs which help us in hearing sound.
- **The outer ear** is called **pinna**. It collects the sound from surroundings.
- This sound passes through the auditory canal.
- At the end of auditory canal, is a thin elastic membrane called ear drum or tympanic membrane.
- **The middle ear** contains of three bones : hammer, anvil and stirrup linked with one another. Free end of hammer touches ear drum and that of stirrup linked with membrane of oval window of inner ear.
- The lower part of middle ear has a narrow ‘Eustachian tube’.
- **The inner ear** has a coiled tube called cochlea, which is connected with oval window. Cochlea is filled with a liquid containing nerve cells. Other side of cochlea is connected to auditory nerve which goes to brain.



### Working :

- When compression of sound wave strikes the ear drum, the pressure on the outside of ear drum increases and pushes the ear drum inwards.



While during rarefaction ear drum moves outwards. Thus, ear drum starts vibrating back and forth.

- These vibrations are increased by three bones and middle ear transmits these amplified pressure variations received from sound waves to inner ear.
- In the inner ear the pressure variations are turned into electric signals by the cochlea.
- These electric signals are sent to the brain via auditory nerve and the brain interprets them as sound.

### **Working of Human ear**

Sound waves → Pinna → Ear canal → Vibrate Ear drum → Hammer → Anvil → Stirrup → Oval window → Cochlea → Auditory nerve → (Brain (which interprets these electrical impulses as sound and we get the sensation of hearing)).

## **QUESTIONS**

### **VERY SHORT ANSWER QUESTIONS**

1. Why sound waves are called mechanical waves ?
2. Which characteristic of sound determine : (a) Pitch, (b) Loudness ?
3. Which property of sound leads to the formation of echo?
4. Write the hearing range of human being.
5. Name that part of ear which vibrates when outside sound falls on it.
6. Write full form of 'SONAR'

## SHORT ANSWER QUESTIONS

1. Name the two types of waves which can be generated in a slinky.
2. What is SI unit of frequency ? Write its bigger unit also.
3. How is sound produced ?
4. In which medium sound travels fastest : air, water or steel ?
5. Name two devices which work on the reflection of sound.
6. State two laws of reflection of sound.
7. Define the terms wavelength & frequency.
8. Define the term time period and amplitude.
9. Can astronauts talk to each other in outer space?
10. What is sound ?

## LONG ANSWER QUESTIONS

1. Explain why, the flash of lightning reaches us first and the sound of thunder is heard a little later ?
2. What is meant by supersonic speed ?
3. Why are the ceiling of concert halls made curved ?
4. What is reverberation ? How can reverberation in a big hall be reduced ?
5. What is echo ? How is echo formed ? How thunder of clouds is formed ?
6. Write any three applications of ultrasound.
7. Explain how bats use ultrasound to catch the prey.
8. What is SONAR ? Explain its working. Give its uses.
9. A wave is moving in air with a velocity of 340 m/s. Calculate the wavelength if its frequency is :  
(a) 512 vibrations per second (b) 100 Hz.  
[Ans: (a) 0.66 m (b) 3.4 m]
10. A sonar station picks up a return signal after 3 seconds. How far away is the object ? [Speed of sound in water = 1440 m/s] [Ans: 2160 m]
11. A stone is dropped from the top of a tower 500 m high into a pond of water at the base of tower. When is the splash heard at the top ? Given  $g = 10 \text{ ms}^{-2}$  and speed of sound = 340 ms<sup>-1</sup>. [Ans: 11.475]  
*[Hint : Time taken by stone to reach at pond,  $t = ?$ , Use  $s = ut + \frac{1}{2}gt^2$ ,  $500 = 0 + \frac{1}{2} \times 10t^2$ ; so,  $t^2 = 100$  or  $t = 10 \text{ sec.}$ ]*
12. What is vacuum ? Why sound can not travel through vacuum ?

## OBJECTIVE TYPE QUESTIONS

1. **A sound wave has a frequency of 1KHz and wavelength 25cm, to travel 2.2km it takes.**  
(a)  $2\frac{3}{7}$  sec =  $\frac{17}{7}$  sec (c)  $80\frac{2}{5}$  min. =  $\frac{402}{5}$  min.  
(c) 5/4 min. (d)  $\frac{44}{5}$
2. **A body produces sound only if it is**  
(a) made of steel (b) made of glass  
(c) made of iron (d) vibrating
3. **Sound travels fastest in**  
(a) air (b) vacuum  
(c) steel (d) water
4. **A sound produces 50 crests and 50 troughs in 0.5 seconds. What is the frequency of the wave?**  
(a) 50 Hz (b) 100 Hz  
(c) 150 Hz (d) 200 Hz
5. **The voice of a friend is recognised by its**  
(a) Pitch (b) Quality  
(c) Velocity (d) Intensity
6. **A 440 Hz sound wave travels with a speed of  $340\text{ ms}^{-1}$ . The wavelength of the wave is**  
(a)  $1.5 \times 10^5$  m (b) 0.77 m  
(c) 1.3 m (d) 1.1 m
7. **Earthquake produces which kind of sound before the main shock begins?**  
(a) Ultrasound (b) Infra sound  
(c) Audible Sound (d) None of these
8. **A mechanical wave will be transverse or longitudinal depending on :**  
(a) the nature of medium (b) the whole of excitation  
(c) frequency (d) amplitude
9. **Which of the following can travel through vacuum?**  
(a) Light waves (b) Heat waves  
(c) X-rays (d) Sound waves
10. **The velocity of sound is affected by change in**  
(a) Temperature (b) Medium  
(c) Pressure (d) Wavelength

## Assertion and Reason Type Question

- **Directions : In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Mark the correct choice as :**

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true and reason (R) is not correct explanation of assertion (A).
- (c) Assertion (A) is true but (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

Q1. Assertion (A) – In the rainy season, the flash of lightning is seen first and the sound of the thunder is heard is little later.

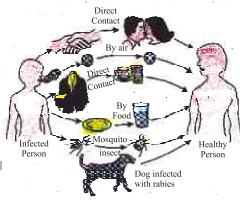
Reason (R) – Speed of Sound is faster then speed of light.

Ans. (c) As speed of light is faster than the speed of sound, we see the flash of lightening first and then the sound of thunder is heard. So, the assertion (A) is true but reason (R) is false.

Q2. Assertion (A) – Elephants communicate with each other through ultrasonic sounds.

Reason (R) – The sounds of frequencies higher than 20k Hertz are known as ultrasonic sounds.

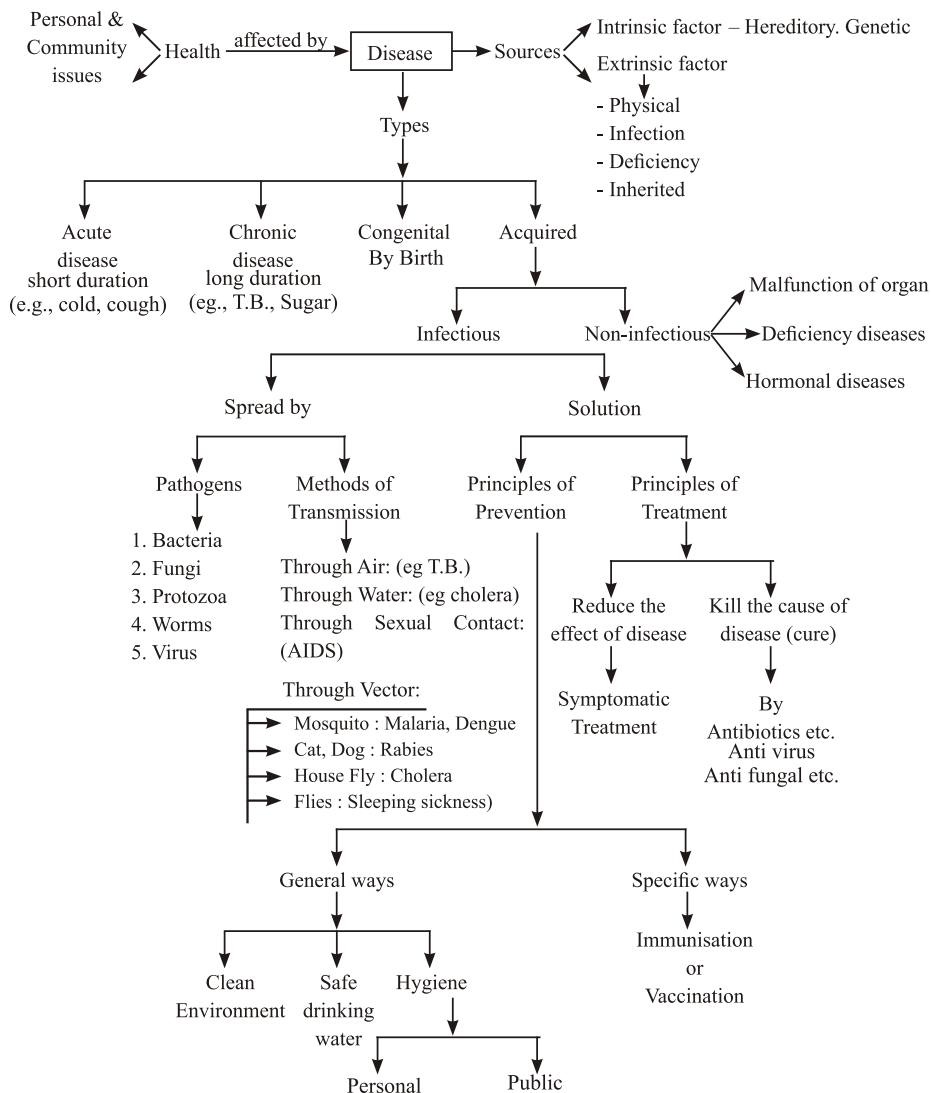
Ans. (d) The sounds of frequencies higher then 20,000 hertz i.e. 20 kilohertz are known as ultrasonic sound but Elephants produce infrasonic sound. So, (A) is false but (R) is true.



## Chapter - 13

# Why Do We Fall Ill ?

### CONCEPT MAPPING



Health is a general condition of a person's mind and body. According to WHO (World Health Organisation) health is a "state of physical, mental and social well-being of a person".

To make people aware and conscious of keeping healthy and disease-free we celebrate WORLD HEALTH DAY on 7th April every year.

- 'Health' is a state of being well enough to function well physically, mentally and socially.
- The diseases/infections can be prevented by life style (exercise, proper sleep, enough relaxation) modification, taking balanced diet, good personal health and hygiene and also maintaining a clean and healthy surrounding.
- Treatment involves killing of the microbes/pathogens.

### **Significance of Health**

Good health has following advantages:

- (i) It increases our working efficiency & helps us to perform various activity at our best.
  - (ii) It helps us to cope up with the social & mental pressure without much difficulty.
  - (iii) It makes our life joyful.
- The conditions necessary for good health are :
    - (i) Good physical and social environment.
    - (ii) Good economic conditions.
    - (iii) Active life style
  - Good physical and social environment includes clean surroundings, good sanitation, proper garbage disposal and clean drinking water.
  - Good economic conditions includes job opportunities for earning to have nutritious food and to lead a healthy life.
  - Active life style includes regular exercise and health conscious attitude.

### **Personal and Community Issues Both Matter for Health**

#### **Community Health :**

It refers to maintenance, protection and improvement of whole community in which an individual lives.

- Personal and community health are supplementary to each other.
  - We protect ourselves by keeping our body clean.
  - For this, we also require a good and healthy environment in our surroundings.
  - We can have this only by the means of community health and development.
  - So, both personal and community health are inter-related.

### Differences between Being Healthy and Disease-free

Being Healthy	Being Disease-free
1. It is a state of being well enough to function well physically, mentally and socially.	1. It is a state of absence from diseases.
2. It refers to the individual, physical and social environment.	2. It refers only to the individual.
3. The individual has good health Energetic	3. The individual may have good health or poor health.

### Disease and Its Causes

**Diseases :** It refers to any condition that disturbs or modifies the normal functioning of the living organisms.

#### What does disease look like ?

- When a person is affected by a disease either the functioning or the appearance of one or more systems of the body will change for the worse.
- These changes give rise to symptoms and signs of disease.
- On the basis of the symptoms the physicians look for the signs of a particular disease and conduct tests to confirm the disease.

**Sign :** It gives more definite indications of the presence of a particular disease it include laboratory test, ultrasound etc.

**Symptoms :** Symptoms of diseases are the indications that we feel as being wrong , such as cold, headache, loose motion etc.

## Causes of Diseases

*Diseases are caused by :*

- Pathogens like virus, bacteria, fungi, protozoans or worms.
- Poor health and under nourishment.
- Hereditary and genetic disorder.
- Lack of proper treatment immunization.
- Environmental pollution (air, water etc.)

## Types of Diseases

- Acute Diseases** : Acute diseases which last for only very short period of time and affect body suddenly and quickly. E.g., Cold, cough, typhoid etc.
- Chronic Diseases** : The diseases which last for a long time, even as much as a life time, are called chronic diseases. E.g., Diabetes, tuberculosis, elephantiasis etc.
- Infectious Disease Communicable** : The diseases which spread due to infection by micro-organisms are called infectious diseases. It is communicated from diseased person to healthy person, caused by some biological agents/pathogens like viruses, bacteria, fungi, protozoans, worms. e.g. corona, T.B etc
- Non-infectious Diseases – Non Communicable** : The diseases which does not spread by contact between infected and healthy person through air and water, is called non-infectious disease. *E.g.*, Arthritis, heart diseases, Diabetes, Hyper Thyroids etc.
  - Deficiency diseases – caused due to deficiency of nutrient. eg. goitre etc.
  - Degenerative diseases – ex. arthritis.
  - Allergies
  - Cancer – Leukemia
- Congenital diseases** : The diseases present since birth, caused due to genetic abnormalities or defective development of embryo. e.g., haemophilic.

### Difference between Infectious & Non-infectious disease

Infectious/Communicable	Non-infectious/Non-Communicable
1. These disease spread from one person to another.	1. These do not spread from one person to another.
2. These are caused due to pathogens like viruses, bacteria	2. These could be caused due deficiency, cancer, degeneration, injury or metabolic disorders
3. May be chronic & acute	3. Primary by chronic nature
4. for eg:, common cold, T.B. etc	4. for e.g.: Kwashiorkar, cancer etc.



**Pathogens** : The disease causing organisms are called pathogens. These can also be known as infections agents.

**Categories of infectious agents are :-**

- Bacteria (e.g., Salmonella typhi, Micobacterium tuberculi, Staphylococcus etc.
- Fungi : Posinous mushrooms,
- Protozoan - Amoeba, Trypanosoma, Plasmodium, Leishmania)
- Worm - Ascaris etc.

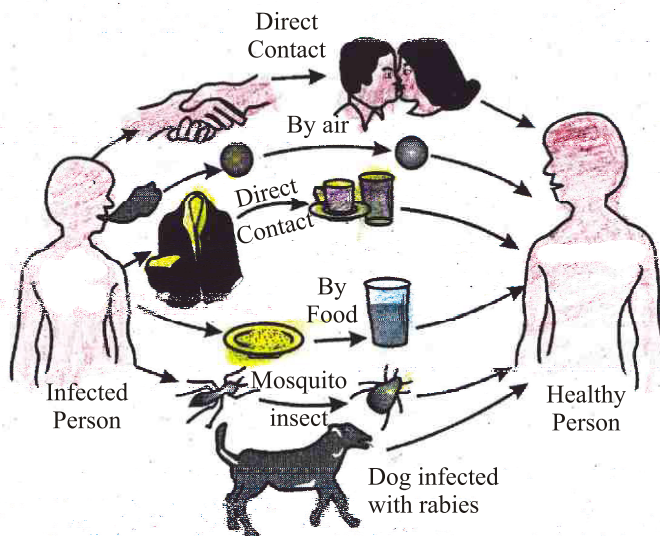
**Epidemic diseases** : Some infectious diseases that develop and spread rapidly to many people in a community are called epidemic diseases. e.g. corona virus.

Micro-organisms and there Diseases

S. No.	Infectious Agents		Diseases
1.	Viruses	SARS HIV-AIDS	Dengue, Smallpox, Polio, flu, fauch Common cold, influenza, measles, chicken pox, AIDS, Hepatitis-B etc.
2.	Bacteria	Salmonella Typhi, Staphylococcus.	Cholera, Penumonia , typhoid, TB, tetanus, anthrax, food poisoning, Syphilis etc.
3.	Fungi	Poisonous Mushroom	Skin infections, Ringworm, athlete's foot
4.	Protozoan	Amoeba, Trypanosoma Plasmodium etc.	Malaria, kala-azar, Leishmania amoebic dysentery, sleeping sickness (Trypanosoma)
5.	Worms	Ascaris	Intestinal worm infections, elephantiasis

## Common method of transmission of diseases

(Diseases spread from affected person to healthy person)



### Means of Spread of Infectious Diseases

Infectious diseases spread from an infected person to a healthy person through air, water, food, vectors, physical contact and sexual contact.

- **Through air :** By sneezing and coughing, the microbes spread into air and enter into the body of a healthy person, like common cold, tuberculosis, pneumonia etc.
- **Through water :** The microbes enter into our body by drinking/eating polluted and contaminated water/food, like cholera, amoebic dysentery etc.
- **Vectors :** Some infected organisms like Dog, Cat, Monkey & Mosquito (female anopheles mosquito) spread the diseases to a healthy person when they bite them like Rabies malaria, dengue, yellow fever etc.
- **Through sexual contact (STD) :** Syphilis, AIDS spread by sexual contact with infected person. AIDS virus can also spread through blood transfusion and from the mother to her child during pregnancy and through breast feeding.
- **Through physical contact :** Some disease spread when we use the clothes food etc. used by infected person e.g., Scabies, Fungal infection etc.

### AIDS (Acquired Immuno Deficiency Syndrome)

#### Causes :

AIDS is caused by a retro-virus called HIV (Human Immuno Deficiency Virus).

## **Method of transmission of AIDS :**

The transmission of AIDS from an infected to a healthy person takes place :

- through sexual contact
- blood transfusion
- use of infected needle or blade etc.
- This may also get transmitted from infected mother to her foetus.

## **Prevention :**

- Avoid transfusion of infected blood. This can be done by testing whether the blood is HIV negative or not.
- Always use disposable needle and syringe.
- Avoid sexual contact with unknown person.
- Avoid the same razor used in the salons.

## **ORGAN – Specific and Tissue-specific Manifestations**

Disease causing microbes enter the body by different means and goes to different organs and tissues. The signs & symptoms of a disease will depend on the tissue, organ which the Microbes Target.

- (i) Microbes which enter through the nose are likely to go to the lungs.  
(Bacteria which cause tuberculosis of lungs).
- (ii) Microbes which enter through the mouth are likely to stay in the gut  
(bacteria which causes typhoid) or liver (bacteria which causes jaundice).
- (iii) Virus which causes AIDS enter the body through sexual organs during sexual contact and spread through the lymph to all parts of the body and damages the immune system.
- (iv) Virus which causes Japanese encephalitis (brain fever) enters the body through mosquito bite and goes and infects the brain.

## **Principles of Treatment :**

The treatment of infectious diseases consists of two steps. They are **to reduce the effects** of the disease (symptoms) and to kill the microbes which caused disease.

- (i) **To reduce the effects of the disease :** This can be done by taking medicines to bring down the effects of the disease like fever, pain or loose motions etc. and by taking bed rest to conserve our energy.

### **Some Categories of medicines for symptomatic relief are:**

Anti pyretic	- For fever and pain	- ex. Paracetamol
Analgesic	- For pain & also relieve fever	- ex. Analgin, Combiflame
Antispasmodic	- For abdominal pain & spasm	
Antiemetic	- For vomiting & nausea	- ex. Domperidone, Avomine
Anti inflammatory	- For help to reduce inflammations	- ex. Combiflame etc.
Antiallergic	- For itching & other allergic response	- ex. Avil, cetirizine etc.

**(ii) To kill the microbes :** This can be done by taking suitable antibiotics and drugs which kills the microbes and the disease incurred.

**To cure disease specific medicine are used to kill that microbes, some medicines are :**

**Anti bacterial / antibiotic :-** These drugs are used to kill or stop the growth of bacteria in the body. These drugs are very specific means they and work only against bacterial infections. ex. Pencilline, Tetracycline, Cefixime etc.

Antibiotics acts by blocking some biochemical pathways that are important for bacterial growth like many bacteria make cell wall after division protect themselves but the Antibiotics block the pathway that is required to build cell wall and thus bacteria dies & diseases is cured.

As these biochemical pathways are different for different microbes. Thus these medicines only work against a particular categories of microbes and not on other.

**Antiviral medicine** – These drugs are used against viral infections.

**Antifungal medicine** – These drugs are used only against fungal infections.

**Antiprotozoal medicine** – These drugs are used only against protozoal infections

**Anthelmintic medicine** – These medicines can used to treat infections as caused by parastic worms

### **Principles of Prevention.**

"Prevention is better than its cure".

There are two ways of prevention of infectious diseases. They are general ways and specific ways.

**(i) General ways of prevention :** Public & Personal hygiene and Balanced Diet are most important for prevention of infectious diseases. Proper and sufficient food for everyone will make people healthy to resist the infection.

Air borne diseases can be prevented by living in conditions that are not crowded. Water borne diseases can be prevented by providing safe drinking water. Vector borne diseases can be prevented by providing clean environment.

(ii) **Specific ways of prevention** : There are disease specific measures which are used to fight them. It is done by Immunisation. This is the process of introducing a weakened pathogen inside the body of the host to fool his/her immune system to produce antibodies against that particular disease. Not only does our immune system fight the disease (feeble pathogen), but also keeps a memory of the incident by keeping those antibodies in blood. Thus, next time even if the disease will strike the host's body with full vigor, the body will be able to protect itself with the help of these antibodies. This is also the basic law followed by vaccination programmes done for infants.

3. **Vaccination** : Vaccination is the administration of a vaccine to help the immune system develop protection from a disease. Vaccines contain a microorganism in a weakened or killed non infective state.

**Vaccines available against are:**

Tetanus, diphtheria, whooping cough, measles, polio, BCG. [*Bacillus Calmette Guerin*) used against prevention of TB]

The small pox vaccine was invented in 1796 by Edward Jenner.

### A Few Diseases

Disease	Pathogen	Vector (if any)	Symptoms
1. Malaria	Protozoa	Female anopheles mosquito	Recurrent fever, chills
2. Typhoid	Bacteria – <i>Salmonella</i>	Cockroaches etc.	High fever and intestinal infections
3. AIDS	Virus – HIV	–	Not a disease in itself, it affects our lymph glands thereby decreasing our immunity
4. Dengue	Virus	Female <i>Aedes aegypti</i>	Headache + fever

5. Worms	Worms in intestine	—	Stomach ache
6. Kala azar	Protozoa – <i>Leishmania</i>	—	Brain fever
7. Round worms	Ascaris in intestine	—	Stomach ache
8. SARS	Bacteria	—	—
9. Swine flu	Virus	Pig + human	Fever – spreads
10. Bird flu	Virus	Birds	Fever – spreads
11. Ebola	Ebola virus	Bat	Fever – spreads

## QUESTIONS

### VERY SHORT ANSWER QUESTIONS

1. Write the full form of WHO.
2. Name two non-infectious diseases.
3. Write two water-borne diseases.
4. Write the difference between acute and chronic disease.
5. Write the expanded form of AIDS.
6. What is the difference between 'Being healthy' and 'Disease free'?
7. Name two disease that can be prevented by using vaccine.
8. Name the methods for treatment of infectious diseases.

### LONG ANSWER QUESTIONS

1. Why is food necessary for us?
2. Name two methods for treatment of infectious diseases.
3. How do micro-organisms enter into our body?
4. Name four diseases caused by protozoa, virus, bacteria, fungi.
5. What are the different means by which infectious diseases spread?
6. What precautions can you take in your school to reduce the incidence of infectious diseases?

