BIOLOGY

REFERENCE STUDY MATERIAL

for

CLASS – IX

2017 – 18

CHAPTER WISE CONCEPTS, FORMULAS AND QUESTIONS INLCUDING HOTS QUESTIONS

CHAPTER – 5

THE FUNDAMENTAL UNIT OF LIFE

CELL

Cell is called the fundamental unit of life.
A cell is capable of independent existence and can carry out all the functions which are necessary for a living being. A cell carries out nutrition, respiration, excretion, transportation and reproduction; the way an individual organism does. Unicellular organisms are capable of independent existence which shows a cell's capability to exist independently. Due to this, a cell is called the fundamental and structural unit of life. All living beings are composed of the basic unit of life, i.e. cell.

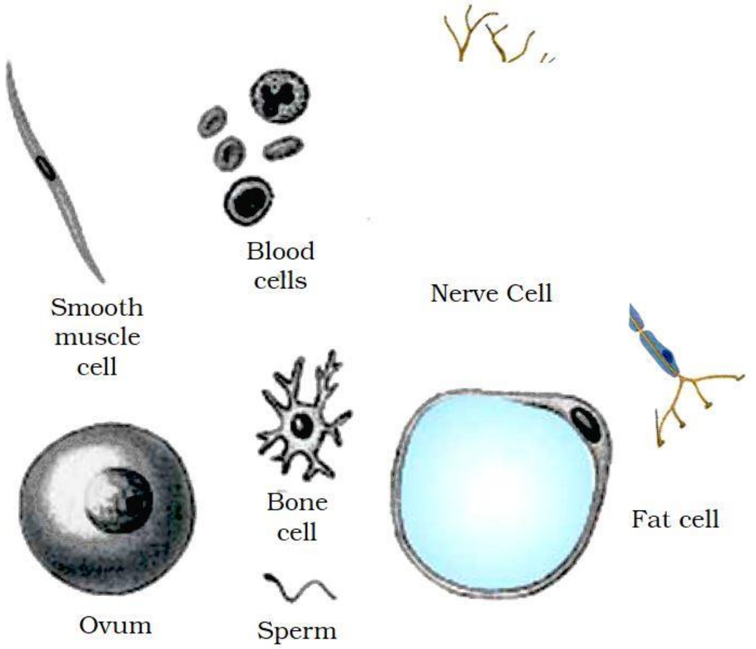
CELL THEORY (Schleiden, Schwann and Virchow):

• All living organisms are composed of one or more cells.
• The cell is the basic unit of structure, function, and organization in all organisms.
• All cells come from preexisting, living cells.

CELL SIZE, SHAPE AND NUMBER

There is much variation in size, shape and number of cells in different organisms, and also in various parts of the body. Most of the cells are only a few micrometres in diameter and are visible only with the help of a microscope.
Cells may be spherical, spindle shaped, elongated, polyhedral or irregular in shape. The shape of the cells is determined by the specific function they perform.
The number of cells is related to the size of the organ or body. Thus, small organisms have limited number of cells, while the larger ones such as elephant, whale or banyan tree have a countless number of cells.

Some organisms can also have cells of different kinds. Look at the following picture. It depicts some cells from the human body.



Various cells from the human body

INTEXT QUESTIONS PAGE NO. 59

Q1. Who discovered cells, and how?
Answer: Cells were discovered in 1665 by an English Botanist, Robert Hooke. He used a primitive microscope to observe cells in a cork slice.

Q2. Why is the cell called the structural and functional unit of life?
Answer: Cells constitute various components of plants and animals. A cell is the smallest unit of life and is capable of all living functions. Cells are the building blocks of life. This is the reason why cells are referred to as the basic structural and functional units of life. All cells vary in their shape, size, and activity they perform. In fact, the shape and size of the cell is related to the specific functions they perform.

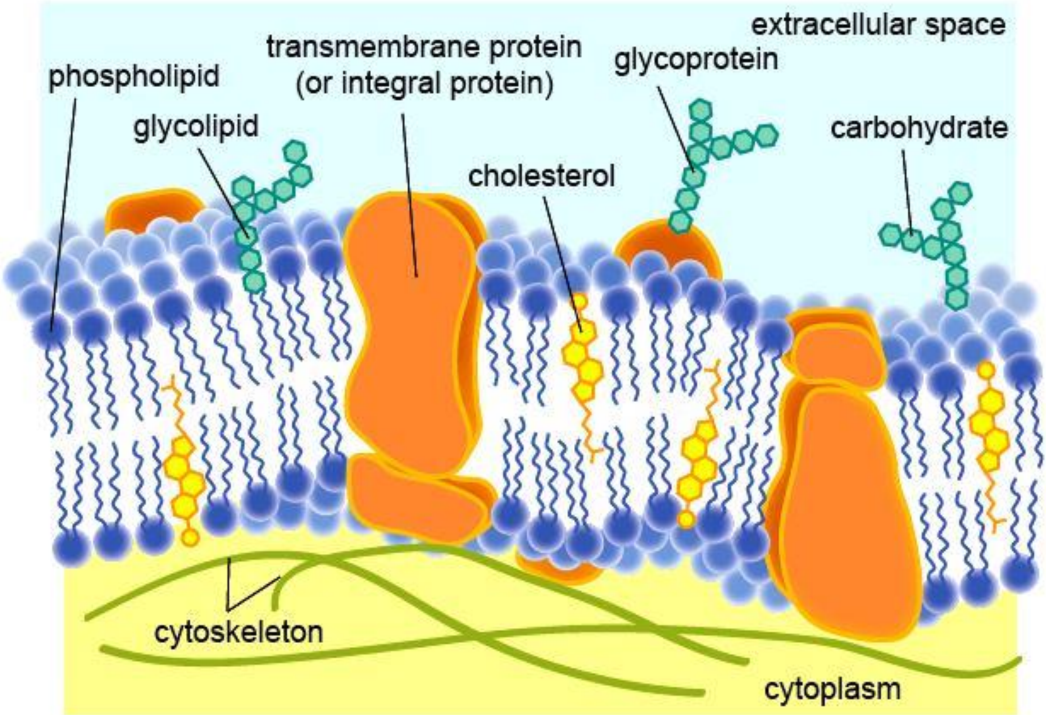
STRUCTURE OF CELL

PROTOPLASM

A cell is made of life giving substance called protoplasm. The protoplasm is a highly organised jelly like, viscous, semifluid, composed of molecules of various chemicals. Most of these are organic molecules such as proteins, carbohydrates, fats, nucleic acid etc. Protoplasm is commonly called the ‘physical basis of life’.
A plant cell consists of a cell wall and protoplast. Cell wall is absent in animal cells. Protoplast denotes the whole of protoplasm present in a cell. It is differentiated into plasma membrane, nucleus and cytoplasm.

PLASMA MEMBRANE

Plasma membrane is a semi-permeable membrane. It is composed of bilayer of lipid and protein. This is the outermost covering of the cell that separates the contents of the cell from its external environment. The plasma membrane allows or permits the entry and exit of some materials in and out of the cell. It also prevents movement of some other materials. The cell membrane, therefore, is called a selectively permeable membrane.


extracellular space
transmembrane protein
(or integral protein)
glycoprotein
phospholipid
glycolipid
carbohydrate
cholesterol
cytoskeleton
cytoplasm

Functions of Plasma Membrane

- Plasma membrane selectively regulates the entry and exit of the substances into and out of the cell. Therefore, it is called a selectively permeable membrane or semipermeable membrane.
- It provides an outer boundary to the cell and protects the cell from injury.
- It allows the flow of materials and information between different organelles of the same cell, as well as between the adjacent cells.
- It provides some organic connections between the adjacent cells.

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Q1. How do substances like CO_2 and water move in and out of the cell? Discuss.
Answer:
The cell membrane is selectively permeable and regulates themovement of substances in and out of the cell.

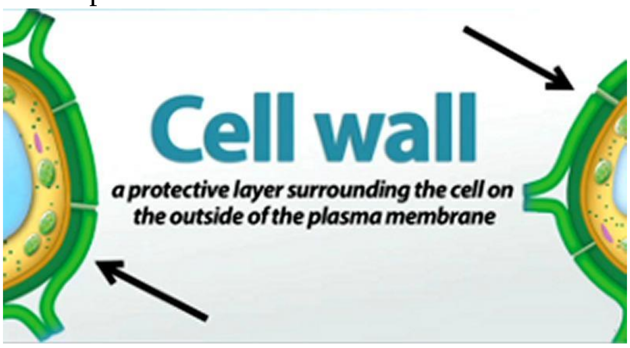
Movement of CO_2: CO_2 is produced during cellular respiration. Therefore, it is present in high concentrations inside the cell. This CO_2 must be excreted out of the cell. In the cell's external environment, the concentration of CO_2 is low as compared to that inside the cell. Therefore, according to the principle of diffusion, CO_2 moves from a region of higher concentration (inside the cell) towards a region of lower concentration (outside the cell). Similarly, O_2 enters the cell by the process of diffusion when the concentration of O_2 inside the cell is low as compared to its surroundings.

Movement of water: Water moves from a region of high concentration to a region of low concentration through the plasma membrane. The plasma membrane acts as a semi-permeable membrane, and this movement of water is known as osmosis. However, the movement of water across the plasma membrane of the cell is affected by the amount of substance dissolved in water.

Q2. Why is the plasma membrane called a selectively permeable membrane?
Answer: The cell membraneor the plasma membraneis known as a selectively permeable membrane because it regulates the movement of substances in and out of the cell. This means that the plasma membrane allows the entry of only some substances and prevents the movement of some other materials.

CELL WALL

Cell wall is made of cellulose. Cell wall is present only in plant cells. It is a rigid protective covering outside the plasma membrane. Presence of cell wall in plant cells distinguishes them from animal cells. Most of the plant cell walls are made of cellulose.



The cell wall consists of three layers namely, middle lamella, primary wall and secondary wall.

The middle lamella is a thin amorphous cement like layer between two adjacent cells. Primary wall is the first formed wall of the cell and is produced inner to the middle lamella. The secondary wall is a thick layer found inner to the primary wall.

Functions of Cell Wall:

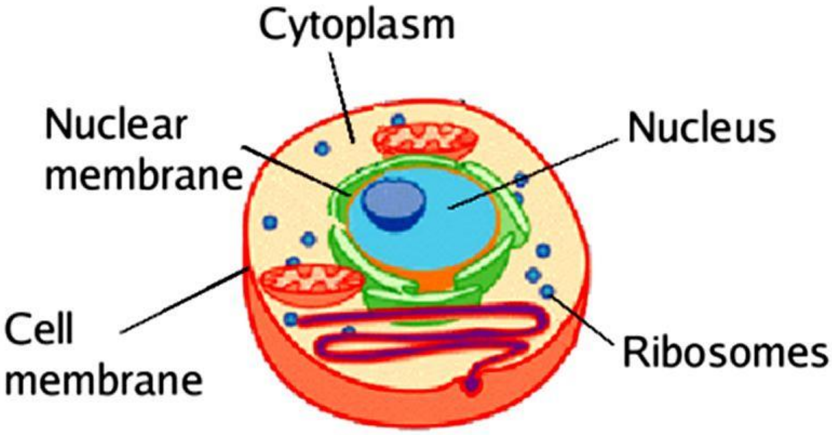
- Cell wall gives a definite shape to the plant cells.
- It provides mechanical strength to the cell.
- It protects the protoplasm against injury.
- It gives rigidity to the cell.

CYTOPLASM

A cell is enclosed in a membranous casing and is filled with a liquid substance which is called the cytoplasm. There are many cell organelles in a typical cell. Some of the main structures of a cell are as follows: The cytoplasm is the fluid content inside the plasma membrane. It also contains many specialised cell organelles. Each of these organelles performs a specific function for the cell.

Functions of Cytoplasm

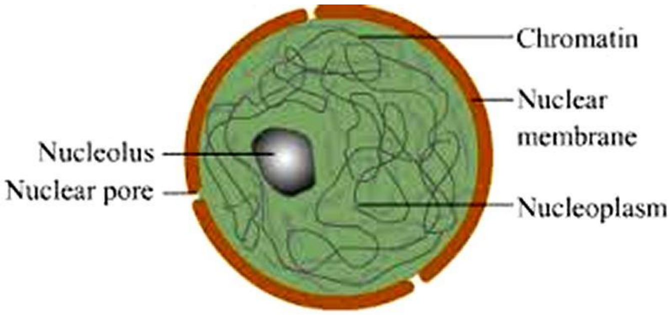
- Cytoplasm helps in intracellular distribution of enzymes, nutrients and other biomolecules within the cell.
- Synthesis of different types of biomolecules such as proteins, nucleotides, fatty acids etc., takes place in the cytoplasm.



NUCLEUS

Nucleus is the major central structure in the cell. It is a dense spherical structure embedded in the cytoplasm. Nucleus has a double membraned envelope called nuclear envelope. Nuclear envelope encloses a ground substance called nucleoplasm or karyolymph. The nuclear envelope possesses many pores called nuclear pores.

The nucleoplasm has two types of nuclear structures i) the nucleolus and, ii) chromatin.



Structure of a Nucleus

The nucleolus is a spherical body rich in protein and RNA. It is the site of ribosome formation. There may be one or more nucleoli in the nucleoplasm. The chromatin is a network of fine threads composed of genetic material DNA (Deoxyribo nucleic acid) and proteins. During cell division chromatin is condensed into thick cord like structures called Chromosomes. The chromosomes contain genes and each gene is responsible for one hereditary character of the organism. Genes contain information for inheritance of features from parents to next generation in the form of DNA molecule.

Functions of Nucleus:

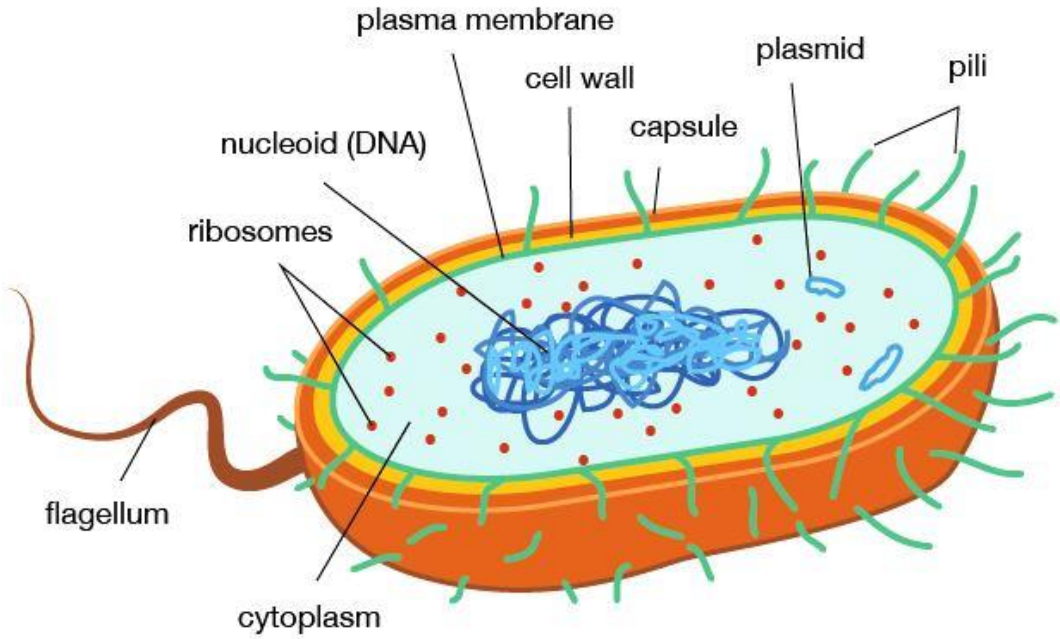
i) Nucleus controls all the metabolic activities of the cell.
ii) It controls the inheritance of characters from parents to off-springs.
iii) It controls cell division.

PROKARYOTES AND EUKARYOTES

Based on the complexity of organization, especially nuclear organization, the cells are classified into two types.
i) Prokaryotic cells.
ii) Eukaryotic cells.

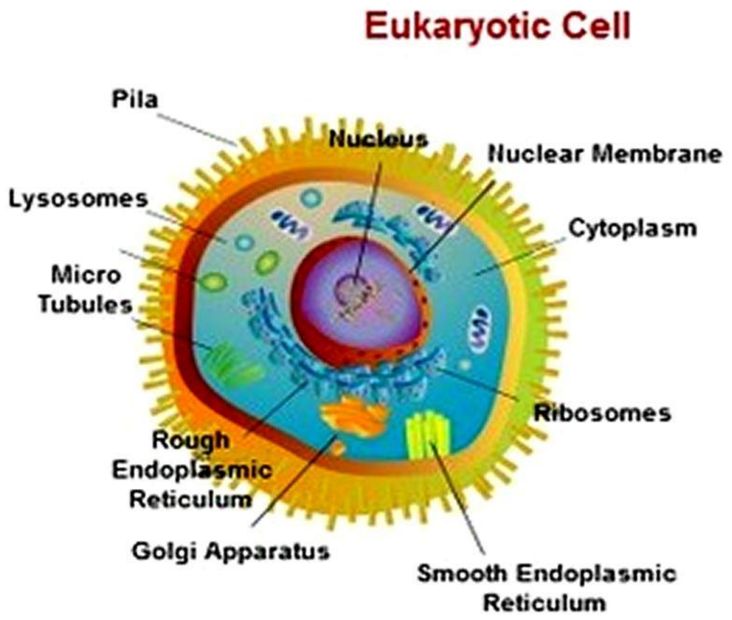
PROKARYOTIC CELLS

The cells of Bacteria and Cyano Bacteria (blue green algae) lack a well organised nucleus and are called prokaryotic cells. Their DNA (Deoxyribo Nucleic Acid) is not enclosed by a nuclear membrane. They also lack membrane bound organelles. The organisms which possess prokaryotic cells are called prokaryotic organisms or prokaryotes. They are considered to be primitive organisms.



EUKARYOTIC CELLS

The cells of all plants (except bacteria and cyano bacteria) and animals possess a well organised nucleus and are called Eukaryotic cells. Their genetic material is enclosed by a nuclear membrane. They possess membrane bound organelles like Endoplasmic reticulum, golgi body, mitochondria, plastids and vacuoles. The organisms which possess eukaryotic cells are called Eukaryotic organisms or eukaryotes.



INTEXT QUESTIONS PAGE NO. 63

Q1. Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.

Prokaryotic Cell	**Eukaryotic Cell**
1. Size : generally small (1-10 µm) $1\ \mu m = 10^{-6}\ m$	1. Size: generally large (5-100 µm)
2. Nuclear region: ________________ ________________ and known as ________________	2. Nuclear region: well defined and surrounded by a nuclear membrane
3. Chromosome: single	3. More than one chromosome
4. Membrane-bound cell organelles absent	4. ________________ ________________ ________________

Answer:

Prokaryotic Cell	**Eukaryotic Cell**
1. Size : generally small (1-10 µm) $1\ \mu m = 10^{-6}\ m$	1. Size: generally large (5-100 µm)
2. Nuclear region: poorly defined because of the absence of a nuclear membrane, and is known as nucleoid	2. Nuclear region: well defined and surrounded by a nuclear membrane
3. Chromosome: single	3. More than one chromosome
4. Membrane-bound cell organelles absent	4. Membrane-bound cell organelles such as mitochondria, plastids, etc., are present

CELL ORGANELLES

A cell performs a variety of functions such as i) Synthesis of complex molecules and their breakdown, ii) Production of energy, iii) Secretion of certain substances, etc.. These activities of the cell are performed by different cell organelles. These organelles are enclosed by membranes. To understand the functioning of the cell, it is necessary to know briefly about the structure of cell organelles.

ENDOPLASMIC RETICULUM

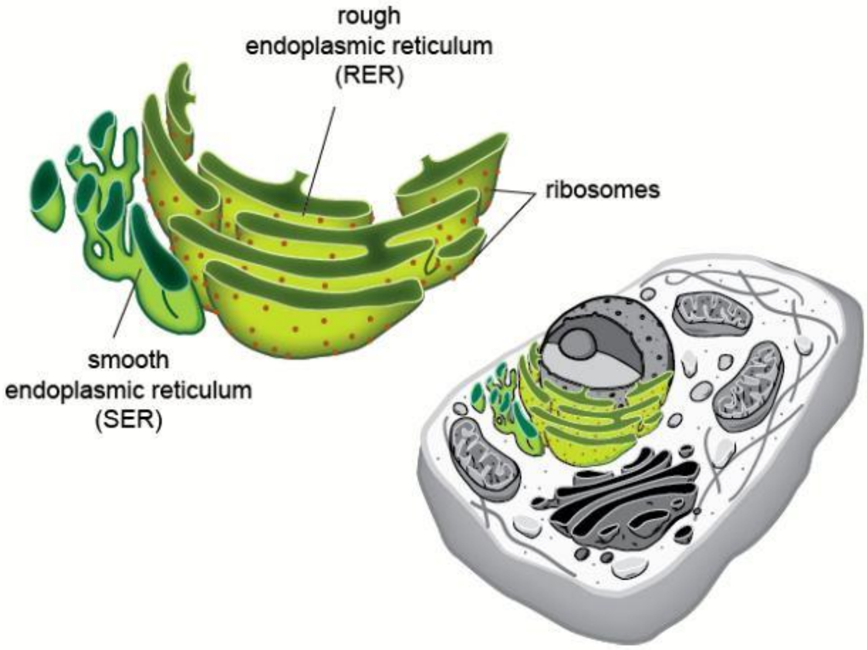
Endoplasmic reticulum is a complicated and interconnected system of membrane bound channels and tubules.

It is spread throughout the cytoplasm and is continuous with the plasma membrane and nuclear membrane.

There are two types of Endoplasmic Reticulum.
a) Rough Endoplasmic Reticulum. (RER)
b) Smooth Endoplasmic Reticulum. (SER)

Rough endoplasmic reticulum (Granular endoplasmic reticulum)
They are found in cells which synthesize proteins. This type of endoplasmic reticulum possesses rough walls because the ribosomes remain attached with membrane of endoplasmic reticulum.

Smooth endoplasmic reticulum (Agranular endoplasmic reticulum)
They are found in cells which synthesize lipid. The walls are smooth and ribosomes are not attached to its membrane.

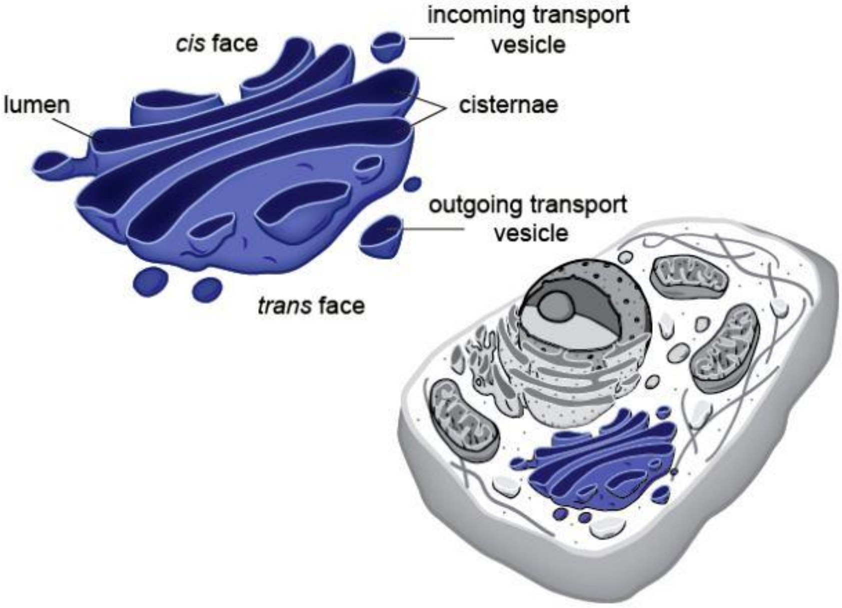


Functions of Endoplasmic Reticulum

- Endoplasmic Reticulum (E.R) provides large surface area for the metabolic activities of the cell.
- Rough endoplasmic reticulum plays an important role in protein synthesis.
- Smooth endoplasmic reticulum is involved in the synthesis of steroid, hormones and lipids.

GOLGI COMPLEX OR GOLGI APPARATUS

The Golgi apparatus was first described by Camillo Golgi. Golgi complex consist of saucer-like compartments called cisternae, network of interconnecting tubules, vesicles and vacuoles at the peripheral regions. In plant cells, Golgi apparatus is referred to as dictyosomes.

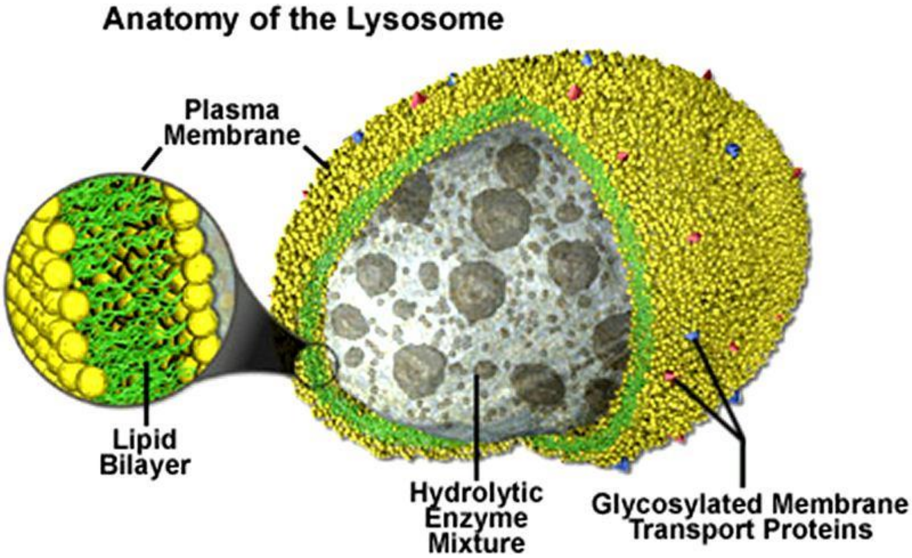


Functions of Golgi Complex

- Golgi apparatus is involved in the formation of lysosomes.
- It is also responsible for the synthesis of cell wall and cell membrane.

LYSOSOMES

Lysosomes are small membrane bound vesicles which contain various types of digestive enzymes. These serve as intracellular digestive system, hence they are called digestive bags.
They are produced by the joint activity of Endoplasmic reticulum and Golgi apparatus. If the membrane of Lysosome happens to get ruptured, the enzymes of Lysosome would digest the entire cellular structure causing death of the cell. So Lysosomes are called 'suicide bags'.



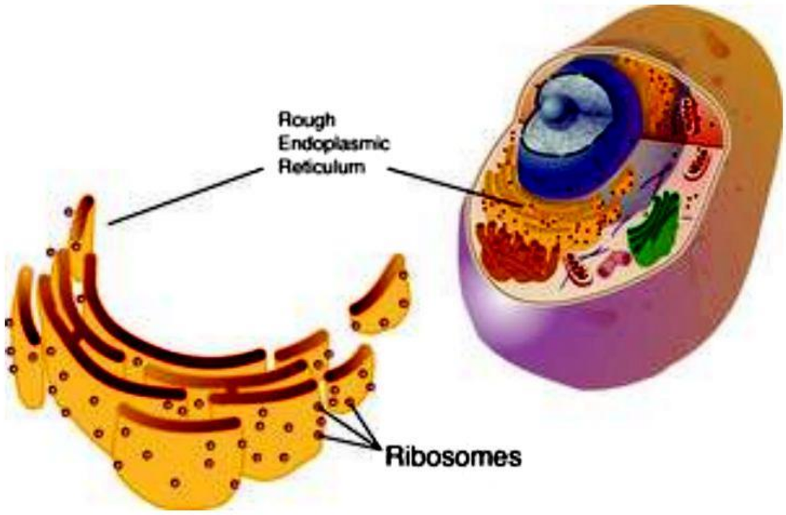
Functions of Lysosomes

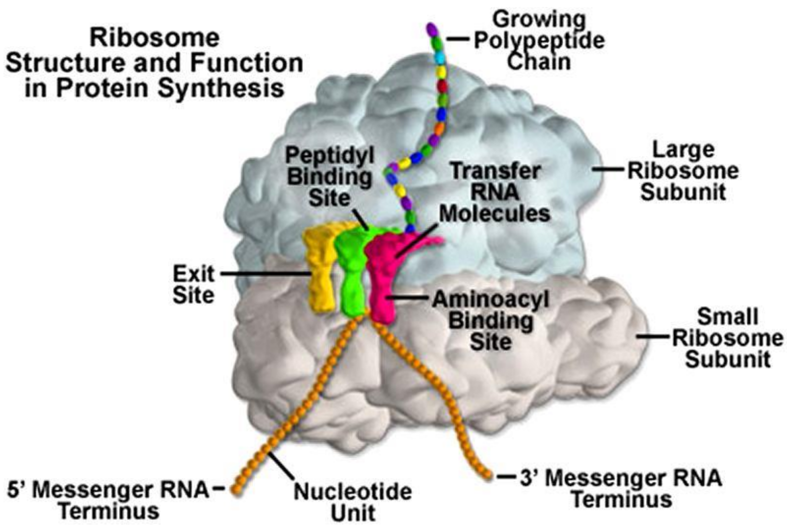
- Lysosomes are involved in the intracellular digestion of food particles ingested by the cell through endocytosis.

➢ The lysosomes of WBCs (White blood cells) destroy pathogens and other foreign particles and thus take part in natural defence of the body.

RIBOSOMES

Ribosomes are small granular structures made up of ribo nucleic acids (RNA) and proteins. They occur free in the cytoplasm as well as attached to the outer surface of the rough endoplasmic reticulum. Each ribosome consists of two subunits – a small subunit and a large subunit. At the time of protein synthesis many ribosomes get attached to messenger RNA and form a structure called polyribosome or polysome.





Functions of Ribosomes

Ribosomes play an important role in protein synthesis. So they are called, 'protein factories' of the cell.

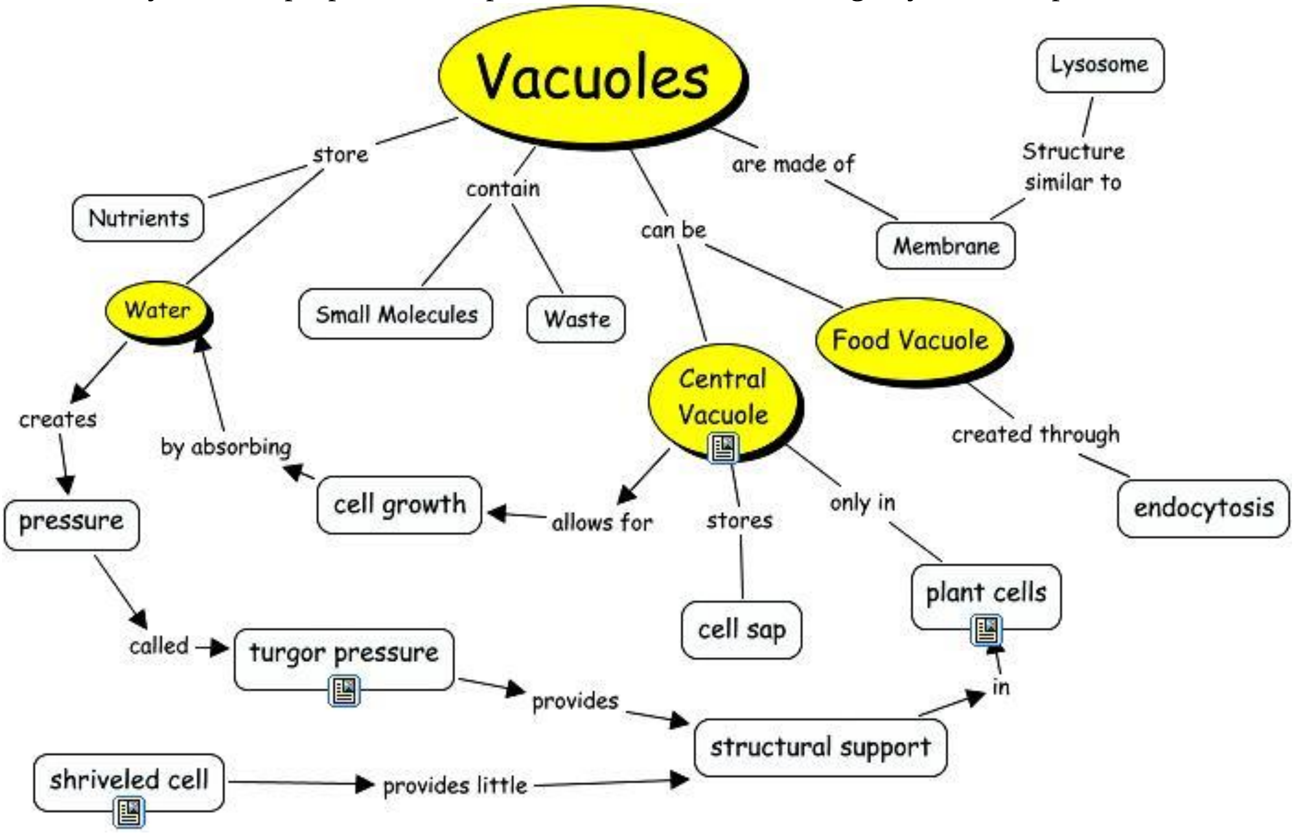
VACUOLES

Vacuoles are fluid- filled sacs bound by a single membrane and are present in plant cells as well as in certain protozoans as food vacuoles and contractile vacuoles. In plant cells, major portion of the cell is occupied by vacuoles and are bound by the definite membrane called tonoplast.

Vacuoles of plants are filled with cell sap containing minerals, sugars, amino acids and dissolved waste products.

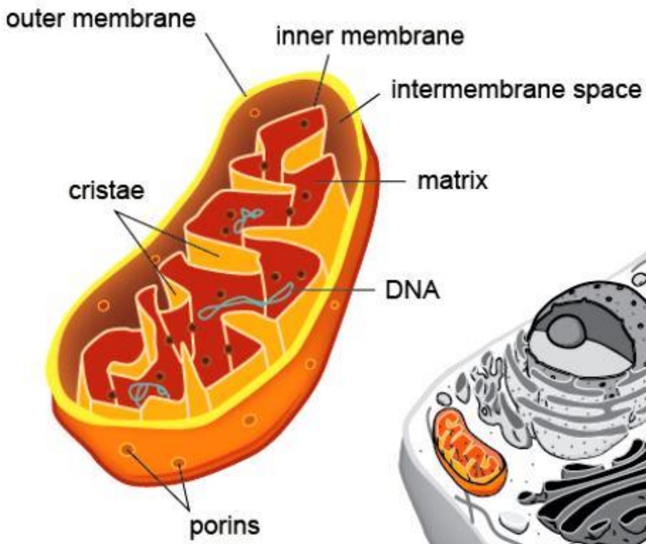
Functions of Vacuoles

- Vacuoles store and concentrate mineral salts as well as nutrients.
- They maintain proper osmotic pressure in the cell for its turgidity and absorption of water.



MITOCHONDRIA

Mitochondria are globular or cylindrical organelles. Each mitochondrion is bound by two membranes – an outer continuous membrane and an inner membrane thrown into folds called cristae. These cristae divide the inner chamber incompletely. The inner chamber is filled with homogenous dense material called the matrix. The cristae have pin headed bodies called F1 particles or Oxysomes which play an important role in respiration.



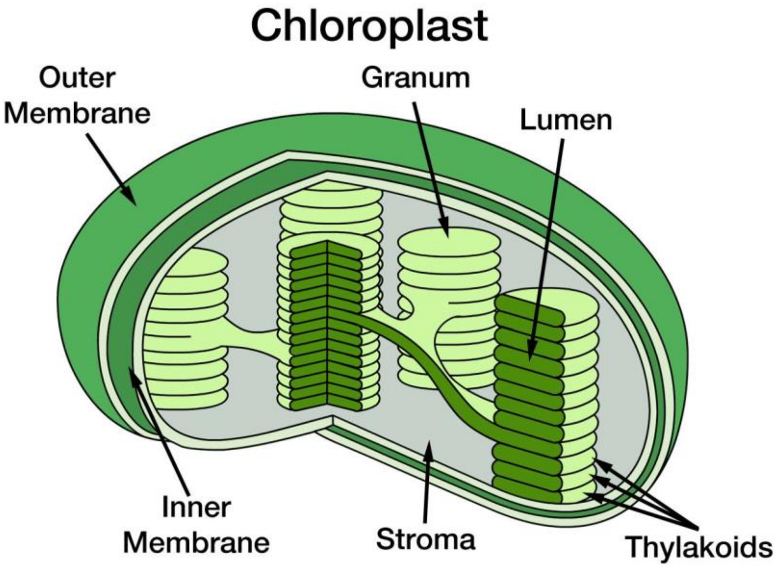
The matrix of mitochondria contains enzymes necessary for the oxidation of food during respiration and release of energy in the form of ATP molecules. Therefore mitochondria are called power houses of the cell. The mitochondria contain proteins, lipids and a small amount of DNA.

Functions of Mitochondria

- Mitochondria synthesize energy rich compounds such as ATP.
- Mitochondria provide important intermediates for the synthesis of several biochemicals like chlorophyll, cytochromes, steroids, aminoacids etc.

PLASTIDS

Plastids are disc or oval shaped organelles which occur in plant cells only. Plastids are of three types. They are Leucoplasts, Chromoplasts and Chloroplasts.
i) **Leucoplasts:** These are colourless plastids which store food in the form of starch, lipids and proteins
ii) **Chromoplasts:** These are yellow or reddish in colour due to the presence of pigments other than chlorophyll. Chromoplasts provide colour to many flowers and fruits.
iii) **Chloroplasts:** These are green coloured plastids which possess the photosynthetic pigment chlorophyll.



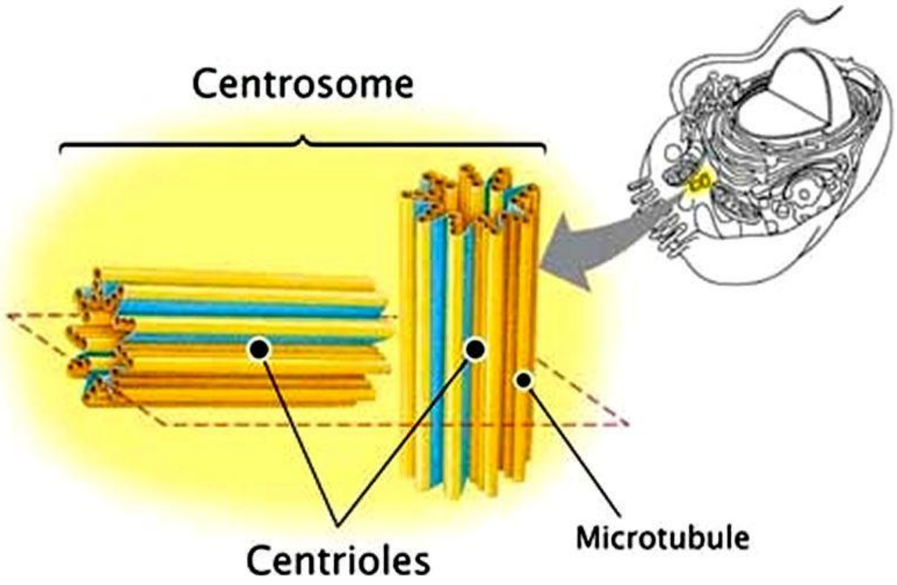
Each chloroplast consists of a double membraned envelope and a matrix. The inner membrane is arranged along the length of the plastids as lamellae. At certain regions, the lamellae are thickened and appear like pile of coins. These are called the grana. Each granum consists of disc shaped membranous sacs called thylakoids. Inside these grana, the chlorophyll is located. The non-thylakoid portion of the matrix is called stroma. It contains a number of enzymes involved in photosynthesis.

Functions of Plastids: Leucoplasts are responsible for storing food; such as carbohydrates, protein and lipid. Chromoplasts impart various colours to the plant parts. A leaf of a plant is green in colour because of chloroplast. Chloroplast is the site of photosynthesis.

CENTROSOME

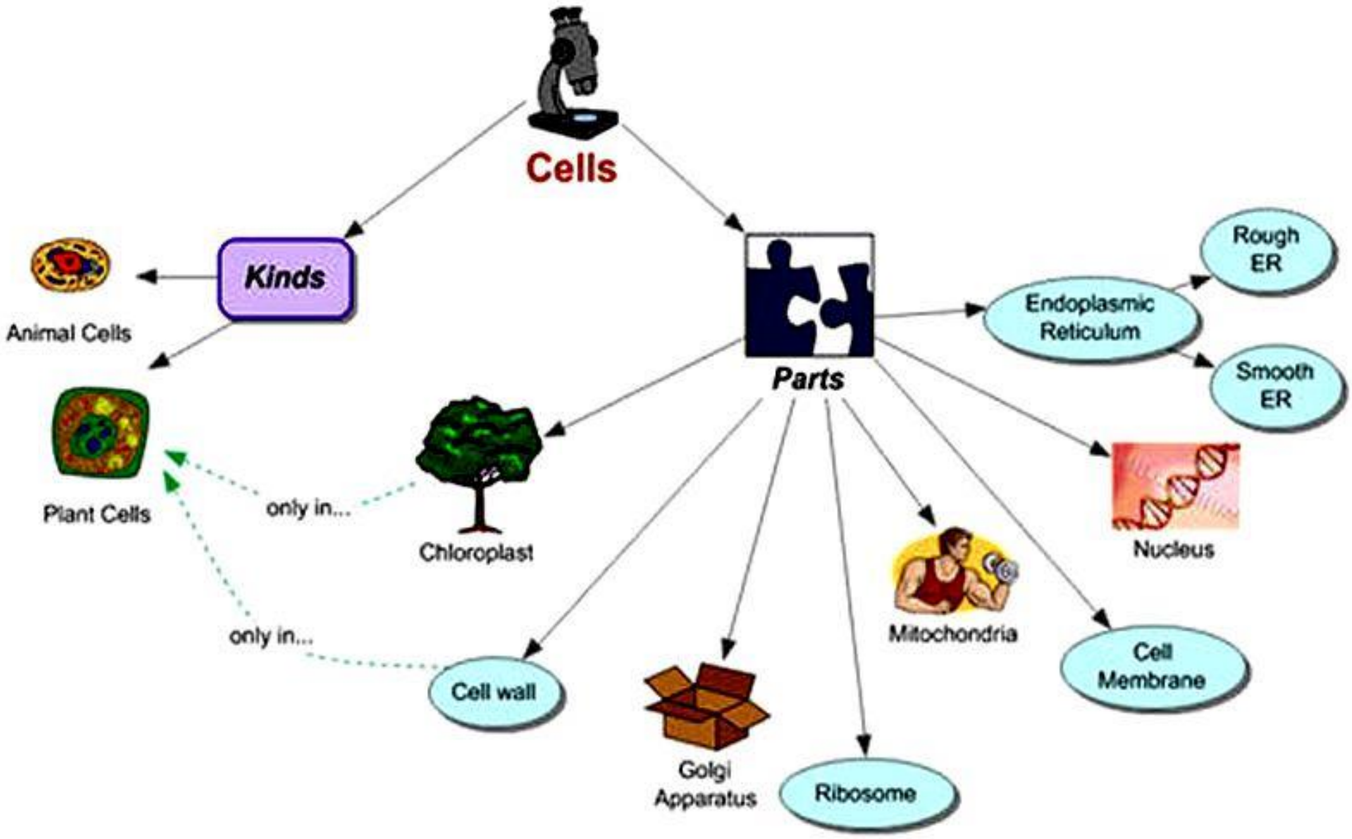
Centrosome is present in animal cells and in certain lower plants. It is absent in prokaryotic cells and in higher plant cells. It is located near one pole of the nucleus. It contains a pair of small, hollow granules called centrioles.

Functions of Centrioles
Centrioles play an important role in the formation of spindle fibres during cell division.



SUMMARY

STRUCTURE OF CELL

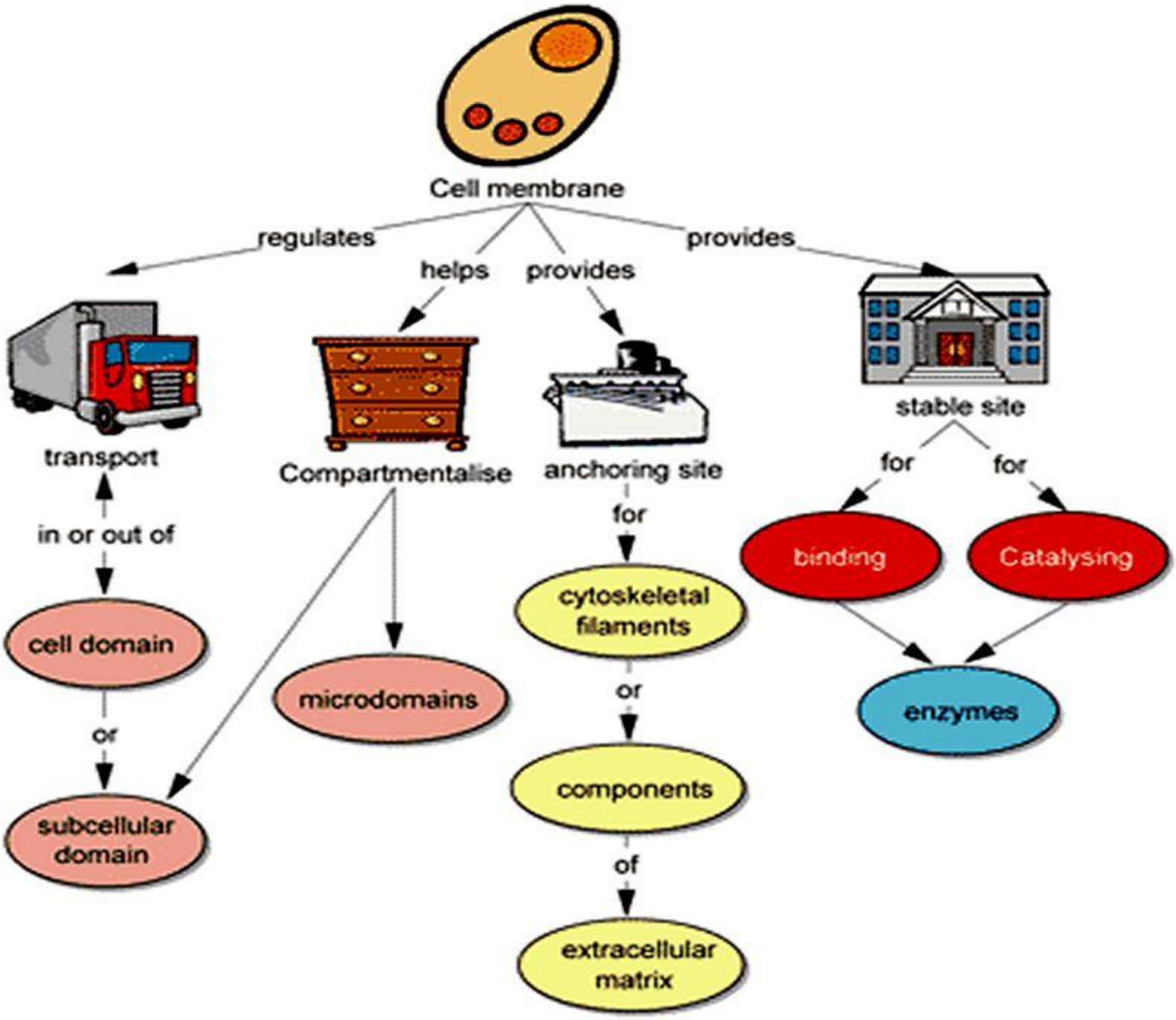


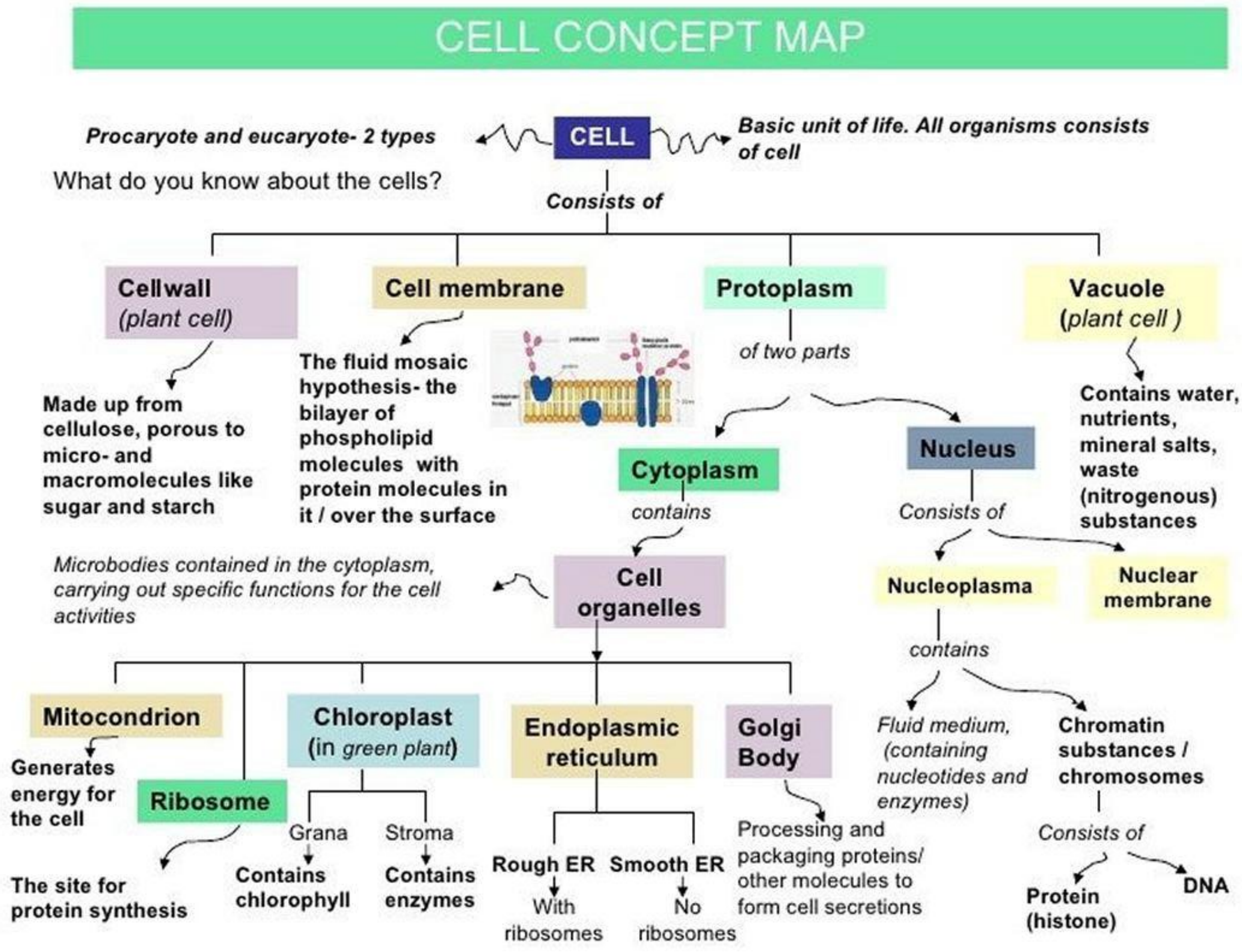
HISTORY OF DISCOVERY OF CELLS
- Robert Hooke was the first to discover cell (1665).
- Leeuwenhoek was the first to discover free living cells in pond water (1674).

- Robert Brown discovered the nucleus (1831).

- Purkinje coined the term ‘protoplasm (1839).
- Schleiden (1838) and Schwann (1839) proposed the Cell Theory. Virchow (1855) made further addition to the cell theory.
- The discovery of electron microscope (1940) made it possible to study the structures of cell organelles.

FUNCTION OF CELL MEMBRANE




CELL CONCEPT MAP
Procaryote and eucaryote- 2 types
CELL
Basic unit of life. All organisms consists of cell
What do you know about the cells?
Consists of
Cellwall (plant cell)
Made up from cellulose, porous to micro- and macromolecules like sugar and starch
Cell membrane
The fluid mosaic hypothesis- the bilayer of phospholipid molecules with protein molecules in it / over the surface
Protoplasm
of two parts
Cytoplasm
contains
Cell organelles
Microbodies contained in the cytoplasm, carrying out specific functions for the cell activities
Nucleus
Consists of
Nucleoplasma
Nuclear membrane
contains
Fluid medium, (containing nucleotides and enzymes)
Chromatin substances / chromosomes
Consists of
Protein (histone)
DNA
Vacuole (plant cell)
Contains water, nutrients, mineral salts, waste (nitrogenous) substances
Mitocondrion
Generates energy for the cell
Ribosome
The site for protein synthesis
Chloroplast (in green plant)
Grana
Contains chlorophyll
Stroma
Contains enzymes
Endoplasmic reticulum
Rough ER
With ribosomes
Smooth ER
No ribosomes
Golgi Body
Processing and packaging proteins/ other molecules to form cell secretions

INTEXT QUESTIONS PAGE NO. 63

Q1. Can you name the two organelles we have studied that contain their own genetic material?
Answer: Mitochondria and plastids are the two organelles that contain their own genetic material. Both these organelles have their own DNA and ribosomes.

Q2. If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?
Answer: Cell is the smallest unit of life, which is capable of all living functions. If the organisation of a cell is destroyed due to some physical or chemical influence, then the ability of the cell to perform all living functions such as respiration, nutrition, excretion, etc. would be affected.

Q3. Why are lysosomes known as suicide bags?
Answer: Lysosomes are membrane-bound vesicular structures that contain powerful digestive enzymes. These enzymes are capable of breaking down any foreign food particle or microbes entering the cell. Sometimes, lysosomes can cause self-destruction of a cell by releasing these digestive enzymes within the cells. Hence, they are also known as 'suicidal bags'.

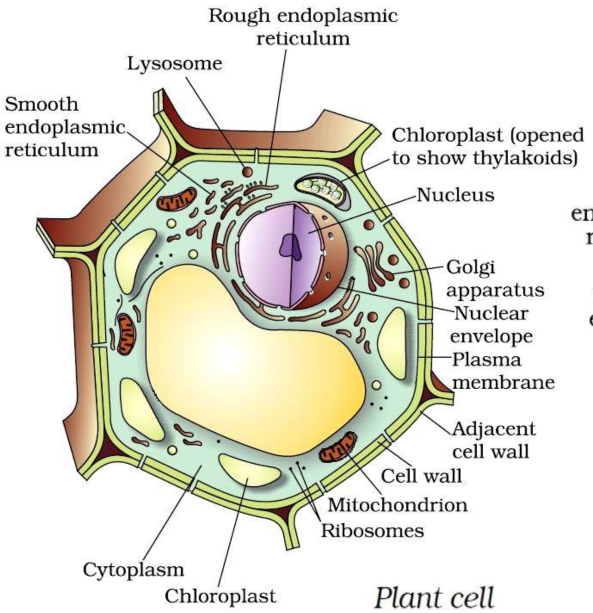
Q4. Where are proteins synthesized inside the cell?
Answer: Ribosomes are the site for protein synthesis. Ribosomes are very small structures found either in a free state, suspended in the cytoplasm, or attached to the surface of the endoplasmic reticulum. They are composed of ribonucleic acids and proteins.

EXERCISE QUESTIONS PAGE NO. 66 and 67

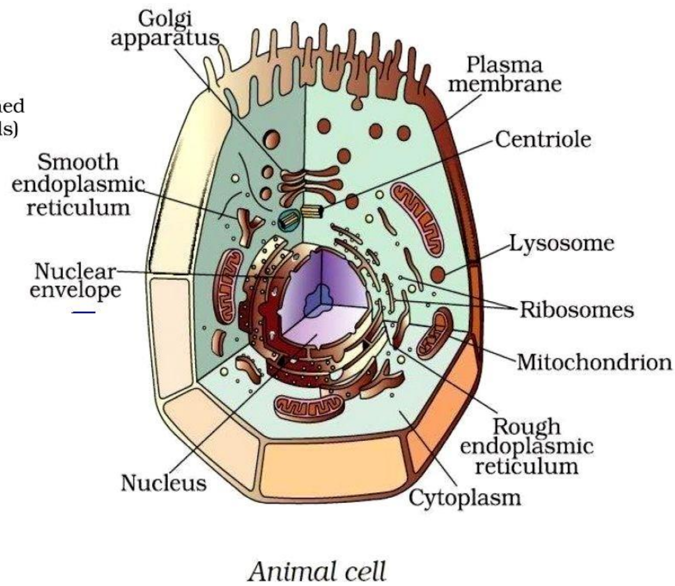
Q1. Make a comparison and write down ways in which plant cells are different from animal cells.
Answer:

Differences between Plant cell and Animal cell

S.No.	Plant cell	Animal cell
1.	Plant cell has an outer rigid cell wall which is made up of cellulose.	Animal cell lacks a cell wall.
2.	Plant cell is larger than animal cell.	Animal cell is comparatively smaller in size.
3.	Plant cell has large vacuoles which occupy more space in the cell.	Animal cell usually lacks vacuoles. Even if they are present, they occur in minute sizes.
4.	Centrosome is present only in the cells of some lower plants.	All the animal cells have centrosomes.
5.	Lysosomes are found only in the eukaryotic plant cells.	Lysosomes are found in all animal cells.
6.	Plant cell contains plastids.	Plastids are absent
7.	Mostly, starch is the storage material.	Glycogen is the storage material.



Plant cell



Animal cell

Q2. How is a prokaryotic cell different from a eukaryotic cell?
Answer:
Differences between Prokaryotic cell and Eukaryotic cell

Prokaryotic Cell		Eukaryotic Cell	
1.	It is generally smaller (1-10 micro metre) in size	1.	It is comparatively larger (5-100 micro metre) in size.
2.	It lacks a well organised nucleus as its nuclear material is not surrounded by a nuclear membrane.	2.	It contains a well organized nucleus as its nuclear material is surrounded by a nuclear membrane.
3.	It has a single chromosome	3.	It has more than one chromosome.
4.	Nucleolus is absent	4	Nucleolus is present
5.	It lacks membrane bound cell organelles.	5.	It possess membrane bound cell organelles.
6.	Cell division occurs by fission or budding. Mitotic and meiotic divisions are absent	6.	Cell division takes place by mitosis and meiosis.
7.	Ribosomes are smaller	7.	Ribosomes are larger

Q3. What would happen if the plasma membrane ruptures or breaks down?
Answer: If the plasma membrane of a cell is ruptured, then the cell will die. The plasma membrane regulates the movement of substances in and out of the cell by diffusion or osmosis. Thus, if the plasma membrane is ruptured, then the cell might leak out its contents.

Q4. What would happen to the life of a cell if there was no Golgi apparatus?
Answer: If there was no Golgi apparatus in the cell, then most activities performed by the Golgi apparatus will not take place.

(i) Membranes of the Golgi apparatus are often connected to ER membranes. It collects simpler molecules and combines them to make more complex molecules. These are then packaged in small vesicles and are either stored in the cell or sent out as per the requirement.

Thus, if the Golgi apparatus is absent in the cell, then the above process of storage, modification, and packaging of products will not be possible.

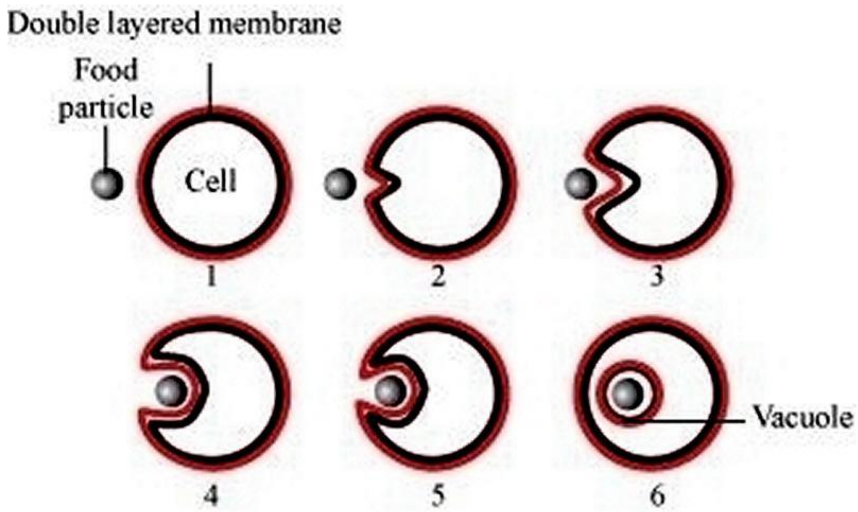
(ii) The formation of complex sugars from simple sugars will not be possible as this takes place with the help of enzymes present in Golgi bodies.

(iii) The Golgi apparatus is involved in the formation of lysosomes or peroxisomes. Thus, if the Golgi body is absent in a cell, the synthesis of lysosomes or peroxisomes will not be possible in the cell.

Q5. Which organelle is known as the powerhouse of the cell? Why?
Answer: Mitochondria are known as the powerhouse of cells. Mitochondria create energy for the cell, and this process of creating energy for the cell is known as cellular respiration. Most chemical reactions involved in cellular respiration occur in the mitochondria. The energy required for various chemical activities needed for life is released by the mitochondria in the form of ATP (Adenosine triphosphate) molecules. For this reason, mitochondria are known as the powerhouse of cells.

Q6. Where do the lipids and proteins constituting the cell membrane get synthesised?
Answer: Lipids and proteinsconstituting the cell membrane are synthesized in the endoplasmic reticulum.
SER (Smooth endoplasmic reticulum) helps in the manufacturing of lipids.
RER (Rough endoplasmic reticulum) has particles attached to its surface, called ribosomes. These ribosomes are the site for protein synthesis.

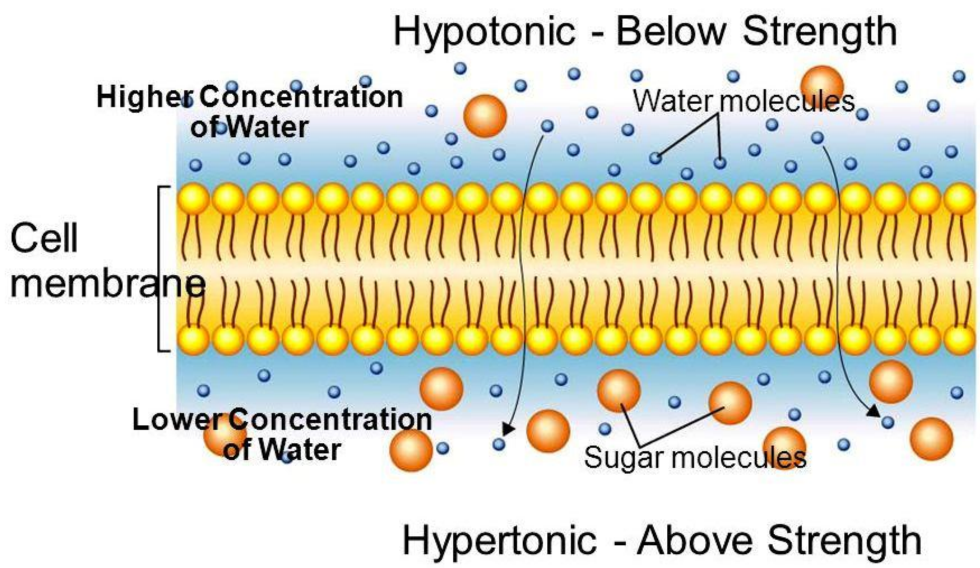
Q7. How does an *Amoeba* obtain its food?
Answer: Amoeba obtains its food through the process of endocytosis. The flexibility of the cell membrane enables the cell to engulf the solid particles of food and other materials from its external environment.



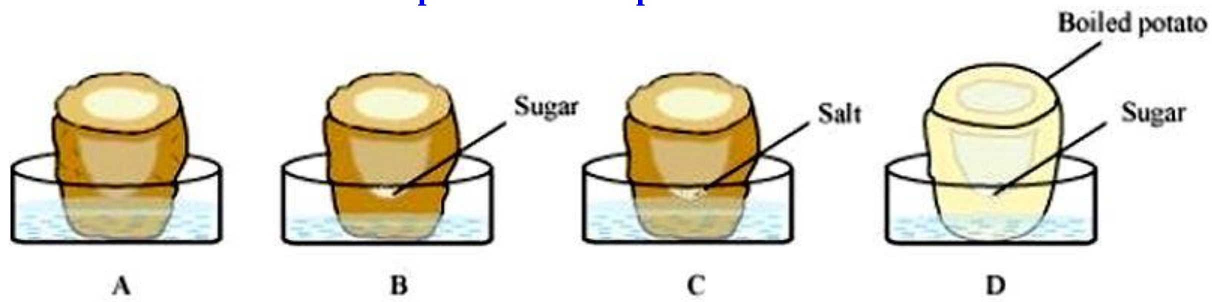
<u>Cell engulfing food particle</u>

Q8. What is osmosis?
Answer: The movement of water molecules from a region of high concentration to a region of low concentration through a selectively permeable membrane is called osmosis. It is a special case of diffusion, where the medium is water.

For example, if the medium surrounding the cell has a higher water concentration than the cell i.e., if the solution is a dilute solution, then the cell will gain water by osmosis.



Q9. Carry out the following osmosis experiment: Take four peeled potato halves and scoos each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now,
(a) Keep cup A empty
(b) Put one teaspoon sugar in cup B
(c) Put one teaspoon salt in cup C
(d) Put one teaspoon sugar in the boiled potato cup D.
Keep these for two hours. Then observe the four potato cups and answer the following:
(i) Explain why water gathers in the hollowed portion of B and C.
(ii) Why is potato A necessary for this experiment?
(iii) Explain why water does not gather in the hollowed out portions of A and D.
Answer: **Experimental set up**



(i) Water gathers in the hollowed portions of set-up B and C because water enters the potato as a result of osmosis. Since the medium surrounding the cell has a higher water concentration than the cell, the water moves inside by osmosis. Hence, water gathers in the hollowed portions of the potato cup.
(ii) Potato A in the experiment acts as a control set-up. No water gathers in the hollowed portions of potato A.
(iii) Water does not gather in the hollowed portions of potato A because potato cup A is empty. It is a control set-up in the experiment.

Water is not able to enter potato D because the potato used here is boiled. Boiling denatures the proteins present in the cell membrane and thus, disrupts the cell membrane. For osmosis, a semi-permeable membrane is required, which is disrupted in this case. Therefore, osmosis will not occur. Hence, water does not enter the boiled potato cup.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 5
THE FUNDAMENTAL UNIT OF LIFE

1. Define Cell

2. What will happen to a cell if its nucleus is removed?

3. Who proposed the Cell theory ?

4. What is Nucleoid ?

5. Fill in the blanks:-

(a) New cells are formed from _______________.

(b) Movement of water molecules from their higher concentration to their lower concentration through a semi- permeable membrane is called _______________.

(c) The functional components of cell are _______________, _______________& _______________.

(d) Protoplasm has two parts- _______________ & _______________.

(e) Nucleus, mitochondria & plastids have their own ____________ & _____________.

(f) The shrinkage or contraction of the contents of the cell away from the cell wall is known as _______________.

(g) The process by which Amoeba can engulf a food particle is _______________.

(h) _______________ is the manufacture of lipids required for making cell membrane.

(i) A cell that lacks nuclear membrane is called a prokaryotic cell & the nuclear region is called _______________.

(j) Movement of materials in & out of the cell takes place by _______________ & _______________.

6. Identifiy and name the following cell structures:

a) The undefined nuclear region of Prokaryotic cell.

b) Site of energy release inside the cell.

7. Name the kind of plastid which is important for photosynthesis in leaves of the plants.

8. Name the two components of chromosomes.

9. When does the chromatin network separate out to form chromosomes?

10. Name the cell organelle that detoxifies poisons and drugs.

11. Name the cell organelle that is associated with protein synthesis.

12. Name a cell which changes its shape.

13. Name the functional unit of DNA that carries genetic informations.

14. Expand the word DNA.

15. State the primary functions of plasma membrane.

16. Name a cell that lacks cell wall

17. Name the main constituent substance present in plant cell wall.

18. Name the cell which is responsible for intracellular transport.

19. Name the Reticulum which has ribosome's attached to it .

20. Name a cell that does not have a nucleus, what are they called?

21. The largest cell in the human body is -

(a) Nerve cell (b) Muscle cell

(c) Liver cell (d) Kidney cell

22. The barrier between the protoplasm and the other environment in an animal cells -

(a) Cell wall (b) Nuclear membrane

(c) Tonoplast (d) Plasma membrane

23. The term 'Cell' was given by -

(a) Leeuwenhoek (b) Robert hooke

(c) Flemming (d) Robert Brown

24. Who proposed the cell theory? -

(a) Schleiden and Schwann (b) Watson and Crick

(c) Darwin and Wallace (d) Mendel and Morgan

25. A plant cell differs from an animal cell in the absence of -

(a) Endoplasmic Reticulum (b) Mitochondria

(c) Ribosome (d) Centrioles

26. Centrosome is found in -

(a) Cytoplasm (b) Nucleus

(c) Chromosomes (d) Nucleolus

27. The power house of a cell is -

(a) Chloroplast (b) Mitochondrion

(c) Golgi apparatus (d) Nucleolus

28. Within a cell the site of respiration (oxidation) is the -

(a) Ribosome (b) Golgi apparatus

(c) Mitochondrion (d) Endoplasmic Reticulum

29. Which is called 'Suicidal Bag'?

(a) Centrosome (b) Lysosome

(c) Mesosome (d) Chromosome

30. Ribosomes are the center for -

(a) Respiration (b) Photosynthesis

(c) Protein synthesis (d) Fat synthesis

31. Double membrane is absent in -

(a) Mitochondrion (b) Chloroplast

(c) Nucleus (d) Lysosome

32. Cell organelle found only in Plant is -

(a) Golgi apparatus (b) Mitochondria

(c) Plastids (d) Ribosomes

33. Organisms lacking nucleus and membrane bound organelle are -

(a) Diploids (b) Prokaryotes

(c) Haploids (d) Eukaryotes

34. Animal cell is limited by -

(a) Plasma membrane (b) Shell membrane

(c) Cell wall (d) Basement membrane

35. The network of Endoplasmic Reticulum is present in the -

(a) Nucleus (b) Nucleolus

(c) Cytoplasm (d) Chromosomes

36. Lysosome are reservoirs of -

(a) Fat (b) RNA

(c) Secretary Glycoprotein (d) Hydrolytic Enzymes

37. The membrane surrounding the vacuole of a plant cell is called -

(a) Tonoplast (b) Plasma membrane

(c) Nuclear membrane (d) Cell wall

38. Cell secretion is done by -

(a) Plastids (b) ER

(c) Golgi apparatus (d) Nucleolus

39. Centrioles are associated with -

(a) DNA synthesis (b) Reproduction

(c) Spindle formation (d) Respiration

40. Main difference between animal cell and plant cell is -

(a) Chromosome (b) Ribosome

(c) Lysosome (d) Endoplasmic Reticulum

41. Animal cell lacking nuclei would also lack in -

(a) Chromosome (b) Ribosome

(c) Lysosome (d) Endoplasmic Reticulum

42. Plasmolysis occurs due to -

(a) Absorption (b) Endosmosis

(c)Osmosis (d)Exosmosis

43. A plant cell becomes turgid due to -

(a) Plasmolysis (b) Exosmosis

(c) Endosmosis (d) Electrolysis

44. Solute concentration is higher in the external solution -

(a) Hypotonic (b) Isotonic

(c) Hypertonic (d) None of the above

45. A cell placed in hypertonic solution will -

(a) Shrink (b) Show Plasmolysis

(c) Swell up (d) No change in shape or size

46. The radiant energy of sunlight is converted to chemical energy and is stored as -

(a) AMP (b) ADP

(c)ATP (d) APP

47. Which of the following organelle does not have membrane?

(a) Ribosome (b) Nucleus

(c) Chloroplast (d) Mitochondria

48. Root hair absorbs water from soil through -

(a) Osmosis (b) Active transport

(c) Diffusion (d) Endocytosis

49. The number of lenses in compound light microscope is -

(a) 2 (b)3 (c) 4 (d)1

50. The history of the cell began in 1665 with the publication of Micrographia in London by -

(a) Robert Hooke (b) Robert Brown

(c) Strasburger (d)Dujardin

51. Cell inclusions are -

(a) Non-living materials present in the cytoplasm

(b) Another name of cell organelle

(c) Cytoskeletal framework of cell

(d) Combined name for cell wall and plasma membrane

52. Which cell organelle is not bounded by a membrane -

(a) Ribosome (b) Lysosome

(c)ER (d)Nucleus

53. Which of the following cellular part possess a double membrane?

(a) Nucleus (b) Chloroplast

(c)Mitochondrion (d)All of the above

54. Cristae and Oxysomes are associated with -

(a) Mitochondria (b) Plastids

(c) Golgi apparatus (d)Plasma membrane

55. Karyotheca is another name of -

(a) Nuclear envelope (b) Nucleus

(c)Nuclear pores (d)Nucleolus

56. Cell organelle that acts as supporting skeletal framework of the cell is -

(a) Golgi apparatus (b) Nucleus

(c) Mitochondria (d) ER

57. Plastids are present in -

(a) Animal cell only

(b) Plant cells only

(c) Both animal cells and Plant cells

(d) Neither animal nor plant cell

58. Cell wall of plant is chiefly composed of -

(a) Hemicellulose (b) Cellulose

(c) Phospholipids (d)Proteins

59. Intercellular connections of plant cells are called -

(a) Middle lamella (b) Micro fibrils

(c) Matrix (d) Plasmodesmata

60. Genes are located on the -

(a) Chromosomes (b) Nucleolus

(c) Nuclear membrane (d)Plasma membrane

61. Chromatin consists of -

(a) RNA (b) DNA

(c) RNA and histones (proteins) (d)DNA and histones (proteins)

62. Different types of chromosomes can be recognized by the positions of the following separating the two arms -

(a) Centromere (b) Genes

(c) Spindle (d)Nucleus

63. Name of the process that requires energy provided by ATP -

(a)Diffusion (b) Osmosis

(c) Active transport (d)Plasmolysis

64. What is the advantage of multicellularity over unicellularity?

65. What are the chromosomes made up of?

66. A cell placed in a solution swells up. What kind of solution is it? Why does it happen?

67. Why are lysosomes known as “suicidal bags”?

68. Why is the nucleus so significant in a cell?

69. Differentiate between plant and animal cells.

70. Give the major functions of the following cell organelles-

71. Why is the cell known the 'fundamental and structural unit of life '

72. What is a semi permeable membrane? what are the differences between semi permeable membrane and selectively permeable membrane?

73. Which cell in the human body does not have the mitochondria?

74. What are plastids? Write their functions?

75. Which structure of animal cells forms the asters of spindle ?

76. Name two semi- autonomous organelles?

77. Which cell organelle is rich in acid hydrolases?

78. Which cell organelles are called ribonucleoprotine particle?

79. Differentiate between SER and RER

80. What is the difference between eukaryotes and prokaryotes?

81. What is the difference between osmosis and diffusion.

82. Where are peroxisomes found ?

83. What are the chemical reactions take place in cytoplasm, nucleoplasm, and in mitochondria?

84. What is Diffusion?

85. What is dictyosomes ?

86. What would happen if an animal cell is kept in distilled water for 24 hours.

87. Give 5 examples of single celled organisms.

88. What are multicellular organisms ? Give an example.

89. Which cell organelle is commonly referred as the suicidal bags of the cell.

90. Name the process through which an amoeba acquires its food from the external surroundings.

91. State the functions of chromosome in a cell.

92. What is Biogenisis?

93. Who discovered Golgi Apparatus?

94. Name the cell organelle which is involved in the formation of lysosomes.

95. What is Endosmosis?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 5
THE FUNDAMENTAL UNIT OF LIFE

1. Who expanded cell theory by suggesting that all cells arise from pre-existing cells?

2. In which year electron microscope was invented?

3. Name the book in which Robert Hooke published his observations about cork cells.

4. Who discovered nucleus in the cell?

5. Name the two postulates of the cell theory.

6. Who coined the term 'protoplasm'?

7. Name the largest cell?

8. Name the world's smallest cell.

9. Name the smallest cell in human body.

10. Name the biggest cell in human body.

11. Name the longest cell in human body.

12. Name the cell in human body which cannot reproduce.

13. Give an example of anucleate cell i.e. cell without nucleus.

14. Give an example of cells containing two nuclei (Binucleate).

15. Give examples of cells which are muti-nucleate (i.e. having many nuclei).

16. What is the plasma membrane composed of?

17. Who proposed fluid-mosaic model of cell or plasma membrane?

18. Is plasma membrane permeable or selectively permeable?

19. What are different types transport of components across cell membrane?

20. Define Passive Transport.

21. What is diffusion?

22. Define Osmosis. What are different types of osmosis? Give examples of osmosis.

23. What is plasmolysis?

24. What would happen if the plasma membrane ruptures or breaks down?

25. What do you mean by Endocytosis? How does an Amoeba obtain its food?

26. Define Exocytosis.

27. Why are lysosomes known as suicide bags?

28. What happens to a cell (plant cell or animal cell) when placed in the following solutions:

(a) Hypotonic solution

(b) Isotonic solution

(c) Hypertonic solution

29. Place a de-shelled egg in water for five minutes. What do you observe? (Note: De-shelled egg means,the shell of an egg is removed by dissolving it in dilute hydrochloric acid. The shell is mostly calcium carbonate. A thin outer skin now encloses the egg.)

What will happen if a de-shelled egg in a concentrated salt solution for 5 minutes?

30. Put dried raisins in plain water and leave them for some time. Then place them in concentrated solution of sugar or salt. What do you observe in both cases?

31. Viruses are

(a) Uni cellular micro-organisms

(b) Bi-Cellular micro-organisms

(c) Multi-cellular micro-organisms

(d) Non-cellular micro-organisms

32. Who is known as Father of Biology?

33. Who discovered Golgi apparatus?

34. Which cell organelle is known as "protein factory"?

35. What is the energy currency of the cell called?

36. When chromosomes are visible in the nucleus?

37. Which of the following is NOT involved in the synthesis of proteins?

(a) rough ER

(b) smooth ER

(c) Golgi body

(d) ribosomes

38. Are plastids present in all cells? What are its types?

39. Name the sac like structure which form the grana?

40. What are the conditions for osmosis?

41. Will the temperature have any effect on the process of the osmosis?

42. What is osmoregulation?

43. Which organ of the plant body helps in osmoregulation?

44. Which organelle of the cell in animals helps in osmregulation?

45. What are centrosomes? What functions do they perform?

46. Who is known as 'Father of Microscopy'?

47. Are Viruses Prokaryotic or Eukaryotic?

48. Which of the following often distinguishes plant cells from animal cells?

(a) centrioles

(b) nucleus

(c) chromatin

(d) rough ER

49. Which cell organelle is called "kitchen of plant"?

50. Which cell organelle is called 'control center'?

51. Which cell organelle is called 'transport system'?

52. What is Endoplasmic Reticulum(ER)? Name its types?

53. What are the functions of Endoplasmic Reticulum (ER)?

54. What are the components nucleus?

55. What is the function of nucleoplasm?

56. How chromatic network is related to chromosomes?

57. What are chromosomes?

58. What is the full form of DNA and RNA?

59. Who discovered Virus?

60. What are the function of nucleus?

61. Why can't single cells grow very large? Or Big organisms like human beings are multi-cellular? Why can't such big organisms be a single large cell?

62. Why do vegetable vendors (subzi-walla) regularly sprinkle water on the vegetables in their baskets?

63. Why do we stain cells while observing under microscope? List commonly used stains.

64. Are there any exceptions to cell theory proposed by Schleiden & Schwann and Virchow? If yes, what are those?

65. What is the thickness of cell membrane?

66. Why is mitochondria absent in red blood cells?

67. Name the cell organelles which their own DNA and Ribosomes.

68. What is cytoskeleton?

69. Name the cell organelles involved in synthesis, packaging and movement of protein (or other macromolecules) inside a cell.

70. 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) WBC and Amoeba

(d) Paramecium

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 5
THE FUNDAMENTAL UNIT OF LIFE

1. Which of the following can be made into crystal?

(a) A Bacterium

(b) An Amoeba

(c) A Virus

(d) A Sperm

2. A cell will swell up if

(a) The concentration of water molecules in the cell is higher than the concentration of water molecules in surrounding medium

(b) The concentration of water molecules in surrounding medium is higher than water molecules concentration in the cell

(c) The concentration of water molecules is same in the cell and in the surrounding medium

(d) Concentration of water molecules does not matter

3. Chromosomes are made up of

(a) DNA (b) protein

(c) DNA and protein (d) RNA

4. Which of these options are not a function of Ribosomes?

(i) It helps in manufacture of protein molecules

(ii) It helps in manufacture of enzymes

(iii) It helps in manufacture of hormones

(iv) It helps in manufacture of starch molecules

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (iii) and (iv)

(d) (iv) and (i)

5. Which of these is not related to endoplasmic reticulum?

(a) It behaves as transport channel for proteins between nucleus and cytoplasm

(b) It transports materials between various regions in cytoplasm

(c) It can be the site of energy generation

(d) It can be the site for some biochemical activities of the cell

6. Following are a few definitions of osmosis. Read carefully and select the correct definition

(a) Movement of water molecules from a region of higher concentration to a region of lower concentration through a semipermeable membrane

(b) Movement of solvent molecules from its higher concentration to lower concentration

(c) Movement of solvent molecules from higher concentration to lower concentration of solution through a permeable membrane

(d) Movement of solute molecules from lower concentration to higher concentration of solution through a semipermeable membrane

7. Plasmolysis in a plant cell is defined as

(a) break down (lysis) of plasma membrane in hypotonic medium

(b) shrinkage of cytoplasm in hypertonic medium

(c) shrinkage of nucleoplasm

(d) none of them

8. Which of the following are covered by a single membrane?

(a) Mitochondria

(b) Vacuole

(c) Lysosome

(d) Plastid

9. Find out the false sentences

(a) Golgi apparatus is involved with the formation of lysosomes

(b) Nucleus, mitochondria and plastid have DNA; hence they are able to make their own structural proteins

(c) Mitochondria is said to be the power house of the cell as ATP is generated in them.

(d) Cytoplasm is called as protoplasm

10. Find out the correct sentence

(a) Enzymes packed in Lysosomes are made through RER (rough endoplasmic reticulum)

(b) Rough endoplasmic reticulum and smooth endoplasmic reticulum produce lipid and protein respectively

(c) Endoplasmic reticulum is related with the destruction of plasma membrane

(d) Nucleoid is present inside the nucleoplasm of eukaryotic nucleus

11. Which cell organelle plays a crucial role in detoxifying many poisons and drugs in a cell?

(a) Golgi apparatus

(b) Lysosomes

(c) Smooth endoplasmic reticulum

(d) Vacuoles

12. The proteins and lipids, essential for building the cell membrane, are manufactured by

(a) rough endoplasmic reticulum

(b) golgi apparatus

(c) plasma membrane

(d) mitochondria

13. The undefined nuclear region of prokaryotes are also known as

(a) nucleus (b)

nucleolus (c)

nucleic acid (d)

nucleoid

14. The cell organelle involved in forming complex sugars from simple sugars are

(a) endoplasmic reticulum

(b) ribosomes

(c) plastids

(d) golgi apparatus

15. Which out of the following is not a function of vacuole?

(a) Storage

(b) Providing turgidity and rigidity to the cell

(c) Waste excretion

(d) Locomotion

16. Amoeba acquires its food through a process, termed

(a) exocytosis

(b) endocytosis

(c) plasmolysis

(d) exocytosis and endocytosis both

17. Cell wall of which one of these is not made up of cellulose?

(a) Bacteria

(b) *Hydrilla*

(c) Mango tree

(d) Cactus

18. Silver nitrate solution is used to study

(a) endoplasmic reticulum

(b) golgi apparatus

(c) nucleus

(d) mitochondria

19. Organelle other than nucleus, containing DNA is

(a) endoplasmic reticulum

(b) golgi apparatus

(c) mitochondria

(d) lysosome

20. Kitchen of the cell is

(a) mitochondria

(b) endoplasmic reticulum

(c) chloroplast

(d) golgi apparatus

21. Lipid molecules in the cell are sythesized by

(a) smooth endoplasmic reticulum

(b) rough endoplasmic reticulum

(c) golgi apparatus

(d) plastids

22. Cell arises from pre-existing cell was stated by

(a) Haeckel

(b) Virchow

(c) Hooke

(d) Schleiden

23. Cell theory was given by

(a) Schleiden and Schwann

(b) Virchow

(c) Hooke

(d) Haeckel

24. The only cell organelle seen in prokaryotic cell is

(a) mitochondria

(b) ribosomes

(c) plastids

(d) lysosomes

25. Organelle without a cell membrane is

(a) ribosome

(b) golgi apparatus

(c) chloroplast

(d) nucleus

26. 1 μm is

(a) 10^{-6} m

(b) 10^{-9} m

(c) 10^{-10} m

(d) 10^{-3}m

27. Lysosome arises from

(a) endoplasmic reticulum

(b) golgi apparatus

(c) nucleus

(d) mitochondria

28. Living cells were discovered by

(a) Robert Hooke

(b) Purkinje

(c) Leeuwenhoek

(d) Robert Brown

29. Select the odd one out

(a) The movement of water across a semi permeable membrane is affected by the amount of substances dissolved in it.

(b) Membranes are made of organic molecules like proteins and lipids

(c) Molecules soluble in organic solvents can easily pass through the membrane.

(d) Plasma membranes contain chitin sugar in plants

30. Why are lysosomes known as 'suicide-bags' of a cell?

31. Do you agree that "A cell is a building unit of an organism". If yes, explain why?

32. Why does the skin of your finger shrink when you wash clothes for a long time?

33. Why is endocytosis found in animals only?

34. A person takes concentrated solution of salt, after sometime, he starts vomiting. What is the phenomenon responsible for such situation? Explain.

35. Name any cell organelle which is non membranous.

36. We eat food composed of all the nutrients like carbohydrates, proteins, fats, vitamins, minerals and water. After digestion, these are absorbed in the form of glucose, aminoacids, fatty acids, glycerol etc. What mechanisms are involved in absorption of digested food and water?

37. If you are provided with some vegetables to cook. You generally add salt into the vegetables during cooking process. After adding salt, vegetables release water. What mechanism is responsible for this?

38. If cells of onion peel and RBC are separately kept in hypotonic solution, what among the following will take place? Explain the reason for your answer.

(a) Both the cells will swell.

(b) RBC will burst easily while cells of onion peel will resist the bursting to some extent.
(c) a and b both are correct.

(d) RBC and onion peel cells will behave similarly.

39. Bacteria do not have chloroplast but some bacteria are photoautorophic in nature and perform photosynthesis. Which part of bacterial cell performs this?

40. Match the following A and B

(A)	(B)
(a) Smooth endoplasmic reticulum	(i) *Amoeba*
(b) Lysosome	(ii) Nucleus
(c) Nucleoid	(iii) Bacteria
(d) Food vacuoles	(iv) Detoxification
(e) Chromatin material and nucleolus	(v) Suicidal bag

41. Write the name of different plant parts in which chromoplast, chloroplast and leucoplast are present.

42. Name the organelles which show the analogy written as under

(a) Transporting channels of the cell——

(b) Power house of the cell——

(c) Packaging and dispatching unit of the cell——

(d) Digestive bag of the cell——

(e) Storage sacs of the cell——

(f) Kitchen of the cell——

(g) Control room of the cell——

43. How is a bacterial cell different from an onion peel cell?

44. How do substances like carbon dioxide (CO2) and water (H2O) move in and out of the cell?

45. How does amoeba obtain its food?

46. Name the two organelles in a plant cell that contain their own genetic material and ribosomes.

47. Why are lysosomes also known as “scavengers of the cells”?

48. Which cell organelle controls most of the activities of the cell?

49. Why do plant cells possess large sized vacuole?

50. How are chromatin, chromatid and chromosomes related to each other?

51. Which kind of plastid is more common in

(a) roots of the plant

(b) leaves of the plant

(c) flowers and fruits

52. What are the consequences of the following conditions?

(a) A cell containing higher water concentration than the surrounding medium

(b) A cell having low water concentration than the surrounding medium.

(c) A cell having equal water concentration to its surrounding medium.

53. Draw a plant cell and label the parts which

(a) determines the function and development of the cell

(b) packages materials coming from the endoplasmic reticulum

(c) provides resistance to microbes to withstand hypotonic external media without bursting

(d) is site for many biochemical reactions necessary to sustain life.

(e) is a fluid contained inside the nucleus

54. Illustrate only a plant cell as seen under electron microscope. How is it different from animal cell?

55. Draw a neat labelled diagram of an animal cell.

56. Draw a well labelled diagram of an eukaryotic nucleus. How is it different from nucleoid?

57. Differentiate between rough and smooth endoplasmic reticulum. How is endoplasmic reticulum important for membrane biogenesis?

58. In brief state what happens when

(a) dry apricots are left for sometime in pure water and later transferred to sugar solution?

(b) a Red Blood Cell is kept in concentrated saline solution?

(c) the Plasma-membrane of a cell breaks down?

(d) rheo leaves are boiled in water first and then a drop of sugar syrup is put on it?

(e) golgi apparatus is removed from the cell?

59. Draw a neat diagram of plant cell and label any three parts which differentiate it from animal cell.

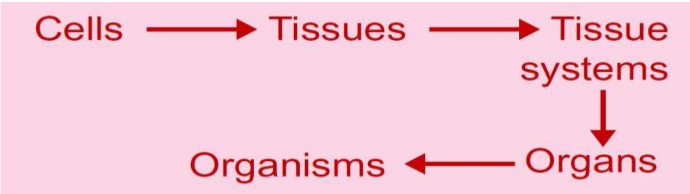
60. Draw a neat diagram of animal cell and label any three parts which differentiate it from plant cell.