7. Name five diseases against which immunization vaccines are available.
8. What is the basic principle of vaccination?
9. It has been observed that despite the availability of the vaccine for Hepatitis A in the market, It may not be necessary to be given to children by the time they are five years old. Why?
10. It is diagnosed that Seema suffers from malaria
  - (a) Which organ of Seema is affected?
  - (b) What is the symptom of this disease?
11.
  - (i) What is balanced diet?
  - (ii) What problems will you face if you do not eat a balanced diet?

## OBJECTIVE TYPE QUESTIONS

### A. Fill in the blanks :

- (i) .....is a state of physical, mental and social well-being.
- (ii) AIDS is a.....(communicable/non-communicable) disease.
- (iii) Common cold is a.....(acute/chronic) disease.
- (iv) Breathing in polluted air causes.....disease.
- (v) Small pox is prevented through..... .

### B. MCQ

#### 1. Which one of the following is an infectious disease?

- |                  |              |
|------------------|--------------|
| (a) Diphtheria   | (b) Diabetes |
| (c) Hypertension | (d) Cancer   |

#### 2. Elephantiasis disease can have

- |                                     |  |
|-------------------------------------|--|
| (a) short-term affect on our health | (b) no effect on our health            |
| (c) long term effect on our health  | (d) sometimes bad effect on our health |

#### 3. Ascaris worm lives in which part of human body?

- |                     |                     |
|---------------------|---------------------|
| (a) Kidneys         | (b) liver           |
| (c) small intestine | (d) large intestine |

#### 4. Microbes which enter the body through nose most likely affect.

- |           |           |
|-----------|-----------|
| (a) liver | (b) heart |
| (c) brain | (d) lungs |

#### 5. Which of the following is a viral infection?

- |                |               |
|----------------|---------------|
| (a) Diphtheria | (b) Influenza |
| (c) Cholera    | (d) Typhoid   |

#### 6. HIV virus when active in body mainly attacks on

- |              |            |
|--------------|------------|
| (a) lungs    | (b) liver  |
| (c) immunity | (d) nerves |

#### 7. An Organism which carries pathogens is termed as

- (a) host
- (b) vector
- (c) parasite
- (d) predator

**8. Diseases which are always present in certain location are called**

- (a) epidemic diseases
- (b) endemic diseases
- (c) acute diseases
- (d) chronic diseases

**9. DPT vaccines are administered to develop immunity against**

- (a) Tetanus
- (b) Diphtheria
- (c) Pertussis
- (d) All of these

**10. Anti-viral drugs are difficult to make because, viruses**

- (a) live outside the host cells
- (b) live inside the host cells
- (c) live in consumed food particles
- (d) live in blood stream

**11. BCG vaccine is used to develop immunity against**

- (a) jaundice
- (b) polio
- (c) influenza
- (d) tuberculosis

**C. Assertion and Reasoning Based :-**

Question consists of an Assertion and a Reason. Use the following key to choose the appropriate answer

- a) If both assertion and reasoning are correct and the reason is the correct explanation of the assertion.
- b) If both assertion and reasoning are correct but reason is not the correct explanation of assertion.
- c) If assertion is correct but reason is incorrect
- d) If assertion is incorrect but reason is incorrect
- e) If both assertion and reason are incorrect

1. Assertion (a) : Tuberculosis is a bacterial diseases

Reason (b) : Tuberculosis is mainly transmitted by droplet infection

2. Assertion (a) : Making anti-viral drug is difficult

Reason (R) : Viruses are on the border line of living and non-living

Ans. 1. (b)      2. (b)

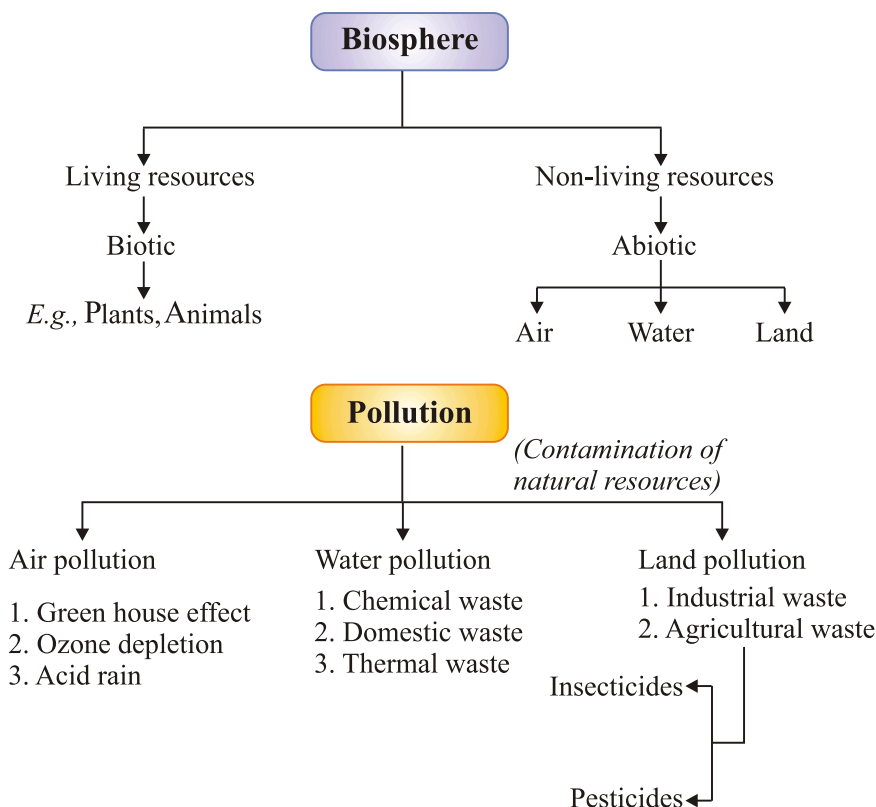




## Chapter - 14

# Natural Resources

### CONCEPT MAPPING



- Life on earth depends on resources like soil, water, air and energy from sun.
- Uneven heating of air over land and water-bodies causes winds.
- Evaporation of water from water-bodies and subsequent condensation give us rain.

- Pollution of air, water and soil affect the quality of life.
- We need to conserve our natural resources and use them in a sustainable manner.
- Various nutrients are used again and again in a cyclic fashion. This leads to a certain balance between the various components of the biosphere.

## Natural Resources

The resources available on the earth and the energy from the sun are necessary to meet the basic requirements of all life forms on the earth.

The stocks of nature which are useful to mankind are known as natural resources.

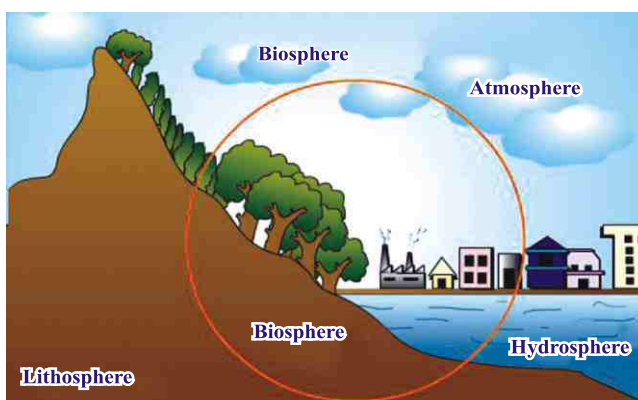
*E.g.*, air, water, soil, minerals etc.

### What are these resources on the earth ?

The outermost crust of the earth is called the **lithosphere**. Water covers 75% of the earth's surface. It is also found underground. These comprise the **hydrosphere**. The air that covers the whole of the earth like blanket is called the **atmosphere**.

## Biosphere

All living things on earth together with atmosphere, the hydrosphere and the lithosphere interact and make life possible is known as biosphere. It may be :



**Biotic components :** Plants and animals.

**Abiotic components :** Air, water and soil.

## AIR

- Air is a mixture of different gases.
- Air contains oxygen which is essential to living organisms for respiration. So it is called breath of life.

## Role of Atmosphere

- Air is a bad conductor of heat. It keeps the average temperature of the earth constant during the day and even during the course of the whole year.
- Prevents the sudden increase in temperature during day time and during the night, it slows down the escape of heat into outer space. *E.g.*, At noon, there is no atmosphere and so the temperature varies from 190°C to 110°C.

## The Movement of Air : Winds

- During the day, the direction of wind is from sea to land. This is because the air above the land gets heated faster and starts rising.
- During the night, the direction of wind is from land to sea. This is because at night, both land and sea start to cool.
- The movement of air from one region to the other creates winds.

## Rain

- Rain is formed by evaporation and condensation of water through water cycle in which distribution of water takes place. Rain is very important because it carries out all the agriculture processes
- So we should conserve rain by constructing dams, pools etc.

## Air Pollution

- An increase in the content of harmful substance (pollutants) in the air like carbon dioxide, carbon monoxide, oxides of sulphur, nitrogen, fluoride, lead, nickel, arsenic and dust particles etc. causes air pollution. It may cause :

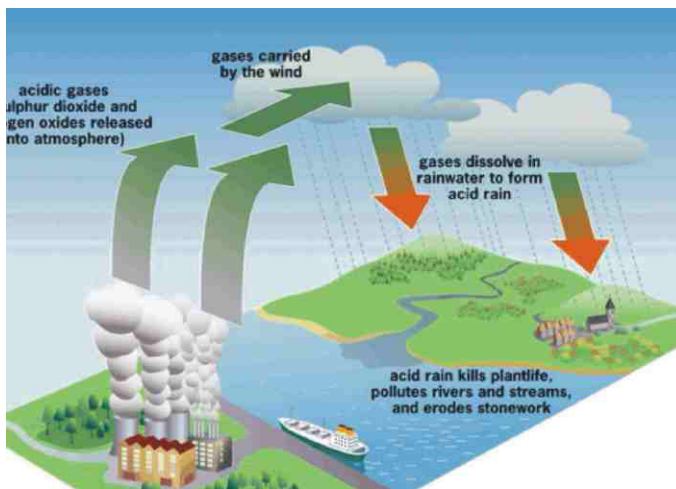
**In Humans :** Respiratory and renal problems, high blood pressure, eye irritation, cancer.

**In Plants:** Reduced growth, degeneration of chlorophyll, mottling (patches/spots of colour) of leaves.

## Acid Rain

- When fossil fuels are burnt, gases like sulphur dioxide and nitrogen dioxide (NO<sub>2</sub>) are released.

- These gases dissolve in water and form nitric acid and sulphuric acid.



**Acid rain kills plant life, pollutes river and streams**

## Green House Effect

- Carbon dioxide keeps the earth warm much like glass which keeps the green house warm.
- Increase in carbon dioxide ( $\text{CO}_2$ ) :
  - (i) intensifies green house effect.
  - (ii) leads to global warming.
  - (iii) increase in average temperature of earth.
  - (iv) may lead to melting of polar caps.
  - (v) submerging number of coastal cities.

Changes in environment affects us and our activities change the environment around us.

## Environmental Problems Caused by Humans

### Depletion of Ozone Layer

- Ozone layer is present in the stratosphere which is a part of our atmosphere from 16 km to 60 km above sea level.
- Ozone is an allotrope of oxygen. Its molecule is made up of three oxygen atoms. Molecular formula is  $\text{O}_3$ .

- Ozone layer absorbs the ultra-violet rays coming from the sun and protects living being from their harmful effects like skin cancer, cataract in eyes, weaken immune system.
- The decline of ozone layer thickness in Antartica was first observed in 1985 and was termed as ozone hole.

### **Reason of Ozone Depletion**

- Excessive use of CFCs (Chloro Fluoro Carbon) in refrigerators, jet planes, spray cans, fire extinguishers.
- Nuclear explosion

### **Smog**

- Smog is a type of air pollution.
- The word ‘smog’ comes from the blend of two words : Smoke and fog.
- Smog can form in any climate where there is a lot of air pollution especially in cities.

### **Water : A wonder Liquid**

- The most unusual natural compound found on earth and which fulfills almost various demands of different living things.
- About three-fourth of the earth surface is 75% are covered with water.
- It is present underground, a very large area on the surface (sea, ocean etc.) and also in the form of water vapour in the atmosphere.

### **Water Necessary for all Organisms**

- It maintains a uniform temperature of the body.
- All cellular processes take place in a water medium.
- All the reactions that take place within our body and within our cells occur between substances that are dissolved in water.
- Water forms the habitat of many plants and animals.

### **Water Pollution**

When water becomes unfit for drinking and other uses, then water is said to be polluted.

### **Causes of Water Pollution**

- Dumping of wastes from the industries into water bodies.

- Washing of clothes near water bodies.
- Spraying chemical in water field.
- Dumping household wastes into the water bodies.



### Various causes of water pollution

*(Bathing of humans and animals, disposal of factory wastes, washing clothes etc.)*

## Soil

Soil is the portion of the earth surface consisting of disintegrated rock and decaying organic material. It provides the support for many plants and animals.

### Creation of Soil : Various Factors

#### Factor 1. Sun

The sun heats up rocks during the day so that they expand. At night these rocks cool down and contract. Since all parts of the rocks do not expand and contract at the same rate, this results in the formation of cracks and ultimately the huge rocks break up into smaller pieces.

#### Factor 2. Water

Fast flowing water carries big and small particles of rock downstream. These rocks rub against other rocks and the resultant abrasion causes the rocks to wear down into smaller particles.

#### Factor 3. Wind

Wind carries sand from one place to another.

## Living Organisms

### Lichen (A slow growing plant)

Lichen, moss also grow on surface of rocks. While growing, they release certain substances that cause the rock surface to powder down and form a thin layer of soil.

### Components of Soil:

Soil contains small particles of rock of different sizes. It contains bits of decayed living organisms called **Humus**. It also contains various micro-organisms. Humus makes the soil more porous. It allows water and air to penetrate deep underground.

### Usefulness of Soil:

The soil holds the roots of the plants. The soil contains certain micro-organisms which help in the growth of plants.

### Different Types of Soil:

1. Alluvial soil (जलोद मिट्टी)
2. Black soil (काली मिट्टी)
3. Sandy soil (बलुई मिट्टी)
4. Laterite soil (लेटेराइट मिट्टी)

## Soil Erosion

Carrying away of upper fertile layer of soil by rain, wind, human activities and wrong agricultural practice is called soil erosion.

### Causes

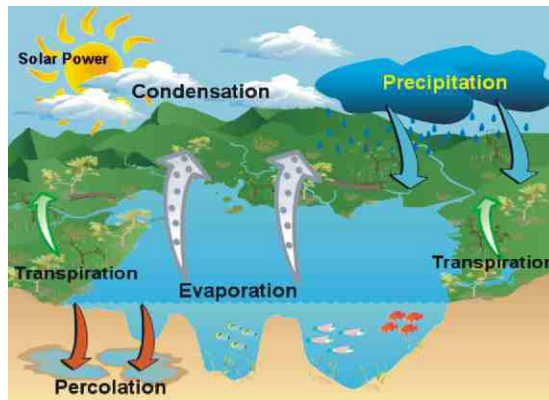
- Over grazing of land.
- Removal of top soil by wind and water.
- Due to lack of trees the upper layer of soil is eroded by air and water.
- Leaving land uncultivated for long time.

### Biogeochemical Cycles

- The flow of substances from non-living to living and back to non-living is called the cycling of substances.

- The cycling of chemical elements like carbon, oxygen, nitrogen, phosphorus, sulphur and water in the biosphere is called **biogeochemical cycle**. It operates through soil, water, air and biotic factors.

## Water Cycle



### Water Cycle

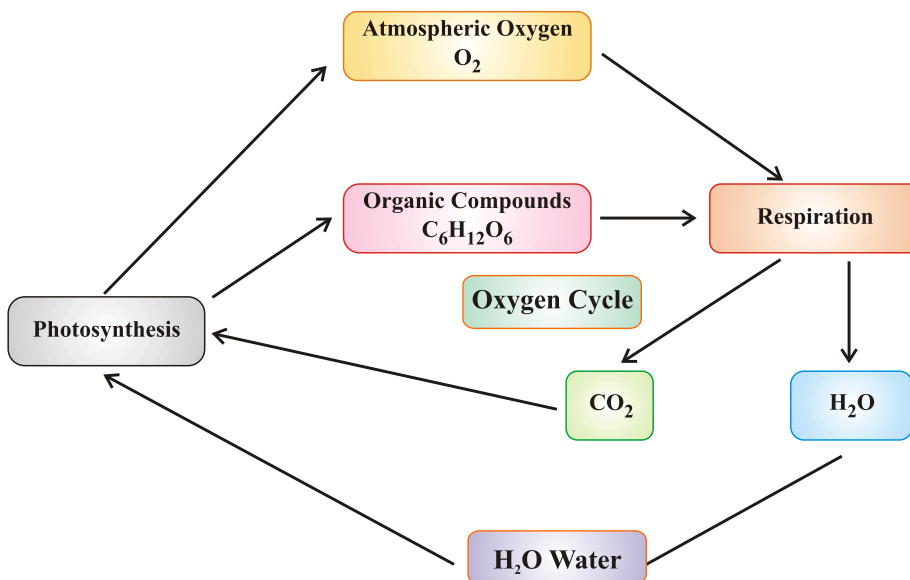
- The whole process in which water evaporates and falls on the land as rain and later flows back into the sea via rivers is known as **water cycle**.
- When sun shines, water evaporates continuously from the water bodies and forms **water vapour**. This water vapour rises up and goes into the **atmosphere**.
- The plants absorb water from the soil and use it during the process of **photosynthesis**.

They also loose water by the process of **transpiration**.

- The water vapour produced by transpiration also goes into the **atmosphere**.
- The process of respiration and evaporation from the surface of animal body produces water vapour which goes into the atmosphere.
- The evaporation and condensation of water vapour leads to rain. During winter, the water falls down in the form of dew or snow.
- All of the water that falls on the land does not immediately flow back into the sea. Some of it seeps into the soil and becomes part of the underground reservoir of fresh water.
- The underground water is again taken by plants and water cycle continues.



## Oxygen Cycle



## Oxygen Cycle

The percentage of oxygen in air is 21%.

- The cyclic process by which oxygen element is circulated continuously through the living and non-living components of the biosphere constitutes oxygen cycle.
- Human beings and animals take oxygen from the atmosphere during the process of respiration.

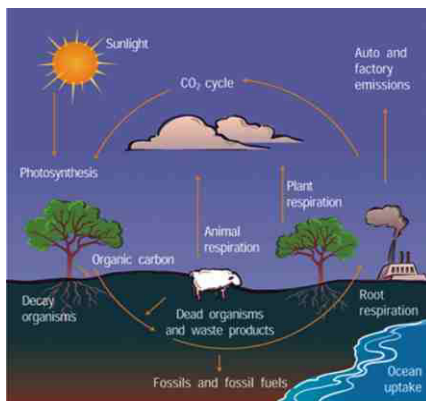
The decomposition of dead organisms also takes in oxygen from the atmosphere.

Respiration and decay of dead organisms release  $CO_2$  and water.

- The carbon dioxide and water are used by the green plants during the process of photosynthesis.
- They give out oxygen during this process. This oxygen is again used by human beings and animals.

Thus, the oxygen cycle keeps repeating in nature.

## Carbon Cycle



### Carbon Cycle

0.03-0.04% carbon is present in the atmosphere in the form of  $\text{CO}_2$ .

- Carbon cycle maintains the balance of the element carbon in the atmosphere. Carbon is found in various forms on the earth.
- Carbon is present in the atmosphere as carbon dioxide.
- Carbon can also occur as carbonates and bicarbonate salts in minerals.
- Carbon is the essential part of nutrients like carbohydrates, fats, proteins, nucleic acids and vitamins.
- Carbon cycle keeps the level of  $\text{CO}_2$  constant in the atmosphere.

**The Carbon Cycle starts in plants as :**

#### Step I.

Plants use  $\text{CO}_2$  in the atmosphere, convert it into glucose in the presence of sunlight by the process of photosynthesis. Plants and animals break these carbohydrates for energy and release  $\text{CO}_2$  through respiration.

#### Step II.

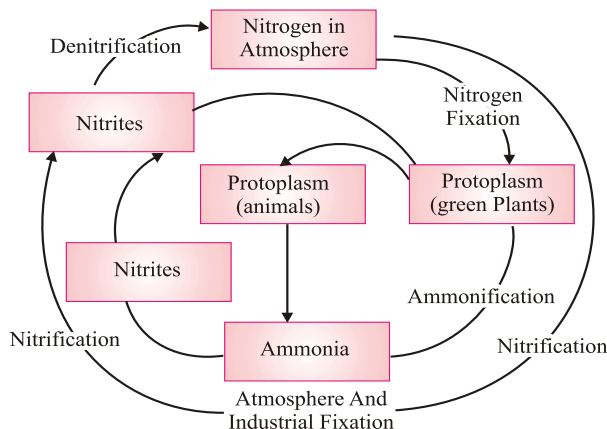
When the plants and animals die, fungi and bacteria decompose the dead remains. This releases the carbon in the remains as carbon dioxide.

#### Step III.

Some of the dead plants and animals which get buried under the earth under certain temperature and pressure get transformed into fossil fuels like coal and petroleum.

On burning these fuels,  $\text{CO}_2$  is released into the atmosphere.

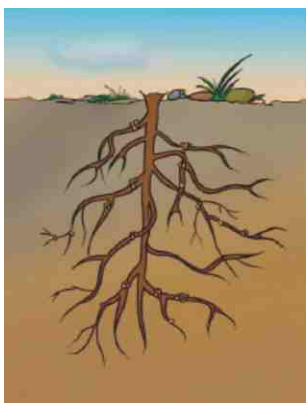
## Nitrogen Cycle



## Nitrogen Cycle

The sequence in which nitrogen passes from the atmosphere to the soil and organisms, and then is eventually released back into the atmosphere, is called nitrogen cycle.

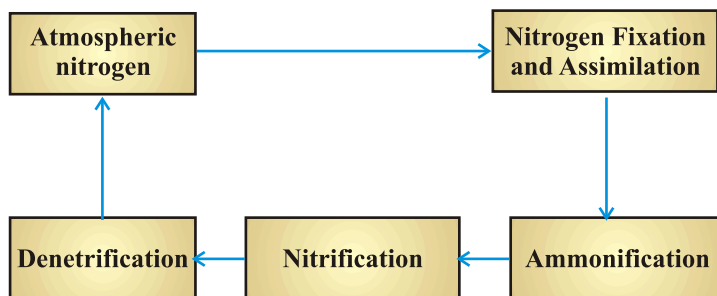
- Nitrogen makes up 78% of the earth's atmosphere.
- Nitrogen is an essential constituent of proteins, nucleic acids like DNA and RNA, vitamins and chlorophyll.
- Plants and animals cannot utilize atmospheric nitrogen readily.
- It has to be fixed by some organisms called nitrogen fixers.
- Nitrogen-fixing bacteria like *Rhizobium* live in symbiotic association in the root nodules of certain leguminous plants.



**Root nodules of leguminous plant**

- These bacteria convert atmospheric nitrogen into ammonia which is utilized readily by plants.
- Nitrogen-fixing bacteria along with free living bacteria in the soil achieve 90% of nitrogen fixation.
- Lightning plays an important role in nitrogen fixation. When lightning occurs, the high temperature and pressure convert nitrogen and water into nitrates and nitrites.
- Nitrates and nitrites dissolve in water and are readily used by aquatic plants and animals.

- **Ammonification** : It is the process by which soil bacteria decompose dead organic matter and release ammonia into soil.
- **Nitrification** : It is the process by which ammonia is converted into nitrites and nitrates.
- **Denitrification** : It is the process by which nitrates are converted into atmospheric nitrogen.



**A flow chart to show the important stages of Nitrogen Cycle**

## QUESTIONS

### VERY SHORT TYPE QUESTIONS

1. What are the resources present on the earth ?
2. Name two gases of air.
3. Expand the term CFCs.
4. Write the formula of ozone.
5. Which acids are present in acid rain ?
6. Name four water borne diseases.
7. What are the nitrogen-fixing bacteria called ?
8. Name three types of soil.
9. Name the disease that can be caused by UV rays.
10. What is the major source of fresh water ?