CHAPTER – 6

TISSUES

TISSUES

The body of plants and animals is made up of different types of cells. These cells originate from a single cell by repeated divisions and get differentiated during development. In unicellular organisms all the body functions are performed by a single cell. But in multicellular organisms, different functions are performed by different groups of cells.
The groups of cells having a common origin and performing similar functions are called **tissues**. Several tissues are organized to form tissue system and the tissue systems form the organs and several organs into organism.



Study of tissues is called **Histology**

Tissue and Division of Labour: In complex organisms, different tasks are carried out by different organs and organ systems. Tissues are the first step towards division of labour in complex organisms.

INTEXT QUESTIONS PAGE NO. 69

Q1. What is a tissue?
Answer: A group of cells that are similar in structure and/or work together to achieve a particular function is called tissue.

Q2. What is the utility of tissues in multi-cellular organisms?
Answer: In multicellular organisms, the body system is based on the division of labour. It means the cells performing a specific function are grouped together to form a particular tissue. The different tissues are organized in a way to provide highest efficiency in functioning of the body.

PLANT TISSUES

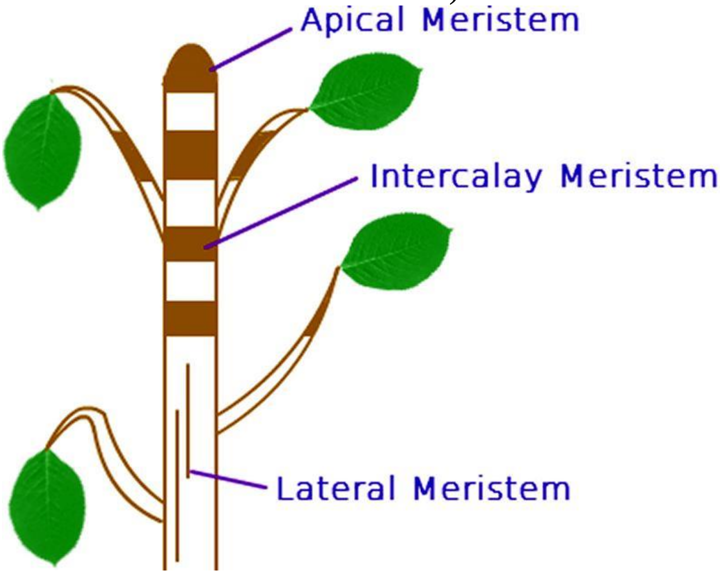
Plant tissues are of two main types, viz. meristematic tissue and permanent tissue.

MERISTEMATIC TISSUE

The growth of plants occurs only in certain specific regions. This is because the dividing tissue also known as meristematic tissue (Meristos – divisible) is located only at these points.

The meristematic tissues are made up of group of similar and immature cells, which can divide and form new cells. Meristematic cells divide continuously and thus help in increasing the length and thickness of the plant. Depending upon the position, meristematic tissues are of three types. They are as follows:

i) **Apical meristems:** Apical meristem is present at the growing tips of stems and roots and increases the length of the plant body. They are responsible for growth in length, i.e. primary growth.
ii) **Intercalary meristems:** These meristems occupy base of the leaves and the base of the internodal regions in plants such as grasses (mostly in monocotyledonous plants). These help in elongation of the internodes.
iii) **Lateral meristems:** This includes the meristematic tissues occupying the lateral regions of the stems and roots which bring about increase in the width of the
plant body. (e.g. Cork cambium and Vascular cambium).



Characteristic features of Meristematic tissues

- The meristematic cells may be round, oval, polygonal or rectangular in shape.
- Their cell walls are thin, elastic and made up of cellulose.
- They are closely arranged without intercellular spaces.
- They have dense cytoplasm with large nucleus.

PERMANENT TISSUE:

Once the cells of meristematic tissue divide to a certain extent, they become specialized for a particular function. This process is called differentiation. Once differentiation is accomplished, the cells lose their capability to divide and the tissue becomes permanent tissue.
Some cells produced by meristematic tissues stop dividing and form a permanent tissue. They have definite structure and function. They are differentiated into various types to perform different functions.

Permanent Tissue

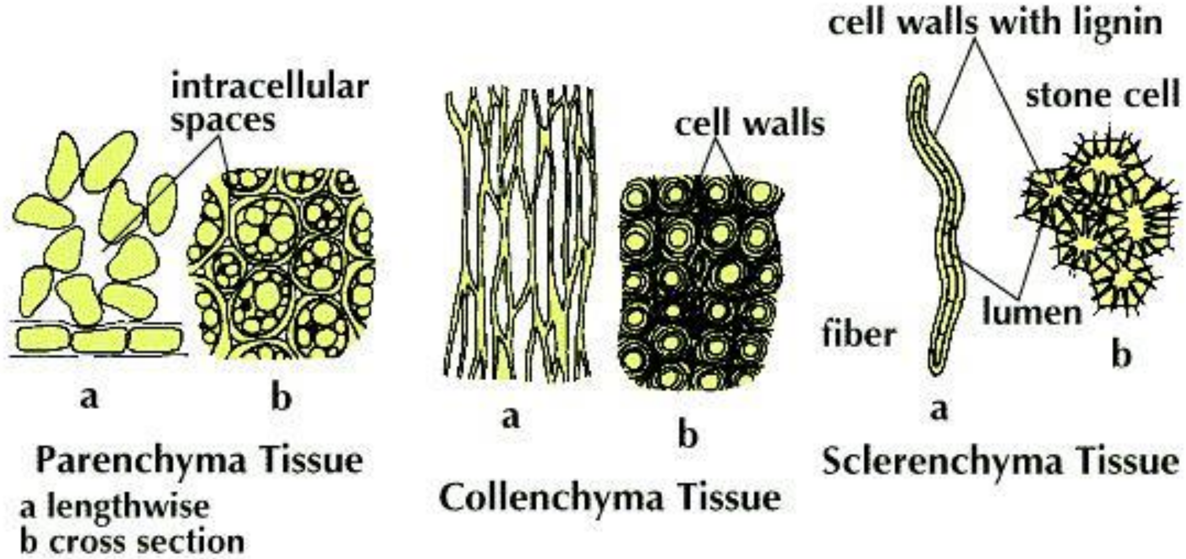
- **Simple Permanent Tissue**
  - **Parenchyma**
  - **Collenchyma**
  - **Sclerenchyma**
- **Complex Permanent Tissue**
  - **Xylem**
  - **Phloem**

The permanent tissues are classified as
i) Simple tissues and
ii) Complex tissues

SIMPLE TISSUES

A tissue with the cells of similar structure (one type of cells) and function is called simple tissue. It is of three types.

1. Parenchyma
2. Collenchyma
3. Sclerenchyma

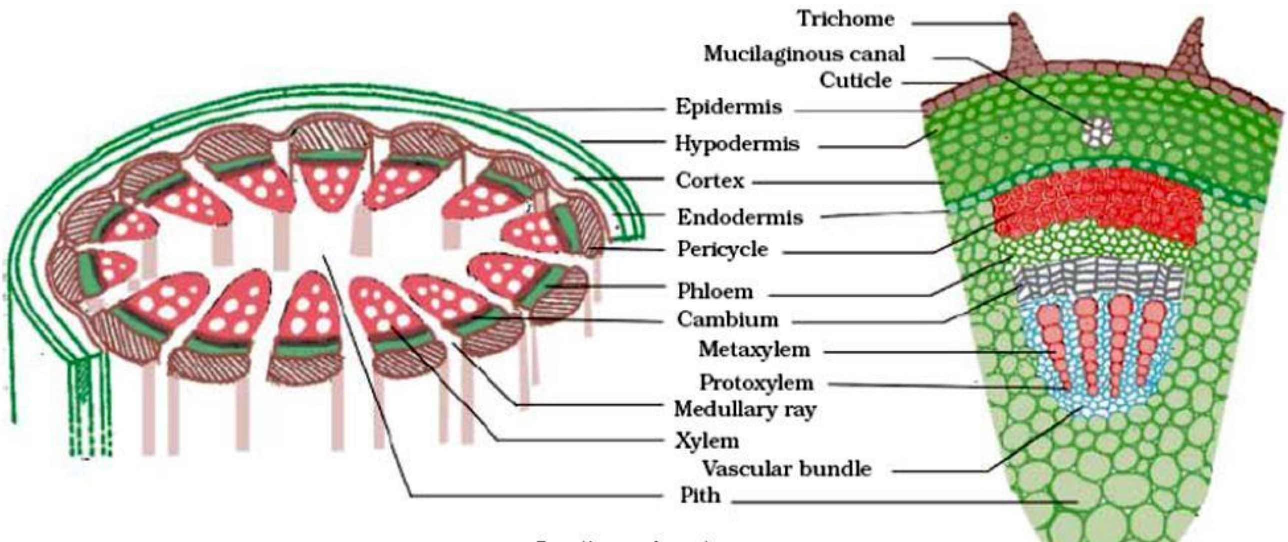


PARENCHYMA

The cells of parenchyma have thin cell wall. They are loosely packed; with lot of intercellular spaces between them. They are living cells. They are generally present in all organs of a plant. They are oval or spherical or rectangular or cylindrical in shape. The cell wall is made of cellulose and pectic materials. Parenchyma makes the largest portion of a plant body. Parenchyma mainly works are packing material in plant parts. The main function of parenchyma is to provide support and to store food. In some plant parts, parenchyma has chlorophyll as well. In that case, parenchyma carries out photosynthesis and is then termed as chlorenchyma. In aquatic plants, large air cavities are present in parenchyma. This provides buoyancy to the plant, and then the parenchyma is known as aerenchyma.

COLLENCHYMA

The cells of collenchyma are polygonal in cross section and have unevenly thickened walls. These thickenings are due to the deposition of more cellulose, hemi-cellulose and pectin. The thickening is confined to the corners of the cells. They generally occur in the dicot stem in two or more layers below the epidermis. It is absent in the roots. It also occurs in petiole and pedicel. Like Parenchyma, Collenchyma is also a living tissue. The main function of Collenchyma is to provide strength and flexibility to the growing organs like young stem.



Section of a stem

SCLERENCHYMA

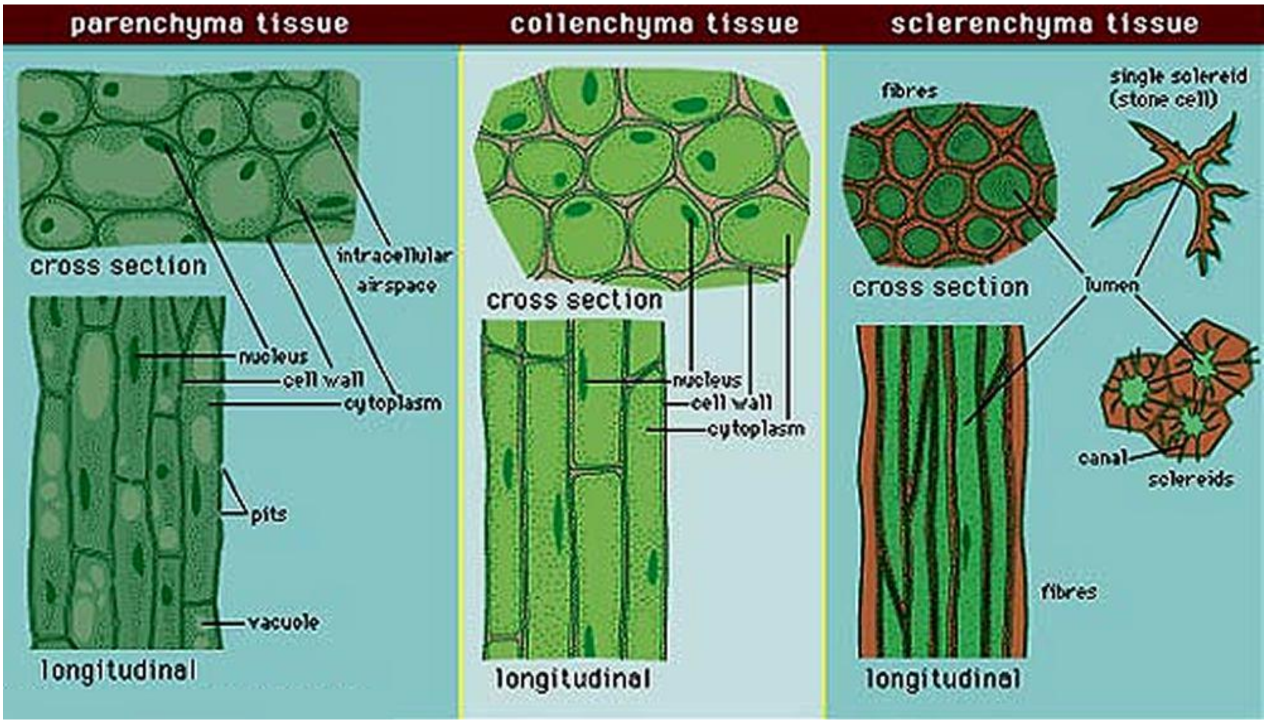
It is a dead tissue. The cells are thick with lignified walls. They give mechanical support to the organs. This has two types of cells – Sclereids and Fibres.

Sclereids

Sclereids are stone cells which are commonly found in shells of the nut, pulp of certain fruits such as Pear and Sapota.

Fibres

The fibres are elongated strands with simple pits throughout its length.



COMPLEX PERMANENT TISSUES

XYLEM

Xylem is mainly concerned with the transport of nutrients, water and minerals upwards in the plant body. It forms a continuous tube through the roots, stems, leaves, flowers and fruits by the fusion of elongated cells.

It is composed of different kinds of cells namely,

1. Tracheids
2. Xylem vessels.
3. Xylem fibres
4. Xylem parenchyma.

Tracheids

Tracheids are elongated, tapering cells with blunt ends. They have lignified secondary wall. They are the chief water conducting elements in Pteridophytes and Gymnosperms.

Xylem vessels

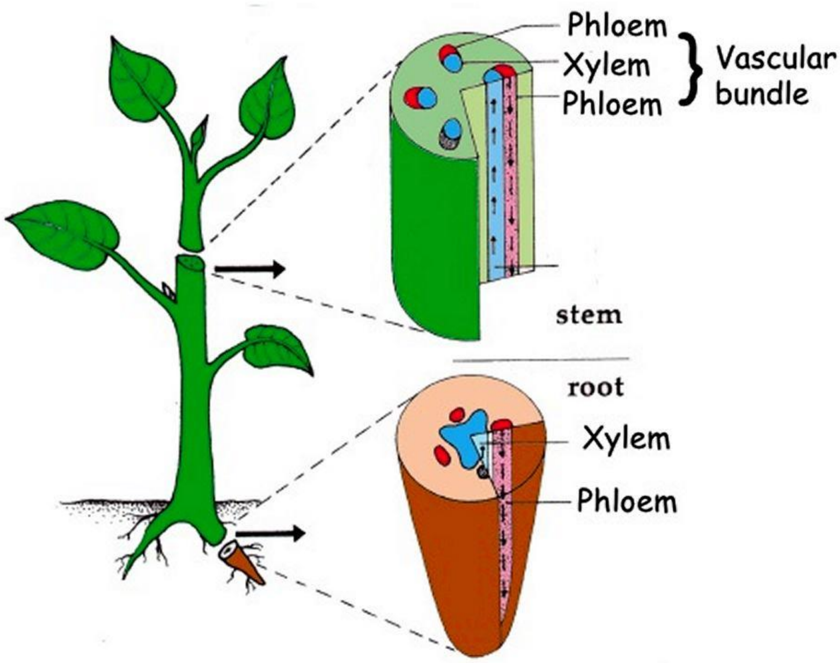
Xylem vessels have perforations at the end and are placed one above the other like a long pipe line. They are seen in the xylem of angiosperms. They conduct water, mineral nutrients and also provide mechanical strength to the plant body.

Xylem Fibres

The fibres of Sclerenchyma associated with the xylem are known as xylem fibres. They give additional mechanical strength to the plant. They are also called wood fibres.

Xylem Parenchyma

The parenchyma cells associated with xylem are known as xylem parenchyma. It is the only living tissue amongst xylem cells. They store food reserves in the form of starch and fat. They also help in conduction of water.



PHLOEM

Phloem conducts food materials from leaves to the other parts of the plant. It is made up of four types of cells.

1. Sieve elements
2. Companion cells
3. Phloem fibres
4. Phloem parenchyma

Sieve elements

Sieve elements are the conducting elements of the phloem. Sieve elements are of two types -

sieve cells and sieve tubes.

Sieve cells are present in Pteridophytes and Gymnosperms where as sieve tubes are present in Angiosperms.

Companion cells

Companion cells are thin walled elongated specialized Parenchyma cells. They are associated with sieve elements. They have a prominent nucleus and cytoplasm. They help the sieve tube in conduction of food materials in angiosperms.

Phloem fibres

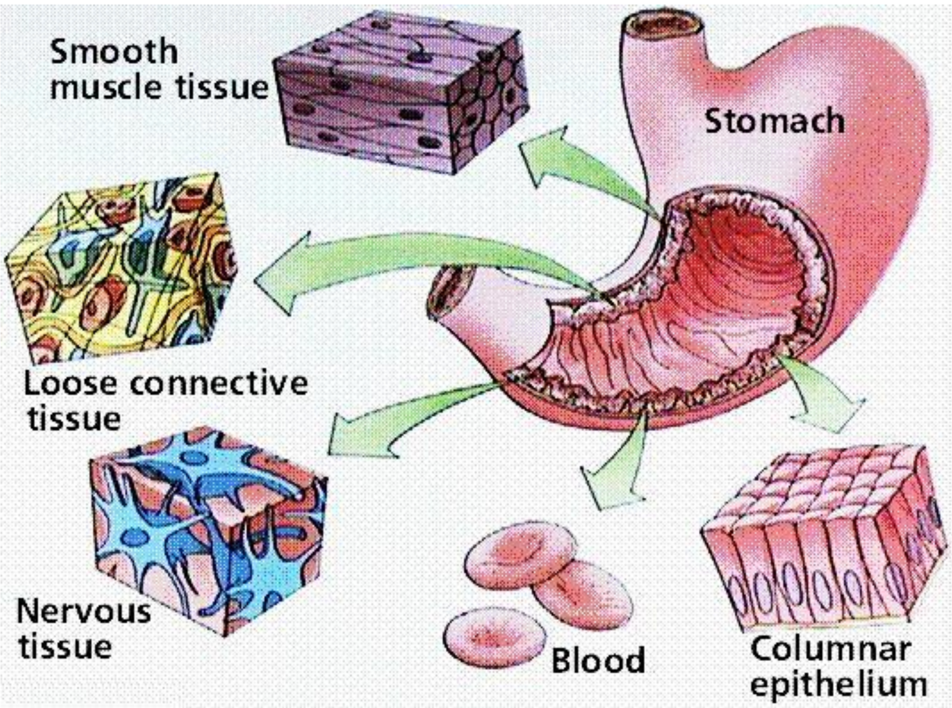
The fibres of sclerenchyma associated with phloem are called phloem fibres.
They are also called bast-fibres. They give mechanical support to the plant. Among the four types of phloem cells, phloem fibres are the only dead tissues.

Phloem parenchyma

The parenchyma cells associated with phloem are called phloem parenchyma. They store starch and fats.

ANIMAL TISSUES

Animal tissues are of four types, viz. epithelial tissue, connective tissue, muscular tissue and nervous tissue.



EPITHELIAL TISSUE:

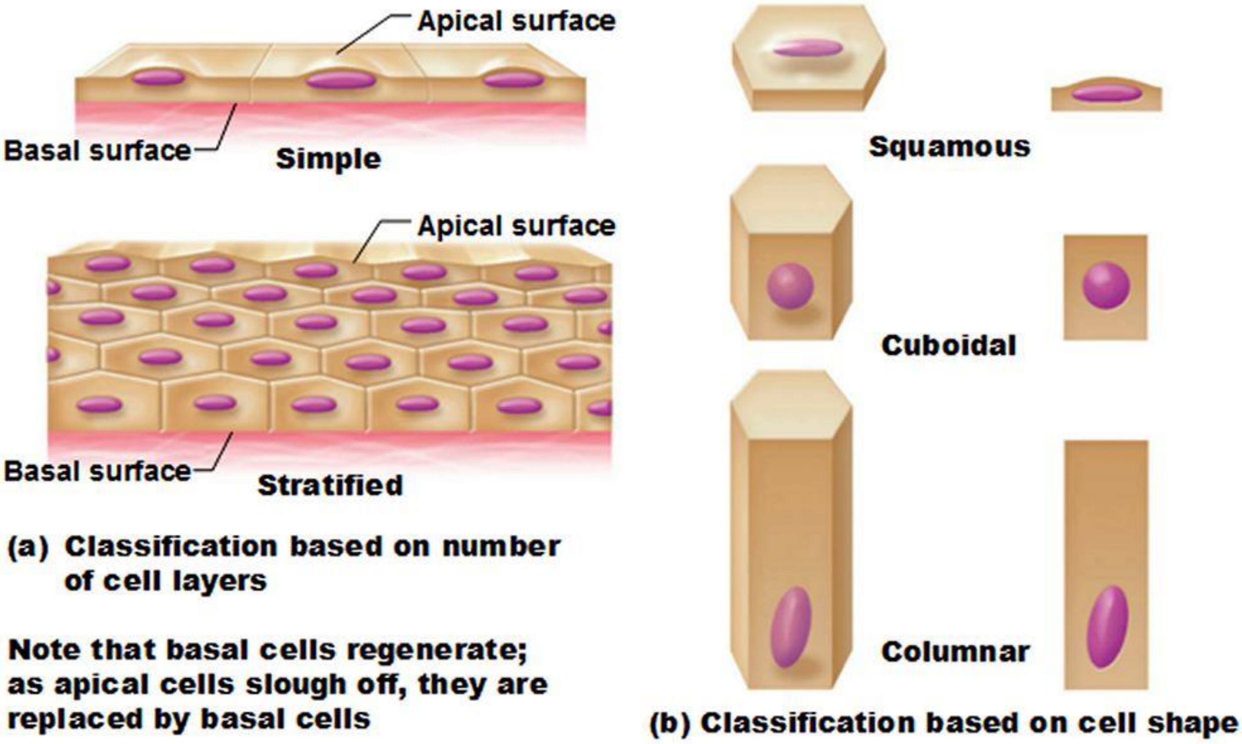
The epithelial tissue forms the covering or lining of most of the organs. The cells of epithelial tissue are tightly packed and form a continuous sheet. There is small amount of cementing materials between the cells and no intercellular space is present. Permeability of the epithelial tissue plays a great role in exchange of materials among various organs it also plays an important role in osmoregulation. All epithelial tissues are separated by the underlying tissue by an extracellular fibrous basement membrane.
Epithelial tissues are of following types:

1. Simple Epithelium
2. Cuboidal Epithelium
3. Columnar Epithelium

4. Stratified Epithelium

Simple Epithelium
The simple epithelium is composed of a single layer of cells. This type of epithelial tissue forms the lining of blood vessels and alveoli. Thin layer of cells facilitates exchange of substances; in such cases.

Cuboidal Epithelium
The cells are cube-shaped in cuboidal epithelium. Linings of kidney tubules and ducts of salivary glands are composed of cuboidal epithelium. Cuboidal cells provide mechanical support. Cells of epithelium may play the role of secretion and then they are called glandular epithelium.



Columnar Epithelium
Cells are column-shaped in columnar epithelium. Columnar epithelium facilitates secretion and absorption. For example; the lining of intestine is composed of columnar epithelium. In some organs, columnar epithelium has cilia present on the outer surface. Cilia facilitate movements of certain substances. The ciliated epithelium in the respiratory tract pushes the mucus forward.

Stratified Epithelium
Cells of the stratified epithelium are in many layers. Skin is an example of stratified epithelium. Stratification of layers prevents wear and tear.

CONNECTIVE TISSUE:

The cells of a connective tissue are loosely scattered in a matrix. The matrix can be a fluid, jelly like, dense or rigid. The nature of matrix depends on the function a connective tissue serves. Following are the various connective tissues:

Areolar (Loose) Connective Tissue
Areolar tissue is found between skin and muscles, around blood vessels and nerves and in bone marrow. Areolar tissue fills the gap between tissues and provides support. It also helps in repair of tissues.

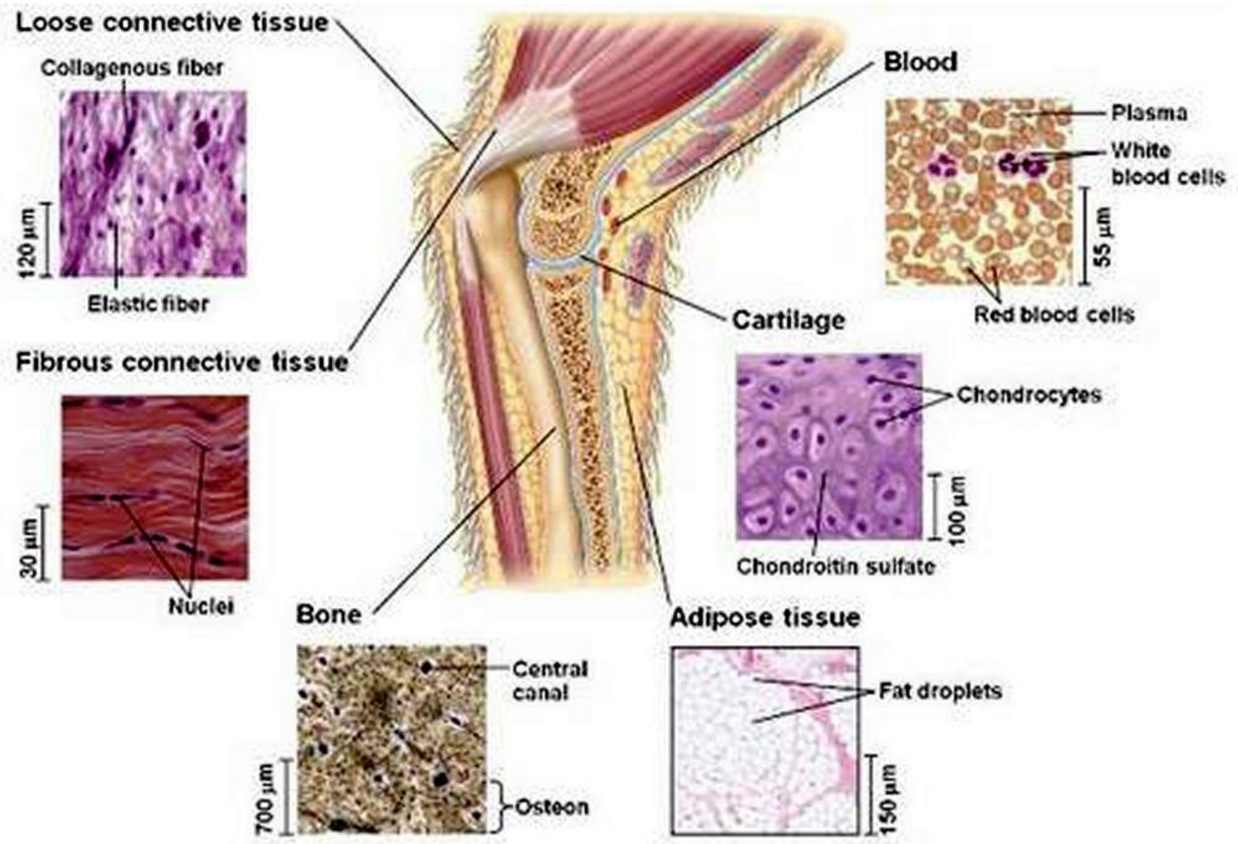
Dense connective tissue(Fibrous connective tissue)
It has thicker, denser fibers and fewer cells. The matrix is made up mostly of collagen fibers, with fibroblasts arranged in rows. This type of connective tissue forms tendons and ligaments, which attach muscle to bone and bone to bone, respectively.

Adipose Tissue
Adipose tissue is composed of fat globules. This tissue is found below the skin and beneath the organs. Adipose tissue provides insulation and works as a cushion.

Bone
Bone is mainly composed of osteoblasts. Bone makes the skeletal system. Skeletal system is responsible for providing structural framework to the body. It provides protection to important organs and facilitates movements.

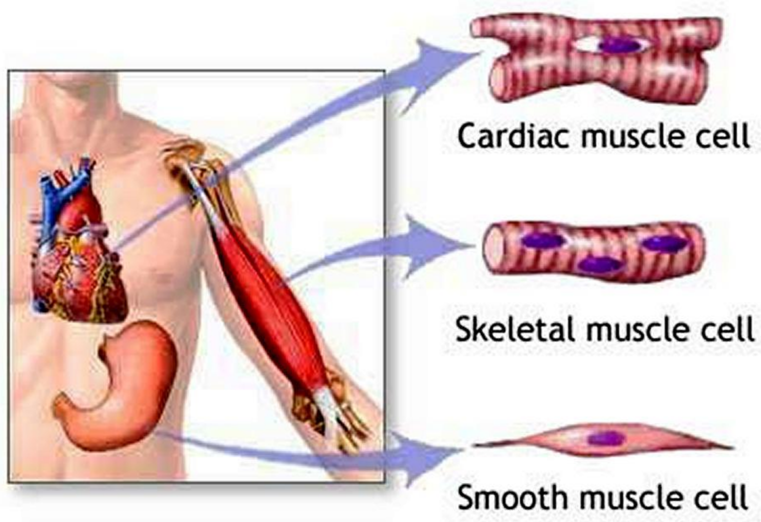
Cartilage
Cartilage is mainly composed of chondrioblasts. Cartilage is present at the ends of articulatory bones. Cartilage is also present in external ear, bronchii, etc.

Blood
Blood is composed of blood cells, platelets and plasma. Blood plays an important role in transportation of various substances in the body. It also helps in osmoregulation and temperature control.



MUSCULAR TISSUE

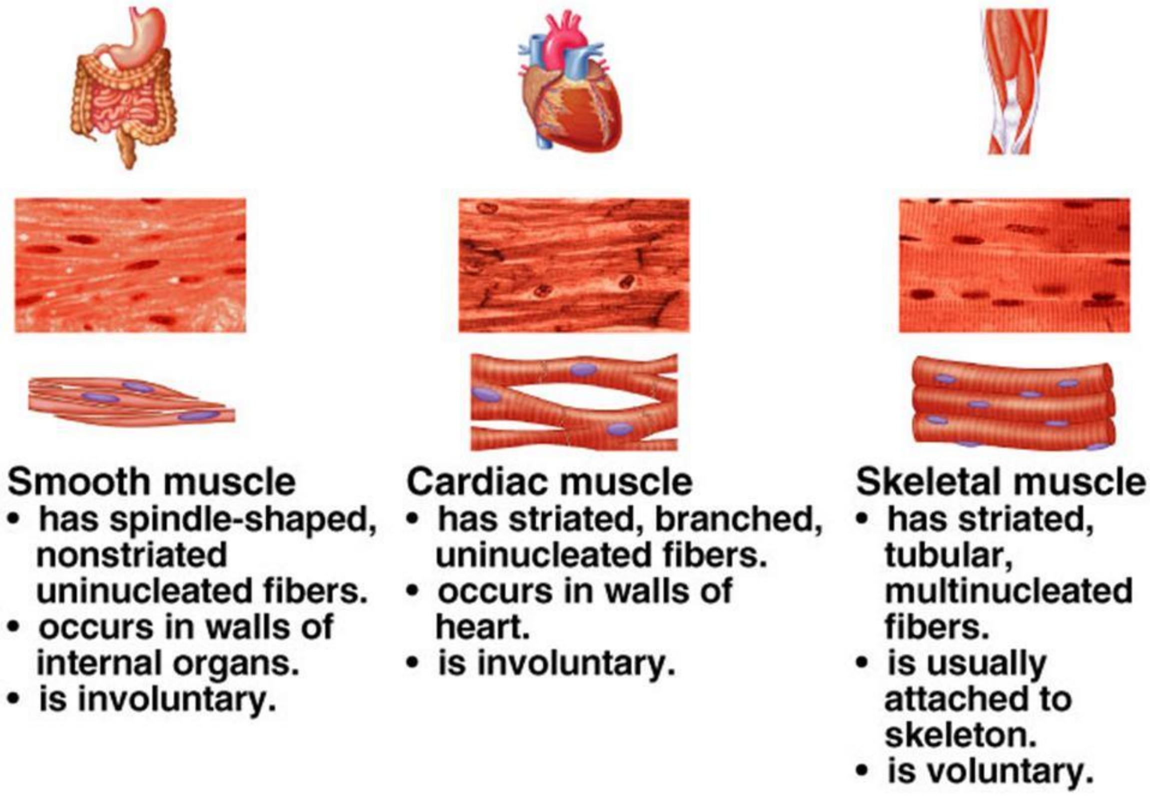
Muscular tissue is composed of muscle cells. Muscle cells are specialized cells which have the capability to contract and expand. Due to contraction and expansion, muscles facilitate various kinds of movements in the body. Muscular tissues are of three types:



Striated Muscles
The cells of striated muscles are in the form of long, unbranched fibres. Cells are multinucleate. Light and dark bands (striations) are present on muscle fibres; which gives the name striated muscles. Striated muscles are found in those organs where voluntary movement is possible, e.g. hands, legs, back, neck, etc.

Smooth Muscles
The cells of smooth muscles are spindle shaped and each has one nucleus. Smooth muscle is found in those organs where involuntary movement is possible, e.g. alimentary canal.

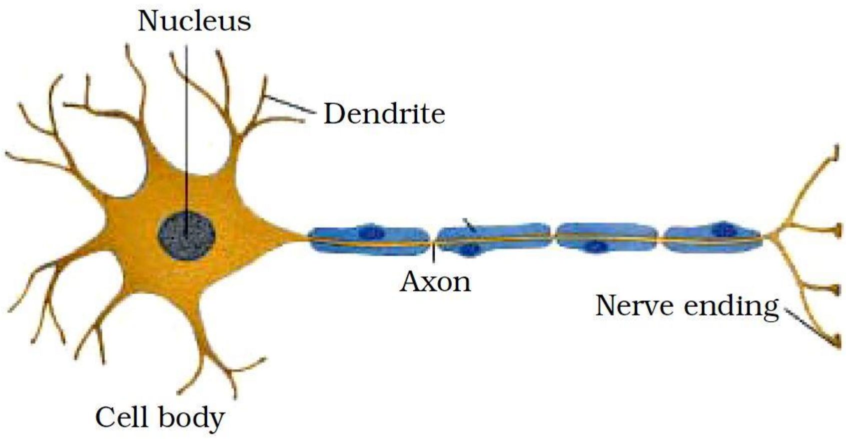
Cardiac Muscles
The cells of cardiac muscles are in the form of branched fibres. Striations are present and cells are uninucleate. These are found in the heart. Cardiac muscles are capable continuous contraction and relaxation throughout the life.



NERVOUS TISSUE

All cells possess the ability to respond to stimuli. However, cells of the nervous tissue are highly specialised for being stimulated and then transmitting the stimulus very rapidly from one place to another within the body. The brain, spinal cord and nerves are all composed of the nervous tissue. The cells of this tissue are called nerve cells or neurons.

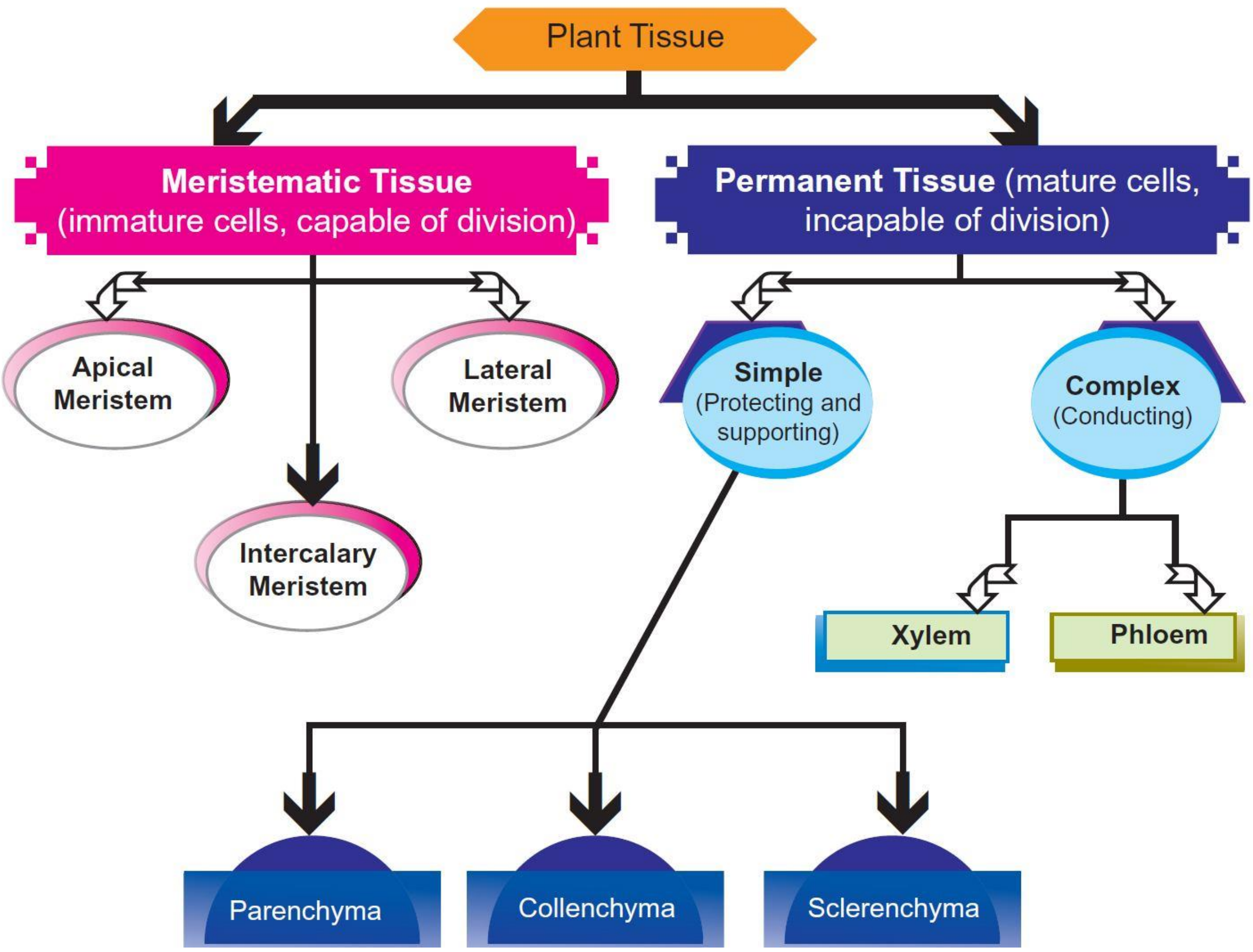
A neuron consists of a cell body with a nucleus and cytoplasm, from which long thin hair-like parts arise.



Usually each neuron has a single long part, called the axon, and many short, branched parts called dendrites. An individual nerve cell may be up to a metre long. Many nerve fibres bound together by connective tissue make up a nerve.

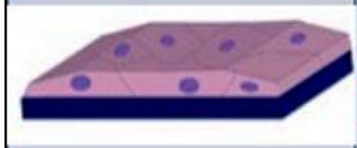
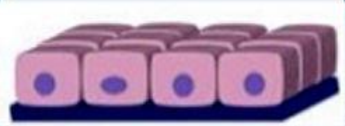
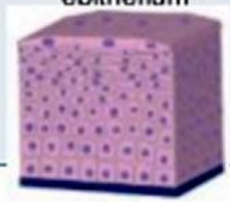
SUMMARY

CLASSIFICATION OF PLANT TISSUE

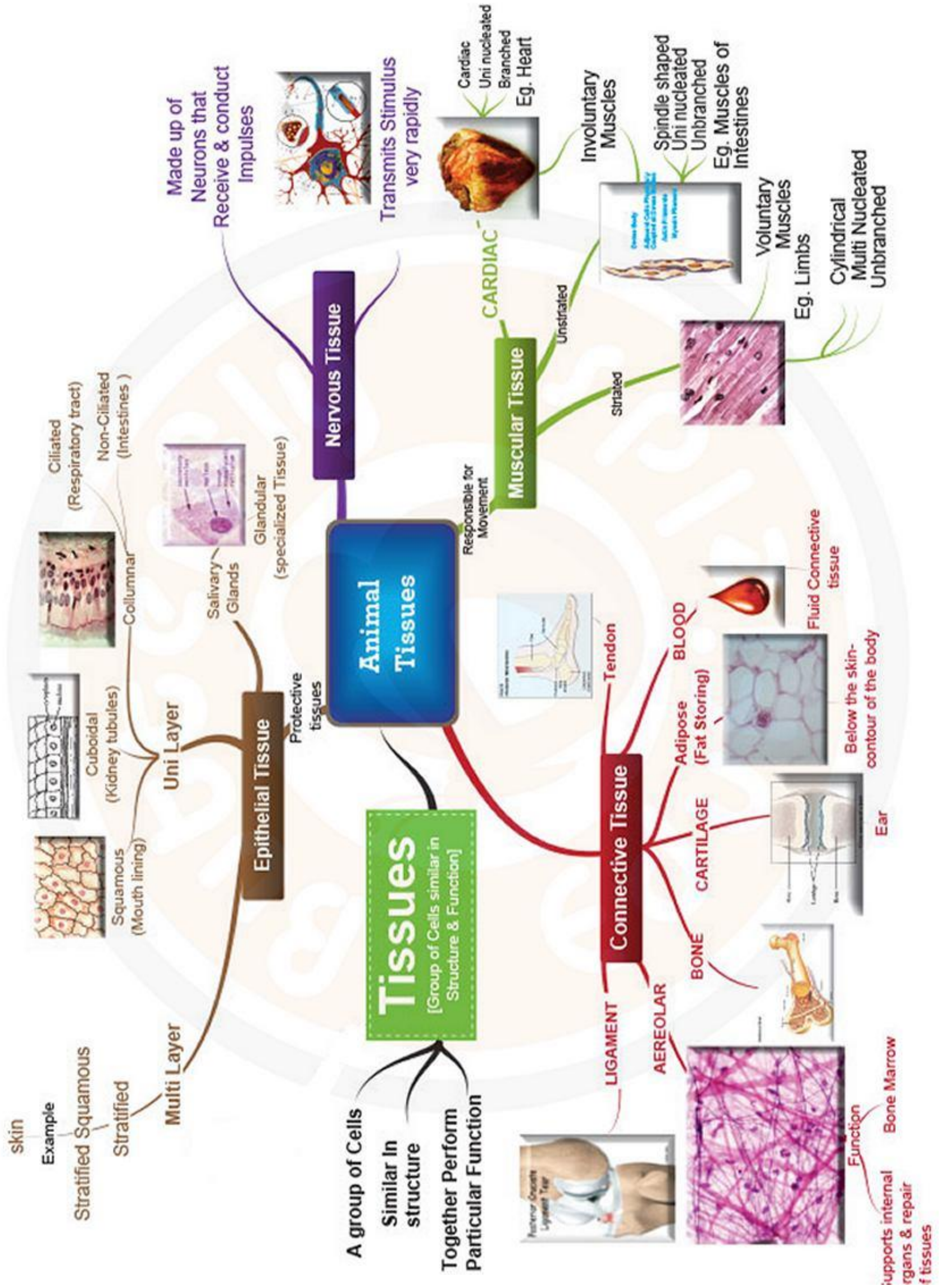


TYPES OF EPITHELIAL TISSUE

Different epithelia show different structures as they perform different functions

Type of Epithelium	Structure	Location in the body	Function
Squamous epithelium 	Cells are thin, flat, irregular cells which fit like floor tiles to form delicate lining called **PAVEMENT EPITHILIUM** **Nuclei in centre**	Oesophagus,lining of mouth, alveoli of the lungs, blood vessels	Protects the underlying tissue from injury,grems Exchange of gases in lungs and materials between cells and blood
Cuboidal epithelium 	Cells are cuboidal with round nucleus in centre **Nuclei in centre**	Kidney tubules, duct of salivary glands	Gives mechanical support At times the epithelial tissue folds,forms a gland that secretes substances. Such epithilium is called **GLANDULAR EPITHILIUM**
Columnar epithelium 	Cells are more tall and less wide (**PILLAR LIKE**), placed side by side. Nucleus is situated near the base. **Nuclei near base**	Inner lining of intestine, In respiratory tract,cells have cilia (hair like) that move and push the mucous to clear it.Such epithilium is called **CILIATED COLUMNAR EPITHILIUM**	Helps in absorption excretion and secretion
Striated squamous epithelium 	Squamous flat cells arranged in many layers to prevent wear and tear of parts.	Skin (to prevent wear and tear) tongue, oesophagus lining of mouth.	Protection, prevent wear and tear

CLASSIFICATION OF ANIMAL TISSUE



INTEXT QUESTIONS PAGE NO. 74

Q1. Name types of simple tissues.
Answer: The three main types of simple tissues are: (i) Parenchyma (ii) Collenchyma (iii) Sclerenchyma

Q2. Where is apical meristem found?
Answer: Apical meristem is present in growing tips of stems and roots of plants. It helps in increasing the length of the stem and the root.