### SHORT ANSWER TYPE QUESTIONS

1. Draw a neat and labelled diagram of water cycle in nature.
2. How is green house effect related to global warming ? Explain.
3. What are the causes of soil erosion ?
4. Why is water necessary for all organisms ?
5. Write the differences between oxygen and ozone.

## LONG ANSWER TYPE QUESTIONS

1. Explain the oxygen cycle.

**OR**

What are the factors or processes that make soil ?

2. (a) What is the greenhouse effect?  
(b) What are the two forms of oxygen found in the atmosphere.
3. (a) What is soil erosion ?  
(b) What are the methods of preventing or reducing soil erosion.
4. What are the causes of water pollution? Discuss how you can contribute in reducing water pollution.
5. (i) What are the effects of ozone layer depletion.  
(ii) Name the compound which damages the ozone layer.
6. (i) Explain the oxygen cycle.  
(ii) Why is water necessary for all organisms.

## OBJECTIVE TYPE QUESTIONS

1. Green plants convert \_\_\_\_\_ into glucose in the Presence of Sunlight.
2. Oxygen is harmful for \_\_\_\_\_ bacteria.
3. Soil is formed from parent rock over long period of time by the process called \_\_\_\_\_
4. Decomposition of organic wastes in water causes \_\_\_\_\_
5. CO<sub>2</sub> absorbs some of the \_\_\_\_\_ that radiates from the surface of Earth to space.  
(a) Ozone      (b) Heat      (c) UV rays      (d) Smog.
6. The process of evaporation, transpiration and precipitation are known for \_\_\_\_\_  
(a) Carbon cycle      (b) hydrosphere or water cycle  
(c) Nitrogen cycle.      (d) all of these
7. Life cannot be sustain on Mars and venus because of \_\_\_\_\_  
(a) Oxygen      (b) Carbon dioxide  
(c) Nitrogen      (d) Ozone
8. Nitrosomonas changes \_\_\_\_\_  
(a) NH<sub>3</sub> to NO<sub>3</sub>      (b) NH<sub>3</sub> to NO<sub>2</sub>  
(c) NO<sub>2</sub> to NO<sub>3</sub>      (d) NO<sub>3</sub> to NH<sub>3</sub>

9. Rhizobium is an important \_\_\_\_\_ bacterium.  
 (a). Nitrogen fixing (b). Nitrifying  
 (c). Denitrifying (d). Ammonifying.
10. Smog is a Combination of \_\_\_\_\_  
 (a). Fire and Water (b). Smoke and Fog  
 (c). Water and smoke (d). Air and water
11. CFCs causes \_\_\_\_\_  
 (a). Depletion of ozone layer (b). Depletion of CO<sub>2</sub>  
 (c). Acid rain (d). Carbon monoxide poisoning
12. Hydrological cycle is under the control of \_\_\_\_\_  
 (a). Grassland (b). Forest (c). Planktons.  
 (d). Epiphytes.

### **Assertion and Reason Type Questions**

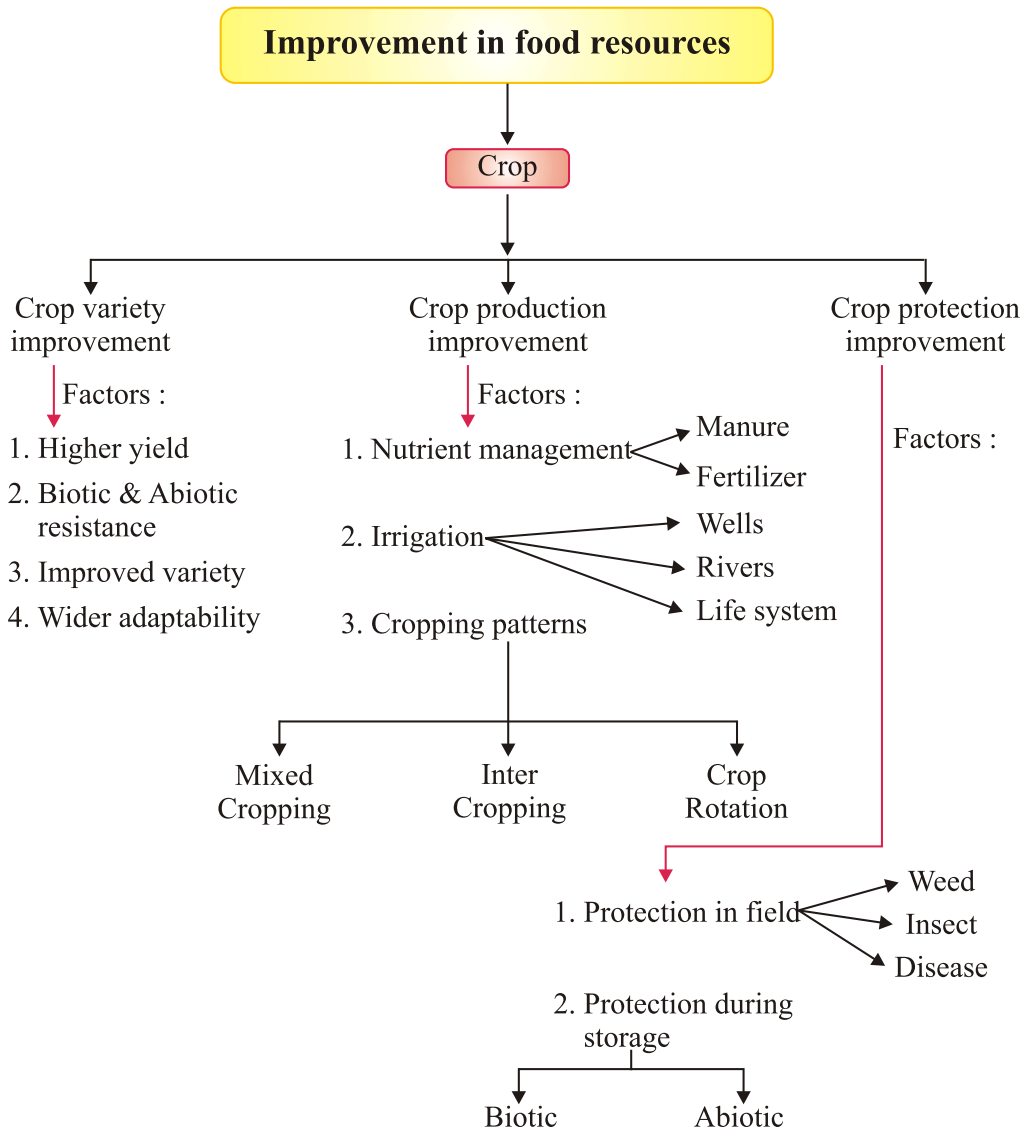
1. Assertion : Extensive use of CFC's increase the chances of skin cancer.  
 Reason : CFCs deplete the ozone layer in the atmosphere.  
 Ans: (a) CFC's deplete the ozone layer, which absorbs the harmful ultraviolet rays from the sun which when penetrate the surface of the earth leads to various disorders like skin cancer.
2. Assertion : There is an adverse effect of pollutants on Taj Mahal.  
 Reason : Discolorations of Taj Mahal is due to Carbon Oxides.  
 Ans: (c) There is an adverse effect of pollutants on Taj Mahal. It is due to sulphur dioxide and Nitrogen dioxides.



## Chapter - 15

# Improvement In Food Resources

### CONCEPT MAPPING



## Green Revolution

Green revolution is a programme introduced in many countries to increase food production by use of modern technology, proper irrigation, improved seeds etc.

## White Revolution

White revolution is a programme in India to increase production of milk in India. This programme made India self-sufficient in production of milk.



### *Improvement in Crop Yields*

#### ***Types of Crops :***

- (a) **Cereals :** They include crops like wheat, rice, maize, barley etc. They provide us carbohydrates.
- (b) **Seeds :** Not all seeds of plants are edible like seeds of apple or cherries. Edible seeds include cereals, pulses, oil seeds and nuts. They provide us fats.
- (c) **Pulses :** They include legumes such as gram, pea, black gram, green gram, lentil. They provide us proteins.
- (d) **Vegetables, spices and fruits :** They provide us vitamins & minerals.



They include apple, mango, cherry, banana, water-melon etc.

Vegetables like spinach, leafy vegetables, carrot etc.

Spices like chilly, black pepper, cinnamon, fennel etc.

(e) **Fodder crops**- They provide green fodder to the cattle eg - oats, sorghum etc.



## Crop Season :

Different crops require different conditions (temperature, moisture, etc.), different photo-periods (duration of sunlight) for their growth and completing life cycle.

*The two types of crops seasons are :*



**(a) Kharif Season :** These crops grow during rainy season (June to October). They are also called summer season crops E.g. of Kharif crops are black gram, green gram, pigeon pea, rice, paddy, soyabean.

**(b) Rabi Season :** These crops are grown during November to April. Rabi crops are known as winter crops. E.g., wheat, gram, peas, mustard, linseed etc.

Approaches which enhance the crop yield are as following :

- (i) Crop variety improvement
- (ii) Crop production improvement
- (iii) Crop protection improvement

(A) **Crop Variety Improvement :** Factors by which variety improvement can be done are :

- Good and healthy seeds
- Hybridization : It is the process of crossing between two or more genetically dissimilar plants to produce a new variety with good properties of both the crops.

## Properties to be possessed by improved seeds

Or

### Factors for which variety improvement in crops is done

- (a) **Higher yield** : To increase the productivity of the crop per acre.
- (b) **Improved quality** : Quality of crop products vary from crop to crop.
- (c) **Biotic & Abiotic resistances** : Crop production reduces due to biotic and abiotic factors. Varieties resistant to these factors can improve crop production.
- (d) **Wider adaptability** : Crops which can grow in different conditions, will help in setting high production.

(e) **Desired agronomic traits** : Crops which contain desired agronomic traits (height, branching, leaves), sets high production.

**(B) Crop Production Improvement** : It involves different practices carried out by farmers to achieve higher standards of crop production. They are :



- (a) Nutrient management
- (b) Irrigation
- (c) Cropping patterns
- (a) **Nutrient Management** : Like other organisms, plants also require some elements for their growth. These elements are called nutrients.

Sources	Nutrients
Air	Carbon, oxygen
Water	Hydrogen, oxygen
Soil	(i) Macro nutrients : Nitrogen – required by plants in large amount, phosphorus, potassium, calcium, magnesium, sulphure.

**(ii) Micro nutrients :** Iron, Mn – required in small amount, boron, Zn, copper, molybdenum, chlorine.

## Manure and Fertilizers

To increase the yield, the soil can be enriched by supplying nutrients in the form of manure and fertilizers.

### Manure :

- It is a source of organic matter.
- It supplies small quantities of nutrients to the soil.
- It is prepared by the decomposition of animal excreta and plant waste.

### Various forms of Manures :

- (A) Compost :** The process in which animal excreta (like cow dung), kitchen waste, plant remains, waste food, sewage waste etc. are decomposed in pits is known as composting.
- (B) Vermicompost :** Compost prepared by using earthworms to hasten the process of decomposition of plants and animals refuse is called vermicompost. Here, an earthworm is physically aerator, crusher and mixer, chemically a degrader and biologically a stimulator of decomposition.
- (C) Green manure :** Some plants like sunn hemp, guar etc. are grown and after sometime mulched by ploughing in the field. These green plants turn into green manures. They are rich in nitrogen and phosphorus.

### Fertilizers :

Fertilizers are prepared in factories. They are made up of chemical substances. They have large amount of nutrients like nitrogen, phosphorus and potassium. Fertilizers are easily absorbed by the plants since they are soluble in water. It is costly.

### Difference between Manures and Fertilizers

Manures	Fertilizers
1. These are organic substances.	1. These are inorganic substances.
2. These are made up of natural substances (decomposition of plant and animal waste).	2. These are made of chemical substances.
3. These have less amount of nutrient.	3. These have large amount of nutrients.

- |   |   |
|---|---|
| 4. These are cheap and are prepared in rural homes or fields.                   | 4. These are costly and are prepared in factories.                                |
| 5. Manures are slowly absorbed by the plants since they are insoluble in water. | 5. Fertilizers are easily absorbed by the plants since they are soluble in water. |
| 6. It is difficult to store and transport.                                      | 6. Their storage and transportation is easy.                                      |

(b) **Irrigation** : The process of supplying water to the crop plants is called irrigation.



### Methods of Irrigation :

(i) **Wells** : These are of two types :

**Dug wells** : In dug wells, water is collected by bullock-operated devices or by pumps.

**Tube wells** : It makes very deep underground water available for irrigation. Motor pump is used to lift water.

(ii) **Canals** : These get water from large rivers.

(iii) **River lift system** : In this system, water is directly taken from rivers through pumps. This system is useful for irrigation in areas close to river.

(iv) **Tanks** : These are small storage reservoirs.

(v) **Rain water harvesting** : Rain water harvesting is a accumulation of water in tanks for later use. This also prevents soil erosion.



- (c) **Crop Patterns :** Different patterns are used to maximize the production from crop field. They are :
- (i) Mixed cropping
  - (ii) Inter cropping
  - (iii) Crop rotation
- (i) **Mixed cropping :** Growing two or more than two crops together on the same piece of land is called mixed cropping. *E.g.*, wheat and gram, wheat and mustard, groundnut and sunflower. This is generally done to minimize the risk of total crop failure due to abnormal weather conditions. Fertility is also seen to be increased.
- (ii) **Inter cropping :** Two or more crops are grown on the same field in a definite pattern. Few rows of one followed by few rows of the other. *E.g.*, Soyabean + maize, pearl millet (Bajra) + Cow pea (lobia). It makes better use of natural resources of sunlight, land and water and also arrest soil erosion effectively
- (iii) **Crop rotation :** Crop rotation is policy of growing different crops one after another on the same field.
- If some crop is grown again and again on the same field, same nutrients are extracted from soil again and again. So we should choose different crops so that all nutrients of soil are used.
  - **Advantages :**
    - (1) Soil fertility is maintained.
    - (2) It controls pests and weeds.
    - (3) Several crops can be grown in succession with only one soil preparation.

### (C) Crop Protection Improvement

To protect crops against diseases causing organisms and other harming factors is called crop protection. Following methods are used to control these problems :

- (a) Pest control during growth
- (b) Storage of grains

(a) **Pest control during growth :** Pest is any destructive organism which can destroy or harm crops or products obtained from them. Pests are of many types :

- (i) **Weeds :** Unwanted plants in the cultivated field *e.g.*, xanthium.
- (ii) **Insects :** Insects can harm plants in following ways :

- They cut the root, stem and leaf.
  - They suck the cell sap from various parts of the plant.
- (iii) **Pathogens** : Organisms such as bacteria, fungi and viruses which cause diseases in plants are called pathogens. They are transmitted through air, water, soil.
- (b) **Storage of grains** : For getting seasonal foods throughout the year, they are stored in safe storage. But during storage of grains, they can be destroyed and wasted by various means.
- (i) **Biotic problem** : Due to living organisms like insects, birds, mites, bacteria, fungi.
- (ii) **Abiotic problem** : Due to non-living factors such as moisture, inappropriate temperature etc.

These factors affect quality in form of degradation, loss in weight, change in colour, poor germinability.

## Organic Farming

Using fertilizers and pesticides has its own disadvantages. They cause pollution, damage soil fertility in long run. Grains, fruits, vegetables obtained may contain harmful chemical in small amount.

Organic farming is a farming system with no or very little use of chemicals like fertilizers and pesticides.

### *Different ways to protect food grains before they are stored for future use :*

- (a) **Drying** : The food grains should be properly dried in the sun.
- (b) **Maintenance of hygiene** : The grains must not contain insects. The godowns should be cleaned well. The cracks in the roof and on the walls and floor should be sealed completely.
- (c) **Fumigation** : Godowns and stores should be properly sprayed with fumigants. Specially, the seeds should be treated with insecticides and fungicides.
- (d) **Storage devices** : Cleaned and dried grains should be stored in gunny bags or other proper bags. Airtight, moisture-resistant and temperature-resistant storage devices have been developed by various organizations. These should be used.

## ANIMAL HUSBANDRY

Animal husbandry is a scientific management of domestic animals in an efficient manner to obtain food and other useful products from them.

**Cattle farming :** Purpose of cattle farming is :

- (a) For getting milk
- (b) Ploughing fields
- (c) Bull cart for transportation

**Types of cattle :**

- Cow (*Bos indicus*)
- Buffalo (*Bubalus*)

**Milch animals :** These includes milk producing animals (female cattle).

**Draught animals :** Those animals which do not produce milk and are used for agricultural work.

**Lactation period :** The period of milk production between birth of a young one and the next pregnancy is called lactation period.

### Care of Cattle

#### (1) Cleanliness

- Roofed shelter with good ventilation for protection from rain, heat and cold.
- Regular brushing of skin of cattle.
- Sloping floor for shelter for avoiding water-logging.

#### (2) Food

- Roughage mainly containing fibre
- Concentrates containing proteins
- Food containing micronutrients (vitamins and minerals) for enhanced milk production

**Diseases :** Diseases can cause death and reduce milk production.

- Parasites are small organisms living inside or outside the body of another organism (host). They derive food from the body of host.
- External parasites on skin of cattle cause skin diseases.
- Internal parasites like worms cause stomach and intestine problems and

flukes cause liver problems.

- Bacteria, virus cause infectious diseases (diseases that can be easily transmitted from one to another).

**Poultry Farming :** Poultry farming is done for eggs and meat. They both provide protein to our diet.



**Broilers :** Birds grown for obtaining meat are called broilers. They can be used after 6-8 weeks from their birth.

**Layers :** Birds grown for obtaining eggs are called layers. They can be used after 20 weeks when sexual maturity has been attempted to lay eggs.

Most of the broilers and layers are cross-bred.

***Breeding is done to enhance following properties in hens :***

- More and better quality chicks.
- Low maintenance.
- Breeding is done to produce dwarf broilers (meat-giving birds). Feeding cost is the biggest expense in poultry farms. Dwarf broilers need less food and can reduce cost by 30%. Also, they can tolerate more heat.

**Fish Production :**



(a)



(b)



(c)



(d)



(e)



(f)

(a) Catla (b) Silver carp (c) Rohu (d) Grass carp  
(e) Mrigal (f) Common carp



Fish production is a great source of protein to our diet.

*Fish production is of two types :*

- (1) **Fin fish production/True fish production** : Production and management of cartilaginous and bony fishes such as pomphret, tuna, cod, catla, prawns, rohu etc.
- (2) **Shell fish production** : Production of shell-fish such as prawns, mollusks.

*Depending on the mode of obtaining fishes, fishing are of two types :*

- (1) **Capture fishing** : Naturally living fishes in various water bodies are captured.
- (2) **Culture fishing** : Fishes of desired variety are cultivated in confined areas with utmost care to get maximum yield. This is also called aquaculture. Aquaculture can be done in oceans, rivers, lakes, ponds etc. When it is done in oceans, it is called mariculture.

**Marine fishing** : Marine fishing includes fish production in ponds, rivers, reservoirs.

- Popular marine fishes includes Pomphret, Tuna, Sardines, Bombay duck. Some costly fishes found in sea like nulllets, prawns, seaweed, oysters.
- Using satellites, regions of high fish population in sea can be found. Echo-sounders are also used.

**Inland fishing** : It includes fish production in fresh water (for example ponds, rivers, lakes, reservoirs) and brackish water (for example estuaries).

**Composite Fish Culture** : A fish culture system where 5 to 6 varieties of fish are reared in a single fish pond.

- They are selected so that they do not compete for food. They should have different food requirements.

Example :

*Catla* : Feeds in the upper part of water.

*Rohu* : Feeds in middle part of water.

*Mrigals, common carps* : Feeds at bottom.

- **Advantage :** More yield.

**Problems :** Many fishes lay eggs during monsoons only, due to which number of fishes will not grow fast. So hormonal stimulation is used. Using this fishes can be made to reproduce any time.

**Apiculture Bee-keeping :** It is the practice of keeping, caring & management of honeybees on a large scale for obtaining honey and wax.

Many farmers use bee-keeping for additional small income. Also, there are big farms called apiaries/bee farms.

**Apiary :** The setting up of a number of bee hives in desirable location in a systematic manner that allows maximum pollen and nectar collection.

- Some common Indian varieties of bees include *apis carana indica* (Indian bee), *dorsata* (rock bee), *floral* (little bee).
- One Italian variety *mellifera* is also used in India for commercial large scale production because of its following advantage :
  - (a) High honey collection capacity.
  - (b) They reproduce fast.
  - (c) They sting less.
  - (d) They stay in a bee hive for long.

**Honey :** It is a dense sweet liquid.

- It is used in medicines. It is used as sugar.
- It is used as a source of energy.

**Pasturage :** Pasturage is the availability of flowers to the bees for nectar and pollen collection.

Or, Pasturage of flora is the type of crop, flower or other plants from which bee collects nectar and pollens to produce honey.

It affects the quality and quantity of honey because different flora produce nectar and pollen of different types *e.g.*, almond honey of Kashmir is very tasty.

## **QUESTIONS**

### **VERY SHORT ANSWER**

1. Why do we need food ?
2. Name some cereals which provide us carbohydrate.
3. What is kharif season? Name a few kharif crops.
4. What is manure? How is it prepared?
5. What is hybridization?
6. What is the main sources of irrigation in India?
7. What do you mean by mixed cropping.

### **SHORT ANSWER**

1. What are pathogens? How are they transmitted?
2. Write the differences between manures and fertilizers.
3. What are the differences between broilers and layers.
4. Write the advantages of inter-cropping and crop-rotation.
5. What are the benefits of cattle farming.

### **LONG ANSWER**

11. (a) What are the ways to protect food grains before they are stored for future use?  
(b) Write advantages of bee keeping.
12. What is composite fish culture? What is the main problem associated with this practice? What is the criteria of choosing fish for this type of culture.
13. What factors may be responsible for losses of grains during storage?
14. What are macro nutrients? From where the plants get it.

Or

Draw the diagram of Inter cropping.

15. Why should our food contain cereals, pulses, fruits and vegetables?

## OBJECTIVE TYPE QUESTIONS.

1. Match the following :

Column I

Column II

- |                   |                |
|-------------------|----------------|
| a. Micronutrient  | p. Soyabean    |
| b. Kharif crop.   | q. Bee         |
| c. Rabi crop.     | r. Wheat       |
| d. Apis mellifera | s. Molybedrum. |

2. Manure and fertilisers are the main source of

\_\_\_\_\_ supply to plants.

3. Growing two or more crops in definite row pattern is known as \_\_\_\_\_

4. The best way to increase the yield of wheat in India is

- a. To sow seeds of improved varieties.
- b. To use tractors
- c. To reduce the quantity of ration consumers.
- d. To remove weeds from the wheat fields.

5. Birds specially grown for meat only is known as \_\_\_\_\_

- a. Hybrid.
- b. Broiler.
- c. bird management.
- d. Bird culture

6. The drones in honey bee are

- a. Sterile male.
- b. fertile males.
- c. Sterile female.
- d. fertile female.

7. Potato tuber wash and Iodine solution placed together change their colour to \_\_\_\_\_

- a. Blue-Black.
- b. Blue.
- c. Brick-red.
- d. Magenta.

8. Metanil yellow causes \_\_\_\_\_

- a. Stomach ulcer.
- b. Diarrhoea.
- c. Cancer.
- d. Paralysis.

## Assertion and Reason Type Questions

Direction : In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Mark the correct choice as

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of Assertion (A)
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

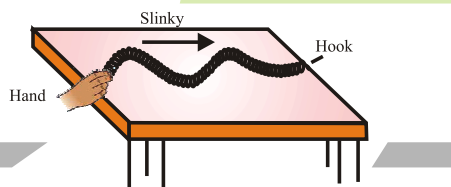
Q1. Assertion (A) Vermicomposting is an important method of preparing compost,

Reason (R) : An earthworm is physically an aerator, crusher and mixer, chemically a degrader and biologically a stimulator of decomposition.