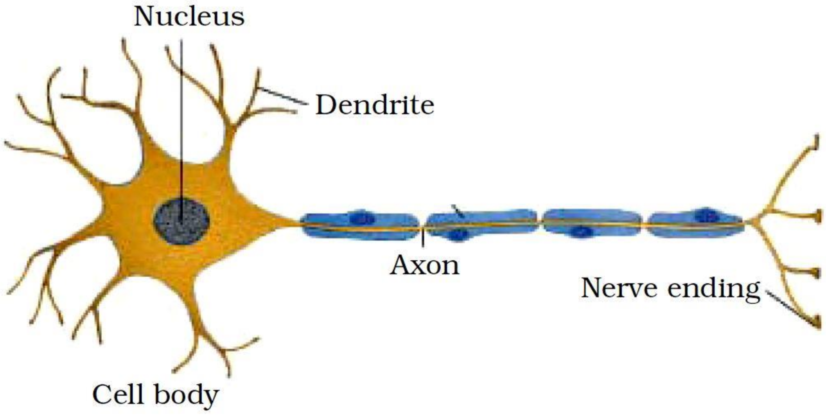
Q3. Which tissue makes up the husk of coconut?
Answer: The husk of coconut is made up of sclerenchymatous tissue.

Q4. What are the constituents of phloem?
Answer: The constituents of phloem tissue are:
(i) Sieve tubes (tubular living cells with perforated end walls)
(ii) Companion cell (living cells)
(iii) Phloem parenchyma (living cells)
(iv) Phloem fibres (non-living and sclerenchyma cells)

INTEXT QUESTIONS PAGE NO. 78

Q1. Name the tissue responsible for movement in our body.
Answer: The movement of our body depends on muscular tissue. It consists of elongated cells (muscle fibres).

Q2. What does a neuron look like?
Answer: A neuron consists of a cell body witha nucleus and cytoplasm. It has two important extensions known as the axon and dendrites. An axon is a long thread-like extension of nerve cells that transmits impulses away from the cell body. Dendrites, on the other hand, are thread-like extensions of cell body that receive nerve impulses. Thus, the axon transmits impulses away from the cell body, whereas the dendrite receives nerve impulses. This coordinated function helps in transmitting impulses very quickly.



Q3. Give three features of cardiac muscles.
Answer: Three features of cardiac muscles are:
(i) Cardiac muscles are involuntary muscles that contract rapidly, but do not get fatigued.
(ii) The cells of cardiac muscles are cylindrical, branched, and uninucleate.
(iii) They control the contraction and relaxation of the heart.

Q4. What are the functions of areolar tissue?
Answer: Functions of areolar tissue:
(i) It helps in supporting internal organs.
(ii) It helps in repairing the tissues of the skin and muscles.

EXERCISE QUESTIONS PAGE NO. 66 and 67

Q1. Define the term "tissue".
Answer: A group of cells that are similar in structure and/or work together to achieve a particular function is called tissue.

Q2. How many types of elements together make up the xylem tissue? Name them.
Answer: The following four types of elements make up xylem tissue:
(i) Xylem tracheids (tubular unicellular).
(ii) Xylem vessels (multicellular).
(iii) Xylem parenchyma (stores food and helps in sideways conduction of water).
(iv) Xylem fibres (provide mechanical support).

Q3. How are simple tissues different from complex tissues in plants?
Answer:

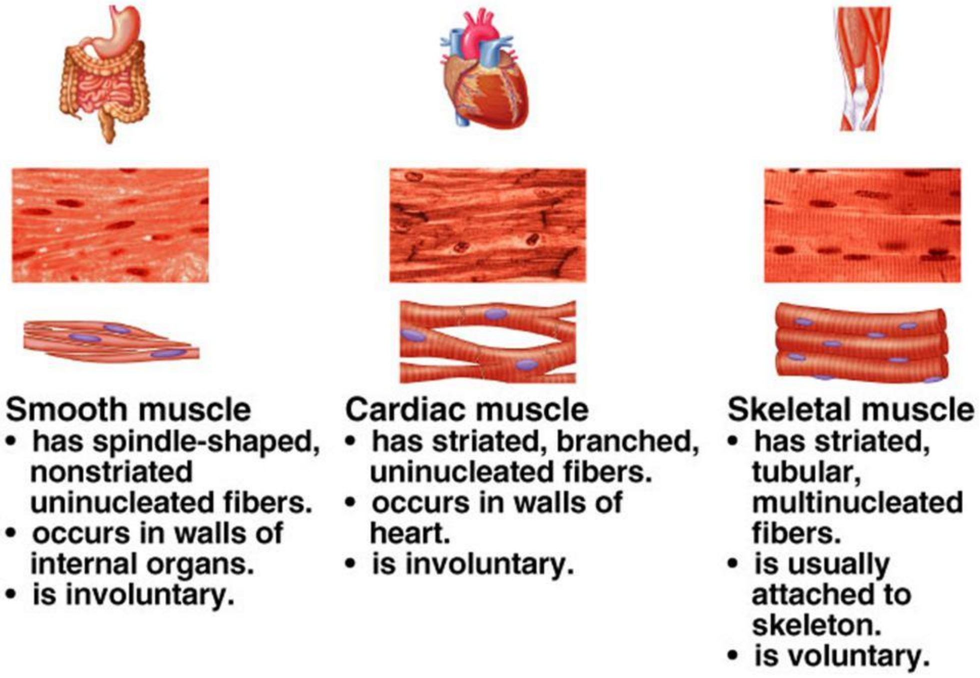
Simple tissue	Complex tissue
These tissues consist of only one type of cells.	These tissues are made up of more than one type of cells.
The cells are more or less similar in structure and perform similar functions.	Different types of cells perform different functions. For example, in the xylem tissue, tracheids help in water transport, whereas parenchyma stores food.
Three types of simple tissues in plants are parenchyma, collenchyma, and sclerenchyma.	Two types of complex permanent tissues in plants are xylem and phloem.

Q4. Differentiate between parenchyma, collenchyma and sclerenchyma on the basis of their cell wall.
Answer:

Parenchyma	Collenchyma	Sclerenchyma
Cell walls are relatively thin, and the cells in parenchyma tissues are loosely packed.	The cell wall is irregularly thickened at the corners, and there is very little space between the cells.	The cell walls are uniformly thickened, and there are no intercellular spaces.
The cell wall in this tissue is made up of cellulose.	Pectin and hemicellulose are the major constituents of the cell wall.	An additional layer of the cell wall composed mainly of lignin is found.

Q5. What are the functions of the stomata?
Answer: Functions of the stomata:
(i) They allow the exchange of gases (CO_2 and O_2) with the atmosphere.
(ii) Evaporation of water from the leaf surface occurs through the stomata. Thus, the stomata help in the process of transpiration.

Q6. Diagrammatically show the difference between the three types of muscle fibres.
Answer:
The three types of muscle fibres are:
Striated muscles, smooth muscles (unstriated muscle fibre), and cardiac muscles.



Q7. What is the specific function of the cardiac muscle?

Answer: The specific function of the cardiac muscle is to control the contraction and relaxation of the heart.

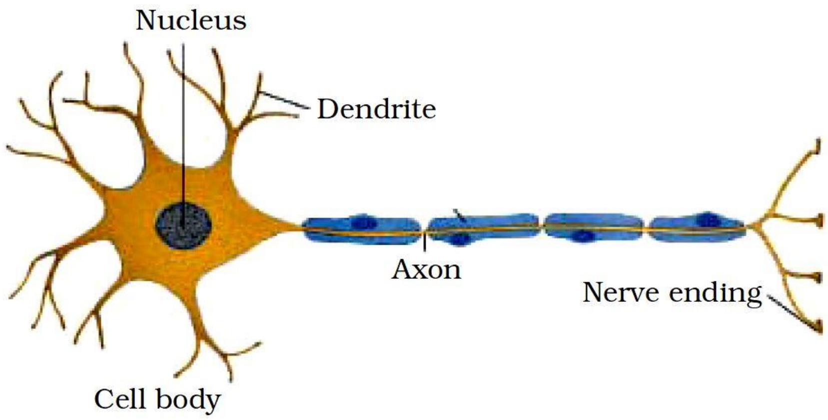
Q8. Differentiate between striated, unstriated and cardiac muscles on the basis of their structure and site/location in the body.

Answer:

Striated muscle	Unstriated muscle	Cardiac muscle
On the basis of structure:		
Cells are cylindrical	Cells are long	Cells are cylindrical
Cells are not branched	Cells are not branched	Cells are branched
Cells are multinucleate	Cells are uninucleate	Cells are uninucleate
Alternate light and dark bands are present	There are no bands present	Faint bands are present
Its ends are blunt	Its ends are tapering	Its ends are flat and wavy
On the basis of location:		
These muscles are present in body parts such as hands, legs, tongue, etc.	These muscles control the movement of food in the alimentary canal, the contraction and relaxation of blood vessels, etc.	These muscles control the contraction and relaxation of the heart

Q9. Draw a labelled diagram of a neuron.

Answer:



Q10. Name the following.

(a) Tissue that forms the inner lining of our mouth.

(b) Tissue that connects muscle to bone in humans.

(c) Tissue that transports food in plants.

(d) Tissue that stores fat in our body.

(e) Connective tissue with a fluid matrix.

(f) Tissue present in the brain.

Answer:

(a) Tissue that forms the inner lining of our mouth → Epithelial tissue

(b) Tissue that connects muscle to bone in humans → Dense regular connective tissue (tendons)

(c) Tissue that transports food in plants → Phloem

(d) Tissue that stores fat in our body → Adipose tissue

(e) Connective tissue with a fluid matrix → Blood

(f) Tissue present in the brain → Nervous tissue

Q11. Identify the type of tissue in the following: skin, bark of tree, bone, lining of kidney tubule, vascular bundle.

Answer:

Skin: Stratified squamous epithelial tissue

Bark of tree: Simple permanent tissue

Bone: Connective tissue

Lining of kidney tubule: Cuboidal epithelial tissue

Vascular bundle: Complex permanent tissue

Q12. Name the regions in which parenchyma tissue is present.

Answer:

Leaves, fruits, and flowers are the regions where the parenchyma tissue is present.

Q13. What is the role of epidermis in plants?

Answer:

Epidermisis present on the outer surface of the entire plant body. The cells of the epidermal tissue form a continuous layer without any intercellular space. It performs the following important functions:

(i) It is a protective tissue of the plant body

(ii) It protects the plant against mechanical injury

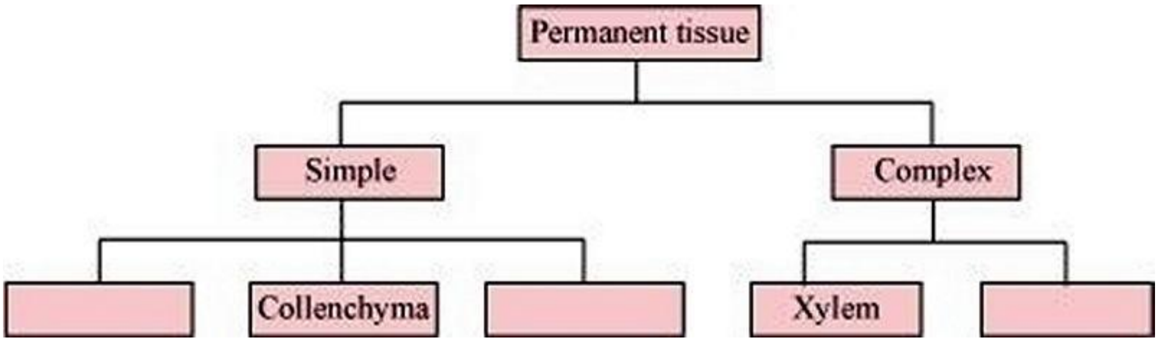
(iii) It allows exchange of gases through the stomata

Q14. How does the cork act as a protective tissue?

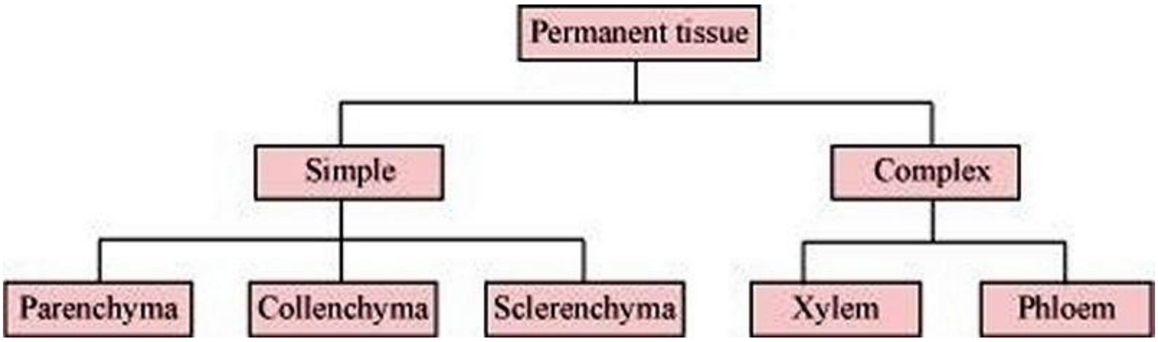
Answer:

The outer protective layer or bark of a tree is known as the cork. It is made up of dead cells. Therefore, it protects the plant against mechanical injury, temperature extremes, etc. It also prevents the loss of water by evaporation.

Q15. Complete the table:



Answer:



ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 6
TISSUES

Fill in the blanks

1. ____________ is the process by which unspecialised structures become modified and specialised for performing specific functions.
2. Differentiation results in ______________ (division/ summation/integration) of labour.
3. The study of the structure of tissues and organs is known as ______________ .
4. Based on ability to divide, plant tissues may be classified as ______________ and ______________ tissues.
5. Meristematic cells possess the power of cell ______________ .
6. Permanent tissues are those which have lost the capacity to ______________ .
7. (Parenchyma/ Collenchyma/ Sclerenchyma) ______________ is a widely distributed, simple plant tissue.
8. (Parenchyma/ Collenchyma/ Sclerenchyma) ______________ is a strong and flexible mechanical tissue.
9. ______________ and ______________ are the conducting tissues or vascular tissues, also called complex tissues.
10. The cell walls of ______________ (Parenchyma/ Collenchyma/ Sclerenchyma) tissue are made up of cellulose hemicellulose and pectin
11. _____________ is the parenchyma with large number of chloroplasts.
12. (Xylem/Phloem) ______________ is popularly known as wood.
13. Xylem is composed of ______________ ,______________ , ______________ and ______________ .
14. Tracheids are ______________ (living/dead) cells ______________ (with/without) protoplasts.
15. Protective tissues include ______________ and ______________ .
16. Epithelial cells have ______________ (little/large) intercellular substances.
17. (Connective/Muscular/Epithelial) ______________ tissue serve to 'connect' or 'bind' the cells of other tissues in the body and gives them rigidity and support.
18. (Tendon/Ligament/Cartilage) ______________is made up of white fibres and connects muscles to bones.
19. Bone is surrounded by a connective tissue known as ______________.
20. Striated muscles are ______________ (voluntary/involuntary) while smooth muscles are ______________(voluntary/involuntary).

21. Based on functions performed, list the types of animal tissues.

22. Which tissues are called covering or protective tissues?

23. Where do we find epithelial tissues on animal body?

24. What are the general identifying features of epithelial tissues?

25. Based on layer and shape of cells, how Epithelial tissues can be classified?

26. The surface of Simple squamous epithelium is _____. (choose the correct option)

(a) Permeable

(b) Selectively Permeable

(c) Impermeable

(d) All of the these

27. What is the shape of simple squamous tissue?

28. Where do you find simple squamous in an animal body?

29. What is the main function of simple squamous epithelium?

30. What is simple stratified epithelium? Where do we find these tissues?

31. What is main purpose of stratified epithelium?

32. What is the shape of cuboidal epithelium? Where do we find these tissues?

33. These are somewhat square or cuboid in shape. Cuboidal epithelium is found in kidney tubules, ducts of salivary glands etc.

34. What is the main function of cuboidal epithelium?

35. How will you identify Columnar epithelium? Where are these tissues located?

36. What is the main purpose of columnar epithelium?

37. What type of epithelium tissues are found in respiratory tract and in intestinal lining? How are these tissues different from each other?

38. Where do we find glandular columnar epithelia? What are their main role?

39. What is Haematology?

40. What is the common characteristic in different connective tissues?

41. Name different types of connective tissues?

42. What are the constituents of connective tissues?

43. List the type of intercellular matrix present in the following connective tissues.

(a) Blood

(b) Lymph

(c) Bone

(d) Cartilage

(e) Tendons

(f) Ligaments

(g) Areolar Tissue

(h) Adipose tissue

44. What are constituents of blood tissue?

45. What does plasma contain?

46. Name different types of white blood corpuscles.

47. List the functions of blood cells

48. Where blood is formed in our body?

49. Name the two fluid connective tissues.

50. Why type of inter cellular matrix is found in bone tissue? What are its constituents?

51. Identify the location of the following connective tissues.

(a) Blood

(b) Lymph

(c) Bone

(d) Cartilage

(e) Tendons

52. Which connective tissue connects two bones?

53. Which connective tissue connects bones to muscles?

54. Name the constituents of matrix found in cartilage.

55. Where do we find Areolar tissue? What are its functions?

56. Name the fat-storing tissues? Where are they located? How do these tissue help?

57. What are different types of muscle tissues? Also list which of these are voluntary or involuntary.

58. Why are striated muscles called skeletal muscles?

59. What are identification marks of striated muscles when seen under microscope?

60. Identify which type of muscles tissues are associated with the following body actions

(a) locomotion

(b) iris movement to control size of pupil

(c) peristaltic movements of the oesophagus

(d) heart beat

(e) movement of blood in blood vessels

61. How will you identify cardiac muscles cells under a microscope?

62. Which muscle tissues show characteristics of both striated and unstriated muscles?

63. Where do we find cardiac tissues? What are the functions of cardiac tissues?

64. Do all cells respond to stimuli or this ability is possessed by nerve cells only?

65. What is the unit of nervous tissues?

66. Where do we find nerve cells?

67. How long a nerve cell can be?

68. How are muscles tissues related to nerve cells?

69. Name the three distinct parts of a neuron.

70. What is myelin sheath? Where do we find it?

71. What happens in polio disease?

72. In plants which of the following have the capability of cell division?

(a) Parenchyma

(b) Scelerenchyma

(c) Xylem

(d) Apical Meristem

73. The growth is plants is

(a) limited to certain regions

(b) uniform in all parts

(c) limited to top region

(d) limited to roots only.

74. 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

75. Cells of the tissue have dense cytoplasm, thin cellulose walls and prominent vacuoles. Identify the tissue.

(a) Collenchyma

(b) Scelerenchyma

(c) Meristem

(d) Parenchyma

76. Dead long and narrow cells in a plant belong to which tissue?

(a) Parenchyma

(b) Scelerenchyma

(c) Collenchyma

(d) Phloem

77. Bone is an example of ______________

(a) Muscular tissues

(b) Connective tissues

(c) Epithelial tissues

(d) Nervous tissues

78. Which animal tissue are usually separated from the underlying tissue by an extracellular fibrous basement membrane?

(a) Muscular tissues

(b) Connective tissues

(c) Epithelial tissues

(d) Nervous tissues

79. Oesophagus and the lining of the mouth are also covered with which tissues?

(a) Squamous epithelium

(b) Ciliated epithelium

(c) Areolar connective

(d) Striated muscle tissues

80. Husk of a coconut is made of which tissues?

(a) Parenchyma tissue

(b) Sclerenchymatous tissue

(c) Collenchyma

(d) Xylem

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 6
TISSUES

1. The study of tissues is called ...

a) cytology

b) embryology

c) histology

d) pathology

2. Which of the following statement is NOT true?

(a) Most of the plant tissues are supportive type.

(b) Tissues ensure division of labour.

(c) Sedantry existence contribute to the organ system design in animals.

(d) Organ systems are far more complex in animals than in plants.

3. Many kinds of tissues organise to form a/an

(a) organ

(b) organ system

(c) body system

(d) organelle

4. Parenchyma is a type of ____

(a) simple tissue

(b) complex tissue

(c) xylem

(d) phloem

5. Which of the following is not a simple tissue?

(a) xylem

(b) parenchyma

(c) collenchyma

(d) sclerenchyma

6. The husk of the coconut is made up of?

(a) collenchyma

(b) sclerenchyma

(c) apical meristem

(d) intercalary meristem

7. The basic principle based on which categorise plant tissues as meristematic and permanent is:

(a) capacity to do photosynthesis

(b) capacity to divide

(c) capacity to locomote

(d) complexity to perform a function.

8. Which type of tissue has lignified cell walls?

(a) Parenchyma

(b) Collenchyma

(c) Sclerenchyma

(d) cambium

9. Which tissue is responsible for the length of the plant?

(a) Apical meristem

(b) lateral meristem

(c) Intercalary meristem

(d) Epidermis

10. The girth of the stem or root increases due to ___

(a) Apical meristem

(b) Cambium

(c) Intercalary meristem

(d) Epidermis

11. Which meristem is present at the base of the leaves or internodes on twigs?

(a) Apical meristem

(b) Cambium

(c) Intercalary meristem

(d) Epidermis

12. Which of the following statements is incorrect?

(a) Some tissues in plants divide throughout the life

(b) Cell growth in animals is more uniform as compared to plants

(c) Animals have more dead tissues as compared to plants

(d) There is no demarcation of dividing and non-dividing regions in animals

13. What are the identifying features of meristematic tissues?

(a) thick cellulose wall, small vacuoles, dense cytoplasm, small nuclei

(b) thin cellulose wall, almost no vacuoles, dense cytoplasm, prominent nuclei

(c) thin cellulose wall,no vacuoles, sparse cytoplasm, prominent nuclei

(d) thick cellulose, large vacuoles, sparse cytoplasm, small nuclei

14. A permanent slide shows thin walled isodiametric cells with a large vacuole. The slide contains:

(a) Parenchyma cells

(b) Nerve cells

(c) Sclerenchyma cells

(d) Collenchyma cells

15. Aditi observed following observations while looking into a permanent slide.

(i) Cells are long and cylindrical

(ii) Light and dark bands are present.

It could be a slide of :

(a) striated muscle fibre

(b) smooth muscle fibre

(c) neuron

(d) parenchyma cells

16. The inner lining of blood vessels is made up of which tissues?

(a) Nervous tissue

(b) Epithelial tissue

(c) Connective tissue

(d) Muscle tissue

17. What is a tissue?

18. What is histology?

19. Explain the statement 'Tissues exhibit division of labour'. Give examples.

20. What is the utility of tissues in multi-cellular organisms?

21. Why do plants have more dead tissues as compared to animals?

22. Why do plant tissue require less amount of energy in comparison to animal tissues?

23. Why do animals tissues require more energy as compared to plant tissues?

24. Name types of simple tissues.

25. Where is apical meristem found?

26. Which tissue helps in increasing the length of stem and root?

27. Which tissues are responsible for the axial growth of plants?

28. Which tissue makes up the husk of coconut?

29. What are the constituents of phloem?

30. Name the tissue responsible for the movement in our body.

31. What does a neuron looks like?

32. Identify which of the following plant tissues are living or dead?

- Apical Meristem
- Parenchyma
- Aerenchyma
- Collenchyma
- Sclereids
- Tracheids
- Xylem Fibres
- Xylem Parenchyma
- Phloem fibre
- Phloem Parenchyma
- Vessel
- Sieve Tubes

33. Give three features of cardiac muscles.

34. What are the functions of areolar tissue?

35. List the characteristics of meristematic tissues.

36. Where do we find intercalary meristem?

37. Which tissues are responsible for the secondary growth of plants?

38. What do you mean by 'Differentiation' in plant tissues?

39. What is the shape of Parenchyma cells?

40. What is the structure and nature of Parenchyma tissue?

41. Where do you find Parenchyma cells in Plants?

42. What are the identifying features of collenchyma tissue?

43. Where do you find collenchyma tissues in plants?

44. Which tissue primarily attributes to easy bending of various parts of plants (like stem, leaves)?

45. Which plant tissues are often called as stone cells?

46. Deepa was shown two slides of plant tissues: parenchyma and sclerenchyma. She can identify sclerenchyma by the

(a) location of nucleus

(b) size of cells

(c) thickness of cell walls

(d) position of vacuoles

47. What is aerenchyma?

48. What is the primary surface tissue of the entire plant?

49. How does epidermis help xerophytes?

50. Which meristem replaces epidermis as the protective covering?

51. List the functions of epidermis.

52. Which tissue is known as living mechanical tissue?

53. Why the cell walls of collenchyma tissues are unevenly thickened?

54. Are Collenchyma tissues present in roots of the plants?

55. Usually Shrubs and herbs grow in open places and are exposed to forceful winds. But they do not break.Why?

56. Name the chemical released by cork cells?

57. How are complex tissues different from simple tissues?

58. Name two types of complex tissues.

59. Why are Xylem and Phloem are called vascular or conducting tissues?

60. Which plant tissue is considered to have played an important role in survival of terrestrial plants?

61. Why vascular tissue is considered a distinctive feature responsible for survival of plants in terrestrial plants?

62. Is xylem (or phloem) homogenous tissue or heterogeneous tissue?

63. List the cellular elements of xylem tissue?

64. What is the role of xylem tissue?

65. Name the cellular elements of Phloem tissue.

66. List functions of phloem tissue?

67. Which Phloem cellular element has tubular structure with perforated walls?

68. Why are Xylem and Phloem known as conducting tissues?

69. Why are Xylem and Phloem called as vascular tissues?

70. Why are Xylem and Phloem known as complex permanent tissues?

71. Why do meristematic cells lack vacoules?

72. Muscles contain special proteins called ________ that help in muscle movement.

(a) recptor proteins

(b) enzymes

(c) nucleo proteins (DNA, RNA)

(d) contractile proteins (actin and myosin)

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 6
TISSUES

1. Which of the following tissues has dead cells?

(a) Parenchyma

(b) Sclerenchyma

(c) Collenchyma

(d) Epithelial tissue

2. Find out incorrect sentence

(a) Parenchymatous tissues have intercellular spaces

(b) Collenchymatous tissues are irregularly thickened at corners

(c) Apical and intercalary meristems are permanent tissues

(d) Meristematic tissues, in its early stage, lack vacuoles

3. Girth of stem increases due to

(a) apical meristem

(b) lateral meristem

(c) intercalary meristem

(d) vertical meristem

4. Which cell does not have perforated cell wall?

(a) Tracheids

(b) Companion cells

(c) Sieve tubes

(d) Vessels

5. Intestine absorb the digested food materials. What type of epithelial cells are responsible for that?

(a) Stratified squamous epithelium

(b) Columnar epithelium

(c) Spindle fibres

(d) Cuboidal epithelium

6. A person met with an accident in which two long bones of hand were dislocated. Which among the following may be the possible reason?

(a) Tendon break

(b) Break of skeletal muscle

(c) Ligament break

(d) Areolar tissue break

7. While doing work and running, you move your organs like hands, legs etc. Which among the following is correct?

(a) Smooth muscles contract and pull the ligament to move the bones

(b) Smooth muscles contract and pull the tendons to move the bones

(c) Skeletal muscles contract and pull the ligament to move the bones

(d) Skeletal muscles contract and pull the tendon to move the bones

8. Which muscles act involuntarily?

(i) Striated muscles

(ii) Smooth muscles

(iii) Cardiac muscles

(iv) Skeletal muslces

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (iii) and (iv)

(d) (i) and (iv)

9. Meristematic tissues in plants are

(a) localised and permanent

(b) not limited to certain regions

(c) localised and dividing cells

(d) growing in volume

10. Which is *not* a function of epidermis?

(a) Protection from adverse condition

(b) Gaseous exchange

(c) Conduction of water

(d) Transpiration

11. Select the incorrect sentence

(a) Blood has matrix containing proteins, salts and hormones

(b) Two bones are connected with ligament

(c) Tendons are non-fibrous tissue and fragile

(d) Cartilage is a form of connective tissue

12. Cartilage is not found in

(a) nose

(b) ear

(c) kidney

(d) larynx

13. Fats are stored in human body as

(a) cuboidal epithelium

(b) adipose tissue

(c) bones

(d) cartilage

14. Bone matrix is rich in

(a) fluoride and calcium

(b) calcium and phosphorus

(c) calcium and potassium

(d) phosphorus and potassium

15. Contractile proteins are found in

(a) bones

(b) blood

(c) muscles

(d) cartilage

16. Voluntary muscles are found in

(a) alimentary canal

(b) limbs

(c) iris of the eye

(d) bronchi of lungs

17. Nervous tissue is not found in

(a) brain

(b) spinal cord

(c) tendons

(d) nerves

18. Nerve cell does not contain

(a) axon

(b) nerve endings

(c) tendons

(d) dendrites

19. Which of the following helps in repair of tissue and fills up the space inside the organ?

(a) Tendon

(b) Adipose tissue

(c) Areolar

(d) Cartilage

20. The muscular tissue which function throughout the life continuously without fatigue is

(a) skeletal muscle

(b) cardiac muscle

(c) smooth muscle

(d) voluntary muscle

21. Which of the following cells is found in the cartilaginous tissue of the body?

(a) Mast cells

(b) Basophils

(c) Osteocytes

(d) Chondrocytes

22. The dead element present in the phloem is

(a) companion cells

(b) phloem fibres

(c) phloem parenchyma

(d) sieve tubes

23. Which of the following does not lose their nucleus at maturity?

(a) Companion cells

(b) Red blood cells

(c) Vessel

(d) Sieve tube cells

24. In desert plants, rate of water loss gets reduced due to the presence of

(a) cuticle

(b) stomata

(c) lignin

(d) suberin

25. A long tree has several branches. The tissue that helps in the side ways conduction of water in the branches is

(a) collenchyma

(b) xylem parenchyma

(c) parenchyma

(d) xylem vessels

26. If the tip of sugarcane plant is removed from the field, even then it keeps on growing in length. It is due to the presence of

(a) cambium

(b) apical meristem

(c) lateral meristem

(d) intercalary meristem

27. A nail is inserted in the trunk of a tree at a height of 1 metre from the ground level. After 3 years the nail will

(a) move downwards

(b) move upwards

(c) remain at the same position

(d) move sideways

28. Parenchyma cells are

(a) relatively unspecified and thin walled

(b) thick walled and specialised

(c) lignified

(c) none of these

29. Flexibility in plants is due to

(a) collenchyma

(b) sclerenchyma

(c) parenchyma

(d) chlorenchyma

30. Cork cells are made impervious to water and gases by the presence of

(a) cellulose

(b) lipids

(c) suberin

(d) lignin

31. Survival of plants in terrestrial environment has been made possible by the presence of

(a) intercalary meristem

(b) conducting tissue

(c) apical meristem

(d) parenchymatous tissue

32. Choose the wrong statement

(a) The nature of matrix differs according to the function of the tissue

(b) Fats are stored below the skin and in between the internal organs

(c) Epithelial tissues have intercellular spaces between them

(d) Cells of striated muscles are multinucleate and unbranched

33. Animals of colder regions and fishes of cold water have thicker layer of subcutaneous fat. Describe why?

34. The water conducting tissue generally present in gymnosperm is

(a) vessels

(b) sieve tube

(c) tracheids

(d) xylem fibres

35. Match the column (A) with the column (B)

(A)	(B)
(a) Fluid connective tissue	(i) Subcutaneous layer
(b) Filling of space inside the organs	(ii) Cartilage
(c) Striated muscle	(iii) Skeletal muscle
(d) Adipose tissue	(iv) Areolar tissue
(e) Surface of joints	(v) Blood
(f) Stratified squamous epithelium	(vi) Skin

36. Match the column (A) with the column (B)

(A)	(B)
(a) Parenchyma	(i) Thin walled, packing cells
(b) Photosynthesis	(ii) Carbon fixation
(c) Aerenchyma	(iii) Localized thickenings
(d) Collenchyma	(iv) Buoyancy
(e) Permanent tissue	(v) Sclerenchyma

37. If a potted plant is covered with a glass jar, water vapours appear on the wall of glass jar. Explain why?

38. Name the different components of xylem and draw a living component?

39. Draw and identify different elements of phloem.

40. Write true (T) or false (F)

(a) Epithelial tissue is protective tissue in animal body.

(b) The lining of blood vessels, lung alveoli and kidney tubules are all made up of epithelial tissue.

(c) Epithelial cells have a lot of intercellular spaces.

(d) Epithelial layer is permeable layer.

(e) Epithelial layer does not allow regulation of materials between body and external environment.

41. Differentiate between voluntary and involuntary muscles. Give one example of each type.

42. Water hyacinth float on water surface. Explain.

43. Which structure protects the plant body against the invasion of parasites?

44. Differentiate the following activities on the basis of voluntary (V) or involuntary (I V) muscles.

(a) Jumping of frog

(b) Pumping of the heart

(c) Writing with hand

(d) Movement of chocolate in your intestine

45. Fill in the blanks

(a) Lining of blood vessels is made up of———.

(b) Lining of small intestine is made up of ———.

(c) Lining of kidney tubules is made up of———.

(d) Epithelial cells with cilia are found in———of our body.

46. Fill in the blanks

(a) Cork cells possesses———on their walls that makes it impervious to gases and water.

(b) ——— have tubular cells with perforated walls and are living in nature.

(c) Bone possesses a hard matrix composed of———and ———.

47. Why is epidermis important for the plants?

48. Fill in the blanks

(a) ———are forms of complex tissue.

(b) ———have guard cells.

(c) Cells of cork contain a chemical called———

(d) Husk of coconut is made of ———tissue.

(e) ———gives flexibility in plants.

(f) ———and———are both conducting tissues.

(g) Xylem transports———and———from soil.

(h) Phloem transport———from———to other parts of the plant.

49. Differentiate between sclerenchyma and parenchyma tissues. Draw well labelled diagram.

50. Describe the structure and function of different types of epithelial tissues. Draw diagram of each type of epithelial tissue.

51. Draw well labelled diagrams of various types of muscles found in human body.

52. Give reasons for

(a) Meristematic cells have a prominent nucleus and dense cytoplasm but they lack vacuole.

(b) Intercellular spaces are absent in sclerenchymatous tissues.

(c) We get a crunchy and granular feeling, when we chew pear fruit.

(d) Branches of a tree move and bend freely in high wind velocity.

(e) It is difficult to pull out the husk of a coconut tree.

53. List the characteristics of cork. How are they formed? Mention their role.

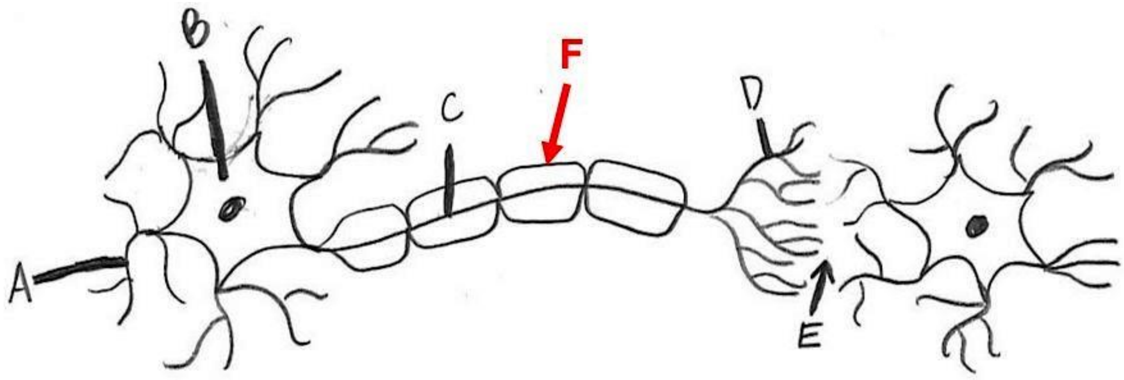
54. Why are xylem and phloem called complex tissues? How are they different from one other?

55. (a) Differentiate between meristematic and permanent tissues in plants

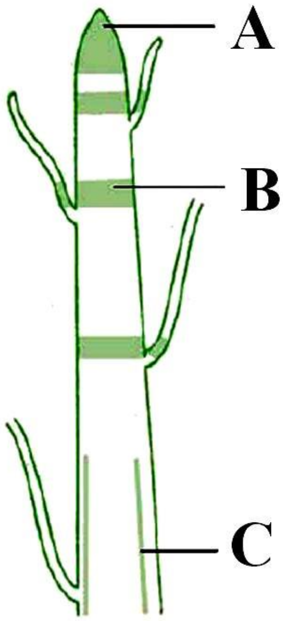
(b) Define the process of differentiation

(c) Name any two simple and two complex permanent tissues in plants.

56. Label the parts of the neuron below:



57. (a) Observe the diagram given below carefully and label the regions marked A, B and C in the diagram.



(b) Which meristematic tissue is responsible for increase in length of root and for the transformation of the stem of a plant into trunk when it grows into a tree.

CHAPTER – 7

DIVERSITY IN LIVING ORGANISMS

CLASSIFICATION

Biodiversity: The variety of living beings found in geographical area is called biodiversity of that area. Amazon rainforests is the largest biodiversity hotspot in the world.

Need for Classification: Classification is necessary for easier study of living beings. Without proper classification, it would be impossible to study millions of organisms which exist on this earth.

BASIS OF CLASSIFICATION

Ancient Greek thinker Aristotle classified living beings on the basis of their habitat. He classified them into two groups, i.e. those living in water and those living on land. But his classification was too simple to justify inclusion of a particular organism into a particular group.

Some examples of scientific bases of classification are as follows:

Organization of nucleus: Nucleus may or may not be organized in an organism. On this basis, organisms can be divided into two groups, viz. prokaryotes and eukaryotes.

(a) Prokaryotes:

When nucleus is not organized, i.e. nuclear materials are not membrane bound; the organism is called prokaryote.

(b) Eukaryotes:

When nucleus is organized, i.e. nuclear materials are membrane bound; the organism is called eukaryote.

Number of cells: An organism can be composed of a single cell or many cells. An organism with a single cell is called unicellular organism. On the other hand, an organism with more than one cell is called multicellular organism.

Mode of Nutrition

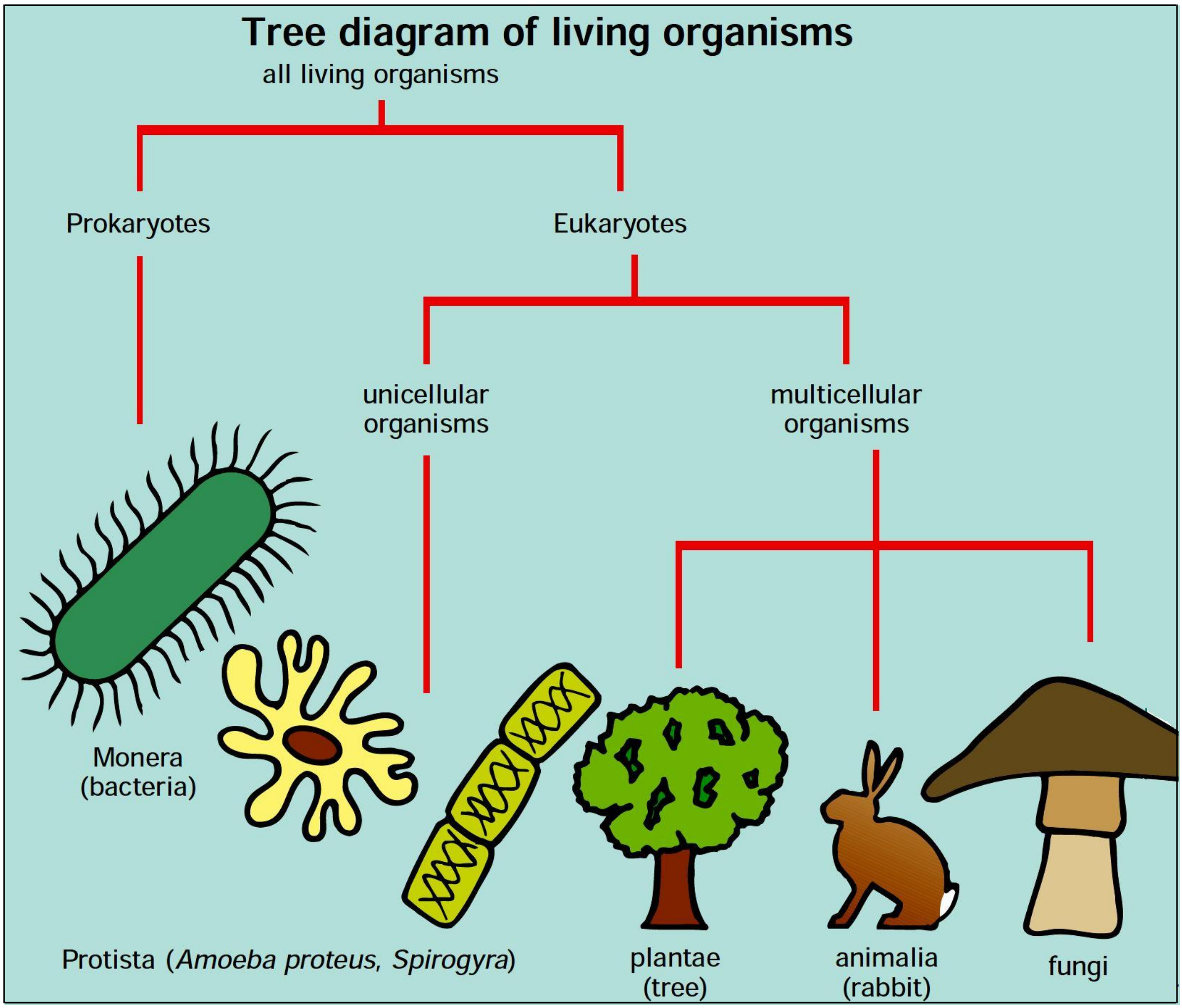
On this basis, organisms can be divided into two broad groups, i.e. autotrophs and heterotrophs. An autotroph makes its own food, while a heterotroph depends on other organisms for food.

Level of Organisation

Even in case of multicellular organisms, there can be different levels of organization. When a cell is responsible for all the life processes, it is called cellular level or organization. When some cells group together to perform specific function, it is called tissue level of organization. When tissues group together to form some organs, it is called organ level of organization. Similarly organ system level of organization is seen in complex organisms.

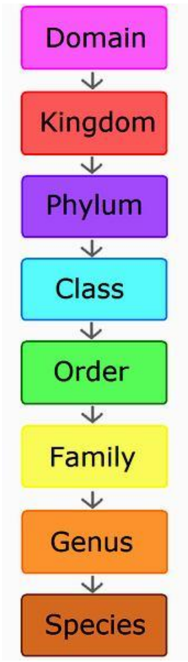
Classification and Evolution

It is a well established fact that all the life forms have evolved from a common ancestor. Scientists have proved that the life begun on the earth in the form of simple life forms. During the course of time, complex organism evolved from them. So, classification is also based on evolution. A simple organism is considered to be primitive while a complex organism is considered to be advanced.