Ans. (a) The degradation of organic waste through the consumption by the earthworms is called vermi composting.

Q2. Assertion (A) - The basic objective in mixed cropping is to minimise the risk and insurance against the total crop failure.

Ans. (b) Both the assertion and reason are true but here, the reason is not the correct explanation of assertion, the mixed cropping is done to minimise the risk and insurance against the crop failure due to abnormal weather conditions and wheat and chick-pea in an example for the same.



# Experiment

## List of Practical

### Experiment No. 1 : Preparation of

- (a) A true solution of common salt, sugar and alum.
- (b) A suspension of soil, chalk powder and fine sand in water.
- (c) A colloidal solution of starch in water and egg albumin/milk in water and distinction between these on the basis of
  - Transparency
  - Filtration criterion
  - Stability

### Experiment No. 2 : Preparation of

- (a) Mixture
- (b) A compound

Using Iron filling and Sulphur powder and distinction between these on the basis of :

- (i) Appearance, *i.e.*, homogeneity and heterogeneity
- (ii) Behaviour towards a magnet
- (iii) Behaviour towards carbon disulphide as a solvent
- (iv) Effect of heat

**Experiment No. 3 :** Separation of the components of mixture of sand, common salt and ammonium chloride (or camphor).

**Experiment No. 4:** Performing the following reactions and classifying them as physical or chemical changes :

- (a) Iron with Copper Sulphate solution in water
- (b) Burning of magnesium ribbon in air
- (c) Zinc with dilute Sulphuric Acid

- (d) Heating of Copper Sulphate Crystals
- (e) Sodium Sulphate with Barium chloride in the form of their solutions in water

**Experiment No. 5:** Preparation of stained temporary mounts of

- (a) onion peel,
- (b) Human Cheek Cells & to record observations and draw their labeled diagrams.

**Experiment No. 6:** Identification of Parenchyme, Collenchyma and Sclerenchyma tissues in plants striped, smooth and cardiac muscle fibers and nerve cells in animals from prepared slides. Drawing of their labeled diagrams.

**Experiment No. 7:** Determination of the melting point of ice and the boiling point of water.

**Experiment No. 8:** Verification of Law of reflection of sound.

**Experiment No. 9:** Determine the density of solid (denser than water) by using a spring balance and measuring cylinder.

**Experiment No. 10:** Establishing the relation between the loss in weight of a solid when fully immersed in

- (a) tap water
- (b) Strongly salty water, with the weight of water displaced by it by taking at least two different solids.

**Experiment No. 11:** Determination of the speed of a pulse propagated through a stretched string/slinky.

**Experiment No. 12:** Study of the characteristics of Spirogyra, agaricus, moss (fern, pinus (either with male or female cone) and an angiospermic plant. Drawing and providing two identifying features of the groups they belong to.

**Experiment No. 13:** Observing the given pictures / charts / models of earthworm, cockroach, bony fish and bird. For each organism, drawing of their picture and recording :

- (a) One specific feature of its phylum.
- (b) One adaptive features with reference to its habitat.

**Experiment No. 14:** Verification of Law of Conservation of mass in a chemical reaction.

**Experiment No. 15:** Study of the external features of root, stem, leaf and flower of monocot and dicot plants.

## EXPERIMENT NO. 1

**Aim :** To prepare :

- (a) a true solution of common salt, sugar and alum
- (b) a suspension of soil, chalk powder and fine sand in water
- (c) a colloidal solution of starch in water and egg albumin water and to distinguish between these on the basis of
  - (i) filtration criterion
  - (ii) transparency
  - (iii) stability

**Appartus required :** Ten hard glass test tubes, test tube stand, a China dish, a glass rod, a tripod stand, funnels, filter paper, torch or flash light.

**Materials (Chemicals) required :** Common salt, sugar, alum, chalk powder, garden soil, egg albumin, fine sand and distilled water.

**Procedure :**

- (a) To prepare true solutions of dry common salt, sugar and alum

Take three test tubes (A, B, C). Pour 10 cc of distilled water in each test tube. Take a pinch of salt and put it in 'A' test tube and shake it vigorously after closing the mouth of test tube. The common salt dissolves completely to form true solution. Do the same procedure with sugar and alum powder and put them in test tubes labelled 'B' and 'C'. The result is also same. They all (salt, sugar and alum) forms true solution with water.

- (b) To prepare suspensions of soil, chalk powder and fine sand in water

Take three test tubes (D, E, F). Pour 10 cc of distilled water in each test tube and pour a pinch of chalk powder in 'D' test tube. Shake it vigorously after closing the mouth of test tube. The chalk powder does not dissolve completely and forms a suspension. Do the same procedure with garden soil and sand (fine sand) in test tubes labelled 'E' and 'F' respectively. The result is also same. All three materials form suspension.

- (c) To prepare colloidal solutions of starch in water and egg albumin in water
- (i) To prepare a colloidal solution of starch in water Take about 1 gm of starch in a China dish. Pour about 20 cc of distilled water in a China dish. Stir the contents with a glass tube till a milky suspension is formed. Heat the 50 cc of water to the boiling point on a Bunsen flame, by placing it on the tripod stand. Stir the contents of the China dish continuously



and pour it in boiling water. Allow the contents to cool. The product so formed is colloidal solution of starch in water in test tube 'G'.

(ii) To prepare a colloidal solution of egg albumin in water

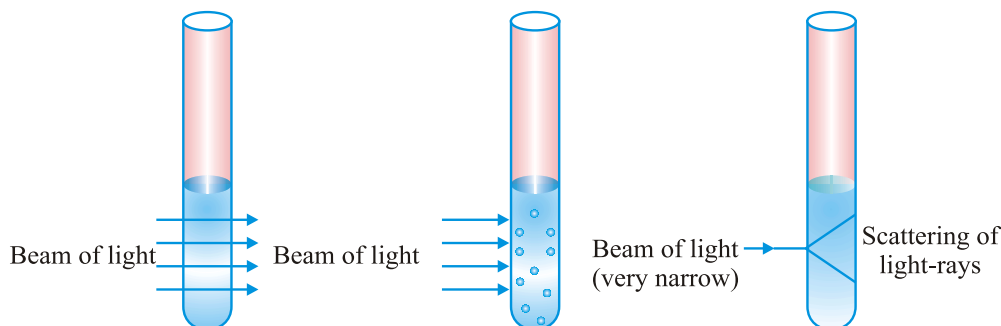
Take about  $\frac{1}{2}$  cc of egg albumin in a test tube. Pour about 10 cc of distilled water in the test tube. Shake the contents of the test tube vigorously for 1 minute and the albumin gets suspended to form turbid (light milky) product. The product so formed is the colloidal solution of egg albumin in water.

To distinguish a true solution, a suspension and a colloid on the basis of

(a) transparency, (b) filtration criterion, (c) stability.

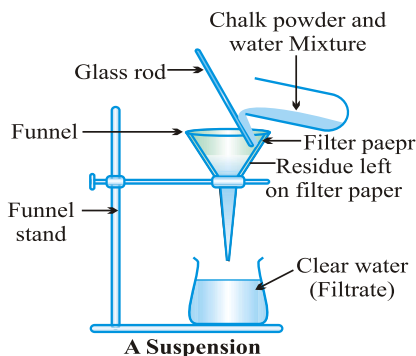
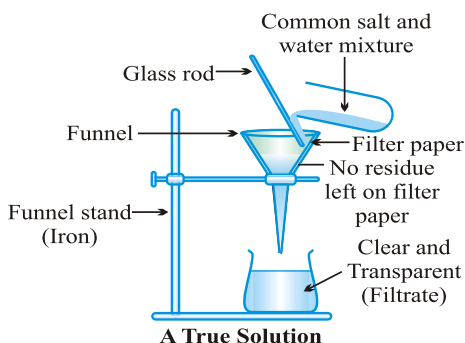
Again take test tube 'A', test tube 'D' and test tube 'G' which are true solution of salt suspension of chalk powder and colloidal solution of starch respectively. Now pass laser light through it to see the transparency. Now filter them all through filter paper and also check their stability in test tubes by allowing its contents to stand for 5 minutes.

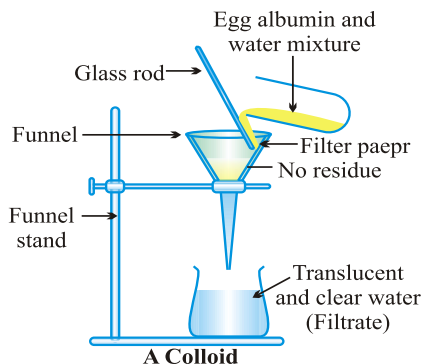
(a) Transparency



**To distinguish a true solution, a suspension and a colloid on the basis of transparency**

(b) *Filtration criterion*





(c) *Stability* : Let the three tubes A, D and G be allowed to stand for 5 minutes.

### Observations

	Transparency	Filteration	Stability
<b>Test tube ‘A’ :</b>  True solution of common salt, sugar, alum	The light rays passes through it.	The contents passes through filter paper leaving no residue. The filtrate is clear and transparent.	No sediments settle down and the solution remains clear.
<b>Test tube ‘D’ :</b>  Suspension of chalk powder	Light rays hardly pass through contents.	The contents leave residue of chalk powder on the filter paper. The filtrate is clear.	The sediments settle down and clear water collects above it.
<b>Test tube ‘G’ :</b>  Colloidal solution of starch	Light rays scatter in contents of the test tube ‘C’.	The content passes through filter paper leaving no residue on the filter paper and filtrate is translucent.	No sediment settles down and there is no change in its consistency.

### Result :

- (a) True solutions are transparent, stable, homogenous and they can pass through filter paper leaving no residue on the filter paper. They do not scatter light

- (b) Suspensions are opaque, leave residue on the filter paper. They are unstable. They do not scatter light.
- (c) Colloids are translucent, leaves no residue on the filter paper and the filtrate is translucent. They are stable and scatter light.

Precautions :

- (a) The test tubes should be neat and clean.
- (b) Wastage of chemicals should be avoided.
- (c) Mix the contents carefully and stir it thoroughly while preparing various types of mixtures.
- (d) Do not taste any material.

## EXPERIMENT NO. 2

**Aim :** To prepare (a) a mixture, (b) a compound

Using iron fillings and sulphur powder and distinguish between these on the basis of :

- (a) appearance i.e., homogeneity and heterogeneity
- (b) behaviour towards a magnet
- (c) behavior towards carbon disulphide
- (d) effect of heat

**Theory :**

**Compound :** A pure substance which is composed of two or more elements, combined chemically in a fixed ratio, such that they can be broken into elements only by chemical means is called a compound.

**Mixture :** When two or more substances (elements, compounds or both) are mixed together in any proportion do not undergo any change but retain their individual properties, the resulting mass is called a mixture.

**Material required :** A hard glass test tube, a test tube holder, mortar and pestle, two watch glasses, a hand lens, a magnet, a rack full of clean test tubes, Bunsen burner or spirit lamp.

**Procedure :**

- (a) Preparation of a mixture of iron and sulphur

Take 7 g of iron fillings and 4 g of sulphur and put them in a mortar. Grind the constituents with pestle thoroughly. The product so obtained is a mixture of iron and sulphur. Divide the mixture into two halves and place them in two watch glasses.

- (b) Preparation of the compound of iron and sulphur (Iron sulphide)

Transfer the mixture of one of the watch glasses to a hard glass test tube. Now hold the test tube in the test tube holder. Heat the mixture strongly on a burner till its contents start glowing with a reddish glow. Stop heating now. Iron reacts with sulphur to form its compound iron sulphide with the release of heat energy. Again transfer the iron sulphide in watch glass.

## Observation :

Experiment	Observation	Inference/Result
<b>1. Action with magnet :</b>		
Roll a bar magnet in the mixture as well as in the compound.	Iron particles cling to the magnet in case of the mixture, but not in case of the compound.	Constituents of a mixture can be separated by physical means, but not that of a compound.
<b>2. Observation under magnifying glass :</b>		
Observe the mixture as well as the compound under a magnifying glass by spreading them thinly on a paper.	<p>In case of the mixture, grey particles of iron and yellow particles of sulphur can be seen clearly and they are not uniform throughout.</p> <p>Black mass of homogeneous substance can be seen</p>	Mixtures are heterogenous in nature, but compounds are homogenous in nature.
<b>3. Action with carbon disulphide :</b>		
Place a small amount of the mixture and compound in separate test tubes and add 5 cc of carbon disulphide. Shake well.	<p>In case of the mixture, yellow particles of sulphur dissolve and grey particles of iron settle down.</p> <p>In case of the compound, nothing dissolves.</p>	Constituents of a mixture can be separated by physical means, but not that of a compound.
<b>4. Effect of heat :</b>		
Heat the small amount of mixture and compound separately in two test tubes.	<p>In mixture, sulphur &amp; iron melts to form compound iron sulphide.</p> <p>In compound, no change.</p>	<p>Mixture shows chemical reactions.</p> <p>Compound do not show chemical reaction.</p>

**Precautions :**

- (a) Heat the mixture of iron and sulphur in the hard glass test tube only.
- (b) While performing various experiments use minimum amount of the mixture or compound.
- (c) Carbon disulphide is inflammable, keep it away from flame.

**Practical Based Questions**

1. What happens when iron filling and sulphur powder are mixed together in a china dish. Write your observation, what do you find in the mixture (Physical nature)
2. If you rotate a magnet into the mixture of iron fillings and sulphur powder. Which substance would stick to magnet and why?
3. If the mixture of iron fillings and sulphur powder are heated for sometime and then magnet is rolled over the compound. Write your observation with reason.
4. If you put some of amount of iron filings and sulphur mixture into carbon disulphide solution. Do you find anything dissolving into carbon disulphide. Name the substance.
5. You are given two test tubes 'A' and 'B' with carbon disulphide solution into them. In test tube 'A' you put a mixture of iron filings and sulphur while in test tube 'B' you put iron sulphide compound. What do you observe in both the test tubes respectively. Write your answer with reason.
6. A student used a test tube for heating a mixture of iron fillings and sulphur powder. What suggestion do we give to the student to perform this experiment correctly.

## EXPERIMENT NO .12

**Aim :** To study characteristics of *Spirogyra*/Agaricus, Moss/Fern, *Pinus* (male or female cone) and an angiosperm plant and give two identifying features of groups they belong to.

**Materials required :** *Spirogyra*, Agaricus, Moss, Fern, *Pinus* male and female cone, angiosperm plant.

**Materials required :** *Spirogyra*, Agaricus, Moss, Fern, *Pinus* male and female cone, angiosperm plant.

### Procedure & Observation :

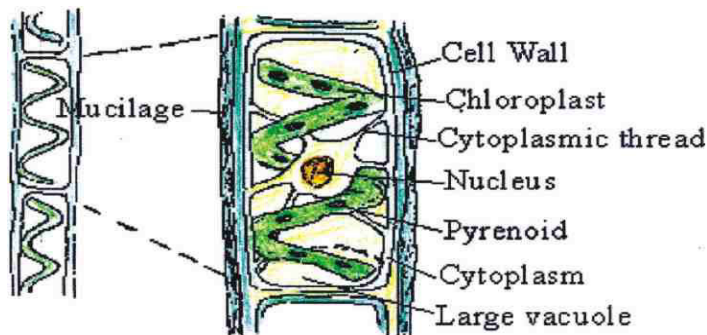
- |    |                         |                        |
|----|-------------------------|------------------------|
| I. | <b>Spirogyra sp</b>     | Kingdom: Plantae       |
|    | <b>Classification :</b> | Division : Thallophyta |
|    |                         | Class : Chlorophyta    |

### Characteristic features :

- (i) It is a filamentous alga which grows in length not in thickness.
- (ii) Chloroplast is ribbon-shaped and are 1-12 in number.
- (iii) It is slimy to touch.
- (iv) It has a large vacuole.
- (v) It has a series of cells joined end to end.
- (vi) Nucleus is in the centre suspended by cytoplasmic strands.
- (vii) Pyrenoids are present which store starch (food).

### Identifying features of the group :

- (i) It is mostly found in fresh water but some varieties are found in sea water and on land.
- (ii) Presence of chlorophyll in it is as high as in plants.



## II. Agaricus

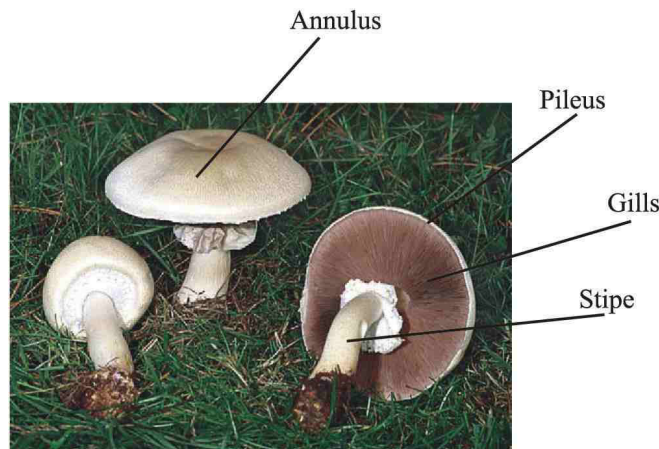
**Classification :** Kingdom: Fungi  
Division: Basidiomycota  
Class: Agaricomycete

### Characteristic features :

- (i) These do not have chloroplast in the thallus.
- (ii) It consists of a stalk and umbrella like cap called pileus.
- (iii) The main body of mushroom appears above ground while vegetative part lies in the soil in the form of mycelium.
- (iv) It is a saprophyte.
- (v) Cell wall is made of a complex sugar chitin.

### Identifying features of the group :

- (i) Chlorophyll is absent.
- (ii) Saprophytic nutrition with intracellular digestion is seen.
- (iii) Reserve food material is found in the form of fat, oil and glycogen.



## III. Moss (Funaria)

**Classification :** Kingdom: Plantae  
Sub kingdom : Cryptogamae  
Division : Bryophyta

### Characteristic features :

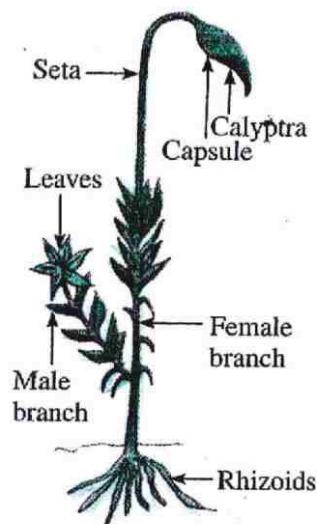
- (i) The moss plants are commonly found on old walls, ground, moist and shady places.
- (ii) The plant is bisexual, both male reproductive organs (antheridia) and female reproductive organs (archegonia) are found on the same plant.



- iii) Plant body is called gametophyte and is well-differentiated into rhizome, stem, leaves.
- (iv) These plants do not contain vascular bundles to transport materials from one place to another the leaf body.

**Identifying features :**

- (i) These are non-vascular plants.
- (ii) These are called bryophytes of plants kingdom as water is essential for fertilization.
- (iii) The plant body is generally thalloid.



**IV. Fern (Dryopteris)**

**Classification :**

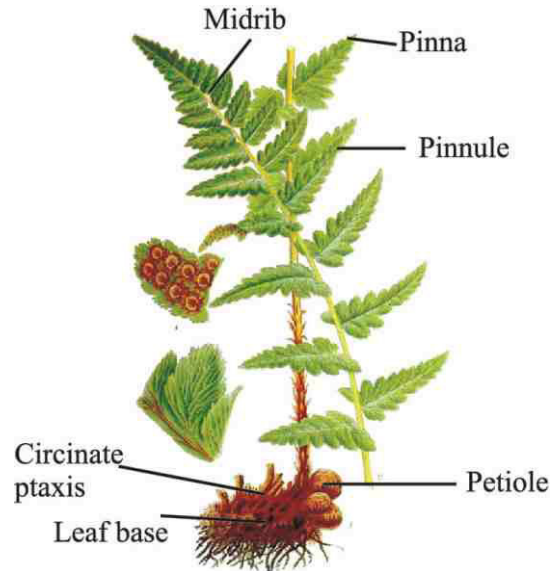
Kindomg : Plantae  
 Sub kingdom : Cryptogamae  
 Division : Pteridophyta

**Characteristic features :**

- (i) Plant body is a saprophyte which has true roots, stem and leaves with vascular tissue.
- (ii) Reproductive organs are multicellular.
- (iii) These are found in damp and dark places.
- (iv) Leaves are quite big and are called fronds.
- (v) As they have soft, big and beautiful leaves, these plants are used as ornamental plants.
- (vi) Immature leaves are coiled like spring.

**Identifying features :**

- (i) They have vascular tissue for conduction of materials within the parts of plant.
- (ii) Sporophyte is dominant having true roots, stem and leaves.

**V. Pinus (With male and female cone)**

Classification :                      Kingdom : Plantae  
   Division : Pteropsida  
   Class : Gymnospermae

**Characteristic features :**

- (i) It is a gymnosperm (which have naked seeds).
- (ii) Flowers are not present.
- (iii) Leaves are needle shaped.

Cones are of two types : Male & Female

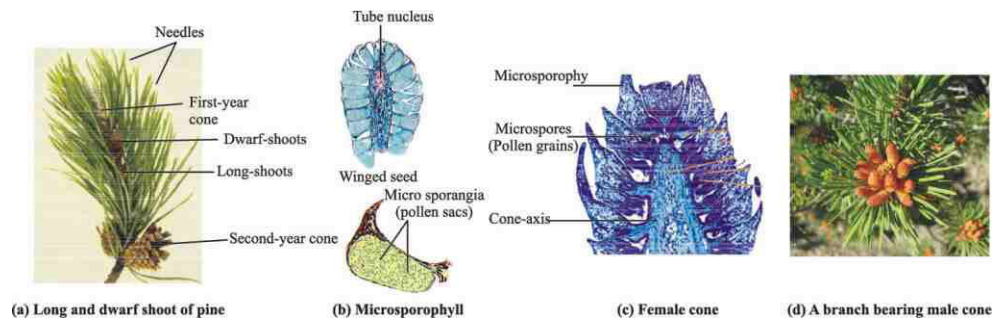
**Male Cone/Staminate :**

- (i) These cones are brown coloured, egg shaped.
- (ii) These are found in groups/bunches.
- (iii) Each male cone has larger number of microsporophylls. Each microsporophyll has 2 microsporangia.
- (iv) Each microsporangia has large number of microspores or pollen grains.

**Female Cone :**

- (i) These are found in between needle shaped leaves in 2-4 in number in bunches.

- (ii) In the first year female cone has megasporophyll which is small and green-red in colour.
- (iii) Size of megasporophyll increases in second year. In third year megasporophylls separate from each other and size of the cone also increases.



## VI. Angiosperm Plant :

### Classification :

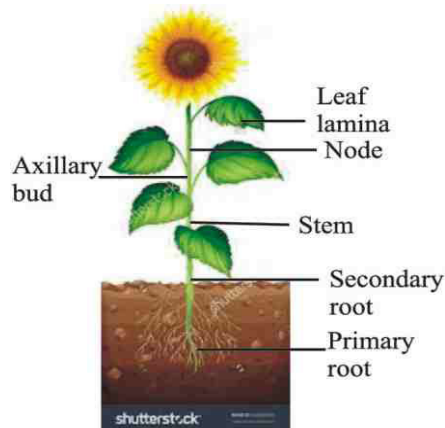
Kingdom : Plantae

Division : Phanerogamae

Class : Angiospermae

### Characteristics :

- (i) Plant body is fully differentiated into roots, stem and leaves.
- (ii) These are flowering plants.
- (iii) Angiosperms are further divided into two groups viz. Monocots (with one cotyledon e.g., rice, maize, wheat) and dicots (with two cotyledons e.g., mustard, mango etc.).
- (iv) Dicots have tap root system, reticulate venation whereas monocots have fibrous root system with parallel venation.



## Questions

1. Why spirogyra is not found in sea?
2. We see trees with needle like leaves in mountaineous regions. Name these and write its features?
3. Fungi show a network of multicellular thread like structure, write the features of fungi.
4. Plants which produce flowers come in which group and give its features.
5. Write identifying features of angiosperm plant.
6. Name some plants that belong to Bryophyta, Pteridophyta.

## EXPERIMENT NO. 13

**Aim :** To observe the given pictures/charts/models of earthworm, cockroach, bony fish, bird.

For each organism draw their picture and record of :

(a) one specific feature of its phylum

(b) one adaptive feature with respect to its habitat.

**Materials required :** The specimen of earthworm, cockroach, bony fish and bird.

### Procedure :

- (i) Observe the given specimen/chart/model keenly.
- (ii) Draw their labelled diagram and write their adaptive features.

#### A. Earthworm :

**Classification :** Kingdom : Animalia

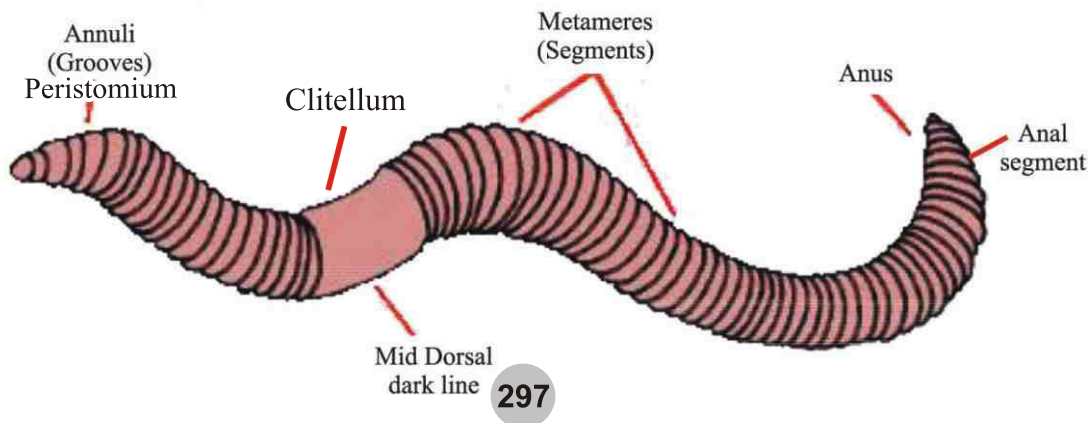
Phylum : Annelids

#### Specific characteristic features :

- (i) They have bilateral symmetry.
- (ii) They are long and body is divided into segments.
- (iii) They have body length of 6-10 inches.
- (iv) Some of the anterior body segments concentrate to form head.
- (v) They mainly eat carbonic compounds (humus) mixed in the soil (moist).
- (vi) They have light brown colour.
- (vii) Exoskeleton is absent.

#### Adaptation/Adaptive features :

- (i) Earthworm reside in holes.
- (ii) Humus in soil is its main food.



**B. Cockroach :**

**Classification :**

Kingdom: Animalia

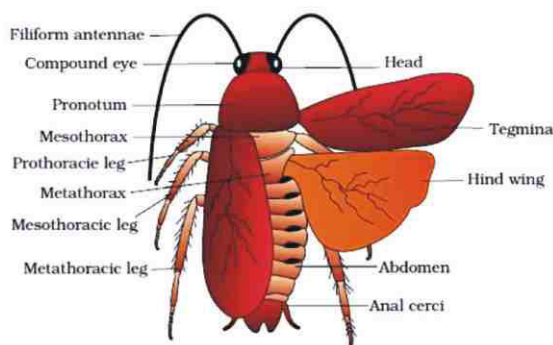
Phylum : Arthropoda

**Specific characteristic features :**

- (i) They have long body, which is bilaterally symmetrical and segmented.
- (ii) They have body length of 5-6 cm.
- (iii) Colour of their body is red or brownish, therefore they are camouflaged in dark and hence protected from their enemies.
- (iv) Their whole body is divided into three parts : head, thorax and abdomen.
- (v) Anterior part of body form a distinct head, bearing compound eyes and a pair of antennae.
- (vi) Thorax consists of three pairs of jointed legs on its posterior side, therefore it has been kept in the phylum Arthropoda.
- (vii) Two pairs of wings are found on anterior side of the thoracic cavity.
- (viii) Its abdominal portion is divided into ten fragments covered by exoskeleton of chitin

**Adaptation/Adaptative features :**

- (i) For respiration, it has spiracles.
- (ii) Three pairs of segmented or jointed legs help it to run fast.
- (iii) On its head it has compound eyes and long sensitive antennae, which help it to move in dark.
- (iv) It is omnivorous.



**C. Bony fish :**

**Classification :**

Phylum : Chordata

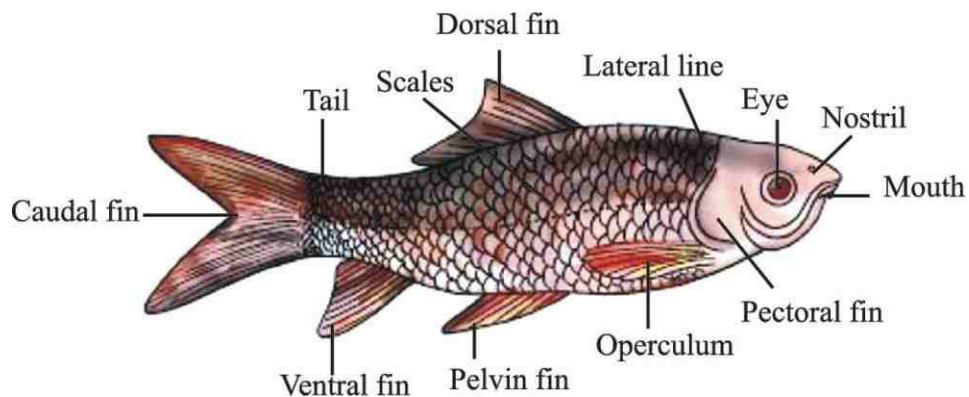
Class : Osteichthyes

**Characteristic features (Specific) :**

- (i) They have streamlined body which help them to survive in water.
- (ii) They have fins to balance themselves and for locomotion.
- (iii) Respiration occur through gills.

**Adaptive features :**

- (i) To reduce friction inside water, their body is streamlined.
- (ii) To get prevented from decaying in water their body is covered with scales.
- (iii) They have air bladder.



**D. Birds :**

**Classification :**

Phylum : Chordata

Class : Aves

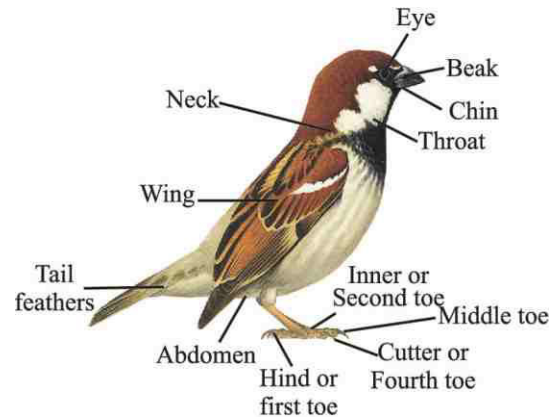
**Characteristic features (Specific) :**

- (i) They have streamlined body, which is an adaptive feature to fly in air.
- (ii) Body is covered with feathers.
- (iii) Forelimbs are modified into wings for flight.
- (iv) Hind limbs bear four clawed digits and are adapted for walking, perching or swimming.
- (v) Bones of endoskeleton are light (Pneumatic) and spongy.
- (vi) Muscles which help in flying are well-developed and strong.

**Adaptive features :**

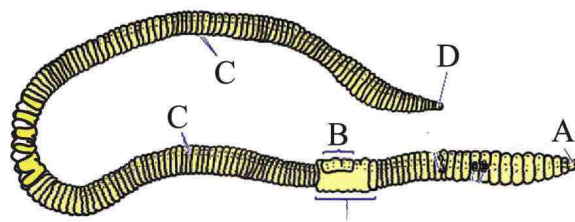
- (i) Body is streamlined.
- (ii) Skeleton is light and hollow.

- (iii) Body is covered with feathers.
- (iv) Forelimbs are modified into wings.

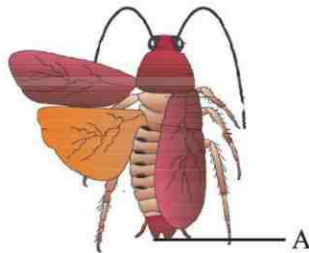


### Practical Based Questions

1. Why do we differentiate organism give two main basis?
2. How do annelid animals differ from arthropods?
3. Write any one specific feature associated with their phylum for the following organisms. 1. Fish 2. Cockroach.
4. Why do we classify organisms?
5. Which kingdom generate food on earth, and initiate food chain?
6. Label A, B, C, D in the following diagram of earth worm.



7. Identify the labelled part A in the following diagram :





## EXPERIMENT NO. 14

**Aim :** To verify the law of conservation of mass in a chemical reaction.

**Materials required :** Physical balance, conical flask, ignition tube, thread, cork (rubber), barium chloride and sodium sulphate.

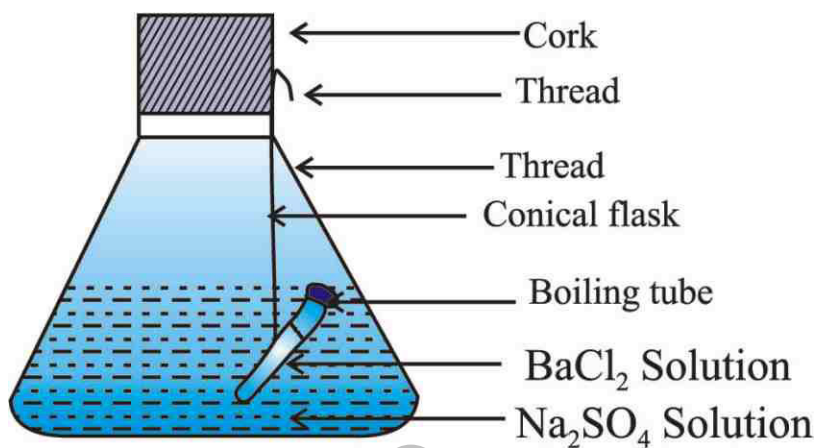
**Principle :** Law of Conservation of Mass : Matter is neither created nor destroyed. Therefore in a chemical reaction the total mass of the substance remain conserved.

**Procedure :**

- (i) Make aqueous solution of barium chloride and sodium sulphate.
- (ii) Barium chloride solution should be taken in an ignition tube and sodium sulphate solution is taken in a conical flask.
- (iii) The ignition tube containing barium chloride is hanged with the help of a thread inside the conical flask having sodium sulphate in it and a cork is applied on the mouth of the conical flask.
- (iv) The whole apparatus is now weighed carefully.
- (v) Now tilt the conical flask in such a way that the two solutions get mixed well into each other.
- (vi) After the chemical reaction, a white coloured precipitate of Barium sulphate is formed in the conical flask.
- (vii) Now again weigh the apparatus in the physical balance.

**Inference :** The total mass inside the conical flask remain same even after the chemical reaction.

**Result :** The mass of the substances don't change and it remains conserved. Therefore, it can neither be created nor be destroyed.



## Questions

1. What colour changes take place on mixing aqueous solution of barium chloride and sodium sulphate? Why?
2. Write any two characteristics of a solution formed by mixing common salt or Alum in water.
3. You are provided with a mixture of sand and Iodine. How will you proceed to separate the mixture? Name this method. Also draw a label diagram of this set up.
4. Why should carbon disulphide be kept away from the flame?
5. 170 g silver nitrate reacts with sodium chloride to give 143.5 g silver chloride and 85 g sodium nitrate. What is the mass of sodium chloride.
6. 12 g Magnesium combine with 16 g Oxygen to give 28 g of Magnesium Oxide. Which law is proven from it?

## EXPERIMENT NO. 15

**Aim :** *To study the external features of root, stem, leaf of a flower of a monocot and dicot plant.*

**Materials required :** A chart showing different parts of a plant or a plant plucked.

**Theory :** Angiosperms with one cotyledon are called monocots and angiosperms with 2 cotyledons are called dicots.

**Procedure :** Take the plant specimen or chart and observe its parts.

### Observations :

#### I. Root :

- (i) Roots in dicots are tap roots i.e., one main root and many lateral roots coming out of it.
- (ii) Roots in monocots are fibrous roots i.e., all are coming out as a tuft.
- (iii) Roots absorb water and minerals from soil.

#### II. Leaf :

- (i) A leaf is attached to the stem with the help of a structure called petiole.
- (ii) Leaves are generally green in colour which do photosynthesis.
- (iii) The flat part of the leaf is called lamina.
- (iv) Arrangement of veins in leaves is called venation. Monocots have parallel venation whereas dicots have reticulate venation.

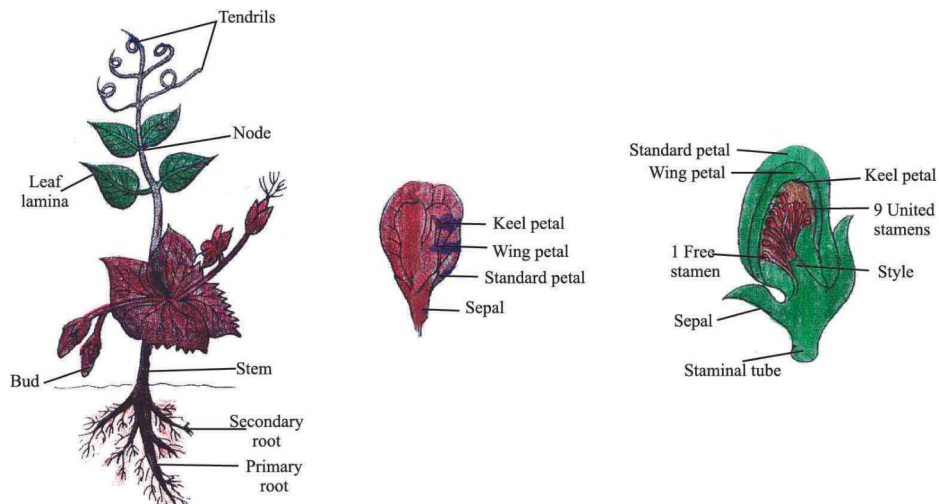
#### III. Stem :

- (i) Stems help in transporting food from leaves to all parts of plant and water and minerals from soil to all plant parts through root with the help of vascular bundles viz. xylem and phloem.
- (ii) Monocot have non woody stem whereas dicot have woody stem

#### IV. Flower :

- (i) Flowers are present in monocots and dicots both.
- (ii) Flowers in monocots are generally trimerous whereas those in dicots are pentamerous.

- (iii) All generally have sepals, petals, stamens and pistils.



### Objective Type Questions

1. What kind of flower do Monocot & Dicot plant have.
2. How leaves, root & flower of Monocot differ from Dicot plant.
3. How will you decide from a seed that it belong to monocot or dicot plant.
4. Name three plant each that belongs to Monocot and Dicot.

## EXPERIMENT NO. 9

**Aim :** To find density of a solid with the help of a spring balance and measuring cylinder.

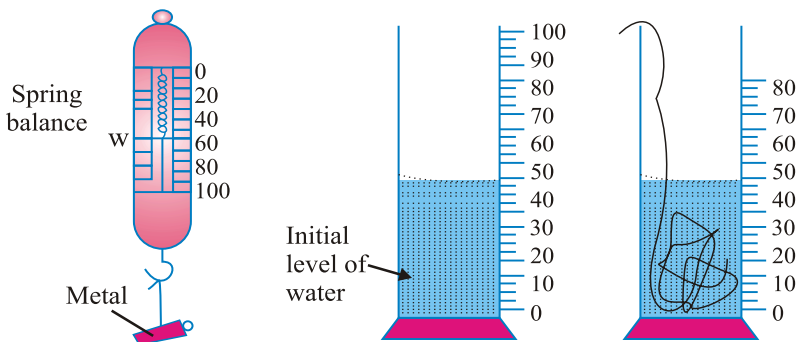
**Materials required :** Spring balance, a piece of metal, spring balance, measuring cylinder, thread, water.

**Theory :** Density is mass per unit volume of a substance. Its unit is  $\text{kg/m}^3$  or  $\text{g/cm}^3$ .

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

### Procedure :

- (i) Tie the piece of the metal (or anything else) with a thread and hang it on a spring balance.
- (ii) Find its mass in air.
- (iii) Fill a measuring cylinder upto half.
- (iv) Immerse this piece of metal fully in water.
- (v) Find the volume of displaced water.
- (vi) Find the volume with different levels of water.



**Observations :** Mass of the object ( $x$ ) = .....grams

S. No.	Initial level of water, $V_1$	Final level of water, $V_2$	Displaced water	Volume $V_2 - V_1 = V$
1				$V_a =$
2				$V_b =$
3				$V_c =$

$$\text{Average volume of solid (v)} = \frac{V_a + V_b + V_c}{3} \text{ ml}$$

**Calculations :** Density =  $\frac{x}{V}$  g/cm<sup>3</sup>

**Result :** Density of the solid is found to be.....  $\boxed{\text{gm/cm}^3}$  .

**Precautions :**

- (i) Metal piece used should be dry.
- (ii) Calculate the zero error of spring balance before handling.
- (iii) There should be no bubble in water.
- (iv) Water should not flow out when we put metal piece in it.
- (v) Read only Lower meniscus of water.

### Practical Based Questions

1. List four steps to find density of a solid with the help of a spring balance and measuring cylinder.
2. Two students A and B are determining the density of water with the help of spring balance and measuring cylinder. Student A took a solid that is denser than water while student B took a solid that is lighter than water. Which student completed experiment successfully and why?
3. List the precautions used in finding the density of a solid.
4. Weight of a solid in air is 50 gm. It displaces 10 ml water when immersed in water. Find its density and write unit of density.

## EXPERIMENT NO. 10

**Aim :** To establish relationship between loss in weight of a solid when fully immersed in (i) tap water, (ii) strongly salty water, with the weight of water displaced by it by taking at least 2 different solids.

**Materials required :** Spring balance, measuring cylinder, piece of iron, thread, tap water, brine, piece of wood, overflow jar.

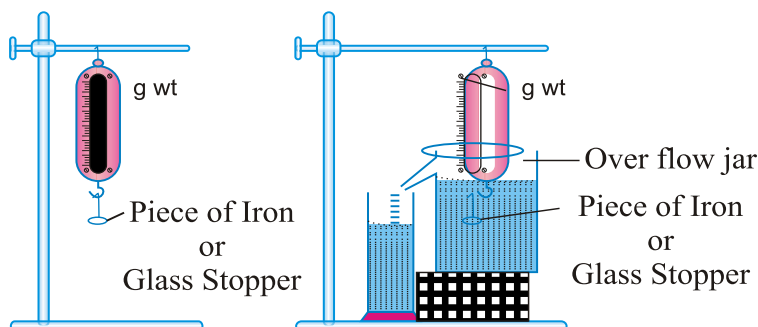
**Theory :** According to Archimedes principle :

“When an object is completely or partially immersed in water, it experiences a decrease in its weight which is equal to the weight of liquid displaced by the immersed part of solid.”

**Procedure :**

- (i) Find weight of an object (glass stopper) in air with the help of spring balance.
- (ii) Keep the overflow jar on a wooden block.
- (iii) Keep filling the overflow jar till water starts flowing.
- (iv) Keep a measuring cylinder at the nozzle of the jar.
- (v) Now, put this spring balance hung with glass stopper, fully immersed in water. Some water will overflow in the measuring cylinder. Find the amount of water collected in the measuring cylinder.
- (vi) Note the weight of this glass stopper in water.
- (vii) Repeat the steps with piece of iron.
- (viii) Repeat the steps with both the objects in brine (saturated solution of salt in water).

**Observations :**



Object	Weight in air, $W_1$	Weight in tap water, $W_2$	Decrease in weight $W_2 - W_1$	Weight in brine, $W_3$	Decrease in weight, $W_3 - W_1$
1. Glass stopper					
2. Piece of iron					

S. No.	Object	Weight of displaced water (tap water)	Weight of displaced brine
1.	Glass stopper		
2.	Piece of iron		

**Conclusion :** Weight of displaced water is equal to the weight of object in tap water or brine.

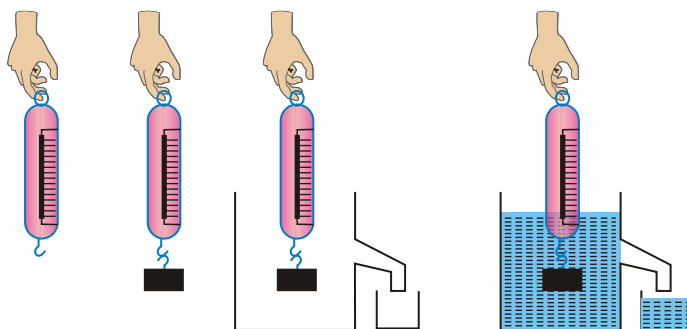
**Precautions :**

- Spring balance should be accurate.
- Measuring cylinder taken should be dry.
- When the object is immersed in water, the water collected in measuring cylinder should not overflow (not even a single drop).
- Object immersed in water should not touch the walls of the container.
- Weight decreased in water should be measured from spring balance only once the object is stable.
- Lower meniscus of colourless solution (Water/Brine) should be read.

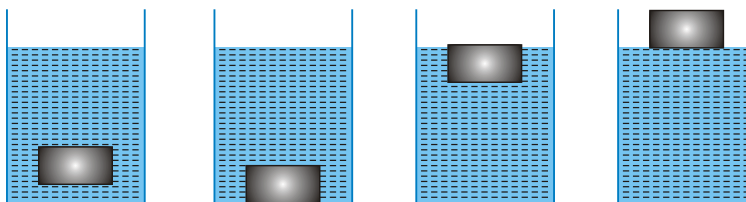
### Practical Based Questions

- In an experiment weight of a solid was measured. Also, weight of displaced water was also measured in the same experiment. Which law is verified by it ? Write law and its definition?
- Out of the following sketches, which shows measurement of weight of displaced water ?





3. An iron nail sinks in sea water but a ship, which is much heavier keeps floating. Write the details why it happen?
4. To find the density of powdered salt, what was taken in a eureka flask? How can we find the density of any thing?
5. A boat A floats on water, a ship B's lower part is immersed in water and a submarine C is completely immersed in water, because why its happen describe in your words?
6. An experiment which shows decrease in the weight of an object when it is immersed in water indicates write its rule and defination?
7. In which of the following, the decrease in the weight of an object (when immersed in water) is equal to the weight displaced :



8. If an object is immersed in water in a eureka vessel and then in extremely salty water in the same eureka vessel, what will happen? Describe in your words?

## EXPERIMENT NO. 11

**Aim :** To find the velocity of pulse propagated through a stretched slinky.

**Materials required :** A slinky, stop watch, meter scale.

**Procedure :**

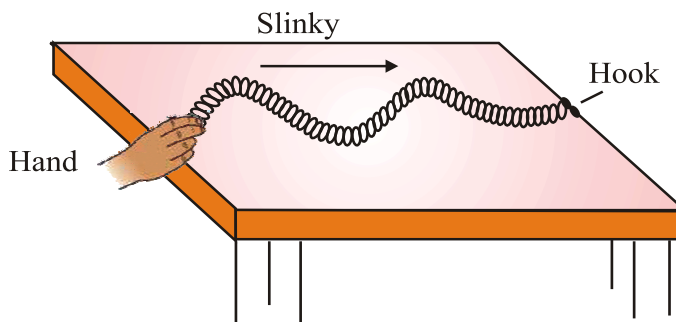
- (i) Take a slinky and spread it on a table or smooth floor as shown in the figure.
- (ii) Fix its one end at a fixed point on wall.
- (iii) Take the slinky in right hand.
- (iv) Jerk your hand from right to left.
- (v) A pulse is generated. Calculate the time taken for 50 pulses.
- (vi) Let this time taken be T seconds.
- (vii) Find the distance between two ends of slinky. Let this be D meters.
- (viii) Speed of pulse =  $\frac{D}{T/50}$  m/s
- (ix) Repeat the same for 5 times and find the average.