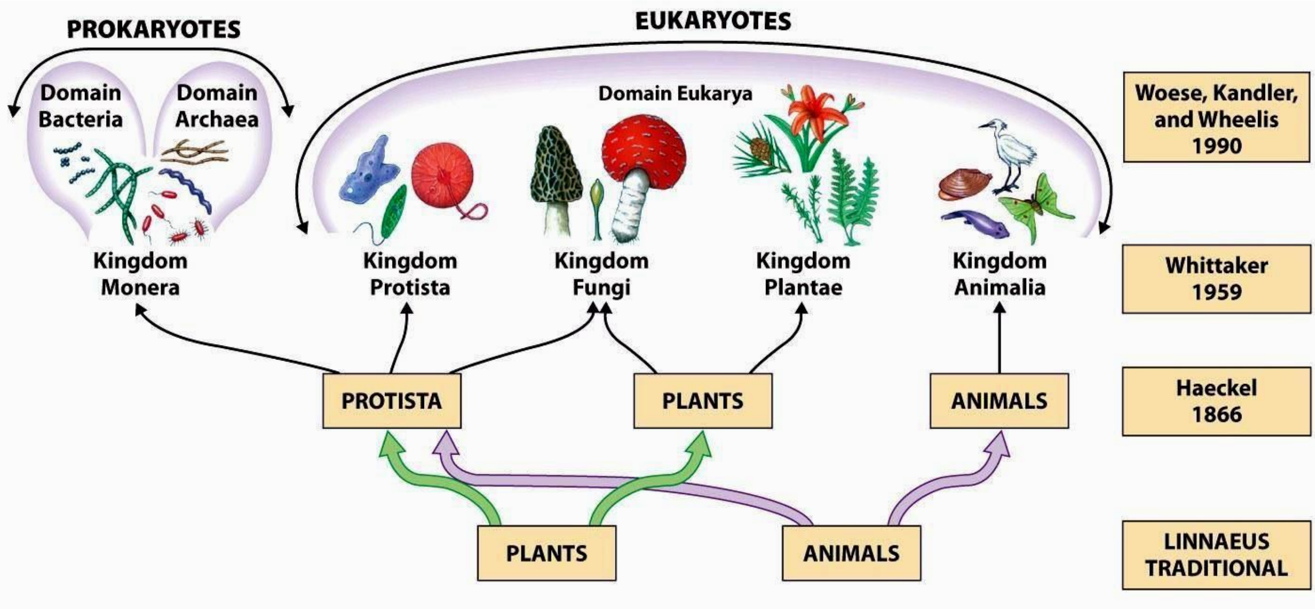


FIVE KINGDOM CLASSIFICATION BY ROBERT WHITTAKER (1959)

This is the most accepted system of classification.
The classification Whittaker proposed has five kingdoms: Monera, Protista, Fungi, Plantae and Animalia, and is widely used. These groups are formed on the basis of their cell structure, mode and source of nutrition and body organisation. Further classification is done by naming the sub-groups at various levels as given in the following scheme:

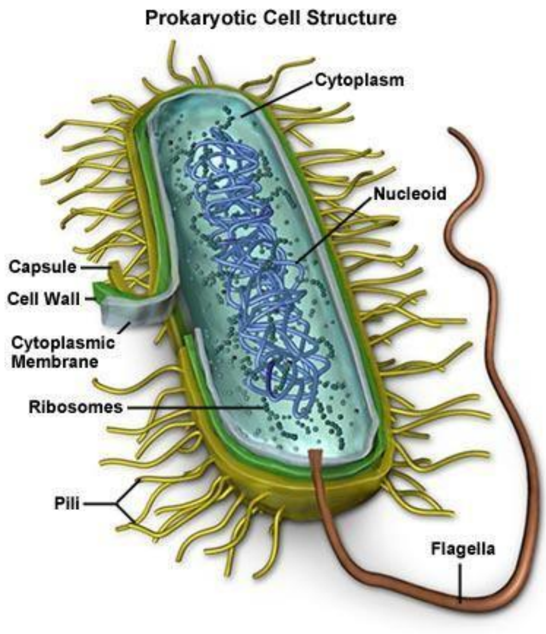


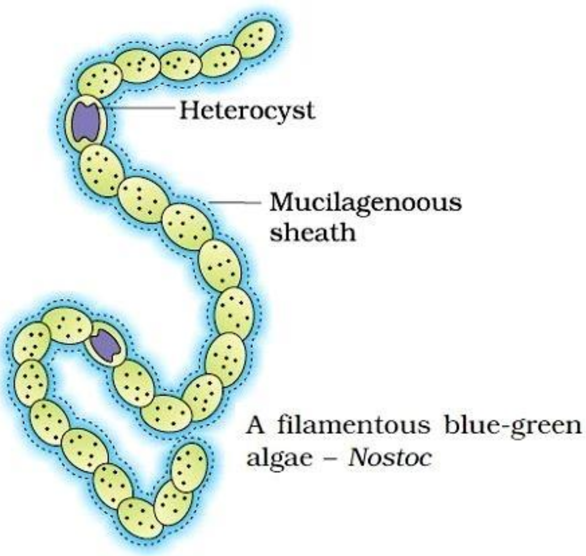
Thus, by separating organisms on the basis of a hierarchy of characteristics into smaller and smaller groups, we arrive at the basic unit of classification, which is a ‘species’. The important characteristics of the five kingdoms of Whittaker are as follows:



1. MONERA

These are prokaryotes; which means nuclear materials are not membrane bound in them. They may or may not have cell wall.
The mode of nutrition of organisms in this group can be either by synthesising their own food (autotrophic) or getting it from the environment (heterotrophic).
All organisms of this kingdom are unicellular. Examples: bacteria, blue green algae (cyanobacteria) and mycoplasma.





2. PROTISTA

These are eukaryotes and unicellular. Some organisms use cilia or flagella for locomotion. They can be autotrophic or heterotrophic. Examples: unicellular algae, diatoms and protozoans.

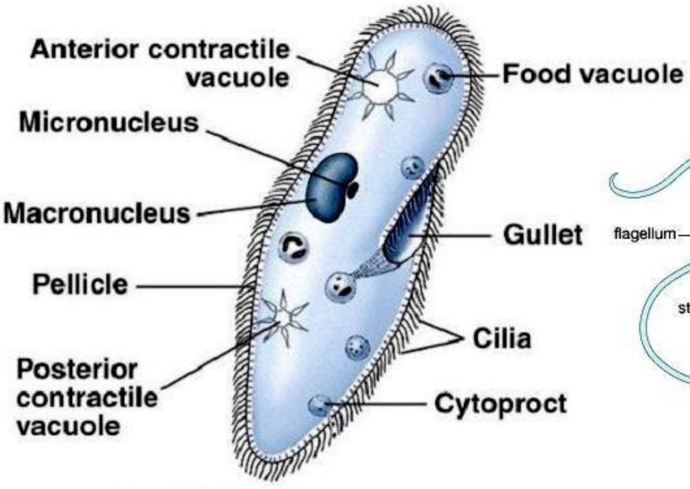
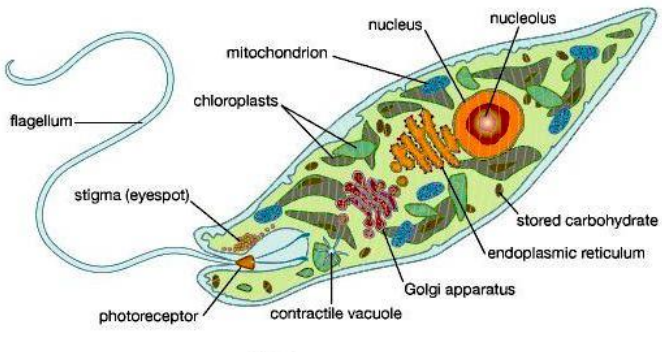


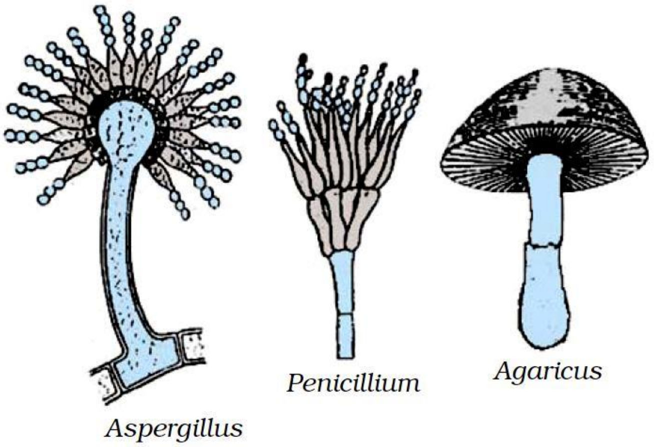
Fig. *Paramecium*



Euglena

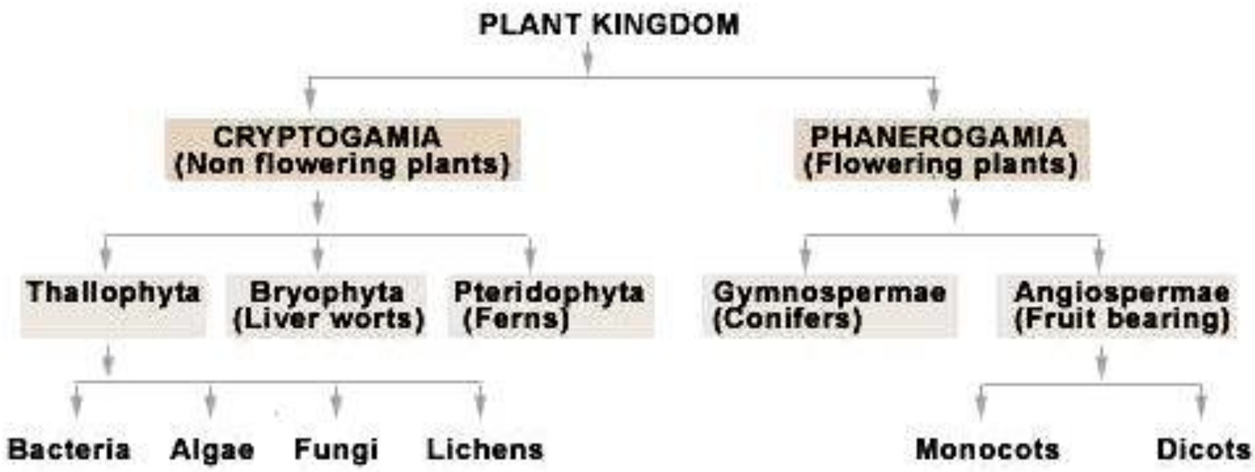
3. FUNGI

These are heterotrohic and have cell wall. The cell wall is made of chitin. Most of the fungi are unicellular. Many of them have the capacity to become multicellular at certain stage in life. They feed on decaying organic materials. Such a mode of nutrition is called saprophytic. Some fungi live in symbiotic relationship with other organisms, while some are parasites as well. Examples: yeast, penicillum, aspergillus, mucor, etc.



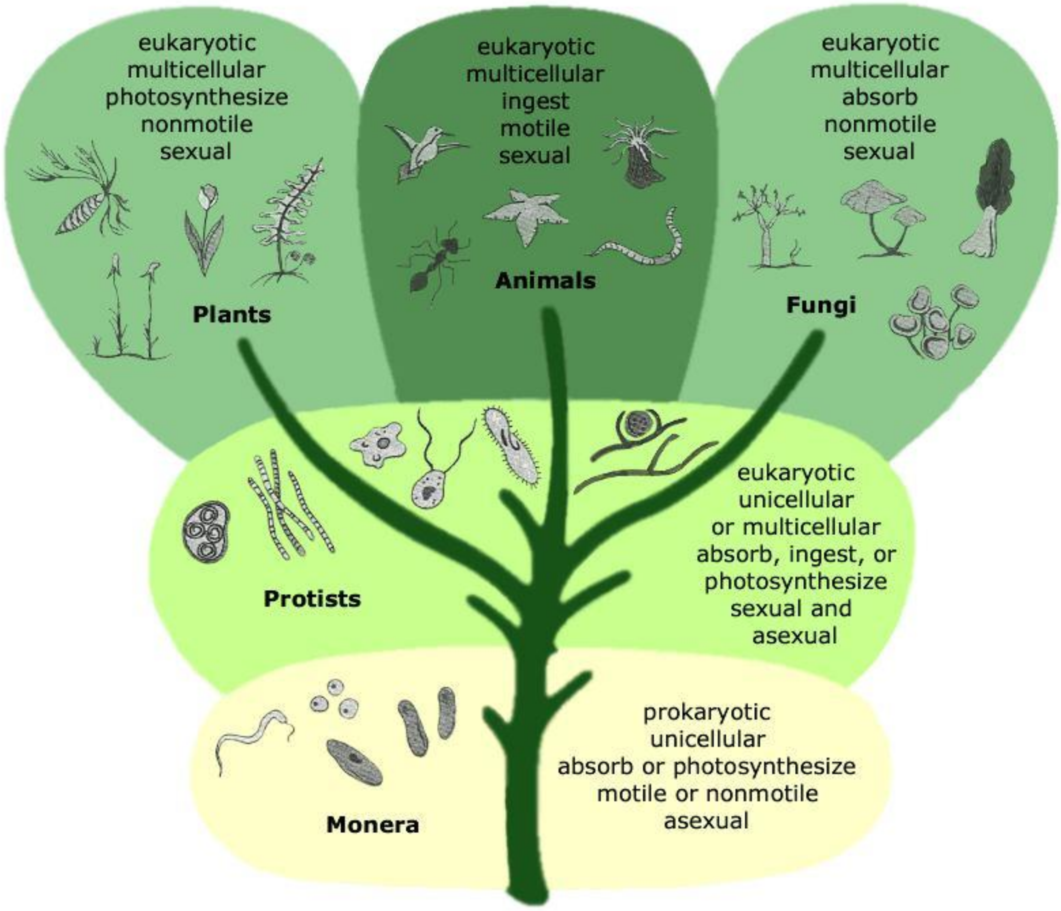
4. PLANTAE

These are multicellular and autotrophs. Presence of chlorophyll is a distinct characteristic of plants, because of which they are capable of doing photosynthesis. Cell wall is present.



5. ANIMALIA

These are multicellular and heterotophs. Cell wall is absent.



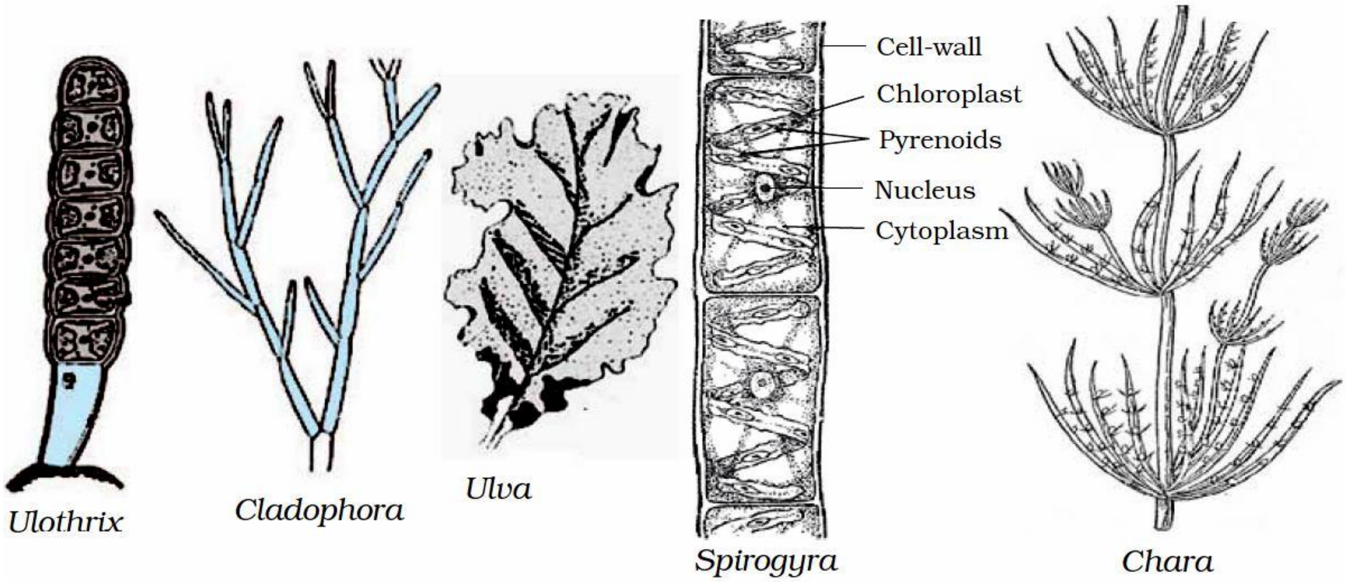
The Five-kingdom System of Classification

PLANTAE (PLANT KINGDOM)

The Plant Kingdom can be further classified into five divisions. Their key characteristics are given below:

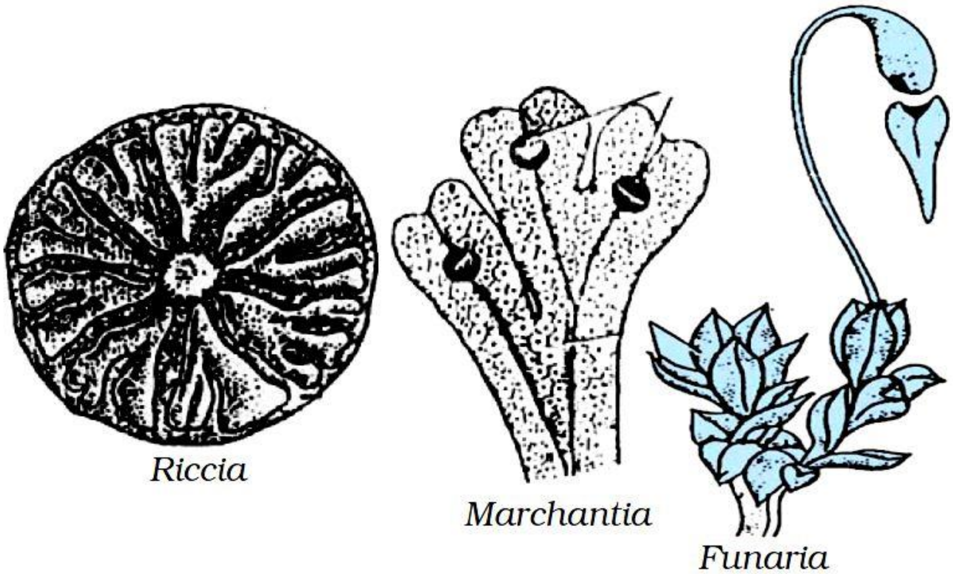
1. THALLOPHYTA

The plant body is simple thallus type. The plant body is not differentiated into root, stem and leaves. They are commonly known as algae. Examples: Spirogyra, chara, volvox, ulothtrix, etc.



2. BRYOPHYTA

Plant body is differentiated into stem and leaf like structure. Vascular system is absent, which means there is no specialized tissue for transportation of water, minerals and food. Bryophytes are also known as the amphibians of the plant kingdom, because they need water to complete a part of their life cycle. Examples: Moss, marchantia.



3. PTERIDOPHYTA

Plant body is differentiated into root, stem and leaf. Vascular system is present. They do not bear seeds and hence are called cryptogams. Plants of rest of the divisions bear seeds and hence are called phanerogams. Examples: Marsilear, ferns, horse tails, etc.

The **primary root** is **short-lived** and is soon replaced by **adventitious roots**

Stem may be aerial or underground.

The **leaves** may be scaly *(Equisetum),*
simple and sessile *(Lycopodium)*
or large and pinnately compound *(Ferns).*

The leaves in pteridophyta are small**(microphylls)** as in *Selaginella* or large**(macrophylls)** as in *Ferns*.

In pteridophytes, the xylem consists of only **tracheids** and phloem consists of **sieve cells** only.
Secondary growth is not seen in Pteridophytes dueto **absence of cambium**.

4. GYMNOSPERMS

They bear seeds. Seeds are naked, i.e. are not covered. The word ‘gymnos’ means naked and ‘sperma’ means seed. They are perennial plants. Examples: Pine, cycas, deodar, etc.

The plant body i.e. sporophyte is differentiated into root, stem and leaves

ROOTS :
Specialized ***Coralloid roots of Cycas*** show association with N_2-*fixing blue-green algae* and
Pinus show association with ***endophytic fungi called mycorrhizae***

STEM :
The gymnospermic **stem** is mostly erect, aerial, solid and cylindrical.
In *Cycas*, it is *unbranched*, while in
Pinus, Cedrus and conifers it is *branched*

LEAVES :
The **leaves** are dimorphic.
The **foliage leaves** are simple, needle like or pinnately compound
Scale leaves are small, membranous and brown.

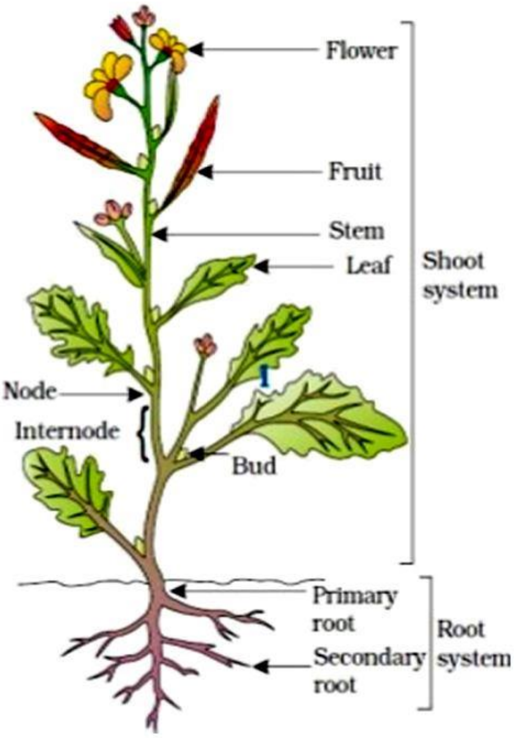
5. ANGIOSPERMS

The seeds are covered. The word ‘angios’ means covered. There is great diversity in species of angiosperm. Angiosperms are also known as flowering plants, because flower is a specialized organ meant for reproduction. Angiosperms are further divided into two groups, viz. monocotyledonous and dicotyledonous.

Most advanced division of the flowering plants

Highly evolved plants, primarily adapted to terrestrial habitat.
Wolffia is the **smallest** angiosperm, l mm in size and *Eucalyptus*grows to over 100 meters.

The plant body is differentiated into **root, stem** and **leaves.**
It has **flowers, fruits** and **seeds.**
Vascular tissues are well developed.
Xylem shows **vessels or tracheae** while phloem has **sieve tubes and companion cells.**



(a) Monocotyledonous

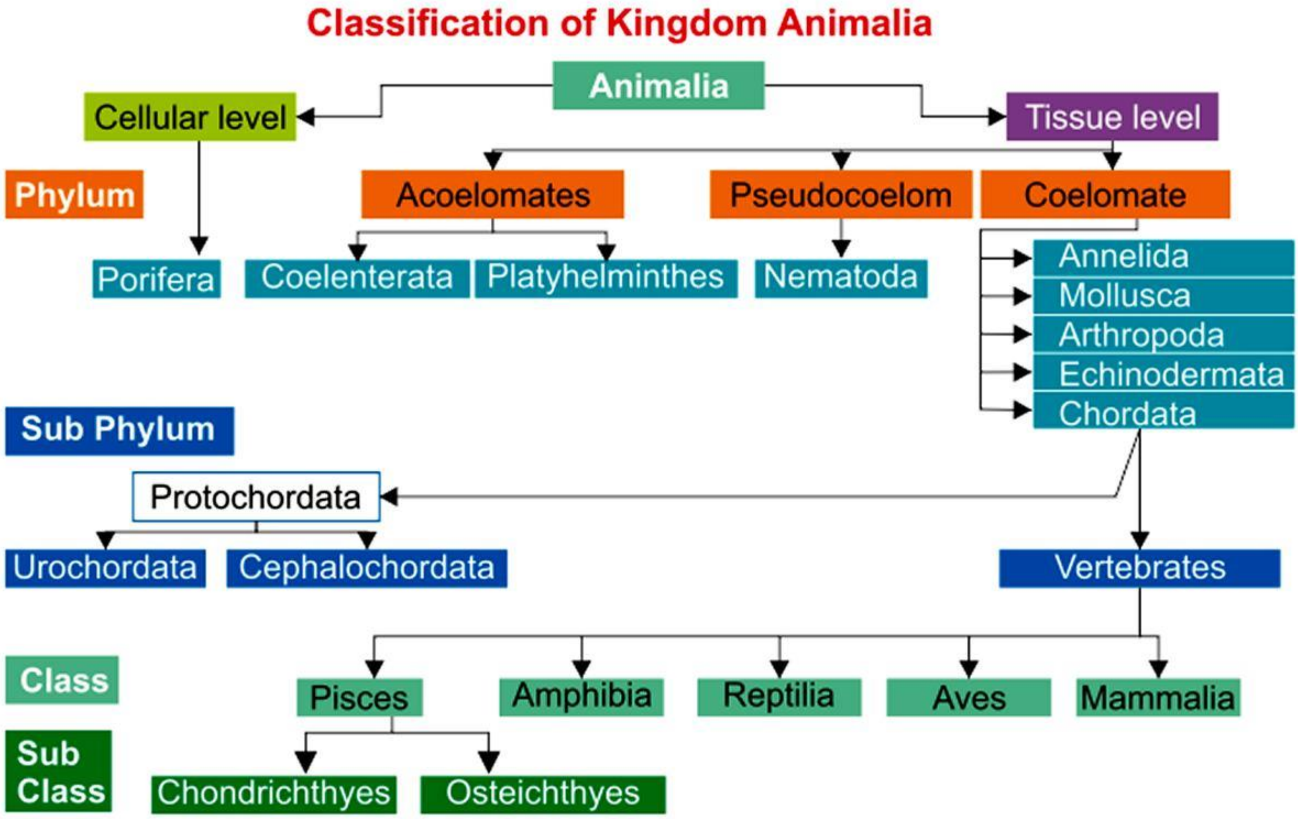
There is single seed leaf in a seed. A seed leaf is a baby plant. Examples: wheat, rice, maize, etc.

(b) Dicotyledonous

There are two cotyledons in a seed. Examples: Mustard, gram, mango, etc.

KINGDOM ANIMALIA

The animal kingdom is classified into different phyla. Their detail is given below:



1. PORIFERA

These animals have pores all over their body. The pores lead into the canal system. Water flows through the canal system and facilitates entry of food and exchange of other materials. The animal is not differentiated into tissues. The body is covered with a hard outer skeleton. These are commonly known as sponges. They are marine animals. Examples: Sycon, spongilla, euplectelea, etc.

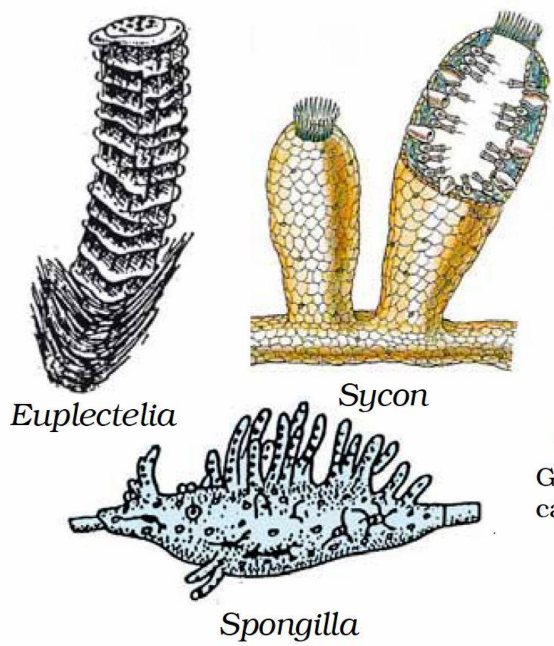


Fig. *Porifera*

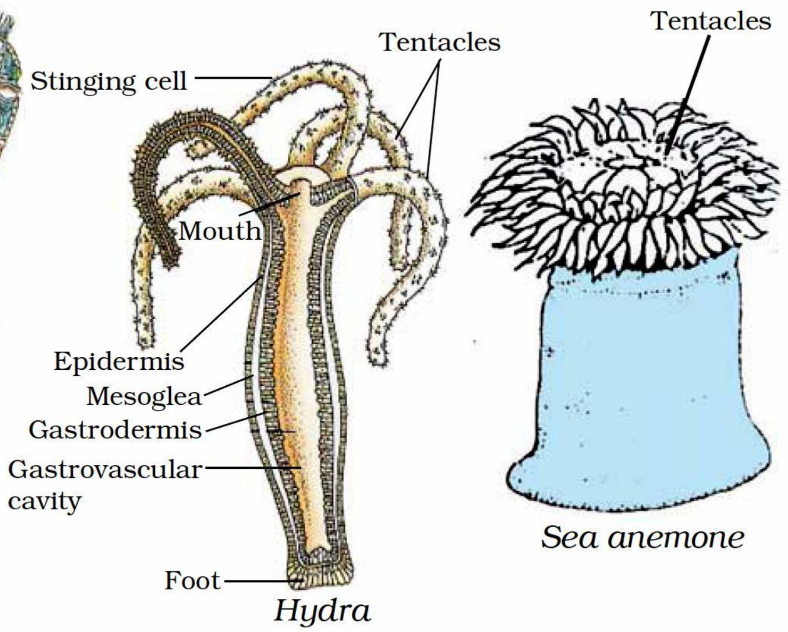


Fig. *Coelenterata*

2. COELENTERATA

The body is made up of a coelom (cavity) with a single opening. The body wall is made up of two layers of cells (diploblastic). Some of the species live a solitary life while others live in colonies. Examples: Hydra, Jelly fish, Sea anemone, etc.

3. PLATYHELMINTHES

The body is flattened from top to bottom and hence the name platyhelminthes. These are commonly known as flatworms. The body wall is composed of three layers of cells (triploblastic). Because of three layers, it is possible to form some organs as well. But a proper ceolom is absent in platyhelminthes and hence proper organs are absent. They are free-living or parasitic animals. Examples: Planaria, liver fluke, tapeworm, etc.

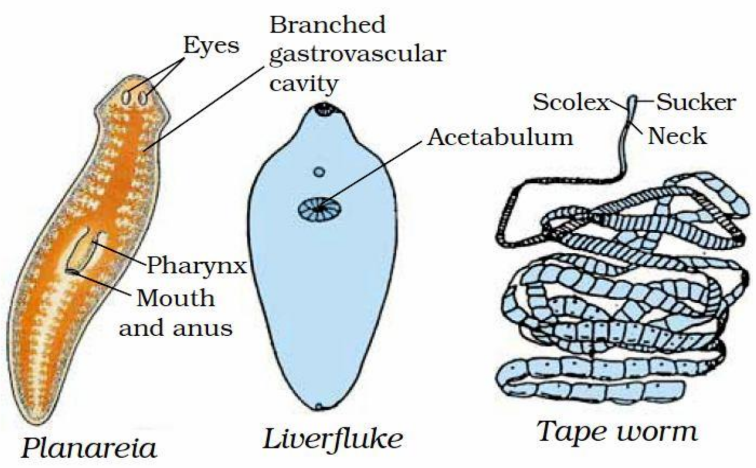


Fig. *Platyhelminthes*

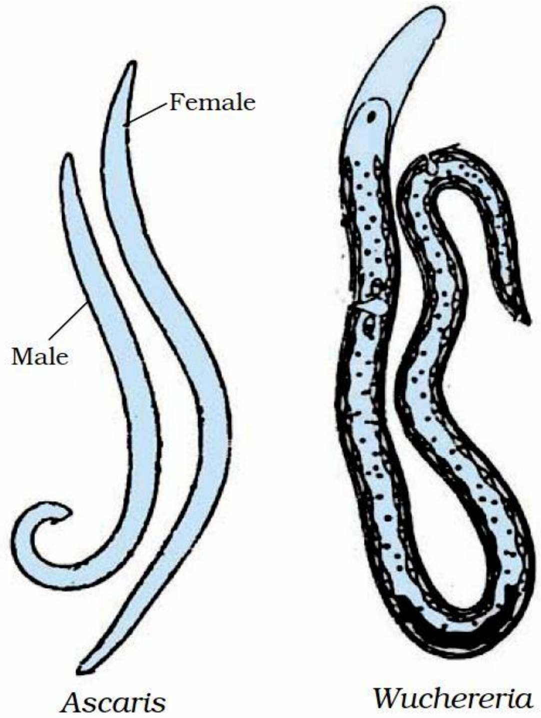


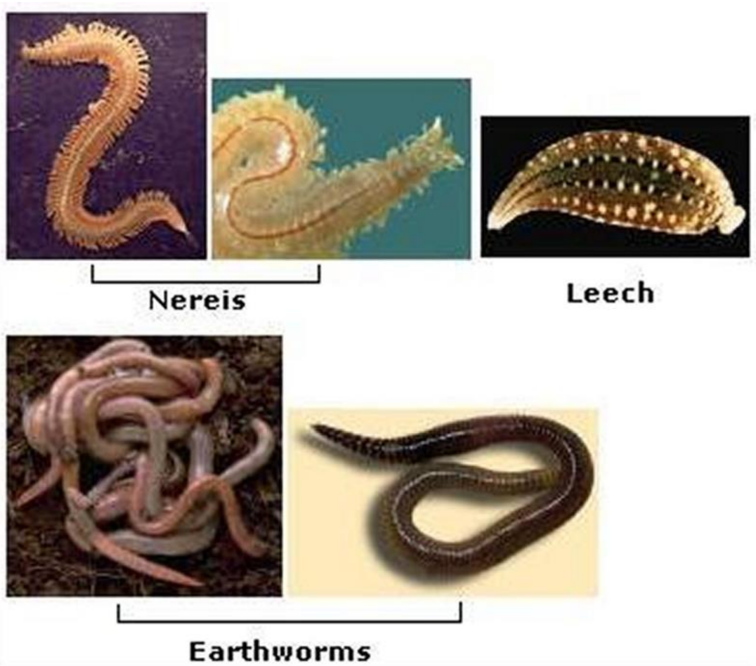
Fig. *Nematodes (Aschelminthes)*

4. NEMATOHELMINTHES

The body is bilaterally symmetric and there are three layers in the body wall. Animals are cylindrical in shape. A pseudocoelom is present and hence organs are absent. Examples: Roundworms, pinworms, filarial parasite (Wuchereria), etc.

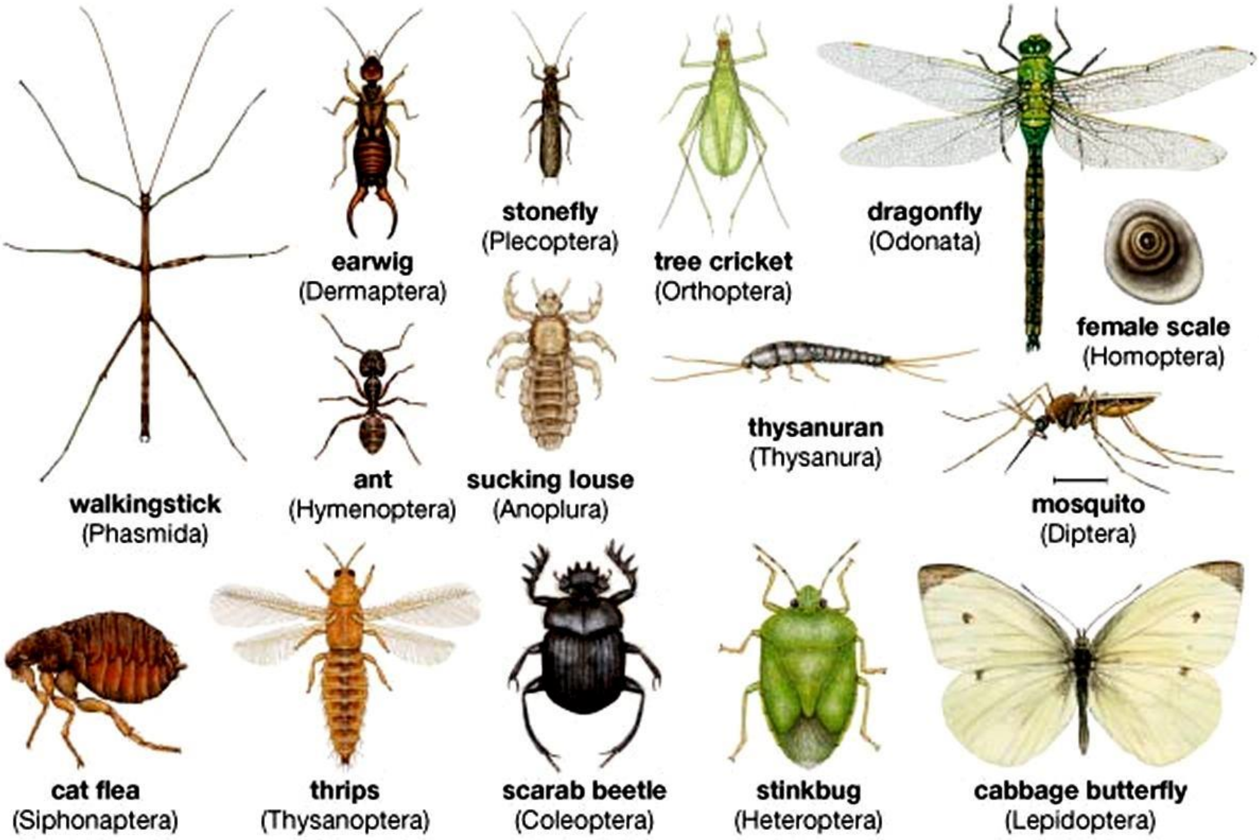
5. ANNELIDA

True body cavity is present in these animals. The body is divided into segments and hence the name annelida. Each segment is lined one after another and contains a set of organs. Examples: Earthworm, leech, Nereis, etc.



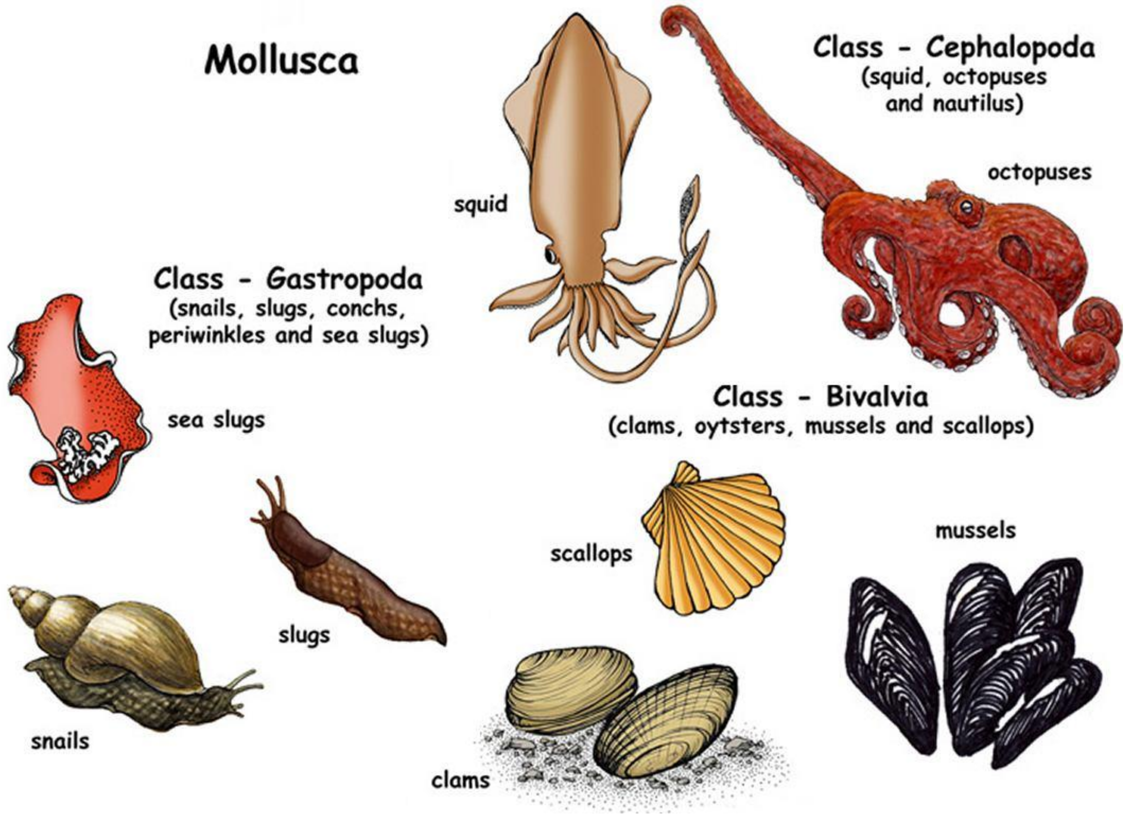
6. ARTHROPODA

Animals have jointed appendages which gives the name arthropoda. Exoskeleton is present which is made of chitin. This is the largest group of animals; in terms of number of species. Circulatory system is open, which means blood flows in the coelomic cavity. Examples: cockroach, housefly, spider, prawn, scorpion, etc.



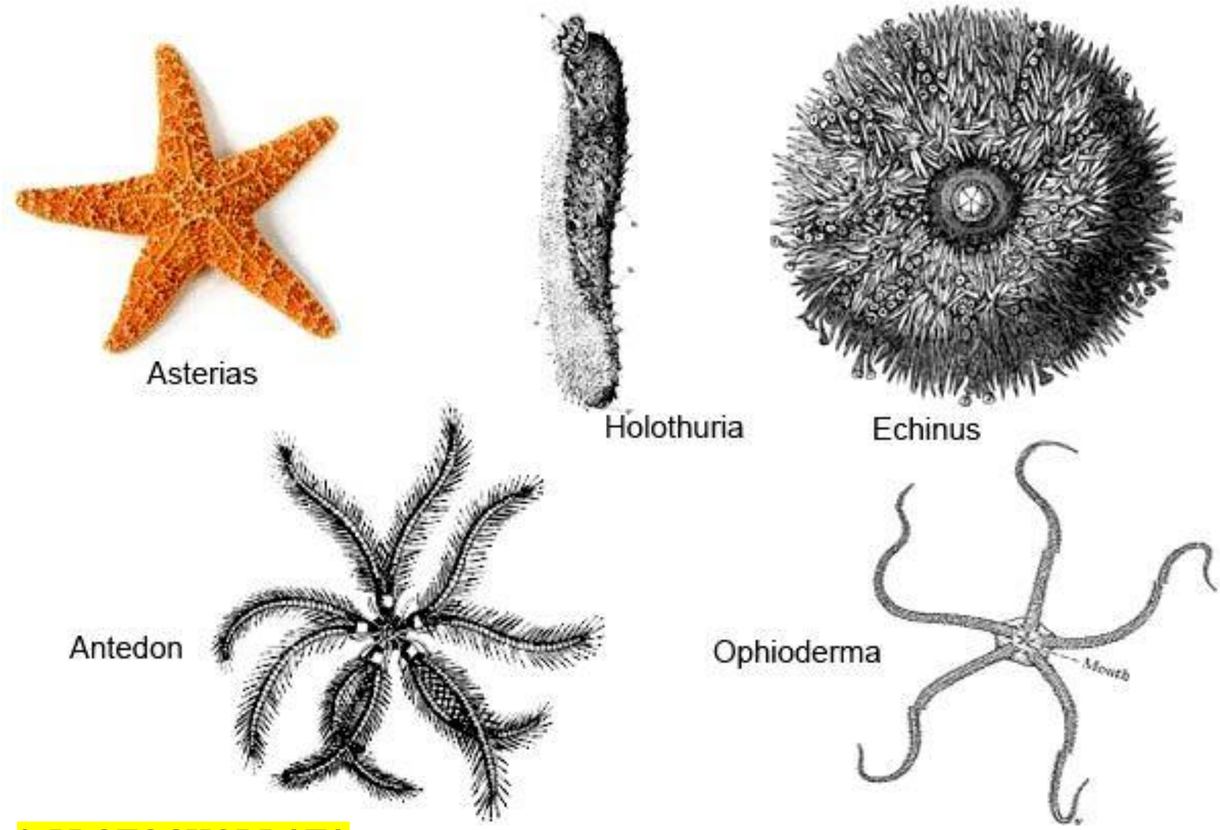
7. MOLLUSCA

The animal has soft body; which is enclosed in a hard shell. The shell is made of calcium carbonate. Circulatory system is open and kidney like organ is present for excretion. The body has well developed muscular feet for locomotion. Examples: Snail, mussels, octopus, etc.



8. ECHINODERMATA

The body is covered with spines, which gives the name echinodermata. Body is radially symmetrical. The animals have well developed water canal system, which is used for locomotion. Skeleton is made of calcium carbonate. Examples: Starfish, sea urchins, etc.



9. PROTOCHORDATA

Animals are bilaterally symmetrical, triploblastic and ceolomate. Notochord is present at least at some stages of life. Notochord is a long rod-like structure which runs along the back of the animal. This provides attachment points for muscles. It also separates the nervous tissues from the gut. Examples: Balanoglossus, herdmania, amphioxus, etc.

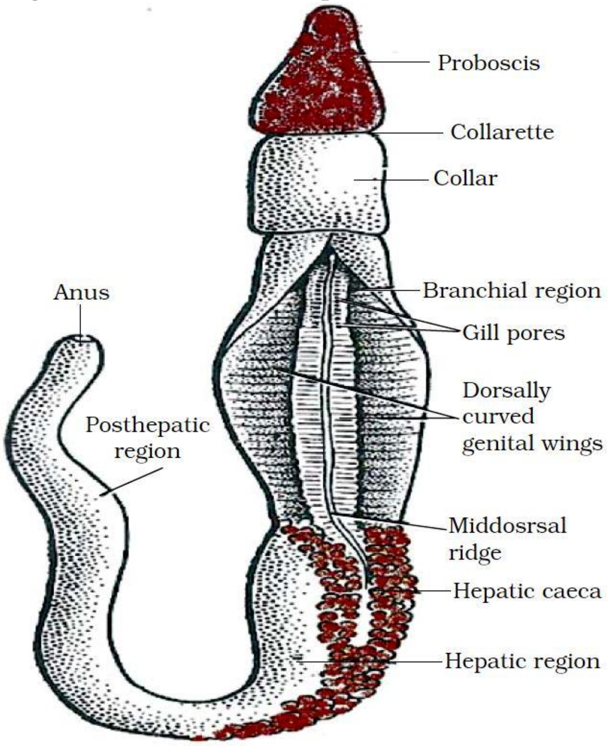


Fig. *A Protochordata: Balanoglossus*

10. VERTEBRATA:

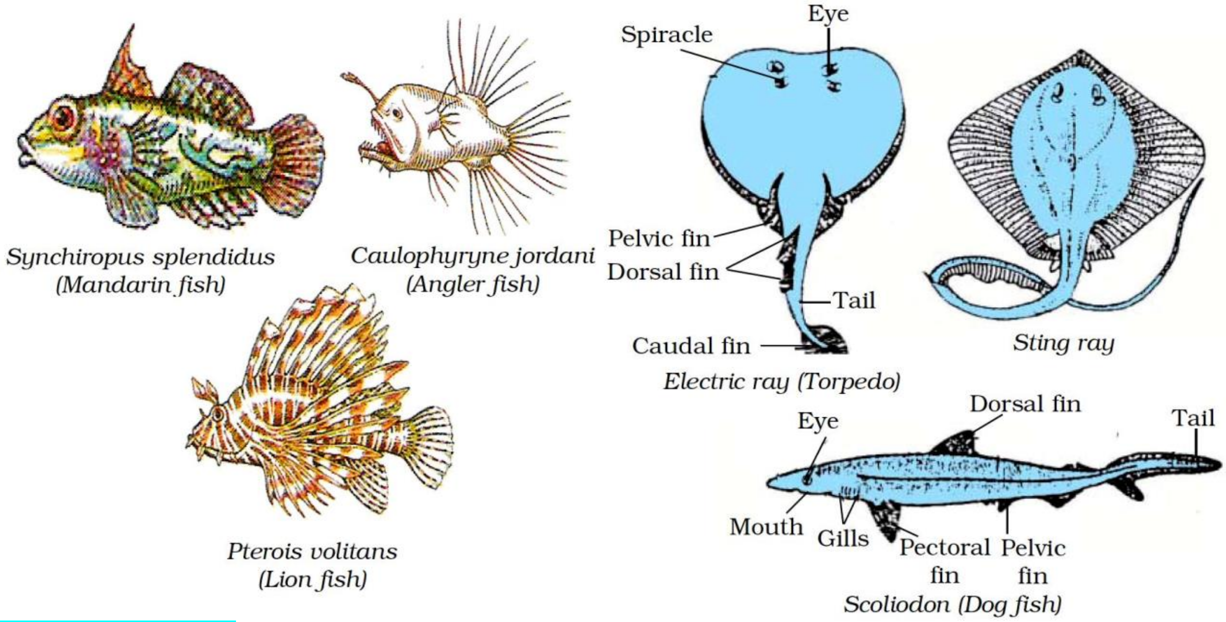
The notochord is replaced by a spinal column during embryonic stage. Following are the main characteristics of vertebrates:

- Notochord present; which is replaced by spinal column.
- Dorsal nerve chord is present.
- Animals are triploblastic and coelomate.
- Animals have paired gill pouches.