**Observations :**

Length of slinky = ..... m

S. No.	Time for 50 pulses T(s)	Speed
1.		
2.		
3.		
4.		
5.		

Average = .....m/s



**Precautions :**

- (i) Choose a slinky of proper length and ductility.
- (ii) Tie one end of slinky properly.
- (iii) Start the stop watch as you jerk.
- (iv) Give a jerk to slinky horizontally.

**Practical Based Questions**

- 1. What kind of waves can be produced in a slinky, and give definition of that waves?
- 2. Each particle in a wave propagated within a slinky or a thread describe?
- 3. A wave produced for a small interval of time. What you call it?
- 4. Thread/slinky used in the experiment what precautions will be taken during experiment.
- 5. What is a pulse describe?
- 6. When the string of a sitar is stretched and left then which types of waves produced in sitar and in the air?
- 7. A wave that travels in the form of compression and rarefaction tell the name of wave. Also define this wave in your words.
- 8. Which type of waves is produced in the water.

## EXPERIMENT NO. 3

**Aim :** To separate the components of a mixture of sand, common salt and ammonium chloride (or camphor) by sublimation.

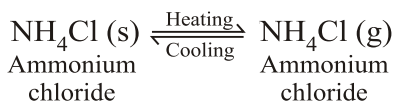
**Materials required :** Given mixture of sand, common salt and ammonium chloride, China dish, wire gauge, tripod stand, funnel, burner, cotton, glass rod, filter paper, beaker, iron stand, watch glass, knife etc.

**Theory :**

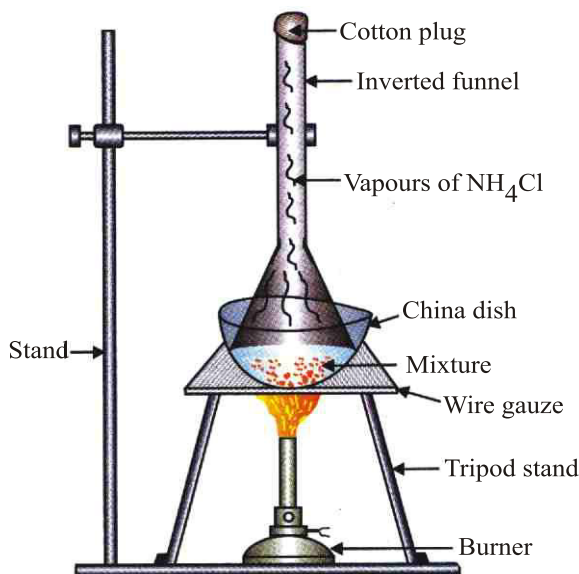
- (a) Some solid substances on heating directly change into vapours without going into liquid state. This process of conversion of a solid directly into vapours is called sublimation.
- (b) Common salt dissolves in water but sand does not, so we can filter it.
- (c) The salt can be obtained from salt solution by evaporation.

**Procedure :**

Physical change can be shown as :



(a) *Separation of ammonium chloride from mixture*



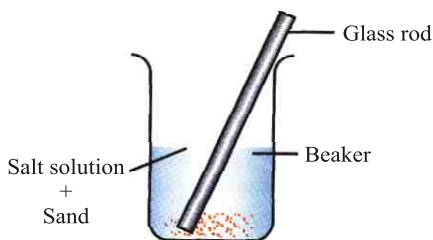
**Separation of ammonium chloride from mixture**

- (i) Place the mixture in a China dish. Place the China dish on a wire gauge placed over a tripod stand.
- (ii) Heat the China dish with a burner/spirit lamp on a medium flame, till dense white fumes start coming out of the mixture.
- (iii) Place a glass funnel in an inverted position on the mixture in the China dish and plug its stem with cotton wool as shown in fig. (above).
- (iv) Go on heating for 5 minutes.
- (v) Remove the funnel from the China dish, scrap the ammonium chloride deposited on its inner sides on a piece of paper.
- (vi) Go on heating the mixture till dense white fumes coming out of it, stop completely. Stop heating and allow the mixture to cool.
- (vii) This mixture consists of sand and common salt.

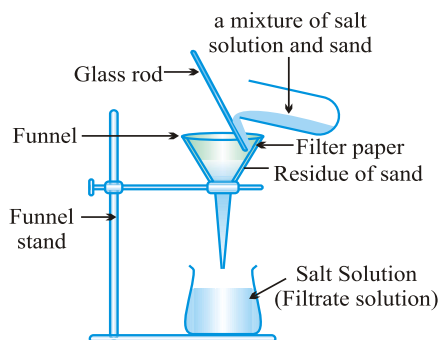
**(b) Separation of sand**

- (i) Transfer the mixture obtained in step (vii) above in a beaker and add 20 cc of water. Stir it with glass rod.
- (ii) Clean the glass funnel and fit a cone of filter paper into it. The cone of filter paper is made by four folding and we take three folds on one side and one fold on the other side.
- (iii) Filter the content slowly as shown in fig. The clear filtrate of common salt will collect in the beaker.
- (iv) Remove the cone from the funnel and place it in the sun. The water evaporates leaving behind dry sand.

Separation of sand from the residue left in the China dish, *i.e.*, sand and common salt mixture



**Dissolution of salt in water**



**Separation of sand and salt**

**(c) Separation of common salt**

Transfer the filtrate containing common salt to a China dish. Heat the China dish on a medium flame. In a few minutes, the water boils off leaving behind dry common salt in the China dish.

**Precautions :**

- (a) All glass apparatus should be clean and dry.
- (b) Do not heat contents on a high flame.
- (c) Do not use large amount of mixture or water.
- (d) Prepare solution in distilled water only.

## Practical Based Questions

1. Name the process by which camphor (solid) changes to its vapour state without changing into liquid.
2. In the given experiment – To separate the components of mixture of sand, common salt and ammonium chloride which component of the mixture should be separated first? and Why?
3. Which particles would you see on the filter paper when the mixture of common salt and sand in water is passed through filter paper, give reason to your answer.
4. Name the process by which common salt can be separated from a solution of common salt in water.
5. While performing the experiment, why the stem of funnel is plugged with cotton during the separation of ammonium chloride from the mixture of ammonium chloride, common salt and sand.
6. In the mixture of ammonium chloride, common salt and sand, name the non-volatile substances.
7. Give one precautionary measure for separating ammonium chloride from mixture of common salt, ammonium chloride and sand.
8. Why filter paper is moistened before filtration?

## EXPERIMENT NO. 4

**Aim :** To carry out the following chemical reactions and classify them as physical or chemical changes :

- (a) Iron nail and copper sulphate solution in water
- (b) Burning of magnesium ribbon in air
- (c) Zinc with dilute sulphuric acid
- (d) Heating of copper sulphate
- (e) Sodium sulphate with barium chloride in the form of their solutions in water

**Materials required :** Test tube stand, tongs, spirit lamp, iron nail, copper sulphate solution, 10 cm long magnesium ribbon, small piece of granulated zinc, dilute sulphuric acid, sodium sulphate solution, barium chloride solution.

### Theory :

**Physical change :** When there is no change in the composition of a substance and no change in chemical nature of the substance.

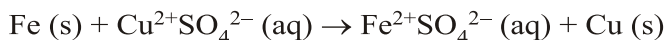
**Chemical change :** It is a change which brings change in the chemical properties of matter and a new substance is obtained.

### Procedure :

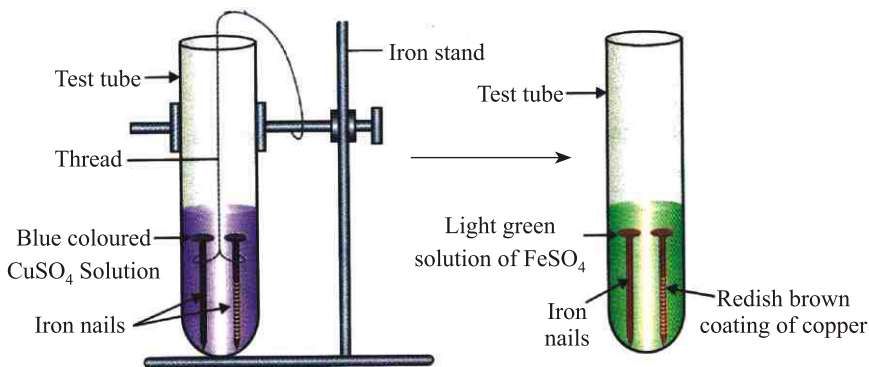
#### (a) *Experiment with iron nail and copper sulphate solution*

Pour about 10 ml of copper sulphate solution in the test tube. Place/Put a clear iron nail in the solution and observe after 15 to 30 minutes. Observations recorded are given below :

- (i) Copper sulphate is blue in colour. On placing nail (iron) in it for 15 minutes or more the colour changes from blue to light blue after 30 minutes finely slightly greenish after 24 hr.
- (ii) Iron nail gets coated with reddish/brownish deposit of copper metal.



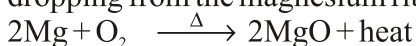




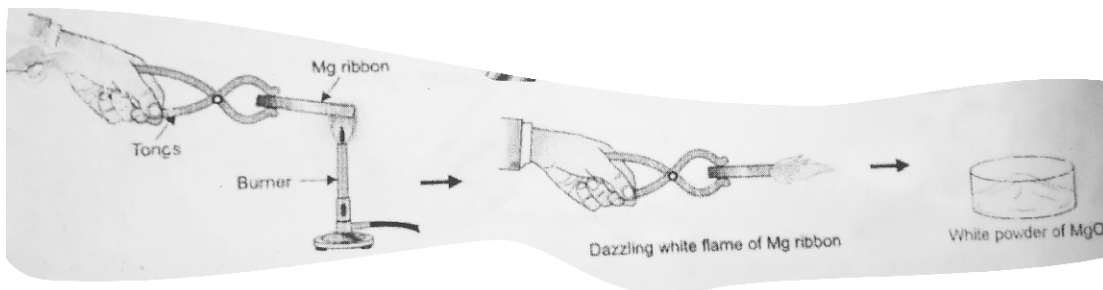
### When iron nails are kept in $\text{CuSO}_4$ solution

- Inference :**
- (i) Chemical change
  - (ii) Iron displaces copper from  $\text{CuSO}_4$  because Iron is more reactive than copper.
- (b) Experiment with burning magnesium ribbon in air  
Hold one end of a 10 cm long magnesium ribbon with tong and burn it in air on spirit lamp.

Observation : The magnesium ribbon burns with a dazzling white flame to form a white powdery mass. This white powdery mass continues dropping from the magnesium ribbon.

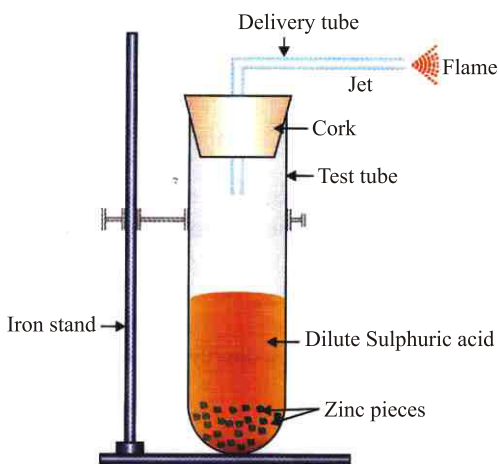
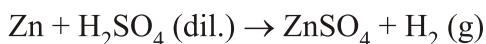
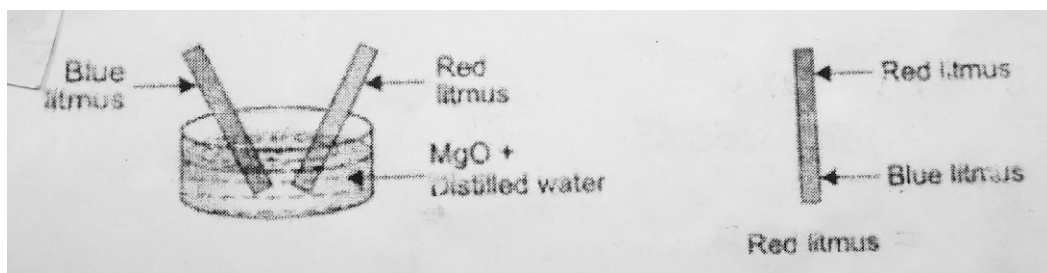


[It turns red litmus to blue being basic in nature]



- Inference :**
- (i) Chemical change
  - (ii)  $\text{MgO}$  is basic in nature
- (c) Experiment with zinc and dilute sulphuric acid  
Introduce a small piece of granulated zinc in a clean test tube. Pour about 5 ml of dilute sulphuric acid in the test tube.

**Observation :** The zinc metal briskly reacts with dilute sulphuric acid. From the surface of zinc, a large number of tiny bubbles of a gas rise. The contents of the test tube get hot. The colourless gas evolved is hydrogen, which explodes with a pop sound when burning matchstick brings to the mouth of test tube.



**H<sub>2</sub> gas is produced, when zinc reacts with dil. H<sub>2</sub>SO<sub>4</sub> which burns with a pop sound**

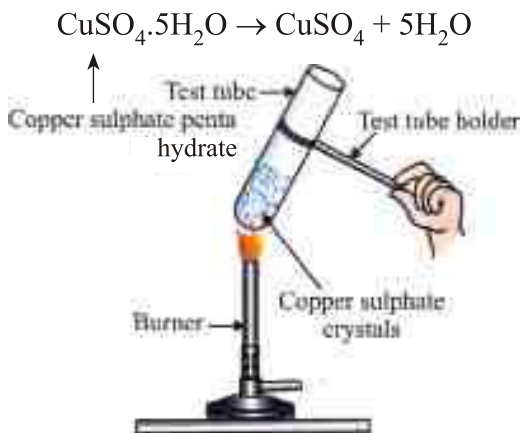
- Inference :** (i) Chemical change  
(ii)  $H_2$  gas is released which burns with pop sound.

*(d) Experiment with copper sulphate on heating*

Heat 2 g of blue coloured copper sulphate in a tube on Bunsen flame for about 2 to 5 minutes. After 5 minutes cool the test tube now add 2 to 3 drop of water in the test tube.

**Observations :**

- (i) Blue coloured copper sulphate crystals crumbled to form white powdery mass.
- (ii) Large amount of steamy fumes are given out.
- (iii) These fumes condense on the cooler part of the test tube.
- (iv) If few drops of water are added again to white powdery mass, it regains its blue colour.



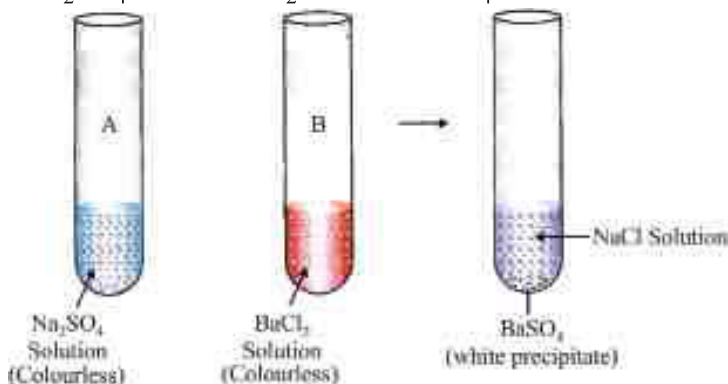
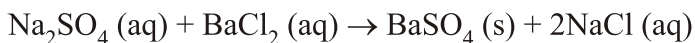
**Heating of copper sulphate crystals**

- Inference :** (i) Physical change.  
(ii)  $CuSO_4 \cdot 5H_2O$  loses water and becomes anhydrous and on adding water, it again becomes blue in colour.

(e) *Experiment with sodium sulphate and barium chloride solutions*

Pour about 5 ml of sodium sulphate in a clean test tube and into this add 5 ml of barium chloride solution. Shake the contents of the test tube.

**Observations :** A white precipitate is formed, which gradually settles at the base of the test tube because insoluble barium sulphate is formed.



**White precipitate of BaSO<sub>4</sub> gets formed when Na<sub>2</sub>SO<sub>4</sub> solution and BaCl<sub>2</sub> solution react with each other**

**Precautions:**

- (a) Test tubes should be clean and dry.
- (b) Use minimum amount of chemicals.
- (c) Always hold the test tube with a test tube holder before heating.
- (d) Use fire tongs for holding magnesium ribbon.

## Practical Based Questions

1. What is the colour of copper sulphate penta hydrate and copper sulphate (Anhydrous)
2. What happen if you mix/react sodium sulphate and barium chloride solution.
3. Why copper sulphate changes its colour on heating.
4. Ram has place a iron nail in a test tube containing copper sulphate. After 30 minutes he observed that colour of copper sulphate faded and a material get deposit on the iron—
  - (a) What will be the colour of the solution if Ram forget the nail in the test tube.
  - (b) Name the material which get deposited on Nail.
5. Why that is a need to clean the Magnesium ribbon with sand paper before burning.
6.
  - (a) What happen when Zinc granules added to dil Sulphuric acid.
  - (b) Which gas will be released and how will you check it.

## EXPERIMENT NO. 5 (a)

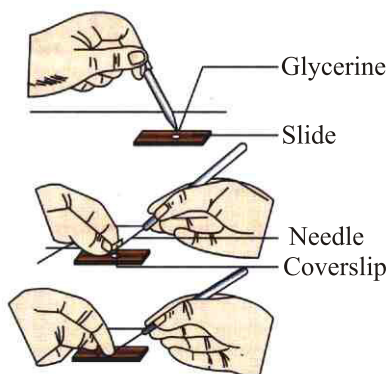
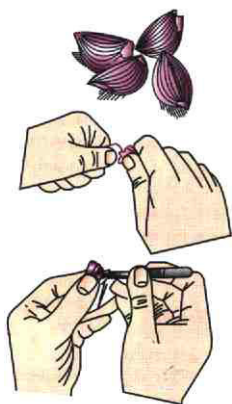
**Aim :** To prepare stained temporary mount of onion peel and to record observations and draw a labelled diagram.

**Materials required :** microscope, onion, knife, needles, forceps, slide, cover slip, brush, methylene blue stain, Safranin stain, glycerine, glass slide, blotting paper, water etc.

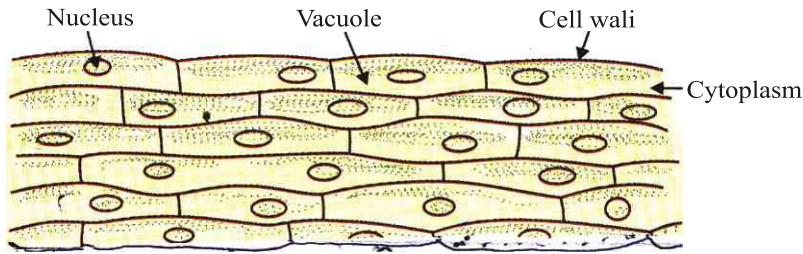
**Theory :** Onion peel is made up of many rectangular cells. These are plant cells. Each cell has a rigid cell wall made of cellulose. Plant cell has plastids and a large central vacuole.

### Procedure :

- (a) Take a thin onion scale from an onion.
- (b) Break it from the concave side to get a transparent and thin piece of membranous onion peel.
- (c) Now keep this piece of onion peel in a watch glass containing water.
- (d) Cut out a small portion of this peel and place it on a glass slide and add a drop of methylene blue solution for a few seconds.
- (e) Drain out the stain and mount the onion peel on a drop of glycerine.
- (f) Cover the peel gently with cover slip with the help of Needle to avoid the entry of air bubbles.
- (g) Gently press the cover slip with a needle so as to spread the glycerine evenly.
- (h) Remove excess glycerine from the edges of the cover slip using a blotting paper.



### Under low power of the Microscope (slide of onion peel)



#### Observations :

- (a) There are large number of brick shaped (rectangular) cells lying side by side in a membrane.
- (b) A distinct darkly stained nucleus is present in each cell.
- (c) A prominent vacuole is seen in the centre and cytoplasm is present on inner surface of cell wall.

#### Precautions :

- (a) Always hold the slide from its edges.
- (b) Do not put excessive stain on slide.
- (c) Put the cover slip at 45° angle to avoid the entry of air bubble.
- (d) Soak excessive water or glycerine on slide with blotting paper.

## EXPERIMENT NO. 5 (b)

**Aim :** To prepare stained temporary mount of human cheek cells and to record observations and draw their labelled diagrams.

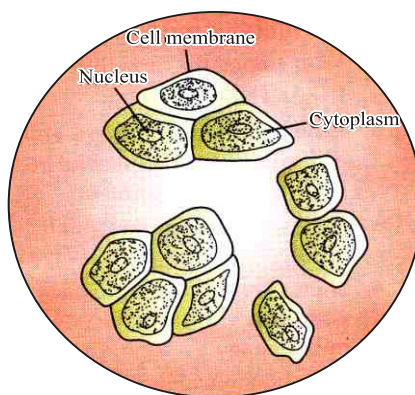
**Materials required :** Watch glass, clean glass slide, cover slip, needles, brush, toothpick, methylene blue solution, blotting paper, high powered microscope.

**Theory :** Human cheek cells are animal cells. They are without cell wall and have denser cytoplasm. Animal cells do not have large vacuoles. They don't have plastids.

#### Procedure :

- (a) Take a clear glass slide and in the middle of it pour a drop of distilled water with the help of a dropper.
- (b) Take a clean toothpick and use it to scrap the inner wall of cheek gently, so as to scrap the epithelial tissue.

- (c) Mix the scrap on the toothpick in the drop of water placed on the glass slide.
- (d) Pour a drop of methylene blue solution on the mixture on the slide and mix it thoroughly.
- (e) After 2-3 minutes remove the excess water and methylene blue solution evenly on the slide by using tip of a blotting paper.
- (f) Put a drop of glycerine on the contents of slide and spread it.
- (g) Take a dry and clean cover slip and hold it from its edges with left hand. Place the cover slip on the slide in such a way that one of its edges comes in contact with the mounting material *i.e.*, glycerine. Now put the cover slip without air bubble.
- (h) Remove the extra material surrounding the coverslip with the help of blotting (filter) paper.
- (i) Examine the slide under high power microscope.



### Slide of cheek cells under microscope

#### Observations :

- (a) Large number of flat cells with irregular boundaries are seen.
- (b) Each cell has a thin cell membrane (or plasma membrane).
- (c) A distinct deeply stained nucleus is seen in each cell.
- (d) There are no intercellular spaces between the cells.
- (e) No cell wall is visible.
- (f) Space between the plasma membrane and the nucleus is filled with granular material called cytoplasm



**Inference :** The examination of material on the slide suggests that it is an animal cell, because cell wall and prominent vacuoles also not seen.

**Precautions :**

- (a) Scrapping of the cheek cells should be done very carefully so that no damage is done.
- (b) The toothpick should be washed thoroughly so that it does not infect the cheek with any foreign bodies.
- (c) The slide should be neatly made with no air bubbles and in just the right amount of glycerine used.
- (d) Overstaining and understaining should be avoided.
- (e) Mounting should be done in the middle of slide.

**Practical Based Questions**

- 1. Why we use glycerine while preparing the temporary slide.
- 2. Which stains are used to stain cheek cell and onion peel.
- 3. What precautions must be taken while preparing the temporary slide?
- 4. Write the steps to prepare a temporary slide of onion peel?
- 5. Draw a diagram of onion peel that you observed under microscope.
- 6. What precautions must be taken while preparing the temporary slide of cheek cell.
- 7. Draw the diagram of cheek cell that you observed under microscope.