Vertebrates are divided into two super classes, viz. pisces and tetrapoda.

A. PISCES

They are commonly known as fish. The body is streamlined. Muscular tail is present which assists in locomotion. Body is covered with scales. Paired gills are present; which can breathe oxygen dissolved in water. They are cold-blooded animals. The heart has only two chambers. They lay eggs. Fishes can be bony or cartilaginous. Shark is an example of cartilaginous fish. Rohu and katla are examples of bony fish.



B. TETRAPODA

Animals have four limbs for locomotion and hence the name tetrapoda. Tetrapoda is divided into four classes, viz. amphibia, reptilia, aves and mammalia.

(1) Amphibia:

These animals are adapted to live both in water and land. Mucus glands on skin keep the skin moist. The animals breathe through skin when in water and through lungs when on land. The heart has three chambers. These are cold blooded animals. Examples: Frog, toad, salamander, etc.

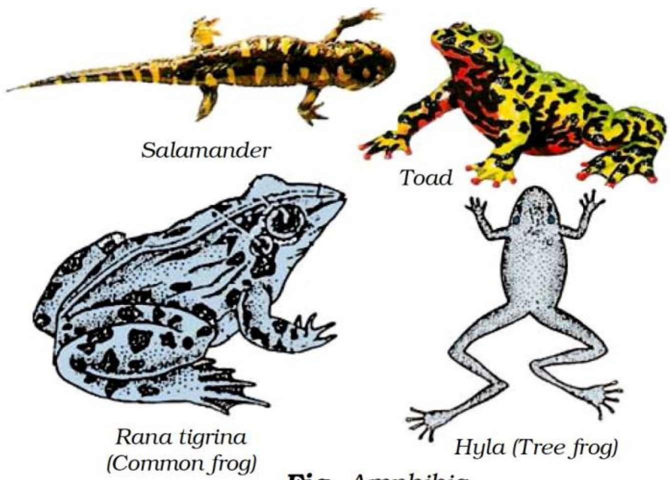


Fig. *Amphibia*

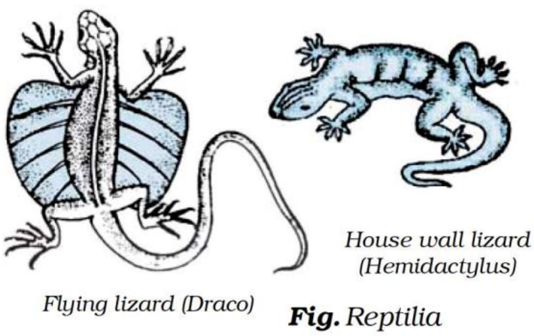
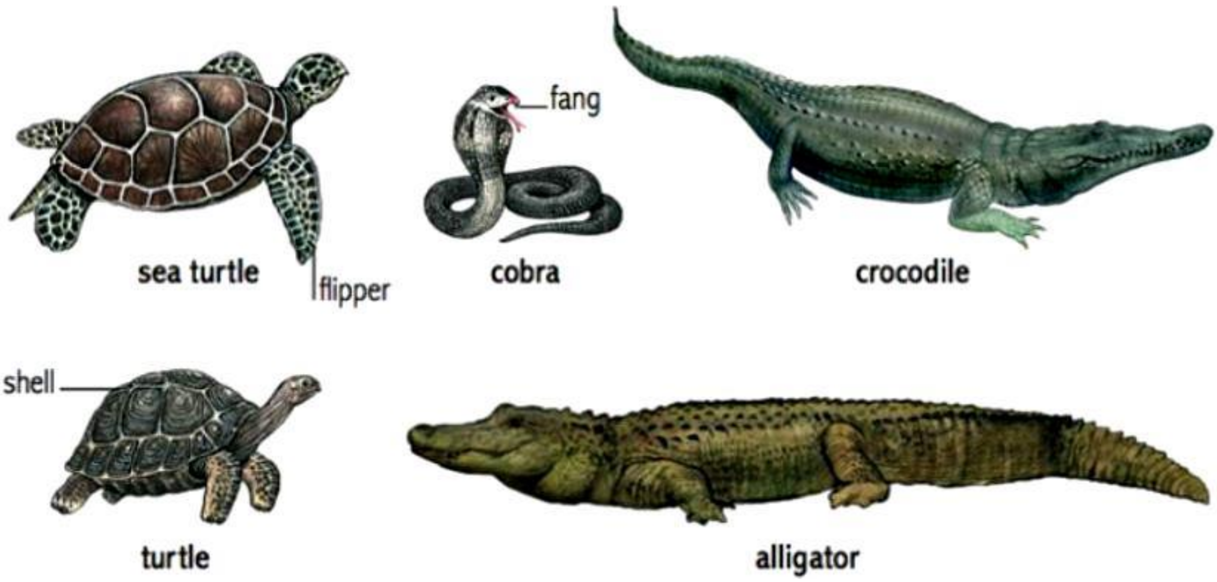


Fig. *Reptilia*

(2) Reptilia:

These animals show crawling movement for locomotion. Skin is hardened to form scales. Most of the reptilians have three chambered heart but crocodile has four-chambered heart. They don't need water to lay eggs, rather eggs are covered with hard shells and laid on land. Examples: snakes, lizards, crocodile, turtle, etc.



(3) Aves:

The body is covered with feathers. Forelimbs are modified into wings. These are warm-blooded animals. The heart has four chambers. Bones are hollow (pneumatic); which assists in flying. All the birds belong to this class.

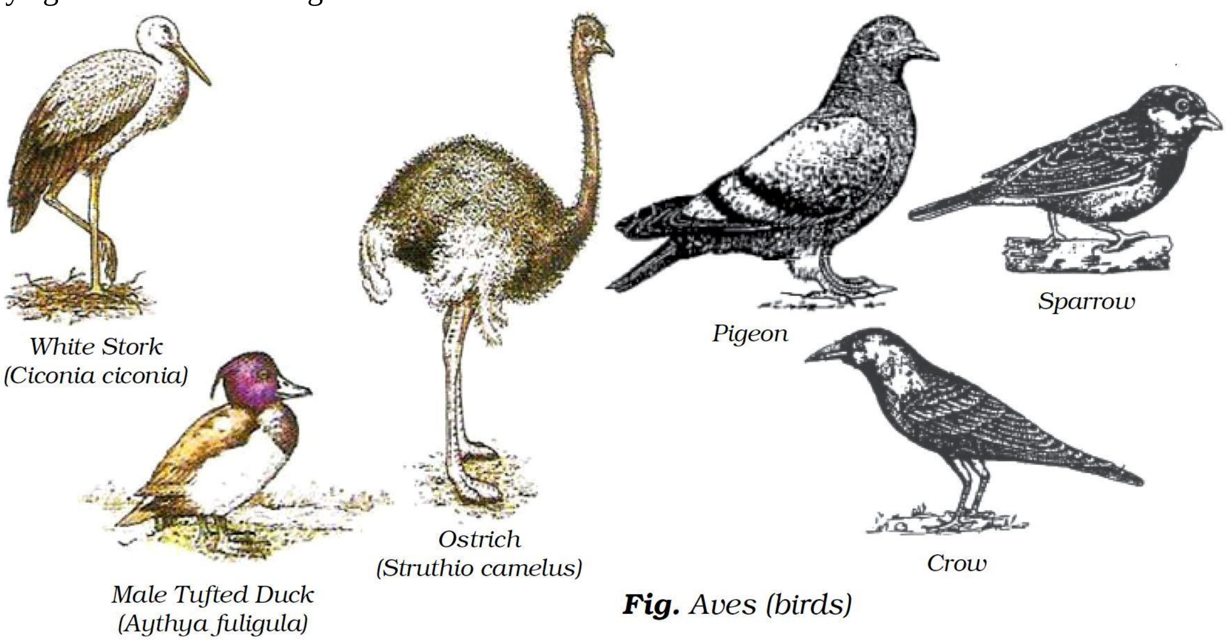
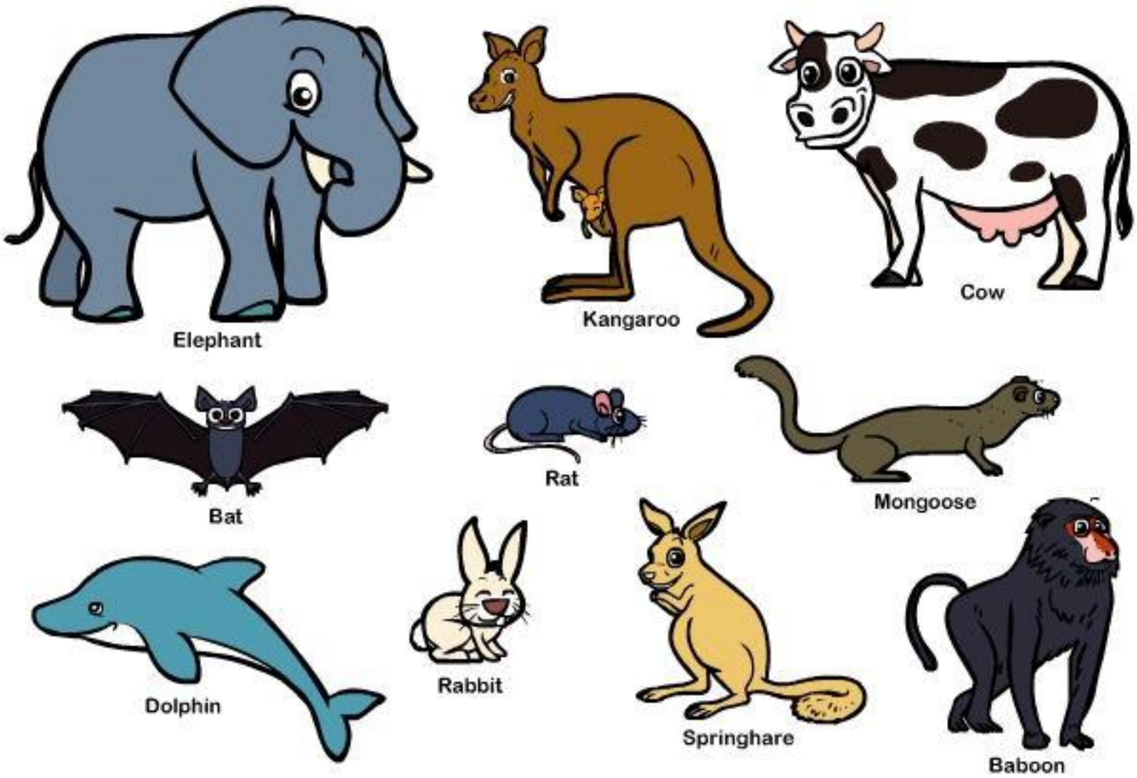


Fig. *Aves (birds)*

(4) Mammalia:

The body is covered with hairs. Skin has seat glands and sebaceous glands. Mammary glands are present in females and are used for nourishing the young ones. Most of the mammalians give birth to young ones and are called viviparous. Some of the mammals lay eggs and are called oviparous. Examples: human, chimpanzee, lion, platypus, horse, etc.



BINOMIAL NOMENCLATURE OF ORGANISMS:
The system of binomial nomenclature was proposed by Carolus Linneaus (1707 – 1778).
Conventions of writing biological name are as follows:

- The biological name is composed of two terms. The first term is called genetic name and the second term is called species name.
- The genus name starts with a capital letter, while the species name starts with a small letter.
- In print, the scientific name is written in italics.
- When handwritten, the genus name and species name need to be underlined separately.

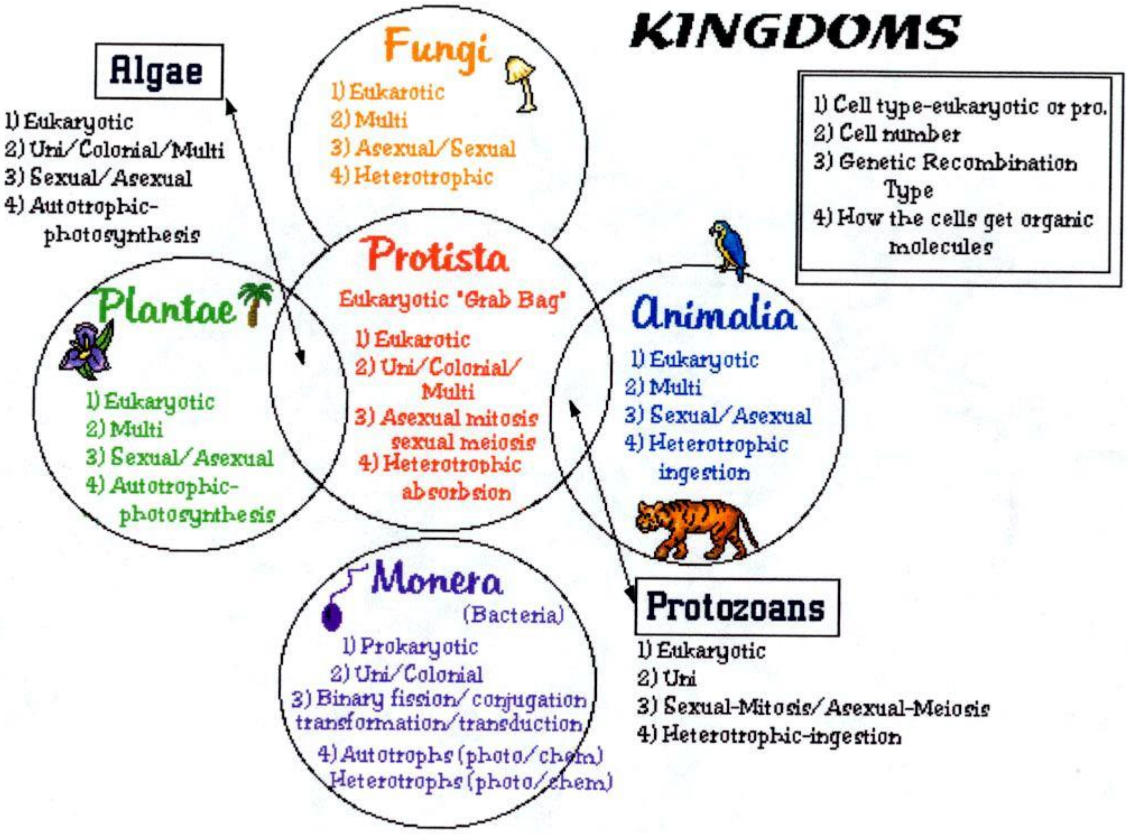
			
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Arthropoda
Class	Mammalia	Aves	Insecta
Order	Rodentia	Passeriformes	Odonata
Family	Castoridae	Icteridae	Gomphidae
Genus and species	*Castor canadensis*	*Icterus galbula*	*Gomphus spicatus*

- System of assigning scientific/binomial names to organisms designed by Carolus Linneaus in 18^{th} century
- Based on idea that every species has a Latin name, made up of two parts
- First part is the name of the **genus**
- Second part specifies the **species**
- Name should be printed in italics (underlined if hand written) and first part capitalized

Example: Binomial name for Humans is ***Homo sapiens***

POINTS TO REMEMBER

FIVE CLASSIFCATION OF KINGDOM



The hierarchy of classification – Groups :-

Living organisms have been broadly classified into five main kingdoms. They are :-

i) Monera ii) Protista iii) Fungi iv) Plante v) Animalia

Each kingdom has been further classified into smaller sub - groups at various levels as :-

Kingdom
- Phylum (for plants) / Division (for animals)
  - Class
    - Order
      - Family
        - Genus
          - Species

By arranging organisms on the basis of hierarchy and characteristics into smaller and smaller groups we arrive at the basic unit of classification called species.

Species :- is group of organisms which are similar enough to breed and perpetuate.

PLANT KINGDOM

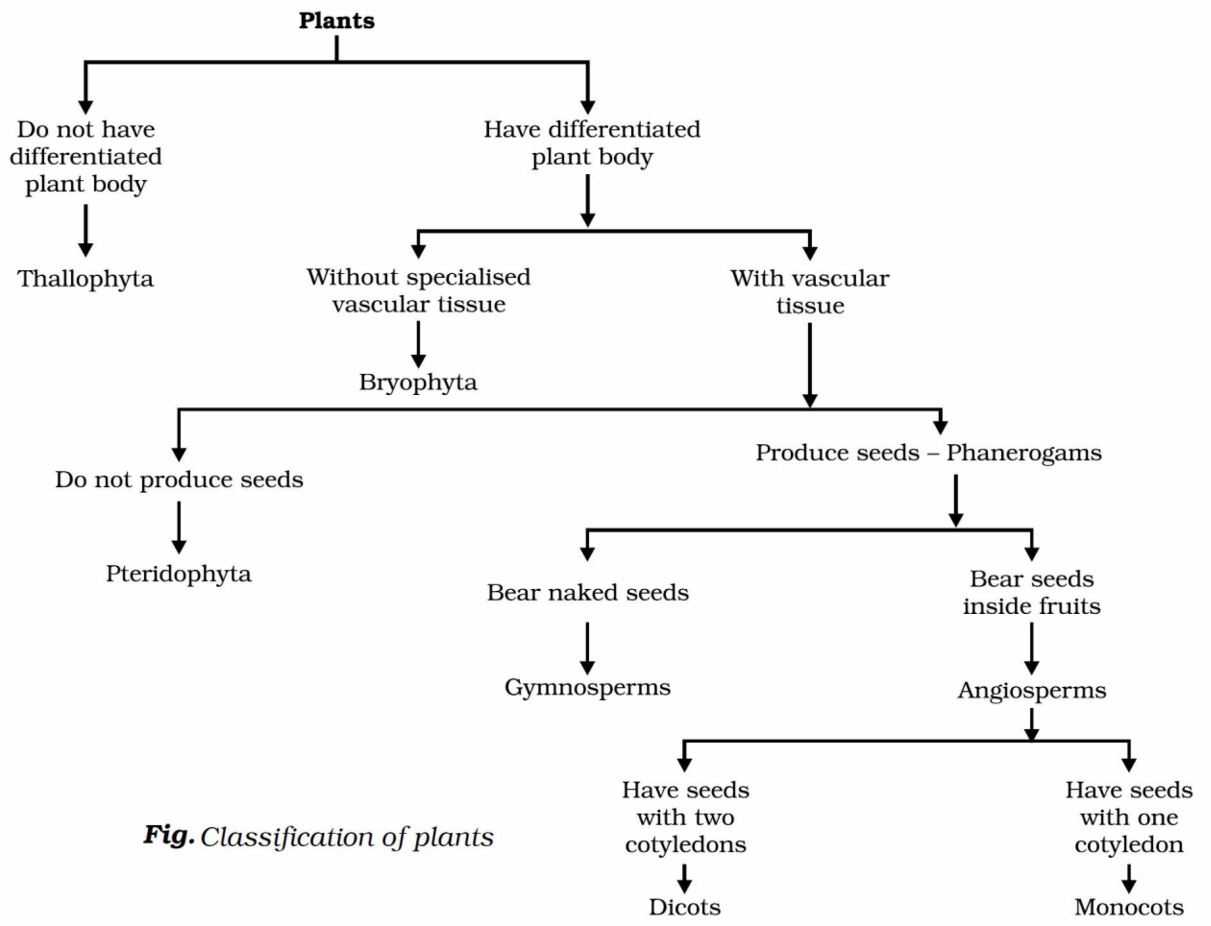
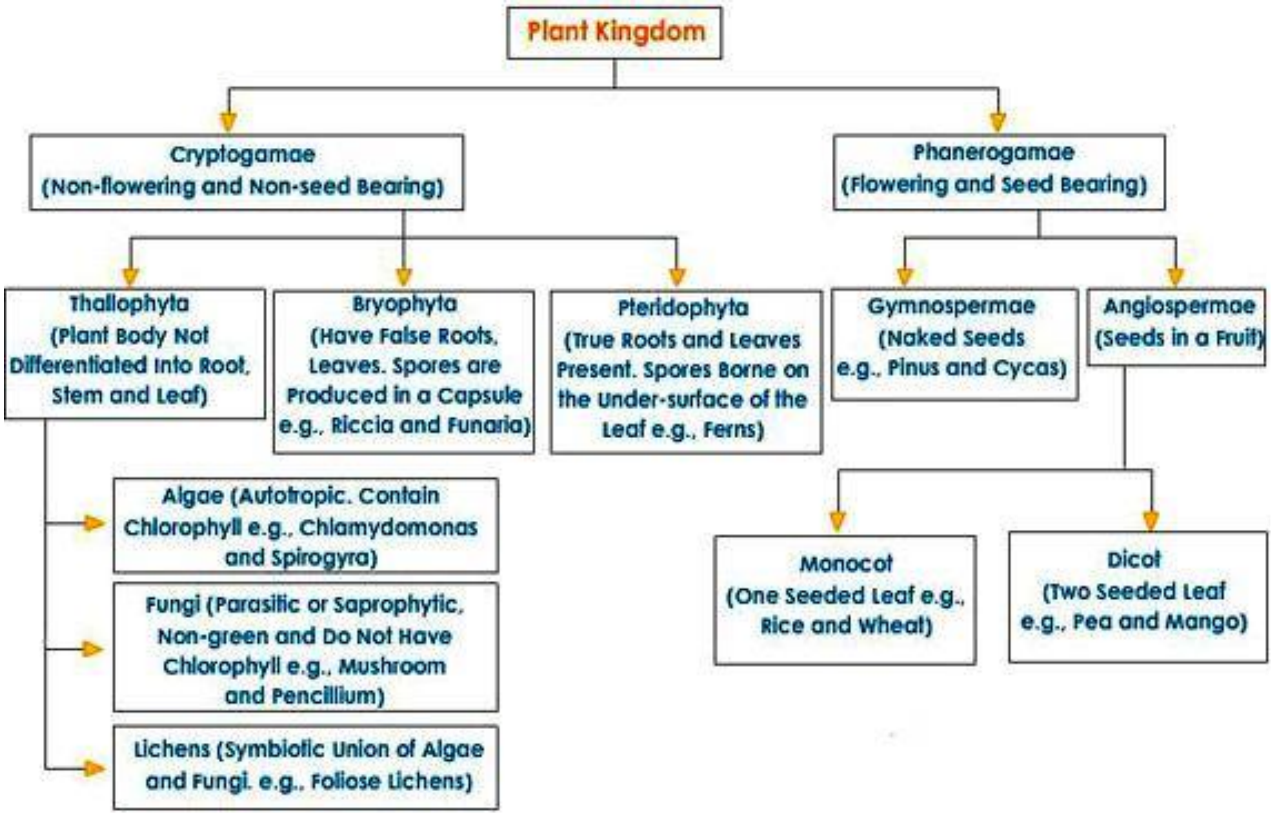


Fig. *Classification of plants*



ANIMAL KINGDOM

Animals

Cellular level of organisation

Porifera

Tissue level of organisation

No body cavity between epidermis and gastrodermis

Coelenterata, Platyhelminthes

Pseudocoelom

Nematoda

Mesodermal cells from a single cell during growth of the embryo

Annelida, Mollusca, Arthropoda

Coelom formed from pouches pinched off from the endoderm

No notochord

Echinodermata

Notochord present

Chordata

Notochord present in at least larval forms, but very rudimentary

Proto chordata

Notochord replaced by vertebral column in adults

Vertebrata

Exoskeleton of scales, endoskeleton of bone/cartilage, breathing through gills

Pisces

Gills in larva, lungs in most adults. slimy skin

Amphibia

Exoskeleton of scales. laying eggs outside water

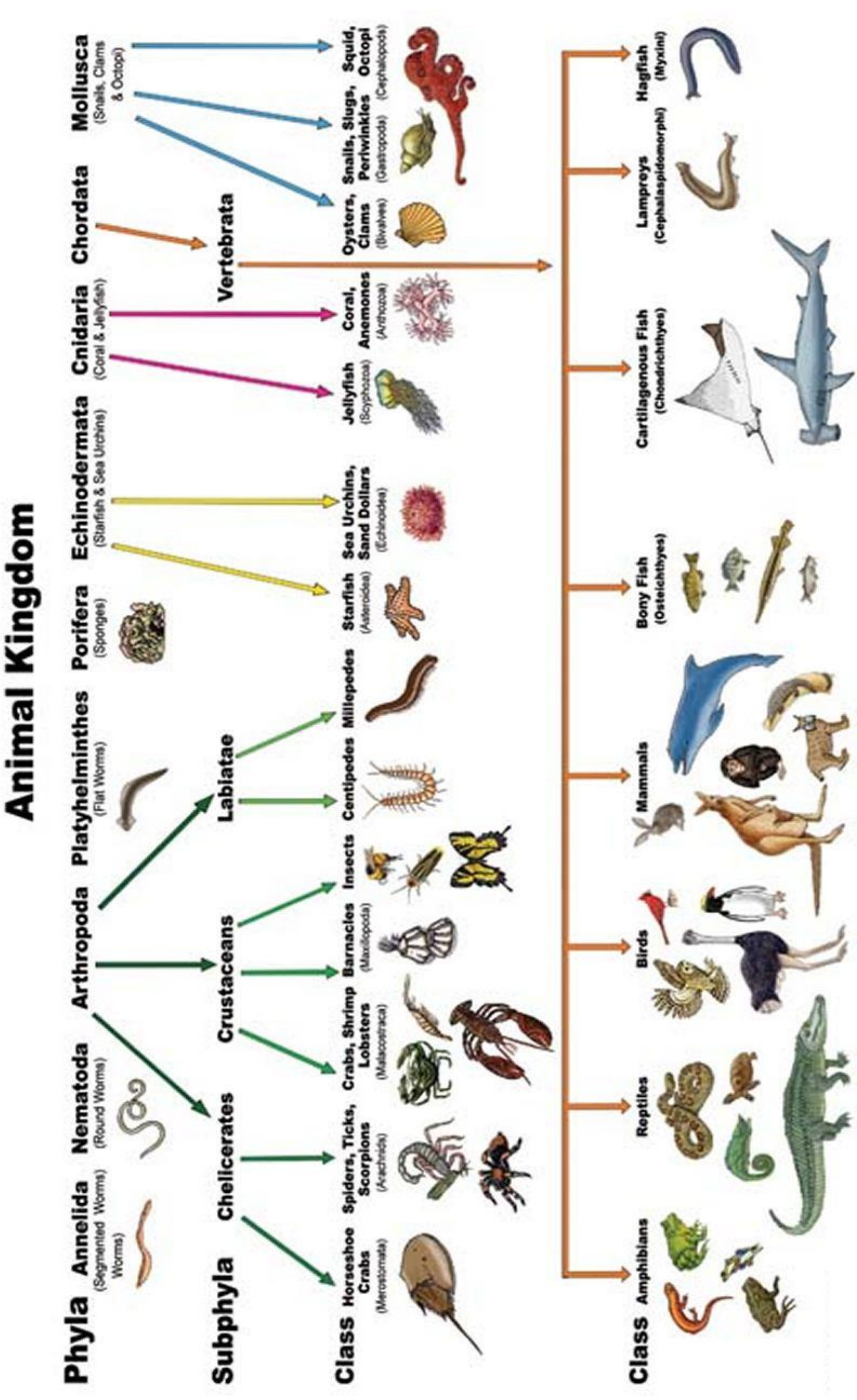
Reptilia

Exoskeleton of feathers. lay eggs outside water, flight possible

Aves

Exoskeleton of hair. external ears, mostly giving birth to live young

Mammalia


Animal Kingdom
Phyla
Annelida
(Segmented Worms)
Nematoda
(Round Worms)
Arthropoda
Platyhelminthes
(Flat Worms)
Porifera
(Sponges)
Echinodermata
(Starfish & Sea Urchins)
Cnidaria
(Coral & Jellyfish)
Chordata
Mollusca
(Snails, Clams & Octopi)
Subphyla
Chelicerates
Crustaceans
Labiatae
Vertebrata
Class
Horseshoe Crabs
(Merostomata)
Spiders, Ticks, Scorpions
(Arachnids)
Crabs, Shrimp Lobsters
(Malacostraca)
Barnacles
(Maxillopoda)
Insects
Centipedes
Millepedes
Starfish
(Asteroidea)
Sea Urchins, Sand Dollars
(Echinoidea)
Jellyfish
(Scyphozoa)
Coral, Anemones
(Anthozoa)
Oysters, Clams
(Bivalves)
Snails, Slugs, Periwinkles
(Gastropoda)
Squid, Octopi
(Cephalopods)
Class
Amphibians
Reptiles
Birds
Mammals
Bony Fish
(Osteichthyes)
Cartilagenous Fish
(Chondrichthyes)
Lampreys
(Cephalaspidomorphi)
Hagfish
(Myxini)

INTEXT QUESTIONS PAGE NO. 82

Q1. Which do you think is a more basic characteristic for classifying organisms?
(a) the place where they live.
(b) the kind of cells they are made of. Why?
Answer: The kind of cells an organism is made of is more basic characteristic of classifying organism because it gives a scientific angle to classification. Moreover, a particular dwelling place can be full of organisms of a wide variety.

Q2. What is the primary characteristic on which the first division of organisms is made?
Answer: Organisation of nucleus is the primary characteristic on which the first division of organisms is made. Based on this, organisms can be either prokaryotic or eukaryotic.

Q3. On what bases are plants and animals put into different categories?
Answer: Plants are autotrophs, while animals are heterotrophs. Cell wall is present in plant cells, while it is absent in animal cells. Plants do not need to move from one place to another, while most of the animals need to move in search of food.

INTEXT QUESTIONS PAGE NO. 83

Q1. Which organisms are called primitive and how are they different from the so-called advanced organisms?
Answer: An organism which is simple is called primitive. On the other hand, an organism with high level of division of labour; by formation of organs and organ system is called advanced.

Q2. Will advanced organisms be the same as complex organisms? Why?
Answer: Complexity in body design evolves because of necessity to adapt according to the changing environment. Hence, a complex organism would be an advanced one; in comparison to a simple organism.

INTEXT QUESTIONS PAGE NO. 85

Q1. What is the criterion for classification of organisms as belonging to kingdom Monera or Protista?
Answer: Organisms which are prokaryotes belong to the kingdom Monera. On the other hand, organisms which are eukaryotes and unicellular belong to the kingdom Protista.

Q2. In which kingdom will you place an organism which is single-celled, eukaryotic and photosynthetic?
Answer: Plant Kingdom

Q3. In the hierarchy of classification, which grouping will have the smallest number of organisms with a maximum of characteristics in common and which will have the largest number of organisms?
Answer: Species will have the smallest number of organisms with a maximum of characteristics in common. On the contrary, kingdom will have the largest number of organisms.

INTEXT QUESTIONS PAGE NO. 88

Q1. Which division among plants has the simplest organisms?

Answer: Thallophyta

Q2. How are pteridophytes different from the phanerogams?
Answer: In pteridophytes, the reproductive organs are hidden and they do not produce seeds. In phaenrogams, reproductive organs are conspicuous and they produce seeds.

Q3. How do gymnosperms and angiosperms differ from each other?
Answer: Seeds are naked in gymnosperms, while they are covered in angiosperms. Gymnosperms do not bear flowers, while angiosperms bear flowers.

INTEXT QUESTIONS PAGE NO. 94

Q1. How do poriferan animals differ from coelenterate animals?
Answer: In porifera, body has numerous pores, which are absent in coelenterates. Body has a cavity in coelenterates, while it is absent in porifera.

Q2. How do annelid animals differ from arthropods?
Answer: Segmented body in annelids, while true segmentation is absent in arthropods. Arthropods have joined appendages, which are absent in annelids.

Q3. What are the differences between amphibians and reptiles?
Answer: Amphibians need water to lay eggs and fertilization is external. Reptilians do not need water to lay eggs and fertilization is internal. Amphibians use both skin and lungs for breathing. Reptilians breathe through lungs only.

Q4. What are the differences between animals belonging to the Aves group and those in the mammalian group?
Answer: In aves, body is covered with feathers; while in mammals, body is covered with hairs. Mammary glands are absent in aves. Forelimbs of aves are modified into wings which is not the case in mammals. Aves are oviparous, while most of the mammals are viviparous.

EXERCISE QUESTIONS PAGE NO. 43, 44

Q1. What are the advantages of classifying organisms?
Answer:- There are millions of species on this earth. For anybody, it is impossible to study about each of them in his lifetime. Classification makes it easy to study the organisms; on the basis of certain common characters.

Q2. How would you choose between two characteristics to be used for developing a hierarchy in classification?
Answer:- We need to look at the fact if given character is present in a small number of organisms or a larger number of organisms. In the first case, the commonality of characters would represent a species. In the latter case, the commonality of characters would represent a higher taxa; like genus, family, order or phylum.
Q3. Explain the basis for grouping organisms into five kingdoms.
Answer: Following points explain the basis of grouping organisms into five kingdoms.
Organization of nucleus: Organisms with unorganized nucleus are kept under the kingdom Monera. Those with organized nucleus are kept in other kingdoms.
Number of cells:- Unicellular eukaryotes are kept in the kingdom Protista, while multicellular eukaryotes are kept in other kingdoms.
Mode of nutrition and presence of cell wall: Hetereotrophic organisms in which cell wall is present are taken under the kingdom fungi. Autotrophic organisms in which cell wall is present are taken in the kingdom Plantae. Organisms in which cell wall is absent are taken in the kingdom Animalia.

Q4. What are the major divisions in the Plantae? What is the basis for these divisions?
Answer: The major divisions of Plantae and the basis for these divisions are as follows:

- **Thallophyta:** Simple body design; with no differentiation into root, stem and leaves.
- **Bryophyta:** Body is differentiated into stem and leaf-like structures. Vascular system is absent.
- **Pteridophyta:** Body is differentiated into root, stem and leaves. Vascular system is present. Reproductive organs are inconspicuous. Seeds are not produced.
- **Gymnosperms:** Seeds are naked.
- **Angiosperms:** Seeds are covered.

Q5. How are the criteria for deciding divisions in plants different from the criteria for deciding the subgroups among animals?
Answer: In the plant kingdom, morphological characters are taken into consideration while deciding about the divisions. Morphology is the study of shapes and forms of various parts. In the animal kingdom, anatomical characters are taken into consideration while deciding about subgroups. Anatomy is the study of various organs' design in animals.

Q6. Explain how animals in Vertebrata are classified into further subgroups.
Answer: Vertebrates are classified into further subgroups on following bases:

1. **Pisces:** The body is streamlined. Muscular tail is present which assists in locomotion. Body is covered with scales. Paired gills are present; which can breathe oxygen dissolved in water. They are cold-blooded animals. The heart has only two chambers. They lay eggs.

2. **Tetrapoda:** Animals have four limbs for locomotion and hence the name tetrapoda. Tetrapoda is divided into four classes, viz. amphibia, reptilia, aves and mammalia.
   a. **Amphibia:** These animals are adapted to live both in water and land. Mucus glands on skin keep the skin moist. The animals breathe through skin when in water and through lungs when on land. The heart has three chambers. These are cold blooded animals. Examples: Frog, toad, salamander, etc.
   b. **Reptilia:** These animals show crawling movement for locomotion. Skin is hardened to form scales. Most of the reptilians have three chambered heart but crocodile has four-chambered heart. They don't need water to lay eggs, rather eggs are covered with hard shells and laid on land. Examples: snakes, lizards, crocodile, turtle, etc.
   c. **Aves:** The body is covered with feathers. Forelimbs are modified into wings. These are warm-blooded animals. The heart has four chambers. Bones are hollow (pneumatic); which assists in flying. All the birds belong to this class.
   d. **Mammalia:** The body is covered with hairs. Skin has seat glands and sebaceous glands. Mammary glands are present in females and are used for nourishing the young ones. Most of the mammalians give birth to young ones and are called viviparous. Some of the mammals lay eggs and are called oviparous. Examples: human, chimpanzee, lion, platypus, horse, etc.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 7
DIVERSITY IN ORGANISMS

1. What do you mean by bio diversity?

2. Why do we classify organisms?

3. What are the advantages of classification?

4. Define Taxonomy.

5. Who is known as father of taxonomy?

6. Give three examples of the range of variations that you see in lifeforms around you.

7. What is the primary reason for such a huge diversity we find in animals and plants?

8. Which do you think is a more basic characteristic for classifying organisms? (a) the place where they live. (b) the kind of cells they are made of. Why?

9. What is the primary characteristic on which the first division of organisms is made?

10. Define Taxon.

11. On what bases are plants and animals put into different categories?

12. Who wrote the book The Origin of Species?

13. Which region of the earth is called the region of megadiversity?

14. Name five countries that lie in the region of megadiversity.

15. Define evolution.

16. Based on evolution, primarily how organisms are categorized?

17. Which organisms are called primitive and how are they different from the so-called advanced organisms?

18. Will advanced organisms be the same as complex organisms? Why?

19. Name the book written by Carolus Linnaeus on classification of organisms.

20. In how many kingdoms Carolus Linnaeus diving living beings?

21. Name the levels of classification proposed by Linnaeus. What happens to similarities among organisms as we go from top to bottom level?

22. In the hierarchy of classification, which grouping will have the smallest number of organisms with a maximum of characteristics in common and which will have the largest number of organisms?

23. Name the scientist who created the third kingdom for all microscopic unicellular organisms. What did he call it?

24. Who identified the Fungi as a separate multicellular eucaryotic kingdom and introduced five kingdoms? Name the five kingdoms.

25. Explain the basis for grouping organisms into five kingdoms.

26. What is the criterion for classification of organisms as belonging to kingdom Monera or Protista?

27. In which kingdom will you place an organism which is singlecelled, eukaryotic and photosynthetic?

28. In which kingdom you will place an organism which is multicellular, eukaryotic, non-green heterotroph or saprophytic, lacks chlorophyll and has absorptive mode of nutrition?

29. In which kingdom, you will place an organism which is multicellular, eukaryotic, heterotroph, lacks chlorophyll and has ingestive mode of nutrition.

30. What is the contribution of Carl Woese (1977) in classification of living beings?

31. Name the organisms which are outside the classification.

32. According to the five-kingdom system, which kingdom contains organisms whose structure is composed of prokaryotic cells?

33. Blue green algae are classified with bacteria and placed in kingdom Monera.

34. What (a) What are saprophytes? (b) Name the kingdom to which they belong. (c) What is the cell wall of fungi made up of?or

35. How do the saprophytes get their food? Give two examples of a saprophyte.

36. What is Symbiotic? Give example of organisms which exhibit this relationship.

37. Classify the following organisms into their respective kingdoms as per Whittaker's five-kingdom system.

38. What are the major divisions in the Plantae? What is the basis for these divisions?

39. Give examples of Thallophyta plants.

40. Why are Thallophytes called non-embryonic plants?

41. Which division among plants has the simplest organisms?

42. What is a thallus?

43. Why bryophytes are called the amphibians of the plant kingdom?

44. List important characteristics (at least three) of bryophytes.

45. Give examples of bryophytes.

46. What are the uses of bryophytes?

47. How are Pteridophytes' bodies organised?

48. How do thallophytes and pteridophytes differ from each other? Write two differences.

49. Name the plants that are called "First vascular land plants".

50. On what basis plants are divided into two sub-kingdoms?

51. How are pteridophytes different from the phanerogams?

52. How Phanerograms are divided further chiefly?

53. What are naked-seeded plants are called?

54. Give two examples of Gymnosperms.

55. Define Cryptograms.

56. How do gymnosperms and angiosperms differ from each other?

57. How Angiosperms are divided further?

58. Write the diffenences between monocots and dicots.

59. What are the general characteristics found in all animals?

60. In how many Phyla, the animal kingdom is divided into?

61. Name the phylum to which the following are included. (i) Spider (ii) Cockroach (iii) Prawn (iv) Housefly

62. Write two important characteristics of sponges (Phylum: Porifera)

63. What is osculum?

64. Do sponges have nervous system?

65. Give examples of Porifera or Sponges.

66. Identify the phylum having following characteristics: multi-cellular, radially symmetrical, aquatic, hollow gut.

67. What are four main features of phylum coelenterata?

68. 'Animals belong to phylum coelenterata are diploblastic.' What do you mean by the term diploblastic?

69. Which animal phylum is commonly called as flatworms?

70. Which animal phylum is considered to be first triploblastic animals?

71. Write important features about Phylum Platihelminthes.

72. How do poriferan animals differ from coelenterate animals?

73. Which phylum is commonly called roundworms or pinworms?

74. Give examples of animals belong to Nematoda.

75. Name a parasitic disease caused by members of Nematoda.

76. Name the first animals (phylum) that have true body cavity.

77. Leeches and Earthworms belong to which phylum?

78. Differentiate between Annelida and Nematode.

79. Name the largest group (phylum) of animals.

80. Give examples of Arthropod animals.

81. What is the most striking feature of phylum Arthropoda?

82. How is body of Arthropods segmented?

83. What is the type of circulatory system present in Arthropods?

84. How do annelid animals differ from arthropods?

85. Give examples of animals that belong to Phylum Mollusca.

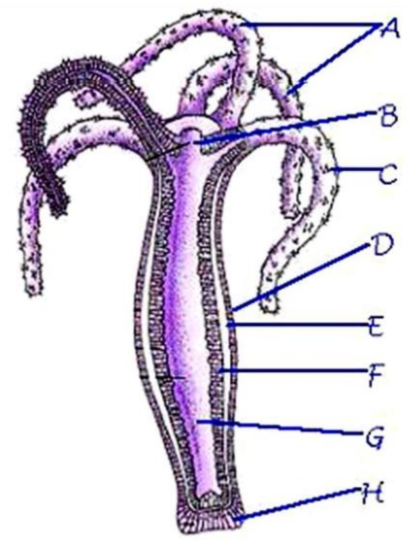
86. What kind of circulatory system is found in animals from Mollusca phylum?

87. How is locomotion brought in animals belonging to Mollusca phylum?

88. Name the phylum to which Start fish and Sea urchin belong to?

89. Name the phylum to which this organism belongs. Write any two characteristic feature of the phylum.

90. Label A to H in the given diagram of hydra.



91. What is a notochord? What does it do?

92. Give examples of organisms which belong to Phylum Protochordata.

93. List three important characteristics of Phylum Protochordata.

94. Why are Bats and whales classified as mammals?

95. A plant specimen was found without differentiated roots.(a) Which plant structure helps in attaching this plant to the substratum?(b) To which group you will keep this plant?(c) Which plant could it be?