## EXPERIMENT NO. 6

**Aim :** To identify parenchyma and sclerenchyma tissues in plants striped muscle fibres and nerve cells in animals from prepared slides and to draw their labelled diagrams.

**Materials required :** Prepared slides of parenchyma tissues, sclerenchymatous tissues, striped muscle fibres, nerve cells and compound microscope.

**Theory :**

**Tissue :** A tissue is a group of similar cells having a common origin and held together by intercellular substances to perform a particular function.

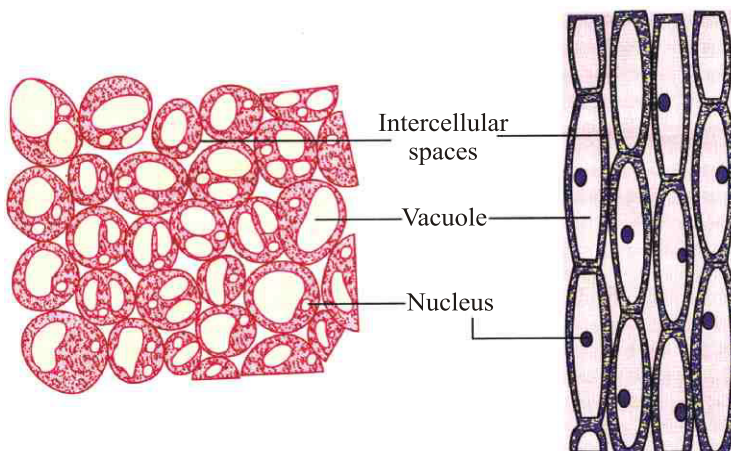
**Permanent tissues :** Some tissues loose their capacity to divide, so they are called permanent tissues. For example, parenchyma, sclerenchyma in plants and striped muscle fibres and nerve cells in animals.

**Procedure :**

- (a) Take a prepared slide and observe it under microscope.
- (b) Study the slide and write its identifying features. Also, draw diagrams in your notebook what you see under observation.

**Observation :**

(a) **Parenchyma**



**Features :**

- (a) The cells are isodiametric *i.e.*, almost equal in length and width.
- (b) There are intercellular spaces at the corners for the exchange of gases.

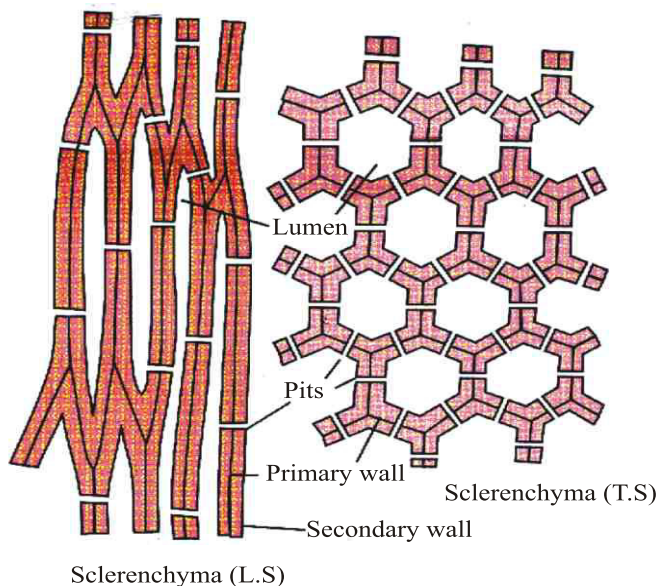
- (c) The cells have thin walls.
- (d) There is a large central vacuole in each cell.
- (e) A distinct nucleus is present in peripheral cytoplasm.

**Inference :**

- (a) Parenchyma tissue is located in soft parts of the stem, leaves, roots, fruits, flowers.
- (b) They act as packaging material, sometimes photosynthesis also occurs.

**Observation :**

**(b) Sclerenchyma**

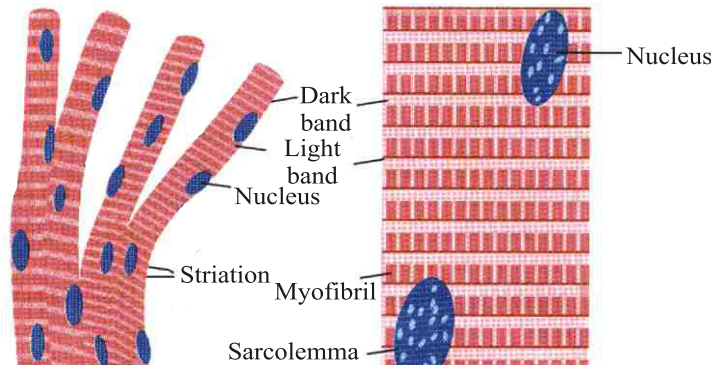


**Features :**

- (a) Sclerenchymatous cells are dead cells.
- (b) They have evenly thickened hard cell walls.
- (c) They have very little or no protoplasm.
- (d) They have hard lignified secondary walls.
- (e) They can be divided into two types :
  - (i) **Fibres** : They are elongated cells with tapering ends.
  - (ii) **Sclereids** : These are irregular isodiametric cells.

**Inference :**

This tissue is very widely distributed tissue and occurs in form of distinct or patches and forms the chief constituents of hard parts of the plant. These cells, being thick walled and having deposition of lignin give mechanical strength to the plant.

**Observation :****(c) Striated muscles or voluntary muscles or striped muscle fibres**

**Diagram showing striated muscle fibres or striped muscle fibres**

**Features :**

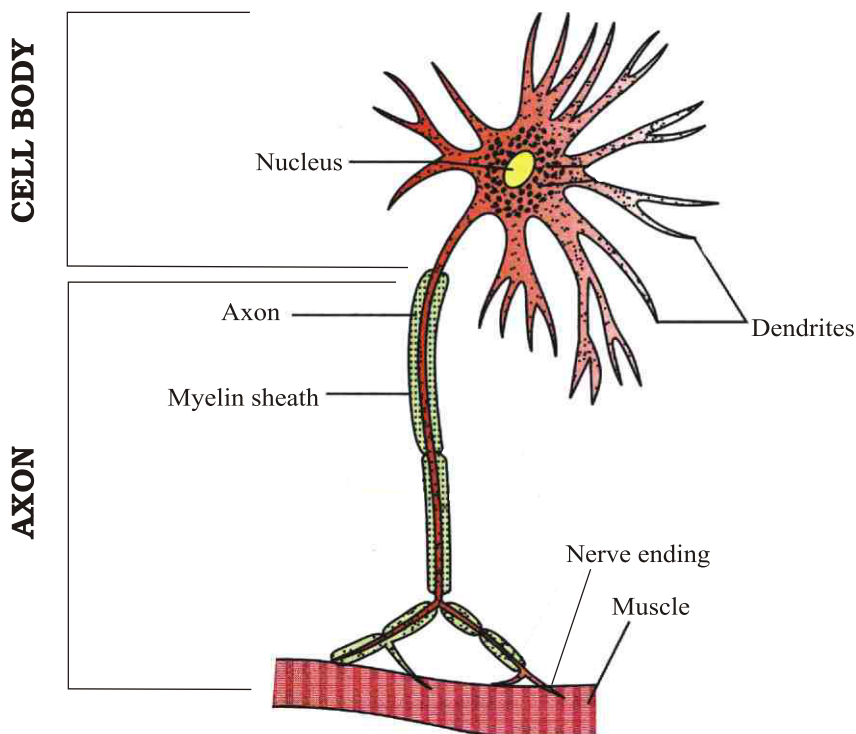
- (a) The fibres are long, cylindrical and unbranched.
- (b) The cells are surrounded by connective tissue.
- (c) The muscle fibres are multinucleated.
- (d) The nuclei lie towards the periphery of the fibres.
- (e) The cells of this muscle are non-tapering.
- (f) Dark and light band appear alternately giving the characteristic striped or striated appearance.

**Inference :**

- (a) Striped muscle fibres are found attached to the bones in different parts of the body.
- (b) These bring about skeletal movements.
- (c) They help in locomotion and maintaining the posture of the body.

## Observation :

### (d) Nerve tissues :



### Features :

- (a) The nerve cell has a larger body called cyton.
- (b) The cell body (cyton) has a prominent nucleus.
- (c) Cyton has cytoplasmic projections called dendrites.
- (d) A group of axons held together by a connective tissue is called a nerve.
- (e) The axons are covered with medullary sheath or myelin sheath.
- (f) The nerve endings are attached to muscles.

### Inference :

Nerve cell has a large cell body with prominent nucleus such that cyton has cytoplasmic projections called dendrites and one a long one, called axon.

## Practical Based Questions

1. What are identifying features of
  - (a) Parenchyma
  - (b) Collenchyma
  - (c) Sclerenchyma
2. Draw diagram of striated muscle that you observed in the slide?
3. Draw a neat labelled diagram of a neuron.
4. What is the difference between striated and smooth muscle.
5. Differentiate between Parenchyma, Collenchyma and Sclerenchyma.
6. Draw a neat labelled diagram of Parenchyma Tissue.
7. Which tissue has cells that are having lignified thickened walls?

## EXPERIMENT NO. 7

**Aim :** To determine the melting point of ice and the boiling point of water.

**Materials required :** A glass beaker (200 cc), a wire gauge, a tripod stand, a Celsius thermometer, a glass rod, an iron stand, a Bunsen burner or a spirit lamp, a magnifying glass, distilled water, ice cubes prepared from distilled water.

**Theory :** When a solid is heated then kinetic energy of the molecules is large enough to overcome the binding forces and the substance changes its state.

**Melting point of the solid :** The constant temperature, at which a solid changes completely to its liquid state at a constant pressure of 1 atmosphere, is called the melting point of the solid.

**Boiling point of the liquid (water) :** The constant temperature, at which a liquid changes completely to its vapour (gaseous) state at a constant pressure is called boiling point of the liquid.

**Procedure :**

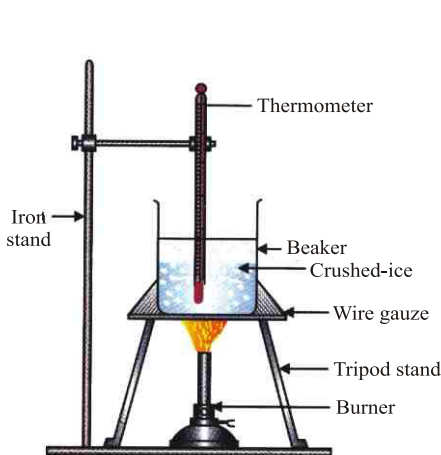
### *(a) Melting point of the solid*

- (i) Take a beaker and put the small ice pieces (crushed ice) into it (about 100 g- 150 g).
- (ii) Insert a stirrer into the ice kept in the beaker.
- (iii) Place the beaker containing ice on the tripod stand with a wire gauze.
- (iv) Suspend a thermometer vertically in the ice by using an iron stand.
- (v) Note the temperature of ice before lighting the burner.
- (vi) Heat the ice pieces. Stir well while heating.
- (vii) Record the temperature when the ice melts completely.

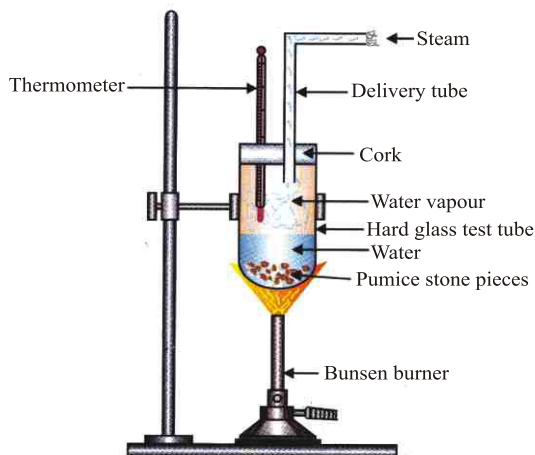
### *(b) Boiling point of the water*

- (i) Take about 50 ml of distilled water in a hard glass test tube.
- (ii) Put 2-3 small pieces of pumice stone to avoid bumping.
- (iii) Fix a cork with bores in the mouth of the test tube and fix it in an iron stand.
- (iv) Fix a thermometer in one of the bores and a delivery tube in the other bore.

- (v) Heat the boiling tube gently. Keep on moving the flame as otherwise the tube is likely to break.
- (vi) Note the temperature when the boiling of water starts. Continue heating of water till the temperature becomes constant and the water starts boiling.
- (vii) Note the constant temperature also.



To determine the boiling point of water



To determine the boiling point of water

### Observation :

Boiling Point of water			Melting point of ice		
S. No.	Time in minutes	Boiling point of Water in °C	S. No.	Time in minutes	Melting point of ice in °C
1.	0	.....	1.	0	.....
2.	1	.....	2.	1	.....
3.	2	.....	3.	2	.....
4.	3	.....	4.	3	.....
5.	4	.....	5.	4	.....

### Result :

- (a) Boiling point of water is .....°C.
- (b) The boiling point does not change with time as long as any water is left for boiling.



- (c) Melting point of ice is .....°C.
- (d) The melting point of ice does not change with time as long as ice is present in the mixture of ice and water formed from it.

**Precautions :**

- (a) Use a good quality thermometer.
- (b) Do not record the temperature in half or quarter degrees as the accuracy of the thermometer is 1 °C.
- (c) Record the boiling point or the freezing point only when the mercury thread is stable at one place for 2 minutes or more.
- (d) Do not immerse the stem of the thermometer in water or ice. This leads to expansion or contraction of the stem which results in recording of wrong temperature.

**Practical Based Questions**

1. List the steps to determine the melting point of ice.
2. List the steps to determine the boiling point of water.
3. Why we use distilled water to determine the boiling point of water?
4. A student put 2-3 pieces of pumice stone in water to determine the boiling point of water. Why does he do so?
5. When on heating, water starts converting itself into vapours (steam), the temperature remains constant. Why?

## EXPERIMENT NO. 8

**Aim :** To verify laws of reflection of sound.

**Material required :** Chart paper, glass sheet/cardboard sheet, watch, gum, table, chalk pieces.

**Theory :** Sound follows laws of reflection like light. These laws are :

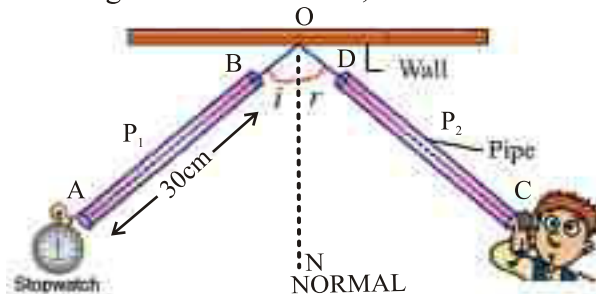
- (a) Incident angle formed by sound wave, reflection angle are equal to each other.

$$\angle i = \angle r$$

- (b) Incident sound ray, reflected sound ray and normal formed at the point of incidence all lie in the same plane.

**Procedure :**

- (i) Make 2 pipes of 30 cm each and equal diameters from chart paper.
- (ii) Put a cardboard/glass sheet between 2 chart pipes or rollers as shown in picture 1.
- (iii) Put a clock in front of pipe  $P_1$ .
- (iv) Now adjust pipe  $P_2$  at different angles and find when do you hear the maximum sound.
- (v) Now mark 2 points each at both the pipes A, B and C, D to mark their positions.
- (vi) Remove the pipes and make lines making angle of incidence (between AO and ON) and reflection angle (CO and ON) and make their values in the following table  $\angle AON = \angle i$ ,  $\angle CON = \angle r$ .



**Observations :**

S. No.	Angle of incidence, $\angle i$	Angle of reflection, $\angle r$	$\angle i - \angle r$
1.			
2.			
3.			
4.			

**Result/Conclusion :**

- (a) Angle of incidence is equal to angle of reflection of sound.
- (b) Incident ray, reflected ray, normal at the point of incidence, all lie in the same plane.

**Precautions & sources of error :**

- (i) Don't change the position of pipe  $P_1$  until you are able to hear the maximum sound from  $P_2$ .
- (ii) Keep watch very close to  $P_1$ .
- (iii) Glass or cardboard should be of such size that you don't hear the direct sound from watch.
- (iv) Table should not move at all.
- (v) Both pipes should be of equal lengths and diameters.

**Practical Based Questions**

1. Write the steps of verification of reflection of sound.
2. Draw a diagram showing reflection of sound and find relationship between  $\angle i$  and  $\angle r$ .
3. A student is performing experiment to verify the laws of reflection of sound with two pipes which are not equal in diameter. Can he get correct result and why?
4. State two laws on which reflection of sound occurs.
5. List the precautions used in experiment to verify the laws of reflection of sound.

## Class-IX Science Sample Paper 1 (solved)

### General Instructions :

1. The question paper comprises four section A,B,C and D. There are 36 questions in the question paper. All questions are compulsory.
2. Section A- Q. No. 1 to 20 all questions on parts their of in this section are of one mark each. These questions contain MCQ, V.S.A, assertion reason type questions. Answer to these should be given in one word or one sentence.
3. Q 17 to 20 consist of five parts , do any four out of these .
4. Section B- Q.No. 21 to 26 are short answer questions, carrying 2 marks each. Answer to these questions should not exceed 30 to 50 words.
5. Section C- Q. No-27 to 33 are short answer questions, carrying 3 marks each. Answer to these question should be in the range of 50 to 80 words.
6. Section D- Q. No- 34 to 36 are long answer questions carrying 5 marks each. Answer to these questions should be in the range of 80 to 120 words.

### SECTION A

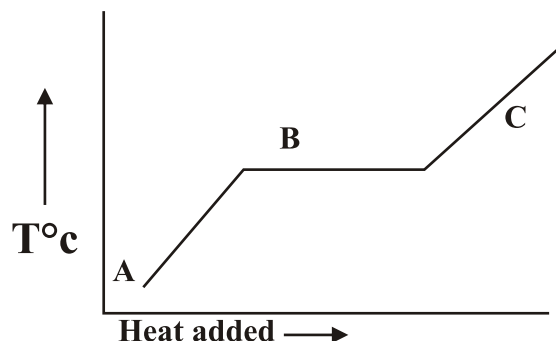
1. Why liquid diffuses slowly as compared to gases?
2. Which organelle is involved in the conversion of green Brinjal to violet?
3. Name the two nucleic acids present in the cell?
4. Why do cells of sclerenchyma tissue have a narrow lumen?
5. Name the tissue responsible for movement in our body.
6. Give the scientific name of the following:  
a) Earth worm                      b) Leech
7. What is the body symmetry of Coelenterates?
8. Name the muscles of heart.
9. Expand AIDS.
10. Define health.
11. Name the target organ of plasmodium.
12. Does displacement of a particle in a given interval of time depend upon the choice of origin?
13. What does the slope of displacement time graph represent?

For question no 14,15 and 16 two statements are given one labeled assertion (A) and other labelled Reason ( R ) select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

- a) Both A and R are true, and R is correct explanation to the assertion.
- b) Both A and R are true, R is not correct explanation of the assertion.
- c) A is true, but R is false.
- d) A is false, but R is true.

14. Assertion (A) : Ball moving on a floor gradually slows down and finally comes to rest.  
Reason (R) : A force of friction due to floor is acting on the ball.
15. Assertion (A): Sound wave is an example of longitudinal wave.  
Reason ( R ): In longitudinal waves, the constituents of the medium oscillate perpendicular to the direction of wave propagation.
16. Assertion (A): Increasing concentration of Ozone near the earth surface reduces crop yields  
Reason ( R ) : Increase in Ozone concentration in stratosphere protect us.
17. Read the following paragraph and answer any four questions.
- During evaporation the heat needed is absorbed from the surroundings which is therefore cooled. According to the kinetic Theory particles in a liquid are in continuous random motion at different speeds. However the average kinetic energy of the particles remain constant provided the temperature of the liquid does not change collision between particles produce some fast moving particles.
- The particles especially near the surface can escape from the intermolecular force of attraction of their neighbouring particles and jump out of the liquid.
- During evaporation particles of a liquid change into vapours:
    - From the surface
    - from the bulk
    - from the bottom
    - from all over the liquid
  - which of the following liquid on evaporation causes maximum cooling?
    - Acetone
    - Water
    - Ethanol
    - Vinegar
  - The Process of evaporation causes:
    - Cooling
    - Dryness
    - Heating
    - All of the above.
  - Evaporation increases with :
    - Increase is surface area
    - Increase is temperature
    - Both (a) and (b)
    - None of these
  - The process of change of liquid state into gaseous state at constant temperature is known as :
    - Boiling
    - Melting
    - Fusion
    - Evaporation

18. Answer any 04 questions following the graph made of two liquid being distilled :



- i) What observation can be made regarding point B?
    - a) The first liquid component is boiling.
    - b) The Second component has already boiled.
    - c) The mixture is homogenous
    - d) Energy is being removed from the liquid.
  - ii) What is the minimum temperature difference required between boiling point of two liquids to be distilled ?
    - a) 10-20 K
    - b)  $10^{\circ}\text{C}$  -  $20^{\circ}\text{C}$
    - c) 5-15 K
    - d)  $5^{\circ}\text{C}$  -  $15^{\circ}\text{C}$
  - iii) what observation can be made regarding point 'C'
    - a) The second component has already boiled.
    - b) The temperature of first component start increasing
    - c) The temperature of Second component start increasing
    - d) None of these.
  - iv) Temperature remains constant for :
    - a) A
    - b) B
    - c) C
    - d) for all
  - v) Zero degree Celsius is equals to :
    - a) 273 K
    - b) 293 K
    - c) 0 K
    - d) 300 K
19. The rules that you have to follow while writing a chemical formula are as follow :  
The valencies or charges of the ion must balance.

When a compound consists of a metal and non-metal the name or symbol of the metal is written first for example" Calcium oxide (CaO), Sodium chloride (NaCl), Iron Sulphide (FeS), Copper oxide (CuO) etc. where oxygen, chlorine, Sulphur are non metal and are written on the right where as calcium , sodium , Iron and copper are metals and are written on the left.

In compounds formed with polyatomic ion,the number of ions present in the compound is indicated by enclosing the formula of ion in a bracket and writing the number of ion outside the bracket For example  $\text{Mg}(\text{OH})_2$ . In case the number of polyatomic ion is one the bracket is not required for example, NaOH

- i) What is the sequence of writing, the metals and nonmetal in a compound?
  - ii) How do you indicate the number of ions present in compound with polyatomic ions?
  - iii) Write one polyatomic ion each with valences -1,-2 and -3.
  - iv) What is the Valency of sodium ion in sodium chloride.
  - v) What is the formula of Calcium oxide?
20. Isotopes are the atoms of the same elements having different mass number for example hydrogen ,  $^1_1\text{H}$ ,  $^2_1\text{H}$ ,  $^3_1\text{H}$  and chlorine  $^{35}_{17}\text{Cl}$ ,  $^{37}_{17}\text{Cl}$  etc. The chemical properties of the isotopes are similar and each isotope of element is a pure substance?
- i) what are isotopes?
  - ii) Give the names and symbols of Isotopes of Hydrogen.
  - iii) Is there any difference between the physical and chemical properties of isotopes ?
  - iv) Name the radioactive isotope of Hydrogen.
  - v) State whether isotopes are pure or not.

### SECTION B

21. List two points of difference between Homogenous and Heterogeneous mixtures.
22. Find the number of mole in :
  - i) 176 g of  $\text{CO}_2$
  - ii)  $1.044 \times 10^{23}$  molecules of  $\text{CO}_2$
23. An element is represented as  $^{16}_8\text{X}$ .

- a) The number of electrons in element X.
  - b) mass number of the element X
24. Give three examples of the range of variation that you see in the life forms around us?
25. List down at least three points of precaution that need to be taken while using antibiotics.
26. Which wave property determines :
- a) Loudness
  - B. Pitch.