96. Why is there a need for classification and systematic naming of living organisms?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 7
DIVERSITY IN ORGANISMS

1. Who introduced the system of scientific nomenclature of organisms?
2. In which Kingdom, an organism does not have a well defined nucleus and organelles?
3. In the hierarchy of classification, which group will have the largest number of organisms?
4. Which in your opinion is more basic characteristic for classifying organism. The place where they live in or the kind of cells they are made of?
5. Give examples of the organisms that have cilia and flagellum for moving around.
6. In the hierarchy of classification, which group will have the smallest number of organisms and a maximum number of similar characteristics?
7. Name the substance which makes the cell wall of fungi.
8. Name a symbiotic life form that grows on the bark of a tree as large, coloured patches.
9. In which kingdom would you place an organism which is unicellular, eukaryotic and photosynthetic?
10. What is the primary characteristic on which the first division of organisms is made?
11. What is the mode of nutrition in Mushroom?
12. Eichler classified the plant kingdom into two sub-kingdoms. Name the two sub kingdoms.
13. Name the kingdom which includes the simplest form of eukaryotes.
14. Do Protozoans have eyes?
15. Name the simplest of plants that do not have a well-differentiated body design.
16. Which division of plants are often called amphibians of the plant kingdom?
17. Woese introduced by dividing the Monera kingdom into two sub-kingdoms. Name the two?
18. Write the name of the group of plants, which produces seeds, but not fruits.
19. Amar, Ujala and Anara wrote the scientic name of mango as follows. Who wrote it correctly. 1) Amar - Mangifera Indica 2) Ujala - Mangifera indica 3) Anara - mangifera indica
20. Algae belongs to which division of Plantae?
21. Name the three divisions of Plantae that have inconspicuous reproductive organs. What are their seeds called?
22. Name the two groups of Plantae that are commonly called phanerogams.
23. Identify the division of Plantae having following characteristics: i).Seeds not enclosed

within fruit. ii).Flowers represented as cones (unisexual) iii). Ovules not located in ovary.

24. Identify plant group which has parallel venation, scattered vascular bundles, flower petals/parts in multiple of three, fibrous roots.

25. Identify the plant groups which has net like veins in leaves, flower parts in group of fours or fives, vascular bundles are in a ring and two seed leaves.

26. Give two examples of Bryophyta plants?

27. Give two examples of Pteridophyes

28. Pines and Deodar belong to which group of Plants?

29. Sunflower, Maize, Wheat and Pea belong to which group of plants?

30. Identify which of the following are monocots and dicots: garlic, onion, tomatoes, corn, peppers, potatoes, wheat, beans

31. Minimal body design, have holes which lead to canal system that helps in circulating water, marine habitat. Which division of Animalia it refers to?

32. Hydra, Jelly Fish, corals belog to which group of animals?

33. Commonly called flatworm, bilateral symmetrical, acoelomates are the features of which animal division?

34. Filarial worms, (Ascaris)round worms, (Wuchereria)pin worms belong to which group of animalia?

35. Which is the largest group of animals?

36. Identify the Animalia group having following features: i). jointed legs ii). bilaterally symmetrical segmented body iii). blood filled body cavity (open circulatory system)

37. Which worms cause elephantiasis. Name the group it belongs to?

38. Give three examples of organisms that are arthopods.

39. Give three examples of Molluscs

40. What type of circulatory system do Molluscs have?

41. Spiny skin, marine, triploblastic coelomates having water-driven tube system for locomotion. What type of group are we talking of?

42. Give three examples of animals belong to Echinodermata

43. Give three examples of Protochordata animals.

44. What is the main basis of differentiation between vertebrates and non-vertebrates?

45. Cold blooded, two chamber heart, stream lined body, scales on skin, gills present, aquatic life. Which group of vertebrates are we referring to?

46. Ambibian heart is divided into how many chambers?

47. Name the fish which is entirely made of cartilage.

48. Name the fish having skeleton made of both bone and cartilage.

49. No scales on skin, mucus glands on skin, three chambered heart, respiration through gills, lungs and skin, oviparous, live on land and in water. Name the group of these vertebrates.

50. Give three examples of Amphibians.

51. Snakes, turtles, lizards and crocodiles belong to which category of vertebrates?

52. Name a reptile which has four chambered heart.

53. What changes are evolved in limbs of aves?

54. Give three examples of flightless birds.

55. Four Chambered heart, mostly viviparous, skin covered with hairs, skin contains sweat and oil glands, four chambered heart. Which category of vertebrates are we talking about?

56. Give examples of egg laying mammals

57. Give an example of marsupial mammal

58. Give an example of mammal that can fly.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 7
DIVERSITY IN ORGANISMS

1. Find out incorrect sentence

(a) Protista includes unicellular eukaryotic organisms

(b) Whittaker considered cell structure, mode and source of nutrition for classifying the organisms in five kingdoms

(c) Both Monera and Protista may be autotrophic and heterotrophic

(d) Monerans have well defined nucleus

2. Which among the following has specialised tissue for conduction of water?

(i) Thallophyta

(ii) Bryophyta (iii)

Pteridophyta (iv)

Gymnosperms (a)

(i) and (ii)

(b) (ii) and (iii)

(c) (iii) and (iv)

(d) (i) and (iv)

3. Which among the following produce seeds?

(a) Thallophyta (b) Bryophyta

(c) Pteridophyta (d) Gymnosperms

4. Which one is a true fish?

(a) Jellyfish (b) Starfish

(c) Dogfish (d) Silverfish

5. Which among the following is exclusively marine?

(a) Porifera (b) Echinodermata

(c) Mollusca (d) Pisces

6. Which among the following have open circulatory system?

(i) Arthropoda

(ii) Mollusca

(iii) Annelida

(iv) Coelenterata

(a) (i) and (ii)

(b) (iii) and (iv)

(c) (i) and (iii)

(d) (ii) and (iv)

7. In which group of animals, coelom is filled with blood?

(a) Arthropoda

(b) Annelida

(c) Nematoda

(d) Echinodermata

8. Elephantiasis is caused by

(a) Wuchereria

(b) Pinworm

(c) Planarians

(d) Liver flukes

9. Which one is the most striking or (common) character of the vertebrates?

(a) Presence of notochord

(b) Presence of triploblastic condition

(c) Presence of gill pouches

(d) Presence of coelom

10. Which among the following have scales?

(i) Amphibians

(ii) Pisces

(iii) Reptiles

(iv) Mammals

(a) (i) and (iii)

(b) (iii) and (iv)

(c) (ii) and (iii)

(d) (i) and (ii)

11. Find out the false statement

(a) Aves are warm blooded, egg laying and have four chambered heart

(b) Aves have feather covered body, fore limbs are modified as wing and breathe through lungs

(c) Most of the mammals are viviparous

(d) Fishes, amphibians and reptiles are oviparous

12. Pteridophyta do not have

(a) root (b) stem

(c) flowers (d) leaves

13. Identify a member of porifera

(a) *Spongilla*

(b) *Euglena*

(c) *Penicillium*

(d) *Hydra*

14. Which is not an aquatic animal?

(a) Hydra

(b) Jelly fish

(c) Corals

(d) Filaria

15. Amphibians do not have the following

(a) Three chambered heart

(b) Gills or lungs

(c) Scales

(d) Mucus glands

16. Organisms without nucleus and cell organelles belong to

(i) fungi

(ii) protista

(iii) cyano bacteria

(iv) archae bacteria

(a) (i) and (ii)

(b) (iii) and (iv)

(c) (i) and (iv)

(d) (ii) and (iii)

17. Which of the following is not a criterion for classification of living organisms?

(a) Body design of the organism

(b) Ability to produce one's own food

(c) Membrane bound nucleus and cell organelles

(d) Height of the plant

18. The feature that is not a characteristic of protochordata?

(a) Presence of notochord

(b) Bilateral symmetry and coelom

(c) Jointed legs

(d) Presence of circulatory system

19. The locomotory organs of Echinodermata are

(a) tube feet (b) muscular feet

(c) jointed legs (d) parapodia

20. Corals are

(a) Poriferans attached to some solid support

(b) Cnidarians, that are solitary living

(c) Poriferans present at the sea bed

(d) Cnidarians that live in colonies

21. Who introduced the system of scientific nomenclature of organisms

(a) Robert Whittaker

(b) Carolus Linnaeus

(c) Robert Hooke

(d) Ernst Haeckel

22. Two chambered heart occurs in

(a) crocodiles

(b) fish

(c) aves

(d) amphibians

23. Skeleton is made entirely of cartilage in

(a) Sharks

(b) Tuna

(c) Rohu

(d) None of these

24. One of the following is not an Annelid

(a) Nereis

(b) Earthworm

(c) Leech

(d) Urchins

25. The book Systema Naturae was written by

(a) Linnaeus

(b) Haeckel

(c) Whittaker

(d) Robert Brown

26. Karl Von Linne was involved with which branch of science?

(a) Morphology

(b) Taxonomy

(c) Physiology

(d) Medicine

27. Real organs are absent in

(a) Mollusca (b) Coelenterata

(c) Arthropoda (d) Echinodermata

28. Hard calcium carbonate structures are used as skeleton by

(a) Echinodermata

(b) Protochordata

(c) Arthropoda

(d) Nematoda

29. Differentiation in segmental fashion occurs in

(a) Leech

(b) Starfish

(c) Snails

(d) Ascaris

30. In taxonomic hierarchy family comes between

(a) Class and Order

(b) Order and Genus

(c) Genus and Species

(d) Division and Class

31. The 5-Kingdom classification has given by

(a) Morgan

(b) R. Whittaker

(c) Linnaeus

(d) Haeckel

32. Well defined nucleus is absent in

(a) blue green algae

(b) diatoms

(c) algae

(d) yeast

33. The 'Origin of Species' is written by

(a) Linnaeus (b) Darwin

(c) Hackel (d) Whittaker

34. Meena and Hari observed an animal in their garden. Hari called it an insect while Meena said it was an earthworm. Choose the character from the following which confirms that it is an insect.

(a) Bilateral symmetrical body

(b) Body with jointed legs

(c) Cylindrical body

(d) Body with little segmentation

35. Write true (T) or false (F)

(a) Whittaker proposed five kingdom classification.

(b) Monera is divided into Archaebacteria and Eubacteria.

(c) Starting from Class, Species comes before the Genus.

(d) *Anabaena* belongs to the kingdom Monera.

(e) Blue green algae belongs to the kingdom Protista.

(f) All prokaryotes are classified under Monera.

36. Fill in the blanks

(a) Fungi shows———mode of nutrition.

(b) Cell wall of fungi is made up of ———.

(c) Association between blue green algae and fungi is called as———.

(d) Chemical nature of chitin is ———.

(e) ———has smallest number of organisms with maximum number of similar characters

(f) Plants without well differentiated stem, root and leaf are kept in ———.

(g) ———are called as amphibians of the plant kingdom.

37. You are provided with the seeds of gram, wheat, rice, pumpkin, maize and pea. Classify them whether they are monocot or dicot.

38. Match items of column **(A)** with items of column **(B)**

(A)	**(B)**
(a) Naked seed	(A) Angiosperms
(b) Covered seed	(B) Gymnosperms
(c) Flagella	(C) Bryophytes
(d) *Marchantia*	(D) *Euglena*
(e) *Marsilea*	(E) Thallophyta
(f) *Cladophora*	(F) Pteridophyta
(g) *Penicillium*	(G) Fungi

39. Match items of column **(A)** with items of column **(B)**

(A)	**(B)**
(a) Pore bearing animals	(A) Arthropoda
(b) Diploblastic	(B) Coelenterata
(c) Metameric segmentation	(C) Porifera
(d) Jointed legs	(D) Echinodermata
(e) Soft bodied animals	(E) Mollusca
(f) Spiny skinned animals	(F) Annelida

40. Classify the following organisms based on the absence/presence of true coelom (i.e., acoelomate, pseudocoelomate and coelomate) *Spongilla*, Sea anemone, Planaria, Liver fluke *Wuchereria*, *Ascaris*, *Nereis*, Earthworm, Scorpion, Birds, Fishes, Horse.

41. Endoskeleton of fishes are made up of cartilage and bone; classify the following fishes as cartilagenous or bony Torpedo, Sting ray, Dog fish, Rohu, Angler fish, Exocoetus.

42. Classify the following based on number of chambers in their heart. Rohu, *Scoliodon*, Frog, Salamander, Flying lizard, King Cobra, Crocodile, Ostrich, Pigeon, Bat, Whale

43. Classify Rohu, *Scolidon*, Flying lizard, King Kobra, Frog, Salamander, Ostrich, Pigeon, Bat, Crocodile and Whale into the cold blooded/warm blooded animals.

44. Name two egg laying mammals.

45. Fill in the blanks

(a) Five kingdom classification of living organisms is given by———.

(b) Basic smallest unit of classification is ———.

(c) Prokaryotes are grouped in Kingdom ———.

(d) *Paramecium* is a protista because of its ———.

(e) Fungi do not contain ———.

(f) A fungus ——— can be seen without microscope.

(g) Common fungi used in preparing the bread is ———.

(h) Algae and fungi form symbiotic association called ———.

46. Give True (T) and False (F)

(a) Gymnosperms differ from Angiosperms in having covered seed.

(b) Non flowering plants are called Cryptogamae.

(c) Bryophytes have conducting tissue.

(d) *Funaria* is a moss.

(e) Compound leaves are found in many ferns.

(f) Seeds contain embryo.

47. Give examples for the following

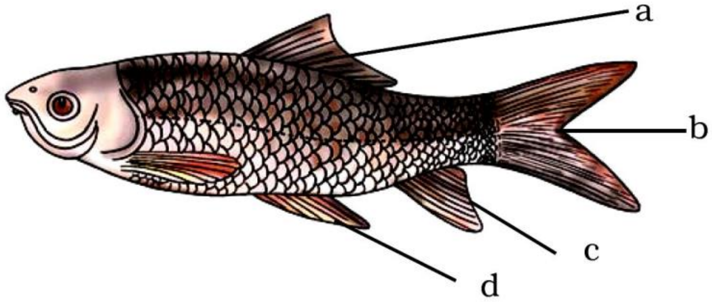
(a) Bilateral, dorsiventral symmetry is found in———.

(b) Worms causing disease elephantiasis is———.

(c) Open circulatory system is found in———where coelomic cavity is filled with blood.

(d) ———are known to have pseudocoelom.

48. Label a, b, c and d. given in below figure. Give the function of (b)



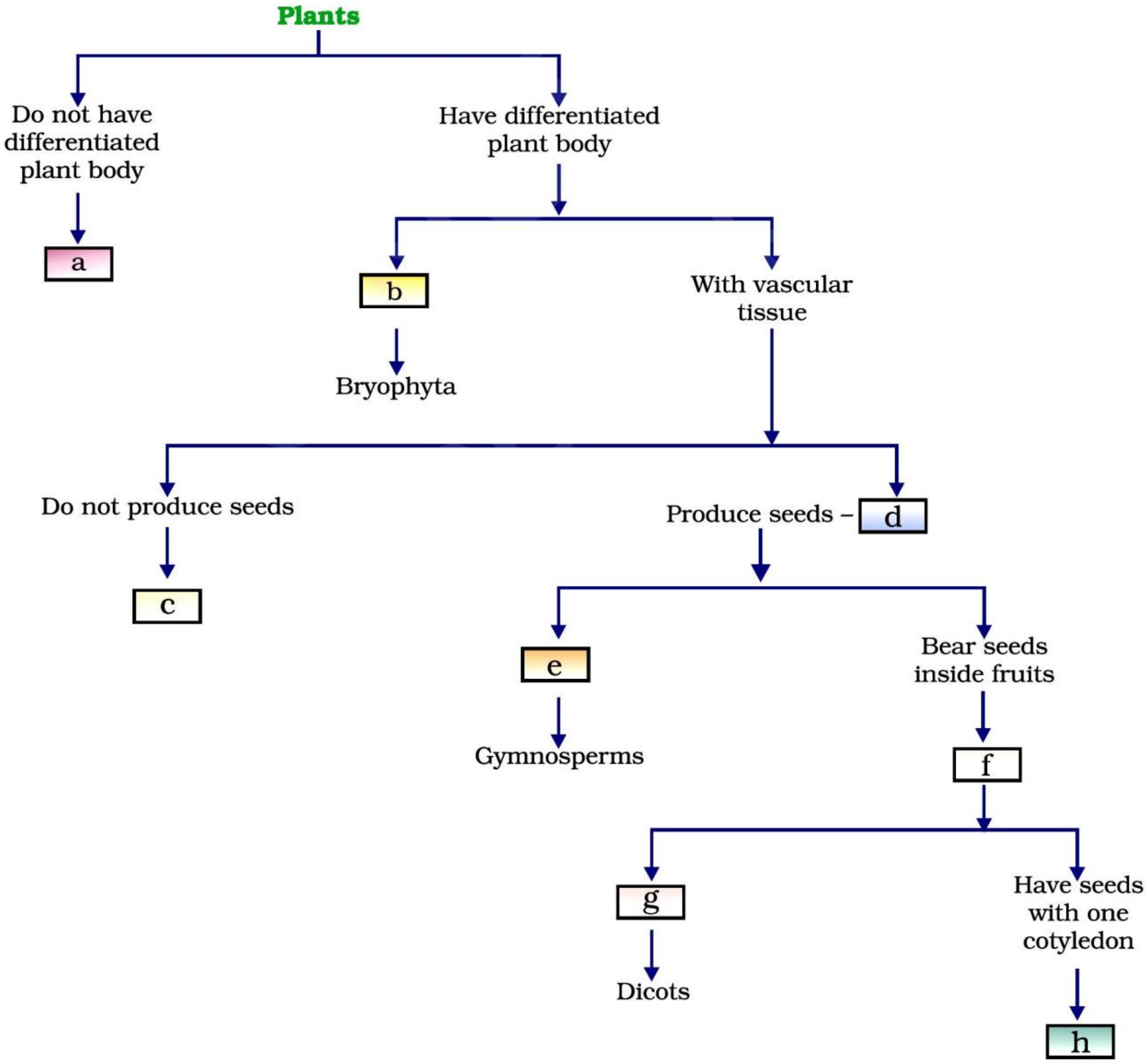
49. Write names of few thallophytes. Draw a labelled diagram of *Spirogyra*.

50. Thallophyta, bryophyta and pteridophyta are called as 'Cryptogams'. Gymnosperms and Angiosperms are called as 'phanerogams'. Discuss why? Draw one example of Gymnosperm.

51. Define the terms and give one example of each (a) Bilateral symmetry (b) Coelom (c) Triploblastic

52. You are given leech, *Nereis*, *Scolopendra*, prawn and scorpion; and all have segmented body organisation. Will you classify them in one group? If no, give the important characters based on which you will separate these organisms into different groups.

53. Fill in the boxes given in below figure with appropriate characteristics/plant group (s)



54. Which organism is more complex and evolved among Bacteria, Mushroom and Mango tree. Give reasons.

55. Differentiate between flying lizard and bird. Draw the diagram.

56. List out some common features in cat, rat and bat.

57. Why do we keep both snake and turtle in the same class?

CHAPTER – 13

WHY DO WE FALL ILL

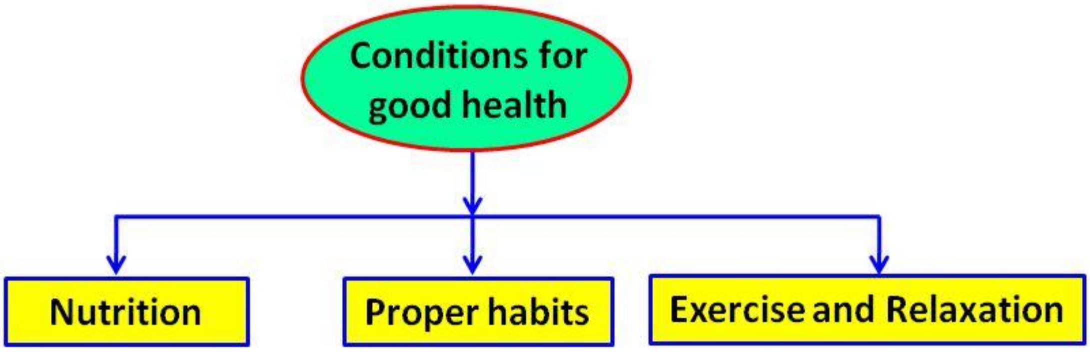
HEALTH AND ITS FAILURE

Good health is a very hard thing to measure, but it is one of life's most precious things. The World Health Organisation has defined health as a state of complete physical, mental and social well-being.
Community health can be defined as "All the personal health along with the environmental services for the importance of health of community".

Some of the health services are given below:
(i) Establishment of health care services like primary health centers, district hospitals, community health centers, medical colleges, all Indian institutes, regional hospitals etc.
(ii) Provision of safe drinking water and proper disposal of garbage.
(iii) Prevention of harmful insect breeding sites.
(iv) Management of different types of environmental pollution by Central and State Pollution Control Boards.
(v) Preventive vaccinations against number of diseases like tuberculosis, diphtheria, whooping cough, tetanus, measles, hepatitis, etc.
(vi) Provision of family planning advices and services.
(vii) Provision of medical care to school going children.
(viii) Prevention of food adulteration.
(ix) Health education.

CONDITIONS ESSENTIAL FOR GOOD HEALTH

There are several conditions which have to be fulfilled for good health. The important ones are
(i) Nutrition,
(ii) Proper habits, and
(iii) Exercise and relaxation.



(i) Nutrition

Nutrition can be defined as the procurement of substances necessary for growth, development, maintenance and activities of a living organism.
We obtain food from various plant and animal sources. In order to keep healthy and energetic, we need to take food. It takes care of the daily energy need also. We consume energy even while sleeping. Energy requirement depends on individual, age and special need. Growing

children, pregnant women and nursing mothers need more energy.

(ii) Proper Habits

Another important aspect of good health is to observe proper dietary habits that are consumption of balanced diet and at fixed time. Good personal and domestic hygiene is very essential. Take full care of the following aspects.

- Your food should be fresh and kept away from dust, flies, insect and microbes to avoid any infection and spoilage.
- Utensils should be kept clean.
- You should wash your face and hands with soap before eating or handling the food.
- Food should be cooked with good feelings and cheerful state.
- Smoking, chewing tobacco, drinking alcohol, taking addictive drugs are bad habits and should be avoided.
- They can have damaging effects on our body and mind.

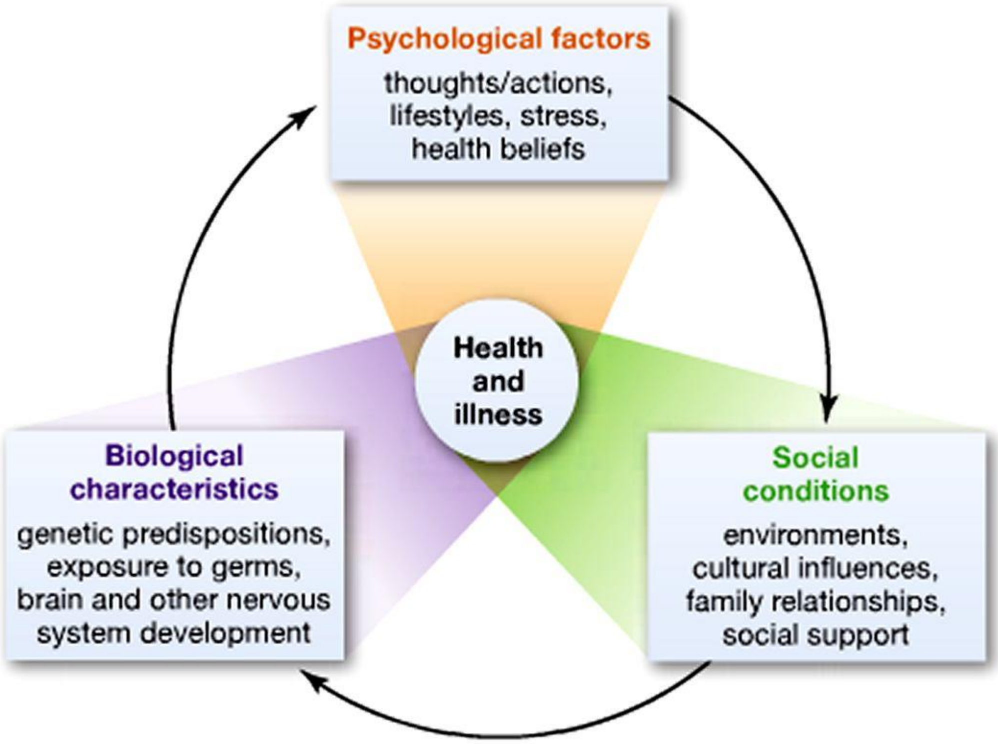
(iii) Exercise and Relaxation

Regular exercise is necessary to keep our body fit. These exercises vary with age, physical condition and nature of work of the individual. In the case of sedentary worker, exercise is even more essential. Another aspect of health is regular sleep and relaxation. The duration of sleep also varies with age and nature of work. Infants sleep for long hours, which is necessary for them to grow. For children, an average of eight hours of sound sleep is sufficient. For adults six hours of sleep is enough. Relaxation improves the capacity to work. Relaxation may be defined as an activity or recreation, which provides a relief or diversion from work or effort. There are various ways of relaxation. Yoga and meditation relax the body and mind. Listening to music and reading magazines are also relaxing.

PERSONAL AND COMMUNITY ISSUES BOTH MATTER FOR HEALTH

Health is a state of physical, mental and social well being. The conditions necessary for good health are :-

i) Good physical and social environment.
ii) Good economic conditions.
iii) Social equality and harmony.



- Good physical and social environment includes clean surroundings, good sanitation, proper garbage disposal and clean drinking water.
- Good economic conditions includes job opportunities for all for earning to have nutritious food and to lead a healthy life.
- Social equality and harmony are necessary for a healthy and peaceful life.

DISTINCTIONS BETWEEN 'HEALTHY' AND 'DISEASE-FREE'

Healthy	Disease free
It is a state of physical, mental and social well being.	It is a state of absence from diseases.
It refers to the individual, physical and social environment.	It refers only to the individual.
The individual has good health.	The individual may have good health or poor health.

DISEASE AND ITS CAUSES

A person may be regarded as suffering from a disease when his body does not function properly. Minor and major disorders of the body may lead to diseases. Infectious diseases are caused by germs. One of the greatest achievements in the history of mankind is the demonstration by Pasteur, Koch and others of germs or microbes that cause diseases. Microbes are the microscopic organisms such as virus, bacteria, some fungi and protozoans that are responsible for causing diseases in human beings. Cholera, tetanus, typhoid, diphtheria and pneumonia are some common diseases caused by bacteria. Polio, common cold, influenza, measles, chicken pox and AIDS are diseases caused by virus. Amoebic dysentery and malaria are caused by protozoans.

Name of the disease	Medium
Tuberculosis, pneumonia, diphtheria, influenza, measles and common cold	Air
Cholera, typhoid, dysentery and diarrhoea	Food, water
Leprosy, ringworm and scabies	Skin contact
Malaria, filarial and plaque	Insects

ACUTE AND CHRONIC DISEASES

When a person is affected by a disease either the normal functioning or the appearance of one or more systems of the body changes for the worse. These changes give rise to signs of the disease called symptoms. On the basis of the symptoms the physicians look for the signs of a particular disease and conduct tests to confirm the disease.

Types of diseases :- Diseases are of different types. They are :- i) Acute diseases :- are diseases which last only for a short period of time and does not have long term effect on health. Eg:- cold, cough, typhoid, cholera etc. ii) Chronic disease :- are diseases which lasts for a long time and has long term drastic effect on health. Eg :- diabetes, tuberculosis, elephantiasis, arthritis, cancer etc.

Difference between Acute Disease and Chronic Disease

Acute Disease	Chronic Disease
They are short duration disease.	They are long lasting disease.
Patient recovers completely after the cure.	Patient does not recover completely.
There is no loss of weight or feeling of tiredness afterward.	There is often loss of weight of feeling of tiredness.
There is short duration loss of work and efficiency.	There is a prolonged loss of work and efficiency.

CHRONIC DISEASES AND POOR HEALTH

Chronic disease is a disease that persists for a long time. Chronic diseases are the major cause of death and disability worldwide.
The total number of people dying from chronic diseases is double that of all infectious diseases (including HIV/AIDS, tuberculosis and malaria), maternal and parental conditions, and nutritional deficiencies combined. 80% of chronic disease deaths occur in low and middle income countries and half are in women. Without action to address the causes, deaths from chronic disease will increase by 17% between 2005 and 2015.

Chronic diseases

- Cardiovascular diseases, mainly heart disease and
- Stroke;
- Cancer;
- others, such as mental disorders, vision and hearing
- impairment, oral diseases, bone and joint disorders,
- chronic respiratory diseases;
- diabetes;
- genetic disorders.

HEART DISEASE

There are many forms of heart disease. Coronary heart disease, also known as coronary artery disease or ischaemic heart disease, is the leading cause of death globally. It is caused by disease of the blood vessels (atherosclerosis) of the heart.

STROKE

Stroke is a disease of the brain caused by interference to the blood supply. Stroke and heart disease are the main cardiovascular diseases.

CANCER

Cancer describes a range of diseases in which abnormal cells proliferate and spread out of control. Other terms used are tumours and neoplasms. There are many types of cancer and all organs of the body can become cancerous.

CHRONIC RESPIRATORY DISEASES

Diseases of the lung take many forms. Chronic obstructive respiratory disease and asthma are the most common forms.
Chronic obstructive respiratory disease is caused by irreversible obstruction of the larger airways in the lung; asthma is caused by reversible obstruction of the smaller airways in the lung.

DIABETES

Diabetes is characterized by raised blood glucose (sugar) levels. This results from a lack of the hormone insulin, which controls blood glucose levels, and/or an inability of the body's tissues to respond properly to insulin. The most common type of diabetes is type 2, which accounts for about 90% of all diabetes and is largely the result of excessive weight and physical inactivity. The usual childhood form of diabetes (type 1 diabetes) is caused by an absolute lack of insulin. Without insulin, type 1 diabetes is rapidly fatal.

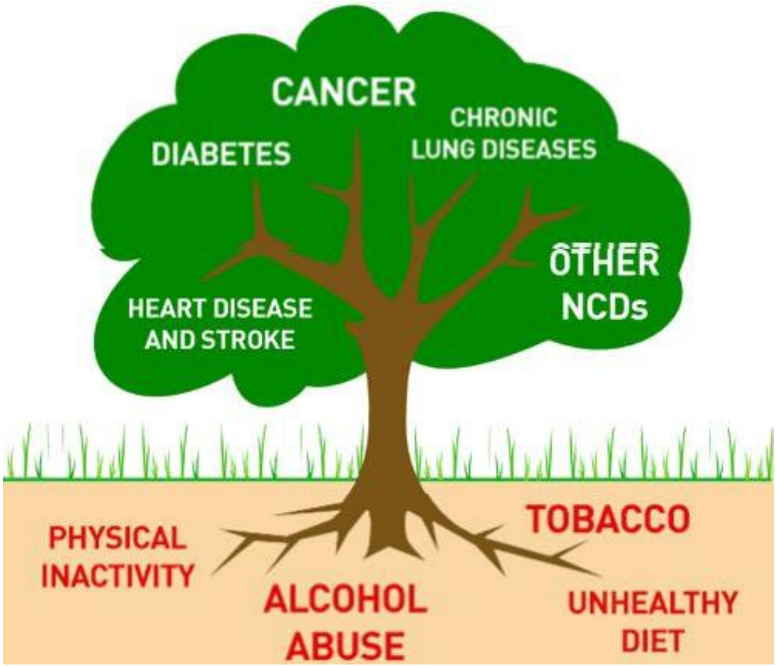
WHAT CAUSES CHRONIC DISEASES?

The causes (risk factors) of chronic diseases are well established and well known; a small set of common risk factors are responsible for most of the main chronic diseases. These risk factors are modifiable and the same in men and women:

- unhealthy diet;
- physical inactivity;

- tobacco use.

These causes are expressed through the intermediate risk factors of raised blood pressure, raised glucose levels, abnormal blood lipids, overweight and obesity. The major modifiable risk factors, in conjunction with the non-modifiable risk factors of age and heredity, explain the majority of new events of heart disease, stroke, chronic respiratory diseases and some important cancers. The relationship between the major modifiable risk factors and the main chronic diseases is similar in all regions of the world.

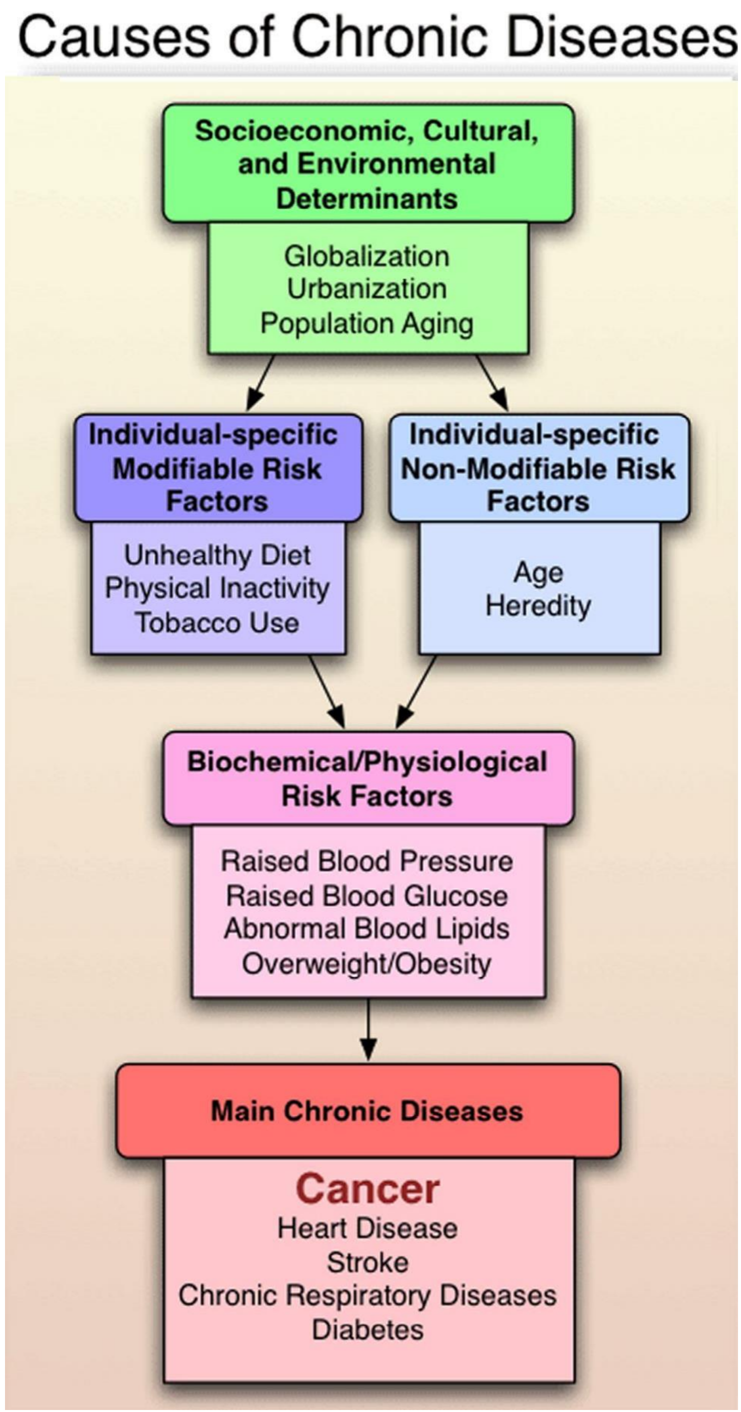


OTHER RISK FACTORS

Many more risk factors for chronic diseases have been identified, but they account for a smaller proportion of disease. Harmful alcohol use is an important contributor to the global burden of disease but its relationship to chronic disease is more complex. Other risk factors for chronic disease include infectious agents that are responsible for cervical and liver cancers, and some environmental factors, such as air pollution, which contribute to a range of chronic diseases including asthma and other chronic respiratory diseases.

PSYCHOSOCIAL AND GENETIC FACTORS ALSO PLAY A ROLE.

- **Childhood risk**
  There is now extensive evidence from many countries that conditions before birth and in early childhood influence health in adult life. For example, low birth weight is now known to be associated with increased rates of high blood pressure, heart disease, stroke and diabetes.
- **Risk accumulation**
  Ageing is an important marker of the accumulation of modifiable risks for chronic disease: the impact of risk factors increases over the life course.
- **Underlying determinants**
  The underlying determinants of chronic diseases are a reflection of the major forces driving social, economic and cultural change – globalization, urbanization, population ageing, and the general policy environment.
- **Poverty**
  Chronic diseases and poverty are interconnected in a vicious circle. At the same time, poverty and worsening of already existing poverty are caused by chronic diseases. The poor are more vulnerable for several reasons, including greater exposure to risks and decreased access to health services.
- **Psychosocial stress also plays a role.**



INFECTIOUS AND NON-INFECTIOUS CAUSES

Infectious diseases (Communicable diseases) :- are diseases which spread from an infected person to a healthy person through air, water, food, vectors, physical contact or sexual contact. Eg :- common cold, chicken pox, mumps, measles, typhoid, cholera, tuberculosis, malaria, AIDS etc.

Non-infectious diseases (Non-communicable diseases) :- are diseases which are not spread from an infected person to a healthy person. Eg :- beri beri, rickets, scurvy, night blindness, diabetes, cancer, high blood pressure etc. 5) Causes of diseases :- Diseases are caused by :- i) Pathogens like virus, bacteria, fungi, protozoans or worms. ii) Poor health and under nourishment. iii) Malfunctioning of body parts. iv) Environmental pollution. v) Genetic disorders.

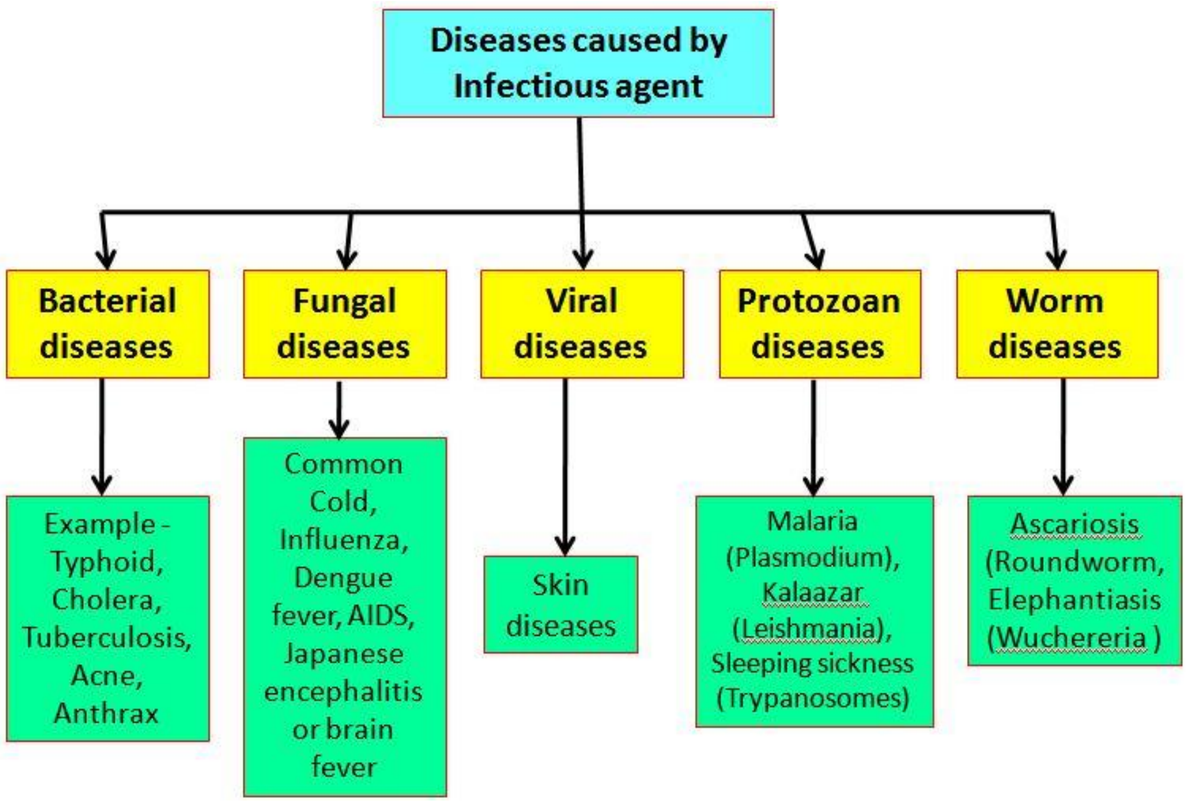
INFECTIOUS AGENTS

Infectious diseases are caused by microorganisms such as viruses, bacteria, fungi or parasites and can spread between individuals.

Microorganisms that cause disease are collectively called pathogens.
Pathogens cause disease either by disrupting the bodies normal processes and/or stimulating the immune system to produce a defensive response, resulting in high fever, inflammation and other symptoms.
Infectious diseases can be spread from one person to another, for example through contact with bodily fluids, by aerosols (through coughing and sneezing), or via a vector, for example a mosquito.

Infectious diseases can be caused by:

- **Bacteria.** These one-cell organisms are responsible for illnesses such as strep throat, urinary tract infections and tuberculosis.
- **Viruses.** Even smaller than bacteria, viruses cause a multitude of diseases — ranging from the common cold to AIDS.
- **Fungi.** Many skin diseases, such as ringworm and athlete's foot, are caused by fungi. Other types of fungi can infect your lungs or nervous system.
- **Parasites.** Malaria is caused by a tiny parasite that is transmitted by a mosquito bite. Other parasites may be transmitted to humans from animal feces.

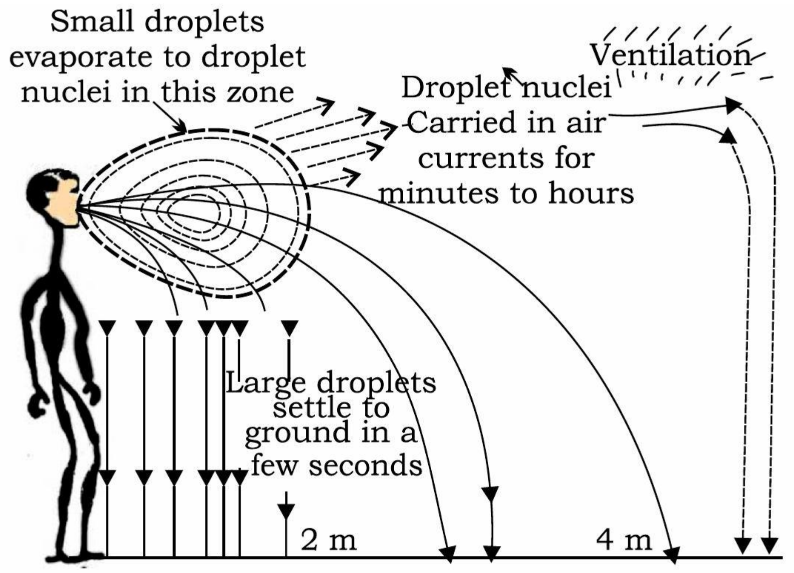


MEANS OF SPREAD

Infectious diseases spread from an infected person to a healthy person through air, water, food, vectors, physical contact and sexual contact.

i) Through air :- Common cold, Tuberculosis, Pneumonia etc.
ii) Through water :- Cholera, Amoebic dysentry etc.
iii) Through vectors :- Mosquitoes :- Malaria, Dengue, Yellow fever etc. Flies :- Typhoid, Tuberculosis, Diarrhoea, Dysentry etc.
iv) Through sexual contact :- Syphilis, AIDS. AIDS virus can also spread though blood transfusion and from the mother to her child during pregnancy and through breast feeding.

The below figure shows how Air-transmitted diseases are easier to catch the closer we are to the infected person. However, in closed areas, the droplet nuclei recirculate and pose a risk to everybody. Overcrowded and poorly ventilated housing is therefore a major factor in the spread of airborne diseases.



Disease can also be spread through water. This occurs if the excreta from someone suffering from an infectious gut gets mixed with water. Eg cholera, gets mixed with the drinking water used by people living near by. The cholera causing microbes will enter new hosts through the water they drink and cause disease in them. Such diseases are much more likely to spread in the absence of safe supplies of drinking water.

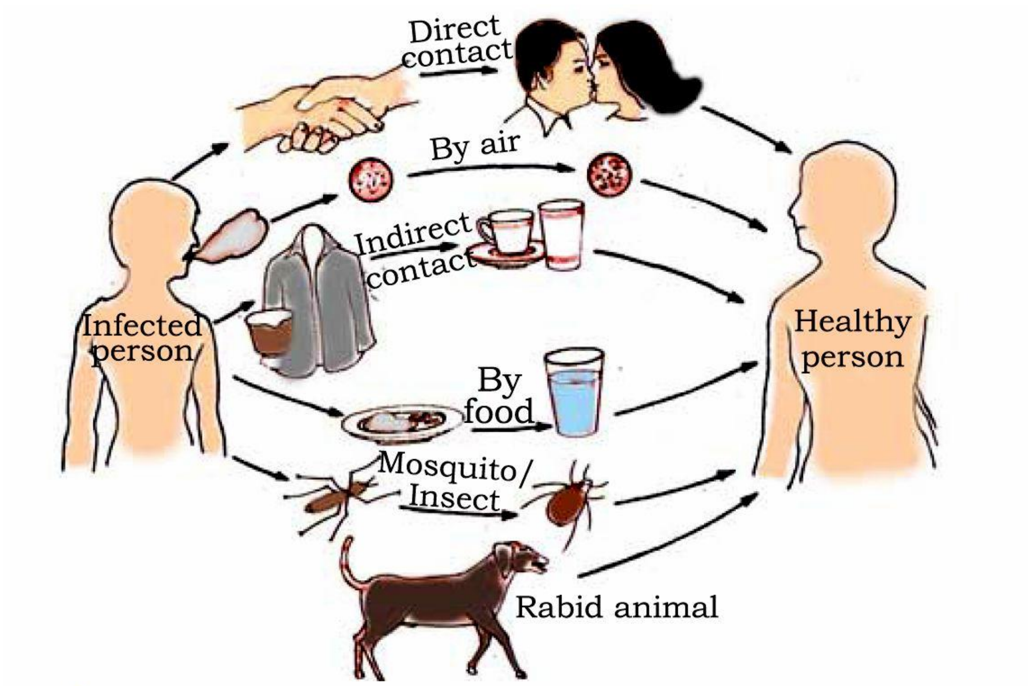


Fig. *Common methods of transmission of diseases.*

The sexual act is one of the closest physical contacts two people can have with each other. Not surprisingly, there are microbial diseases such as syphills or AIDS that are transmitted by sexual contact from one partner to the other. However, such sexually transmitted diseases are not spread by casual physical contact. Casual physical contacts include handshakes or hugs or sports, like wrestling, or by any of the other ways in which we touch each other socially. Other than the sexual contact, the AIDS virus can also spread through blood to blood contact with infected people or from an infected mother to her baby during pregnancy or through breast feeding.