### SECTION C

27. A sound wave travels at a Speed of 340m/s . If the wavelength of wave is 1.4m , what is the frequency of wave?
28. Give 3 desirable characteristics of bee varieties suitable for honey production?
29. List any 3 human activities that you think would lead to air pollution .
30. what are the methods of preventing soil erosion?
31. Differentiate Prokaryotic and Eukaryotic cells.
32. Draw a well labeled diagram of neuron.
33. A bus starting from rest moves with a uniform acceleration of  $0.1 \text{ ms}^{-2}$  for 2 minutes, find the speed acquired and distance travelled.

### SECTION D

34. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 200m in 20 sec. Find its acceleration. Find the force acting on it if its mass is 7000kg.
35. i) State universal law of gravitation  
 ii) What happens to the force between two objects  
 If:
- a) the mass one object is halved?
  - b) The distance between the object is doubled
  - c) The masses of both objects are doubled?
36. i) Derive an expression for the kinetic energy of the body?  
 ii) What is the work done by the force of gravity on a satellite moving around the earth?



### SOLUTION PAPER-1

1. In liquid molecules have strong inter molecular force of attraction.
2. Chromoplast
3. DNA, RNA
4. Lignin
5. Muscular tissue
6. A) Pheretima posthuma                      b) Hirudinaria
7. Radial Symmetry
8. Cardiac Muscle
9. Acquired immunodeficiency Syndrome
10. Health is a state of complete physical, mental and social well being and not mere by an absence of disease.
11. Red Blood cell.
12. No, it does not depend on the choice of origin
13. Velocity
14. A
15. A
16. B
17. (i) a                      (ii) a                      (iii) a                      (iv) c                      (v) d
18. (i) a                      (ii) a                      (iii) c                      (iv) B                      (v) a
19. (i) metal are written first and then nonmetal  
(ii) No. of ion present in a compound is indicated by enclosing the formula of ion in bracket and writing the number of ions outside the bracket.  
(iii)  $\text{NO}^{3-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$   
(iv)  $\text{Na}=1$   
(v)  $\text{CaO}$
20. (i) Atoms of the-same element with different mass number.  
(ii) Protium $^1_1\text{H}$ , Deutrium $^2_1\text{D}$ , Tritium $^3_1\text{T}$   
(iii) Chemical properties of isotopes are same but they have different physical properties.  
(iv) Tritium $^3_1\text{T}$   
(v) Isotopes are pure

21.	Homogeneous mixture	Heterogeneous mixture
	Completely miscible	Completely immiscible
	No Visible Boundary of separation	Visible boundary of separation
	Uniform composition	Non uniform composition
	Example : Salt Solution	Example : Sand solution

22. (i) Mass of  $\text{CO}_2 = 176\text{g}$   
M. Mass of  $\text{CO}_2 = 44$  gram per mole  
No. of moles =  $\frac{\text{Given mass of } \text{CO}_2}{\text{GMM}} = \frac{176}{44} = 4$  moles
- (ii) No. of molecules of  $\text{CO}_2 = 12.044 \times 10^{23}$   
No. of molecules in mole =  $6.022 \times 10^{23} = 2$  mole  
No. of molecules =  $12.044 \times 10^{23} / 6.022 \times 10^{23}$
23.  ${}^{16}_8\text{X}$   
(i) No. of electron = atomic number of neutral atom  
(ii) Mass no. = 16
24. Variation in size, life span and, colour
25. (i) Always take advice of the doctor  
(ii) Complete course of antibiotics  
(iii) take it at right time and in right amount
26. (i) Amplitude (ii) Frequency
27. speed =  $340\text{ m/s}$   
wavelength =  $1.4\text{m}$   
frequency = ?  
 $f = \frac{\text{speed}}{\text{wavelength}} = \frac{340}{1.4} = \frac{3400}{14}$   
 $= 242.86\text{s}^{-1}$
28. (i) High honey collecting capacity  
(ii) They must sting less.  
(iii) They should stay in a given bee hives for long periods and very well.
29. (i) Burning of fossil fuel  
(ii) Burning of wood  
(iii) use of CFCs.



square of distance between them".

$$\text{i.e } f = m_1 m_2$$

$$f = 1/r^2$$

$$f \propto \frac{m_1 m_2}{r^2}$$

$$f = \frac{G m_1 m_2}{r^2}$$

(ii) a) If  $m_1$  = halved  
then  $F_1 = F/2$

b) if  $r$  = doubled  
then  $F_1 = F/4$

c) if  $m_1$  = doubled and  $m_2$  = doubled  
then  $f_1 = 4f$

36. (i) Expression for kinetic energy:

Suppose body of mass is moving with velocity 'V' is brought to rest by applying force, K.E = work done by retarding force to stop it.

$$K.E = F \times S$$

$$\text{Retarding force} = ma$$

$$K.E = mas$$

$$\text{Initial velocity} = u$$

$$\text{Final velocity} = v = 0$$

$$\text{From equation } v^2 = u^2 + 2as$$

$$0^2 = u^2 + 2as$$

$$0 = u^2 + 2as$$

$$\frac{u^2}{2} = -as$$

$$\text{Acceleration} = -a = a'$$

$$\frac{u^2}{2} = a's$$

$$K.E = m \frac{u^2}{2}$$

$$K.E = \frac{1}{2} mu^2$$

(ii) work done by the force of gravity on a satellite moving around the earth = 0

As direction of force and direction of motion are perpendicular ( $\theta = 90^\circ$ )

$$W = FS \cos \theta$$

$$W = FS (\cos 90^\circ)$$

$$\cos 90^\circ = 0$$

$$W = F S (0) = 0 \text{ Joule}$$

## Sample Question Paper -2

### General Instructions:

Same as sample question paper-1 ,

1. Why does a desert cooler cools better on a hot day?
2. If cells of onion peel and RBC, are separately kept in hypotonic solution, what will happen to each of them? Explain.
3. Name two organelles in a plant cell that contain their own genetic material and ribosome .
4. Name the different components of Xylem .
5. Name the tissue that forms the inner lining of our mouth.
6. Euglena is a dual organism why?
7. List out two common features in cat and bat .
8. What is the primary characteristic on which the first division of organism is made?
9. State any two condition essential for good health .
10. Define immunization?
11. Expand HIV.
12. Is speed a scalar or vector quantity?
13. What is the S.I. unit of acceleration?  
Reasoning and Assertion :
14. Assertion (A) : A ball moving on a floor gradually slows down and finally comes to rest.  
Reason ( R ) : A force of friction due to floor is acting on the ball.
15. Assertion (A) : sound waves do not travel through vacuum.  
Reason (R): sound waves, are mechanical waves which require medium for their Propagation.
16. Assertion (A):For crop improvement wild varieties play an important role.  
Reason (R) : wild varieties have better adapted to nature.  
Case study question answer do any 4 out of 5 in Q. No 17,18,19 ,and 20 :
17. Mrs. Khanna was making breakfast in the kitchen for this purpose she was heating water in a pan. In the meantime her 12 years old son Pappu entered the kitchen and saw the water vapours coming out from the pan.
  - (i) Which process is going on in the pan :
    - a) Sublimation                      b) Evaporation
    - c) Condensation                      d) Crystallization
  - (ii) Rate of evaporation increases by :
    - a) Decreasing temperature
    - b) Increasing temperature
    - c) Both A and B
    - d) None of these
  - (iii) During evaporation molecules escape from :
    - a) Surface                              b) Bulk
    - c) Bottom                              d) All the liquid

- (iv) Evaporation can leads to :
- Heating effect
  - cooling effect
  - Both A and B
  - None of the above
- (v) Evaporation takes place at :
- Boiling point of the substance
  - Any temperature
  - Fixed temperature
  - None of these
18. In a physical change, a substance is heated , cooled, compressed or exposed to some other external condition without losing its chemical identity. On the other hand, in a chemical change, the initial substance disappears and new substance with entirely, different physical chemical properties are formed.
- (i) Chemical composition of a substance remain same in :
- Physical change
  - Chemical change
  - Both a and b
  - None of these
- (ii) Burning of kerosene in a lantern is an example of:
- Chemical Change
  - Physical Change
  - Crystallization
  - Condensation
- (iii) Physical Change is :
- Temporary
  - Reversible
  - Both a and b
  - None of these
- (iv) A chemical change is always accompanied by absorption of energy or evolution of energy :
- True
  - False
  - Both a and b
  - None of these
- (v) Original substance cannot be obtained by simple physical method is :
- Chemical change
  - Physical change
19. Molecules of an element contain the same kind of atoms only the molecule of noble gases like Helium(He), Neon(Ne), Argon (Ar) etc are made up of only one atom of that element . In all other cases, a molecule may contain two or more atoms of the same element for example a molecule of chlorine is  $\text{Cl}_2$  a molecule of Nitrogen is  $\text{N}_2$ , a molecule of ozone is  $\text{O}_3$  etc.
- (i) What is the symbol of Neon gas:
- He
  - N
  - Ne
  - Ar
- (ii) Atomicity of noble gases is
- 1
  - 2
  - 3
  - 0
- (iii) Chlorine molecule consist of atoms.
- 2
  - 1
  - 3
  - 4

- (iv) Molecules contain atoms of:
  - a) Same element
  - b) different element
  - c) Both a and b
- (v) Symbol of oxygen molecule:
  - a) 0                      b) 3                      c) 2                      d) 8
- 20. Rutherford atomic model was reasonably good model of structure of atom based on the famous particle scattering experiment . However it was subsequently modified by Neil Bohr , and later on by other, the resulting improvement in understanding of Atomic structure have greatly contributed to further scientific advancement. There are many other similar examples in scientific field when original contribution happily accept modification in their ideas.
  - (i) Scattering experiment was given by:
    - a. Neil Bohr
    - b. J.J. Thomson
    - c. Rutherford
    - d. Crick and Watson.
  - (ii) According to Rutherford's model:
    - a. The electrons revolve around the nucleus.
    - b. Movement of electrons around the nucleus is fixed orbits
    - c. It resemble planetony motion.
    - d. All of the above .
  - (iii) On the basis of Rutherford model of an atom which sub atomic particle is present in the nucleus of an atom :
    - a. Neutron                      b. proton
    - c. Electron                      d. All of the above
  - (iv) Rutherford has given :
    - a. Concept of Neutrality
    - b. Concept of Orbitals
    - c. Concept of motion
    - d. Concept of Nucleus
  - (v) Rutherford allowed a narrow a beam of which particle to strike an extremely thin sheet of gold.
    - a. Beta-particles                      b. Gamma-Particles
    - c. Alpha-Particles                      d. Delta-particles

#### SECTION B

- 21. The average atomic mass of a sample of an element is 16.2 what is the percentage of isotopes  $^{16}_8\text{X}$ , and  $^{18}_8\text{X}$  in the sample.
- 22. Calculate the number of atoms of hydrogen in 3.6g of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ).

23. List the point of difference between Homogeneous and Heterogeneous mixtures.
24. What are the major divisions in the plant kingdom. What is the basis for these divisions?
25. What precaution can you take in your school to reduce the incidence of infectious diseases?
26. Why do ceilings and walls of cinema hall not reflect sound?

### SECTION C

27. A stone is dropped from the top of a tower 500m high into a pond of water to the base of the tower. When is the splash heard at the top.  
Speed of sound =  $340\text{ms}^{-1}$ ,  $g = 10\text{ms}^{-2}$
28. A motor car with its glass totally closed is parked directly under the sun. The inside temperature of the car rises very high .Explain why?
29. Why is atmosphere essential for life?
30. Differentiate manures and fertilizers.
31. Derive graphically Newton 's 2nd equation of motion.
32. Identify the type of tissues in the following :
  - i) Skin
  - ii) Bark of tree
  - iii) inner lining of stomach.
33. What would happen if the plasma membrane ruptures or breaks down?

### SECTION D

34. (i) Why some of the leaves may get detached from the tree if we vigorously shake its branch.  
(ii) An automobile, has a mass of 1500kg , what must be the force between the vehicle and road if the vehicle weigh 1500kg is to be stopped with a deacceleration of  $1.7\text{ms}^{-2}$ ?
35. (i) State two factors on which the gravitational force between two objects depends.  
(ii) Why 'G' is called universal constant?  
(iii) What is the value of 'G; on moon?  
(iv) What is the value of 'g' on moon?
36. (i) What are the conditions for work done to be zero ?  
(ii) A body of mass 100g is lifted to a height of 10m, find the amount of work done?



## SOLUTION PAPER-2

1. On a dry day humidity decreases and the rate of evaporation increases.
2. Cells become turgid due to endosmosis
3. Mitochondria and plastids
4. Tracheid, vessels, xylem parenchyma and xylem fibers.
5. Simple squamous Epithelium.
6. It has characteristics of both plants (chloroplast), animals (Flagellum )
7. (i) Warm Blooded (ii) 4 - chambered heart
8. Nature of the cell-whether, prokaryotic or Eukaryotic
9. Balanced diet and hygiene
10. Process of injecting a vaccine into a person to develop immunity against a particular disease.
11. Human Immuno deficiency virus
12. Scalar
13.  $\text{ms}^2$  or  $\text{ms}^{-2}$
14. a
15. a
16. a
17. (i) b (ii) b (iii) a (iv) b (v) b
18. (i) a (ii) a (iii) c (iv) a (v) a
19. (i) c (ii) d (iii) a (iv) c (v) c
20. (i) c (ii) d (iii) b (iv) d (v) c
21. Average atomic mass = 16.2 u

Let % of X- 16 = p

Then % of X- 18 = 100 - p

Therefore ,

$$16.2 = (p \times 16 + (100-p) \times 18) \div 100$$

$$1620 = 16p + 1800 - 18p$$

$$180 = 2p$$

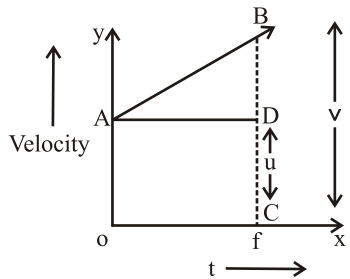
$$p = 90$$

ie % of X - 16 = 90 %

% of X - 18 = 10 %

22. Mass of Glucose = 3.6 g  
 Molar mass of Glucose = 180 u  
 No. Of moles =  $3.6 \div 180 = 0.02$  moles  
 No. Of molecules =  $0.02 \times \text{Avagadros number}$   
 No. Of H atoms =  $0.02 \times \text{Avagadros number} \times 12$
23. Same as answer number 21 in Solved Sample Paper 1
24. Thallophyta, Bryophyta, pteridophyta, Gymnosperm, Angiosperm. Presence or absence of differentiated body part, vascular Tissues  
 Presences or absence of seeds.  
 Whether seeds are enclosed with fruits or not
25. a. Classrooms should be airy  
 b. Ensuring safe drinking water  
 c. Periodic cleaning of water cooler  
 d. Regular medical examination of students.
26. Because of :  
 a. Curved surface of ceilings  
 b. Porous materials such as cork, thermocol is used  
 c. Sound absorbing material used in seats.
27.  $t = \frac{2h}{g} \frac{2 \times 500}{10} = 10 \text{ sec}$   
 Time for the splash sound to travel back =  $t = h/v$   
 $= 500/340 = 1.47 \text{ seconds}$
28. i) Infrared rays pass through the glass and heat the interior of the car.  
 ii) These rays trapped inside the car and raises the temperature
29. i) It acts as a blanket and keeps the average temperature of the earth fairly steady  
 ii) It contains all the gases which are essential for life.  
 iii) It has ozone layer which prevent us from UV rays  
 iv) water cycle is not possible with out atmosphere

30.	Manures	fertilizers
	Natural organic decomposed animal and vegetative waste	Inorganic compound prepared in factories
	Contain all nutrients	It is rich in N, P, K
	cheap	costlier



Distance travelled = Area of Trapezium OABC

$$\begin{aligned}
 &= \frac{1}{2} (OA + OC) \times BC \\
 &= \frac{1}{2} (u + v) \times t \\
 &= \frac{1}{2} (u + at) \times t \\
 &= \frac{1}{2} at^2 + ut
 \end{aligned}$$

$$S = ut + \frac{1}{2} at^2$$

32. i) Epithelial (Squamous Stratified epithelium)  
 ii) cork (protective tissue)  
 iii) cuboidal epithelium tissue
33. i) content of the cell will come in direct contact with surrounding medium  
 ii) unwanted material will be able to enter freely the cell  
 iii) Disruption of metabolic activities
34. i) While shaking a branch we apply force on it and the branch comes in a state of motion, However the leaves tends to maintain their rest position due to inertia of rest.  
 ii)  $m = 1500 \text{ kg}$   
 $a = 1.7 \text{ ms}^{-2}$  (deacceleration)  
 $F = ma = 1500 \times (1.7) = 2550 \text{ N}$
35. i) product of masses  
 ii) distance between the objects  
 iii) its value never change under any condition  
 iv)  $G = 6.673 \times 10^{-11} \text{ Nm}^2 \text{ Kg}^{-2}$   
 v)  $g_m = 1/6 g_e$
36. i) No net force applied on the object  
 ii) Force is being applied but no displacement  
 iii) Direction of force applied is perpendicular to the direction of motion.  
 ii)  $M = 100 \text{ g} = 0.1 \text{ kg}$   
 $h = 10 \text{ m}$   
 $g = 10 \text{ ms}^{-2}$   
 $w = mgh = 0.1 \times 10 \times 10 = 10 \text{ J}$

### Paper-3 (Unsolved)

### General Instructions :

As sample question paper-1(solved)

1. Convert the following temperature to the Celsius scale:  
a) 293 K                      b) 470 K
2. Why water Hyacinth floats on water surface .
3. Which structure protects the plant body against the invasion of parasites?
4. Where will you find more number of ribosomes in cancer cells or in fat cells?
5. Define osmosis.
6. In which kingdom will you place an organism which is single celled, Eukaryotic and photosynthetic?
7. Give reason why whales are not grouped with fishes?
8. Name the phylum to which leech belongs.
9. Name two bacterial disease which spread through sexual contact.
10. Who discovered vaccination?
11. Give one difference between chronic and Acute disease.
12. How will the equation of motion moving with a constant velocity; will change?
13. Is uniform circular motion an accelerated motion?
14. Assertion (A): Momentum of a cricket ball is greater than that of a rubber ball moving with same velocity.  
Reason ( R ) : Momentum of an object is defined as the product of its mass and velocity.
15. Assertion (A): Diffraction is common in sound but not in light waves.  
Reason ( R ) : Wavelength of light is more than the wavelength of sound.
16. Assertion (A): The honey bee queen copulates only once in her life sparn  
Reason(R) : The honey bee queen Can lay fertilized eggs as well as unfertilized eggs.
17. The particles of the matter are bonded together with a force called intermolecular force. In solids the particles are bonded together with strong intermolecular forces. When energy is given, the bonds break. The arrangement of the molecules is disturbed and the solid is converted to liquid. If more energy is given liquid gets converted to gas. Different solids possess intermolecular force of different magnitude.
  - (i) Which state of matter process strong intermolecular force of attraction.
    - (a) Gas
    - (b) Solids
    - (c) Liquids
    - (d) All of the above
  - (ii) Arrange the solids, liquid and gases in order of energy
    - (a) Solid<liquid<gas
    - (b) Liquid<solid<gas
    - (c) Gas<liquid<solid
    - (d) Gas<solid<liquid
  - (iii) On heating solid gets converted to
    - (a) Gas
    - (b) Solid

- (c) Liquids
- (d) Liquid or gas depending upon whether they can be sublime or not
- (iv) Particles of the matter are bonded together with
  - (a) Kinetic energy (b) Potential difference
  - (c) Intermolecular force (d) None of the above
- (v) When energy is given, the bonds:
  - (a) Form (b) Break
  - (c) Remains (d) None of the above
- 18. Colloid is mixture where one of the constituents is dispersed evenly through out another. The size of the constituent particle which is dispersed is in between 10nm to 1 micro meter and called dispersed phase. The medium in which these particles are dispersed is called dispersion medium.
  - (i) Substance which appears to be homogeneous but actually they are heterogeneous are called
    - (a) Solution (b) Colloids
    - (c) Suspension (d) Solute
  - (ii) Colloidal particles ranges.
    - (a) 10nm to 1 micro meter
    - (b) Below 1 nm
    - (c) Above 1 nm
    - (d) 1nm
  - (iii) What is the physical state of dispersed phase and dispersion medium for cheese respectively.
    - (a) Liquid-gas (b) Liquid-solid
    - (c) Solid-solid (d) Solid-liquid
  - (iv) Which of the following is not an example of colloid ?
    - (a) Salt solution (b) Starch solution
    - (c) Milk (d) Both a and c
  - (v) Which of the following has liquid as both dispersed phase and dispersion medium?
    - (a) Paint (b) Blood
    - (c) Face cream (d) Fog
- 19. Ashok conducting an experiment in laboratory involving compound x, one mole of compound x is of weight 35g, if he consume 35g of x in his experiment then :
  - (i) The number of moles of x consumed in above experiment
    - (a) 1 (b) 2
    - (c) 3 (d) 4
  - (ii) The formula of the compound x is
    - (a)  $\text{NH}_4\text{OH}$  (b)  $\text{NH}_4\text{Cl}$
    - (c)  $\text{NaOH}$  (d)  $\text{Na}_2\text{O}_2$

- (iii) 1 mole of any compound consist of:
- $6.022 \times 10^{23}$  molecules
  - $6.042 \times 10^{23}$  atoms
  - $6.022 \times 10^{22}$  molecules
  - $6.042 \times 10^{46}$  atoms
- (iv) If in another experiment only 70g of that substance is required then what will be the number of moles now?
- 3
  - 2
  - 4
  - 1
- (v) Weight of 1 mole substance is
- 35g
  - GMM or GAM
  - 36g
  - 40g
20. In Elements from A to F the distribution of electrons, protons and neutron are as follows:

Atoms/ions	No. of electrons	No. of Neutrons	No. of protons
A	4	4	3
B	10	12	11
C	17	18	17
D	17	20	17
E	18	22	18
F	20	20	20

Make use of these data. Answer the following questions :

- A pair of ions which are isoelectronic
  - A and B
  - B and C
  - C and D
  - D and E
- A pair of isobars:
  - A and B
  - B and C
  - C and D
  - E and F
- A pair of isotopes:
  - A and B
  - C and D
  - E and F
  - C and E
- A pair of ions:
  - A, B and F
  - B, C and D
  - D and E
  - E and F
- Write one application of Isotopes

### SECTION B

21. Differentiate true solution and suspension on the basis of their appearance, visibility, particle size and filterability.
22. Calculate the number of molecules in 53 g of  $\text{Na}_2\text{CO}_3$
23. What are the limitations of Rutherford model of the atom?
24. How do Gymnosperm and Angiosperm differ from each other?
25. What are the different means by which infectious diseases are spread?
26. How does the sound produced by a vibrating object in a medium reach your ear?
27. Two masses  $m$  and  $2m$  are dropped from a height  $h$  and  $2h$ . on reaching the ground which will have more kinetic energy? Why?
28. What are the methods of prevention or reducing soil erosion?
29. Carbon dioxide is necessary for plants. Why do we consider it as a pollutant?
30. Give two advantages of artificial insemination?
31. Which organelle is known as the powerhouse of the cell? Why?
32. List two functions of stomata?
33. A motor boat starting from rest on lake accelerate in straight line at a constant rate of  $3\text{ms}^{-2}$  for 8 seconds. How far does the boat travel during this time?

### SECTION-D

34. A stone of 1kg is thrown with a velocity of  $20\text{ms}^{-1}$  across the surface of a lake and comes to rest after travelling a distance of 50m what is the force of friction between the stone and the ice?
35. (i) Give three differences between mass and weight  
(ii) Why is the weight of an object on moon is  $1/6$  its weight on the earth?
36. A man carrying a bag of total mass 25kg climbs upto a height of 10m in 50 Calculate the power delivered by him to the bag.