ORGAN-SPECIFIC AND TISSUESPECIFIC MANIFESTATIONS

Disease causing microbes enter the body by different means and goes to different organs and tissues.

- Microbes which enters through the nose are likely to go to the lungs. (Bacteria which cause tuberculosis of lungs).
- Microbes which enter through the mouth are likely to stay in the gut (Bacteria which causes Typhoid) or liver (Bacteria which causes Jaundice).
- Virus which causes AIDS enter the body through sexual organs during sexual contact and spreads through the lymph to all parts of the body and damages the immune system.
- Malaria-causing microbes, entering through a mosquito bite, will go to the liver, and then to the red blood cells.
- The virus causing Japanese encephalitis, or brain fever, will similarly enter through a mosquito bite 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 the 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.
ii) To kill the microbes :- This can be done by taking suitable antibiotics and drugs which kills the microbes and the disease is cured.

PRINCIPLES OF PREVENTION

There are two ways of prevention of infectious diseases. They are general ways and specific ways.
i) General ways of prevention :- Public hygiene is most important for prevention of infectious diseases. Proper and sufficient food for every one will make people healthy to resist 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 :- The specific ways to prevent infectious disease is immunisation by taking vaccines. Vaccines provide immunity from infectious diseases like tetanus, diphtheria, whooping cough, measles, polio etc. Our body has an immune system which fights microbial infection. When this system first sees an infectious microbe, it kills the microbe and remembers it. So if the microbe enters the body the next time, it responds more vigorously. Vaccines mimic the infectious microbe and strengthens our immune system and protects the body from infectious diseases.

IMMUNISATION

Immunisation gives a very good level of protection against many serious diseases.

It uses your body's natural defence mechanism, the immune response, to build resistance to specific infection.
There are three reasons why we immunise children.

- **First,** immunisation prevents children from becoming ill with unpleasant and serious infectious diseases, which have a risk of complications and long-term side effects.
- **Second,** we immunise to try and help protect all children in the population. The more people who are immunised, the less of the infectious disease there is around so the less chance there is of anyone catching it. When levels of immunisation against an infectious disease are really, really high - then something happens called 'herd immunity' where the risk of the disease occurring is so low that even those who cannot be immunised are unlikely to be affected.
- **Third,** we immunise to try and wipe out as many infectious diseases as we can everywhere in the world.

National Immunization Schedule

For Infants	Vaccine & Dose	Route
At Birth	BCG 0.1ml + OPV 2drops(0 dose)	Intradermal
6 weeks	BCG 0.1ml [if not at birth]	Intradermal
	DPT-1 0.5ml + OPV-1 2drops	I/M + Oral
10 weeks	DPT-2 + OPV-2	I/M + Oral
14 weeks	DPT-3 + OPV-3	I/M + Oral
9-12 months	Measles 0.5ml + Vit. A 2ml	Deep S/C + Oral
At 18 months	DPT + OPV[Boosters-1]	I/M + Oral
At 24, 30, 36 months	Vitamin A 2ml	Oral
At 5-6 years	DT[Booster-2]	I/M
At 10 and 16 years	Tetanus Toxoid	I/M
For Pregnant Women	**Vaccine & Dose**	**Route**
Early in Pregnancy	TT-1 or Booster	I/M
One month after TT-1	TT-2	I/M

SUPPLEMENTARY NOTES

CAUSES OF INFECTIOUS DISEASES (INFECTIOUS AGENTS)

VIRUSES

Viral diseases are extremely widespread infections caused by viruses, a type of microorganism. There are many types of viruses that cause a wide variety of viral diseases. The most common type of viral disease is the common cold, which is caused by a viral infection of the upper respiratory tract (nose and throat). Other common viral diseases include:

- Chickenpox

- Flu (influenza)

- Herpes
- Human immunodeficiency virus (HIV/AIDS)
- Human papillomavirus (HPV)
- Infectious mononucleosis
- Mumps, measles and rubella
- Shingles
- Viral gastroenteritis (stomach flu)
- Viral hepatitis
- Viral meningitis
- Viral pneumonia

Viral diseases are contagious and spread from person to person when a virus enters the body and begins to multiply. Common ways that viruses spread from person to person include:

- Breathing in air-borne droplets contaminated with a virus
- Eating food or drinking water contaminated with a virus
- Having sexual contact with a person who is infected with a sexually transmitted virus
- Indirect transmission from person to person by a virus host, such as a mosquito, tick, or field mouse
- Touching surfaces or body fluids contaminated with a virus

Viral diseases result in a wide variety of symptoms that vary in character and severity depending on the type of viral infection and other factors, including the person's age and overall health. Common symptoms of viral diseases include flu-like symptoms and malaise.
Viral diseases are not treatable with antibiotics, which can only cure bacterial diseases and infections. However, the most common viral diseases, the common cold and the flu, are self-limiting in generally healthy people. This means that the viral infection causes illness for a period of time, then it resolves and symptoms disappear as your immune system attacks the virus and your body recovers.

In some cases, viral diseases can lead to serious, possibly life-threatening complications, such as dehydration, bacterial pneumonia, and other secondary bacterial infections. People at risk for complications include those who have a chronic disease or a suppressed or compromised immune system, and the very young and very old. In addition, certain types of sexually transmitted viral infections, such as HIV/AIDS and HPV, can lead to serious complications and death. Seek prompt medical care if you think you have a viral disease, especially if you are at risk for complications, or if you believe you have been exposed to a sexually transmitted disease.
Seek immediate medical care if you, or someone you are with, have serious symptoms of an illness or a viral disease, such as shortness of breath, chest pain, passing out (fainting), or a change in alertness or consciousness.

SYMPTOMS OF VIRAL DISEASES

Symptoms of viral diseases vary depending on the specific type of virus causing infection, the area of the body that is infected, the age and health history of the patient, and other factors. The symptoms of viral diseases can affect almost any area of the body or body system. Symptoms of viral diseases can include:

- Flu-like symptoms (fatigue, fever, sore throat, headache, cough, aches and pains)
- Gastrointestinal disturbances, such as diarrhea, nausea and vomiting
- Irritability
- Malaise (general ill feeling)
- Rash
- Sneezing

- Stuffy nose, nasal congestion, runny nose, or postnasal drip

- Swollen lymph nodes
- Swollen tonsils
- Unexplained weight loss

In infants, signs of a viral disease can also include:

- Bulging of the soft spot on the top of the head
- Difficulty with feeding
- Excessive crying or fussiness
- Excessive sleepiness

Serious symptoms that might indicate a life-threatening condition

In some cases, viral diseases can result in serious complications, such as dehydration or pneumonia. Seek immediate medical care (call 911) if you, or someone you are with, have any of the following symptoms:

- Change in alertness or level of consciousness
- Chest pain
- Deep, wet chest cough that produces yellow, green or brownish phlegm
- High fever (higher than 101 degrees Fahrenheit)
- Lethargy or unresponsiveness
- Seizure
- Shortness of breath, wheezing, or difficulty breathing
- Stiff neck
- Yellowing of the skin and whites of the eyes (jaundice)

WHAT CAUSES VIRAL DISEASES?

Viral infections occur when a virus enters the body and invades the inside of the body's cells in order to reproduce. If the body's immune system is unable to fight off the virus, it multiplies and spreads to other cells, repeating the process and leading to a widespread infection.

Types of viruses

There are many types of viruses that cause a wide variety of viral infections or viral diseases. In fact, there are more than 200 different viruses that can cause a cold or an upper respiratory infection. Other common viruses include the following:

- Epstein-Barr virus causes infectious mononucleosis (cytomegalovirus causes a very similar disease in some people).
- Human immunodeficiency virus (HIV) causes AIDS.
- Human papillomaviruses (HPV) cause HPV infection, cervical dysplasia, genital warts, and cervical cancer.
- Influenza viruses, such as H1N1, cause influenza (flu).
- Respiratory syncytial virus (RSV) causes lower respiratory tract infections in young children.
- Rhinoviruses cause the common cold.
- Rotavirus, enteroviruses and noroviruses cause viral gastroenteritis.
- Varicella zoster virus causes shingles and chickenpox.
- West Nile virus causes West Nile fever.

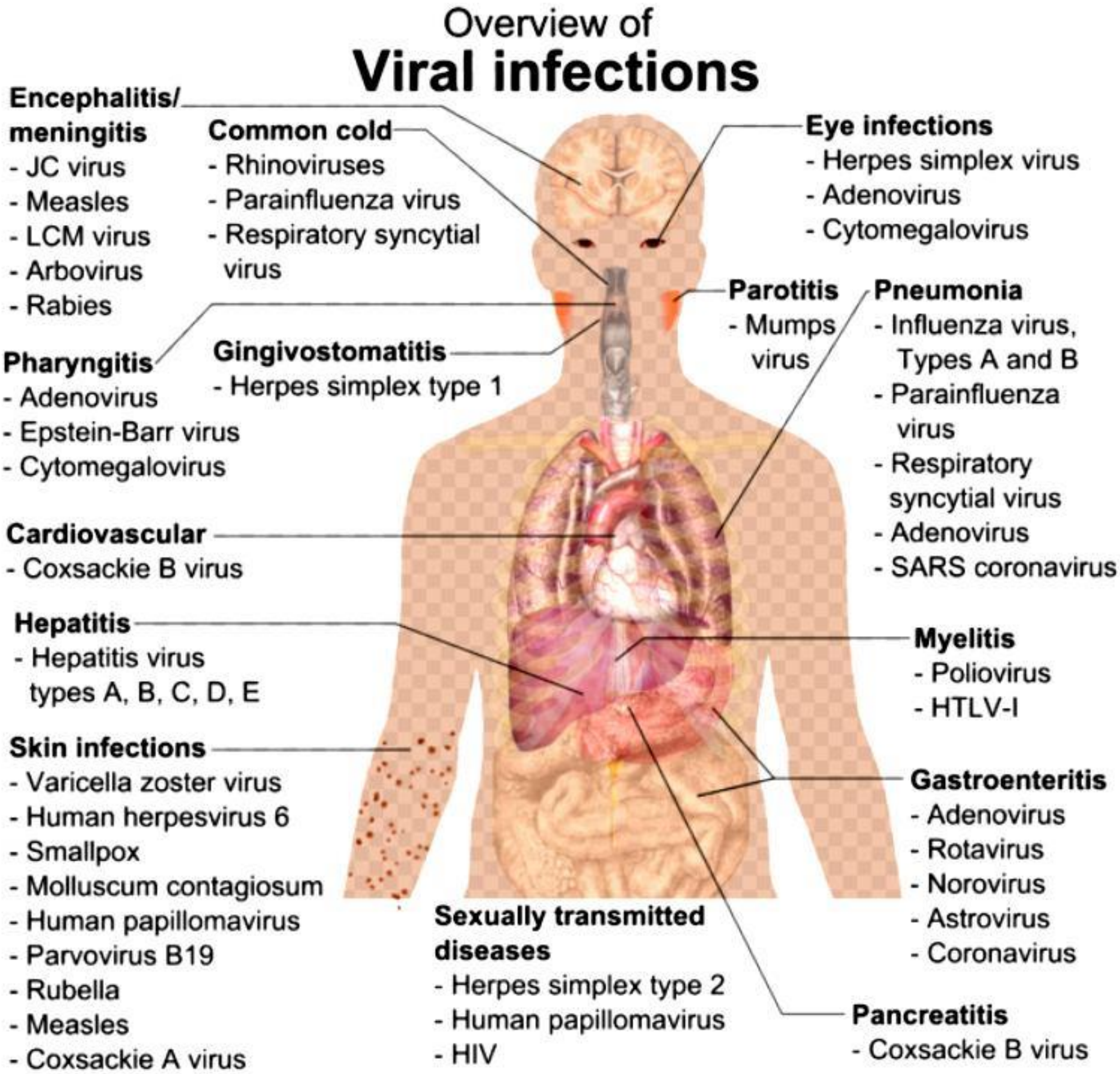
Various ways to become infected with a virus

Our body infected with a virus in a variety of ways including:

- Being bitten by an animal infected with a virus
- Being bitten by an insect infected with a virus, such as with West Nile virus
- Breathing in air-borne droplets contaminated with a virus
- Eating food or drinking water contaminated with a virus

- Having sexual contact with a person who is infected with a sexually transmitted virus

- ➢ Sharing needles for tattooing or drug use with an infected person
- ➢ Touching infected feces or body fluids and not washing your hands before eating or touching your mouth, eyes or nose
- ➢ Touching surfaces contaminated with a virus
- ➢ Transmission of a virus from an infected mother to her baby during pregnancy or delivery



What are the risk factors for contracting viral diseases?

Viral diseases can occur in any age group or population. Everybody contracts viral diseases during their life, although in some cases, the virus does not cause obvious symptoms. Risk factors for catching a viral disease or developing complications of a viral disease include:

- ➢ Advanced age
- ➢ Compromised immune system due to an immunodeficiency disorder, HIV/AIDS, cancer or cancer treatment, kidney disease, or other condition
- ➢ History of chronic disease, such as asthma, COPD, diabetes, tuberculosis, or heart disease
- ➢ Malnourishment
- ➢ Not getting enough rest and having high levels of stress

- Not washing your hands frequently, especially before eating or after using the restroom, or after touching common surfaces
- Sharing needles to inject drugs or for tattooing
- Unprotected sex including vaginal, oral and anal sex with a partner who has had one or more other sexual partners
- Young age including infancy and elementary-school-age children

Reducing your risk of viral diseases

We can lower your risk of catching or spreading a viral disease by:

- Abstaining from sexual activity, or only engaging in sexual activities within a mutually monogamous relationship in which neither partner is infected with a sexually transmitted disease
- Avoiding contact of your hands with your eyes, nose and mouth, which can transmit a virus into the body
- Avoiding contact with a person who has a viral disease
- Covering your mouth and nose with your elbow (not your hand) or a tissue when sneezing or coughing
- Eating a well-balanced diet that includes sufficient amounts of fruits and vegetables
- Sufficient rest
- Using a new condom for each sex act
- Using a sterile, unused needle for each act of tattooing or injectable drug use
- Using appropriate antibacterial cleaners to clean your hands and surfaces
- Vaccination as recommended by your health care provider for viral diseases, such as chickenpox, shingles, influenza, HPV, hepatitis B, hepatitis A, measles, and mumps
- Washing your hands with soap and water for at least 15 seconds after contact with a person who has a viral disease, before eating, or after using the restroom or touching feces, body fluids, surfaces, or foods that are potentially contaminated with viruses

How are viral diseases treated?

Treatment of viral infections varies depending on the specific virus and other factors. General treatment measures are aimed at relieving your symptoms so that you can get the rest you need to keep up your strength and recover without developing complications.

General treatments for viral infections include:

- Acetaminophen (Tylenol) or ibuprofen (Motrin, Advil) for fever, body aches, and pain
- Drinking extra fluids
- Getting extra rest and sleep
- Maintaining good nutrition

Depending on the type of viral infection and the presence of complications, a wide variety of other treatments may be needed. For example, a human papillomavirus (HPV) infection that leads to cervical dysplasia can be treated by surgical removal of the abnormal cells on a woman's cervix.

In general, it is recommended that children younger than age six not use cold or cough medications because of the risk for serious side effects. In addition, people with a viral disease should not use aspirin or products that contain aspirin because of the risk of developing a rare but life-threatening condition called Reye syndrome. Reye syndrome has been linked to taking aspirin during a viral illness, such as a cold or the flu.

Prescription medications used to treat viral diseases

In some cases, certain medications may be prescribed to treat viral diseases:

- Antiretroviral medications, which can help people with HIV/AIDS lead longer lives. Antiretroviral medications hinder the ability of HIV to reproduce, which slows the spread of HIV in the body.

- Antiviral drugs, which minimize the severity and length of some viral infections, such as the flu and shingles, especially in people who are at a high risk for serious complications. For example, the drugs oseltamivir (brand name Tamiflu) and zanamivir (brand name Relenza) may be prescribed for some cases of flu. These drugs are not appropriate for all people with the flu.

Antibiotics, which are not prescribed for viral diseases because they are ineffective in the treatment of viral infections, may be prescribed if a person with a viral disease develops a secondary bacterial infection, such as bacterial pneumonia, bacterial bronchitis, or encephalitis.

Complementary treatments

Complementary and traditional treatments will not cure a viral disease but may help to increase comfort, promote rest, and minimize symptoms of viral diseases. Some possible treatments include:

- Chicken soup to help break up congestion and provide easy-to-digest nutrients and extra fluids to help keep up strength
- Supplements or products that contain vitamin C, echinacea, or zinc
- Using a vaporizer
- Using mentholated ointments on the chest

What are the possible complications of viral diseases?

In some people, viral diseases can break down the body's defenses and lead to more serious infections and life-threatening complications. Therefore, it is important to visit your health care provider when you have symptoms of a viral infection. Once the underlying infection has been determined, following the treatment plan outlined by your health care provider can help reduce any potential complications including:

- Acute bronchitis
- Cervical cancer (from human papillomavirus infection)
- Dehydration
- Frequent life-threatening, opportunistic infections
- Otitis media (ear infection)
- Pneumonia
- Secondary bacterial infection
- Seizures
- Shock and coma
- Sinusitis
- Worsening of asthma

BACTERIA

Bacteria are single-celled microorganisms.

They come in many shapes including ball-, rod- and spiral-shaped.

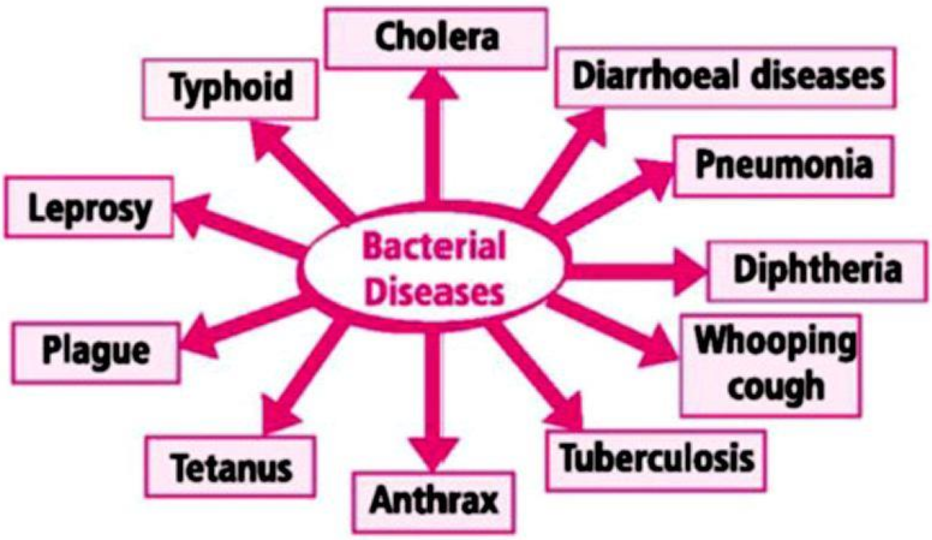
Most bacteria are not harmful and some are actually beneficial. Less than one per cent of bacteria will actually make you ill.

Infectious bacteria can grow, divide and spread in the body, leading to infectious disease.

Some infectious bacteria give off toxins which can make some diseases more severe.

Bacteria are spread in many ways including:

- Spread by aerosols (through coughing and sneezing). For example, Streptococcus.
- Spread by surface and skin contact. For example, Staphylococcus aureus, including MRSA.
- Spread through body fluids, such as blood and saliva. For example, meningococcal disease (meningitis).



Antibiotics are usually given to treat severe bacterial infections.
Antibiotic resistance in bacteria is a significant problem.

TYPHOID (ENTERIC FEVER)

• Typhoid is a common bacterial disease caused by a rodlike bacterium. Salmonella typhi, which is commonly found in the intestine of man.

• Certain humans function as carriers without suffering from it. Mary Mallon, called Typhoid Mary was such a case. She was a cook and typhoid carrier, who continued to spread the disease for several years through her food preparation.

Mode of transmission of Typhoid

• Incubation period varies from 1-3 weeks, average 2 weeks.

• Typhoid spreads through food and water contaminated with faeces of the patient. House flies may carry the pathogens from the faeces to the food, milk and water.

Symptoms of Typhoid

• This disease is characterised by the inflammation of ileum and colon, liver and spleen also become enlarged, abdominal pain, pea-soup diarrhoea which may become haemorrhagic, constant fever, extreme weakness, vomiting, rash of rose coloured spots called rose spots on the upper abdomen and sore throat.

• Typhoid is diagnosed by Widal Test.

Prevention and treatment Typhoid

• Any patient with typhoid requires the highest standards of nursing together with isolation and hygienic disposal of faeces.

• The two most important preventive measures are proper sewage treatment and purification of water supplies.

• Contamination of food can be reduced by personal hygiene and control of flies.

• TAB vaccine provides immunity for about 3 years.

• Antibiotics like ampicillin and chloramphenicol are used to treat typhoid.

CHOLERA

• Cholera commonly called haiza is a water-borne disease caused by the bacterium, Vibrio cholerae.

• Robert Koch discovered this disease.

Mode of transmission of Cholera

• Incubation period varies from a few hours to 2-3 days.

• It spreads through contaminated food and drinks.
• The causative bacterium secretes cholera toxin, enterotoxin which induces excessive secretion of an isotonic electrolyte solution by the intestinal mucosa. This solution is lost in stool.

Symptoms of Cholera
• Cholera is mainly characterized by sudden onset of profuse, effortless, rice-water like stools, vomiting and rapid dehydration, loss of minerals and muscular cramps.

Prevention and treatment of Cholera
• Proper sanitation and hygienic conditions are the best methods of prevention.
• Cholera vaccine is effective for six months only.
• Fluid and salt lost is restored by Oral Rehydration Solution (ORS). It is water with a small amount of sugar and salt.
• Antibiotics like tetracycline and chloramphenicol are used to treat cholera.

DIARRHOEAL DISEASES
• Diarrhoeal diseases are group of diseases caused by different bacteria such as Shigella dysenteriae, Escherichia coli, Campylobacter, Salmonella and Clostridium.

Mode of transmission of Diarrhoeal diseases
• Incubation period is variable.
• Epidemics are common in overcrowded insanitary conditions.
• It spreads through food poisoning, contaminated food, water or drinks, clothes, utensils and bed sheets.

Symptoms of Diarrhoeal diseases
• This is characterised by mild diarrhoea i.e., loose stools if infected by E. coli, frequent stools with blood and mucus and abdominal cramps if infected by Shigella. Other symptoms are dehydration, diminished appetite, fever, low B.P., increase in pulse rate etc.

Prevention and treatment of Diarrhoeal diseases
• One should avoid contaminated food and water.
• ORS is given repeatedly to check dehydration and loss of minerals.

PNEUMONIA
• Pneumonia is a serious disease of lungs characterised by accumulation of mucus/fluid in alveoli and bronchioles to that extent that breathing becomes difficult.
• It is caused by Streptococcus pneumoniae or Diplococcus pneumoniae, and Haemophilus influenzae.

Mode of transmission of Pneumonia
• Incubation period is of 1-3 days.
• A healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person.

Symptoms
• The onset of pneumonia is usually sudden with a single shaking chill, followed by fever, pain with breathing on the side of lung involved, increased pulse and respiratory rates and cough.
• In severe cases the lips and finger nails turn grey to bluish in colour.

Prevention and treatment of Pneumonia

• The patients should be isolated and healthy persons should not share their belongings.

• Pneumococcal conjugate vaccine (PCV13) is available.
• Drugs against pneumonia are erythromycin, tetracycline and sulphonamide. If untreated, pneumonia leads to death.

DIPHTHERIA

• Diphtheria is an acute infectious disease in children mostly characterized by the development of a grey adherent false membrane over the upper respiratory tract or throat.
• It is caused by toxigenic strains of Corynebacterium diphtheriae (rod shaped, Gram +ve bacterium).

Mode of transmission of Diphtheria

• Incubation period is of 2- 5 days.
• Endotoxin produced by pathogen causes nasal diphtheria, pharyngeal diphtheria and laryngotracheal diphtheria.
• The germs are present in the discharges from the nose and throat of patients and also of healthy people who act as the "carriers".
• The patients and the carriers spread the disease through acts like kissing, talking, coughing and sneezing.

Symptoms of Diphtheria

• Symptoms are fever, sore throat, sometimes vomiting, headache, epithelial necrosis by endotoxin and oozing of semisolid material in the throat which develops into a grey false but tough membrane.
• The membrane chokes the air passage. Sometimes, bacterium infects the heart, nerve cells and adrenal glands.
• In severe cases, respiratory tract is blocked causing difficulty in breathing and even death due to choking.
• 'Schick test' tests the presence of antitoxin and the state of hypersensitivity to diphtheria toxin.

Prevention and treatment of Diphtheria

• One should avoid close contact with the patient.
• DPT (diphtheria, pertussis and tetanus) vaccine is available.
• Erythromycin is used to treat diphtheria.

WHOOPING COUGH (PERTUSSIS)

• Whooping cough is caused by Bordetella pertussis and is a common childhood disease affecting the respiratory system.

Mode of transmission

• It has an incubation period of 10 – 16 days.
• It spreads by droplet infection or by direct contact.

Symptoms of Whooping cough (Pertussis)

• It causes loss of appetite, fever, running nose, fatigue, sneezing and constant cough leaving the child breathless, tired and red in face.
• Later the voice becomes hoarse and the cough gives a whoop or a loud crowing sound while inhaling.
• The child usually vomits and there is frothy discharge from his mouth and nose.
• There may be other complications like vomiting, convulsions and pneumonia.

Prevention and treatment of Whooping cough (Pertussis)

• Immunisation of the disease is done in infants by DPT vaccination at six weeks, three months and five months.
• Erythromycin antibiotic is used for the treatment.

TUBERCULOSIS

• Tuberculosis (TB), also called Koch's disease is caused by rod-shaped, Gram +ve bacteria, Mycobacterium tuberculosis.
• The bacterium releases a toxin, tuberculin which destroys the organs it infects.
• It can affect almost any tissue or organ in the body like the lungs, lymph nodes, brain, bones and joints but disease of the lung is by far the most frequent.

Mode of transmission of Tuberculosis
• Incubation period is 3 to 6 weeks or may be years.
• It spreads through sneezing, coughing, contaminated food and water.

Symptoms of Tuberculosis
• Constant cough and in severe cases sputum with blood, pain in chest while coughing, loss of body weight, failure of appetite, slight rise of temperature in the evening are the symptoms of lung T. B.
• Sputum, tuberculin, X-ray and gastric analysis are carried out to diagnose tuberculosis.
• Tuberculin test is also called Mantoux test.

Prevention and treatment of Tuberculosis
• BCG (Bacillus Calmette Guerin) vaccine for TB was obtained from bovine bacillus by Calmette and Guerin in 1921.
• Before giving vaccination to any individual it is important to check if they are already suffering from TB or have recovered from it.
• The test is to puncture the skin with a special instrument which has a ring of six short needles (the Heaf test). This introduces tuberculin, purified from dead tubercle bacilli.
• In the absence of past or present TB the skin shows no reaction, but if an individual has the disease or has recovered, then the skin swells and reddens at the injection site. This indicates a substantial immunity and no vaccine is offered.
• Some of the anti-tuberculosis drugs are streptomycin, rifampicin, isoniazid, thiatazone, PAS (Para amino salicydic acid) etc.
• Direct observation treatment (DOT) is a programme under WHO for treatment of TB across the world.

ANTHRAX (BIOWAR DISEASE)

• Anthrax is an acute infectious disease caused by airborne, spore-forming, rod-like, non-motile bacterium, Bacillus anthracis.
• Bacillus anthracis can be easily grown in the laboratory. Anthrax spores can be produced in a dry form which can be stored as particles.
• These particles can be used in biological warfare. Spores are infective in dry form, not in wet form.
• It most commonly occurs in wild and domestic vertebrates (cattle, sheep, goats, camels, antelopes, and other herbivores), but it can also occur in humans when they are exposed to infected animals or tissues from infected animals.

Mode of transmission of Anthrax (Biowar disease)
• Infected animals shed, a large number of bacilli (bacteria) in the discharges from the mouth, nose and rectum which sporulate in the soil. These spores are source of infection.
• It requires thousands of spores to cause human infection. Anthrax does not spread from

human to human.

Types of Anthrax of Anthrax (Biowar disease)

• Anthrax infection can occur in three different forms: cutaneous (skin), gastrointestinal (by ingestion) and pulmonary (by inhalation).

(i) Cutaneous anthrax occurs when bacteria enter through skin cuts and wounds. A skin lesion begins as a papule and soon becomes a vesicle and breaks, discharging bloody serum. This vesicle, in about 36 hours, becomes a bluish-black necrotic mass (dead tissue). It consists of minute particles rich in spores.

(ii) Gastrointestinal anthrax is caused by taking under- cooked meat of infected animals. Patient experiences chill, high fever, body aches, nausea, vomiting, bloody diarrhoea, loss of appetite, and frequent haemorrhages from the mucous membranes and in the skin.

(iii) Pulmonary anthrax is acquired by inhaling dust containing B. anthracis. Pulmonary anthrax is often called wool-sorter's disease.

Symptoms of Anthrax (Biowar disease)

• Initial symptoms resemble those of common cold. Later there is difficulty in breathing, cough, fever, fast pulse and cardiovascular collapse.

• If left untreated, anthrax in all forms can lead to septicemia and death.

• Death is apparently due to oxygen depletion, secondary shock, increased vascular permeability, respiratory failure and cardiac failure.

Prevention and treatment of Anthrax (Biowar disease)

• The only known effective prevention against anthrax is the anthrax vaccine. The vaccine was developed from an attenuated strain B. anthracis.

• A suitable antibiotic like ciprofloxacin is quite effective, particularly if used in the initial stages of disease. But in cattle, ciprofloxacin may be effective only in chronic area.

• Antibiotics should be given to unvaccinated individuals exposed to pulmonary anthrax. Penicillin, tetracycline and fluoroquinolones are effective if administered before the onset of lymphatic spread or septicemia.

TETANUS (LOCK JAW)

• Lock jaw disease is caused by the spores of Clostridium tetani that enter through wounds.

Mode of transmission

• Incubation period is of 3-25 days during which the bacterium secretes a powerful exotoxin tenanospasmin into the tissue, and blood carries it to the central nervous system and brings about tetanus of muscles.

• Its infection is acquired by contamination of wounds with tetanus spores as these infected spores are abundant in the soil manured with animal dung.

• Spores may survive for 60 or more years in contaminated soil.

Symptoms of Tetanus (Lock jaw)

• Symptoms include painful muscular spasms especially of neck and jaw.

• Lock jaw condition occurs when the patient cannot open the mouth. Convulsions and paralysis of muscles, difficulty in chewing and swallowing, fever and headache are the other symptoms.

Prevention and treatment

• All wounds should be treated carefully and cleaned with iodine solution.

• Immunisation of infants by DPT should be done.

• ATS {antitetanus serum) injection within 24 hours of injury provides passive immunity while TT (tetanus toxoid) gives active immunity.

PLAGUE (BLACK DEATH)

• Plague is caused by a rod-shaped non-motile bacterium called Pasteurella/Yersinia pestis and is transmitted by the bite of infected rat flea, Xenopsylla cheopis.
• The first authenticated plague epidemics in India in modern times occurred in 1895-96 and from 1898 onwards the disease was appreciably manifest, reaching a peak in the year 1907.
• Pasteurella pestis endoparasite of gut of rat flea (which is an ectoparasite of rat and mouse).
• Head louse (Pediculus) and bedbug (Cimex) may also transmit the germs from man to man.

Prevention and treatment of Plague (Black death)

• Plague is confirmed by Wayson stain test.
• Anti-plague vaccine, spray of insecticides, killing of rats, nose caps and high cots (rat flea can jump upto 45 cm) are some preventive measures.
• Streptomycin or oral tetracycline is effective against plague.

LEPROSY (HANSEN'S DISEASE)

• Leprosy is a contagious chronic bacterial disease caused by Mycobacterium leprae which is characterised by the chronic infection of the skin and other tissues.

Mode of transmission of Leprosy (Hansen's disease)

• The incubation period is very long and averages upto 2-5 years.
• Infection occurs by prolonged contact with leprosy patients.
• The bacilli leave the body in nasal discharge, from the throat during coughing, sneezing and even speaking and through broken skin lesions.

Symptoms of Leprosy (Hansen's disease)

These include appearance of light coloured patches on the skin, thickening of the nerves, partial or total loss of sensation in the affected parts of the body.
• These are accompanied by fever, pain, ulcers and skin eruptions. Deformities of toes and fingers may also develop.
Lepromin test is used to evaluate leprosy using an intradermal injection of a lepromin. This test classifies the type of leprosy based on reaction.
• Tuberculoid leprosy gives positive test with lepromin while lepromatous leprosy is negative to lepromin test.

Prevention and treatment of Leprosy (Hansen's disease)

• No vaccine is available.
• Leprosy is treated with drugs like rifampicin, dapsone, and clofazimine.

FUNGI

Fungi are microorganisms characterised by cell walls made from a substance called chitin.
Most fungi are harmless to humans and some are edible.
Other fungi can be infectious and may lead to life-threatening diseases.
Fungi reproduce by releasing spores that can be picked up by direct contact or even inhaled.
Fungal infections often affect the lungs, skin or nails. Some infections may also penetrate the body to affect organs and cause whole-body infections.
Examples of fungal infections include:

- Athlete's foot: itching, scaling or cracking of the skin
- Ringworm: reddish, itchy, scaly rash usually on the skin and scalp
- Thrush: caused by the fungus Candida albicans which can infect the mouth, vagina, stomach and urinary tract.

Fungi that commonly cause skin diseases are called dermatophytes. “Dermatophytes” doesn't refer to a particular group of fungi, but rather to the fact that they attack the dermis, or skin. Fungal infections of the skin can be treated with topical creams as well as prescription drugs.

Athlete's Foot

The best-known fungal skin infection is athlete's foot. It infects approximately 10 percent of the United States population. It is most common among adolescents and adults; however, it may affect people of any age.

Athlete's foot can grow on the feet in different forms, including the following: **Interdigital:** Infection occurs between the toes, with scaling, fissuring, or softened skin. **Moccasin:** The fungi grows as a thick scaling over the entire sole of the foot (like a moccasin) and causes discomfort.

Vesicular: The fungi appear as small, itchy blisters near the instep.

Ulcerative: The infection involves peeling, oozing discharge, and a strong odor that usually starts as red, itchy swelling between the toes.

A good way to combat athlete's foot is to keep feet clean and dry. Topical powders or creams may also help to control infection. Unfortunately, athlete's foot is tough to eliminate and often comes back.

Summary of Human Fungal Diseases

Disease	Symptoms	Fungus	Route of transmission
Athlete's foot	fluid-filled blisters, scaly skin, itching	*Trichophyton* species (Ascomycete) or *Epidermophyton* species	contact with skin lesions or contaminated floors
Ringworm	ring-shaped skin lesions	*Microsporum, Trichophyton* (Ascomycetes)	contact with skin lesions, contaminated floors, or contaminated objects
Vaginal yeast infection	burning sensation, itching, discharge	*Candida*	contact with fecal material, diabetes; antibiotic treatments increase susceptibility
Tinea cruris (jock itch)	intense itching, ring-shaped lesions	*Microsporum, Trichophyton* (Ascomycetes)	contact with skin lesions, contaminated floors, or contaminated objects
Histoplasmosis	fever, chills, headache, body aches, chest pains, nonproductive cough	*Histoplasma capsulatum* (Ascomycete)	inhalation of airborne conidia

Scalp Itch

Scalp itch is a fungal infection of the scalp and hair. It usually occurs in young children, but may appear in all age groups. It is contagious and may be spread from child to child in a school or day care setting.

An antifungal drug called riseofulvin cures scalp itch in one to three months.

Nail Fungus

Nail fungus is most common in adolescents and adults, especially among people who have frequent manicures. These infections can manifest themselves in a variety of patterns. Sometimes a portion of the nail becomes thick and brittle. Other times, the fungi attack the cuticle and the growth spreads out from there. This cuticle-based infection is common in AIDS patients.

PARASITES

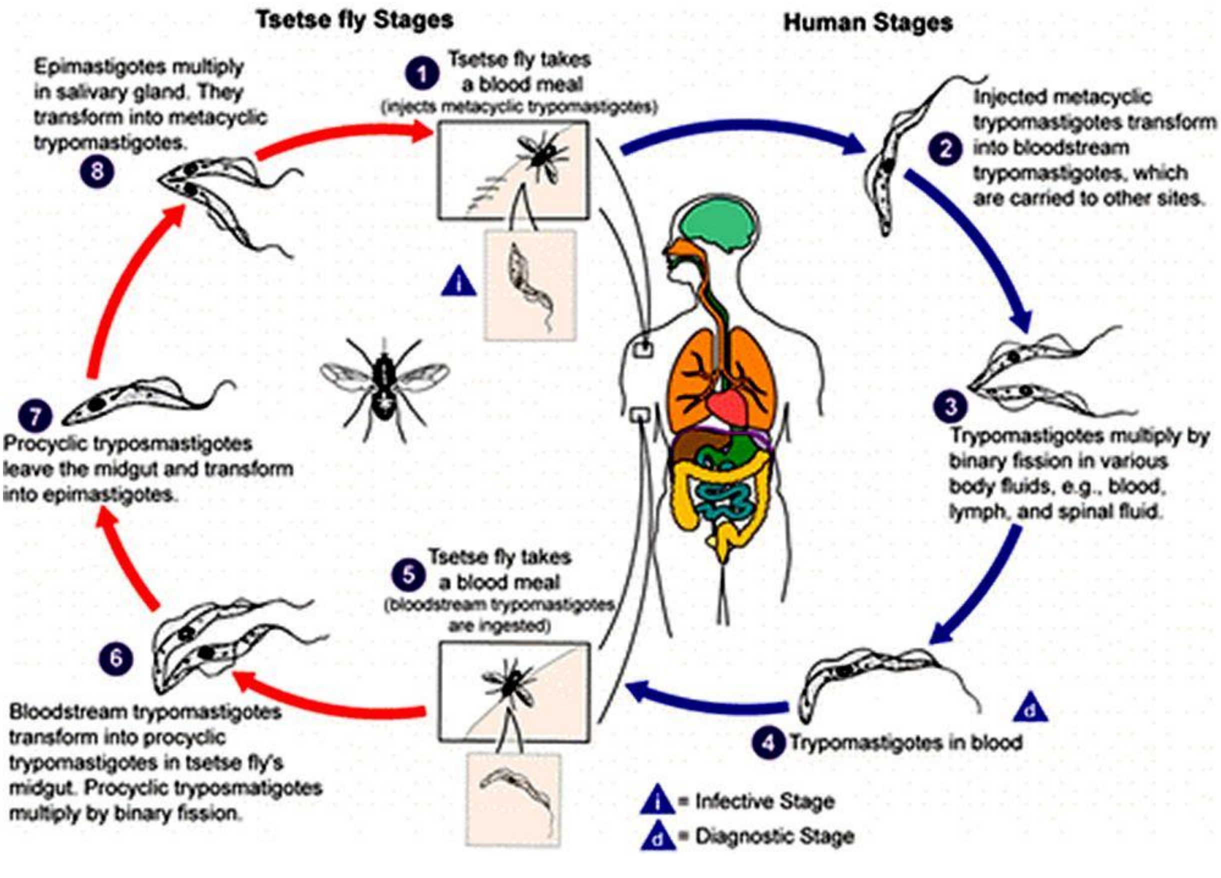
A parasite is an organism that lives off another organism, typically attaching itself to feed from the victim's blood, bowels, or other various bodily fluids. Parasitic diseases are more common than most people realize, and can strike anyone regardless of race, age, or social status. A certain amount of parasites are normally found on the skin and bedding of every human being. Dust mites, and other tiny, harmless mites, are commonly found in all household. Harmful parasites, however, can cause a great deal of damage to the human body if not properly treated.

PARASITIC DISEASES SYMPTOMS

Parasites such as roundworms feed off the human waste in the intestines. Symptoms of various worm infestation include itching, usually of the anus or vaginal area, weight loss, increased appetite, abdominal pain, bowel obstructions, vomiting, disturbed sleep, worms present in the stools or vomit, diarrhea, anemia, symptoms of pneumonia, food poisoning symptoms, aching muscles or joints, or a generally feeling of illness. These symptoms can range from barely noticeable to very severe.

PARASITIC DISEASES CAUSES

Parasitic disease is typically caused by the parasite's entry into the body via the skin or mouth. It is not unusual to pick up parasitic infections from soil, typically by either walking barefoot and allowing entry through the feet, or by placing the hands in the dirt and eventually placing the fingers in the mouth. Often people carry a parasite without ever knowing it.



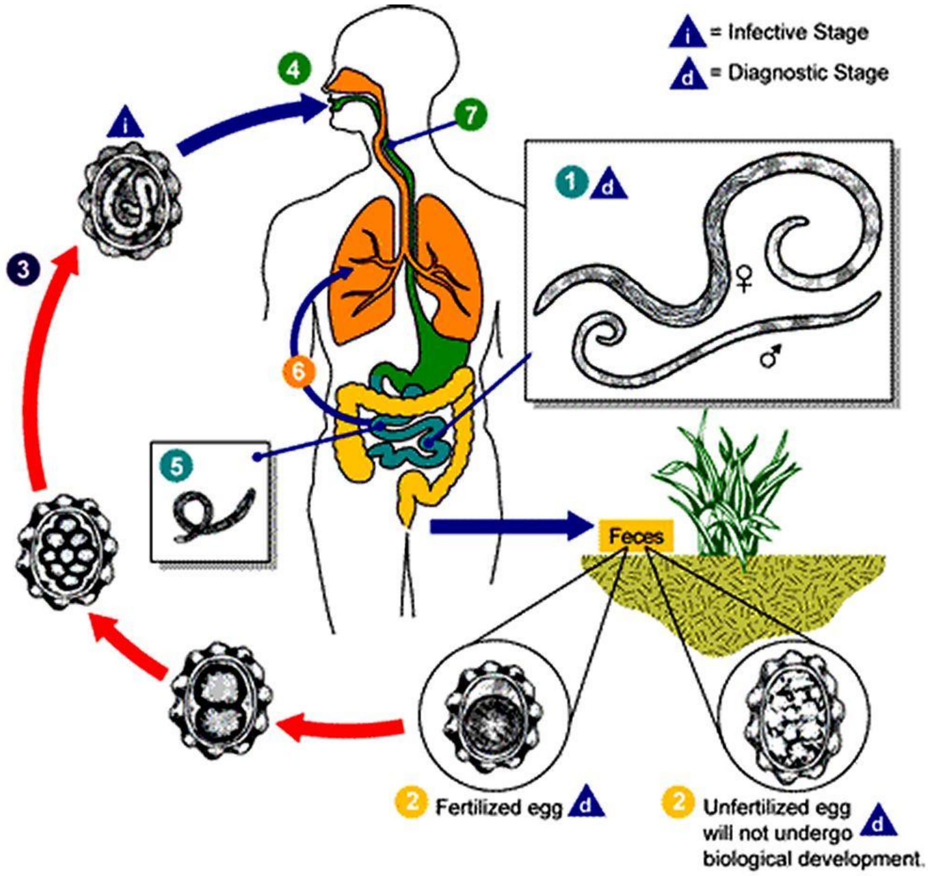
Parasites such as lice are caused through human contact with a person who is infected with lice. Ticks can be picked up through walking outdoors, close contact with a dog or cat, or being brought in from outside in various packages. Mosquitoes are parasites which simply attack humans for their blood and leave as quickly as they came.

PARASITIC DISEASES RISK FACTOR

Risk factors for parasites include children who play outdoors in the dirt, close contact with pets, farming, gardening, outdoor activities that include walking near wooded areas, digging in the dirt, walking outside barefoot, being in close or sexual contact with someone who has specific parasites, or sometimes simply the act of walking from the car to the house. Parasites exist in the world and can not be avoided simply by avoiding being outdoors. Parasites can be found in foods, especially undercooked or exotic foods.

Physicians typically do not screen for parasites without cause. Blood tests or fecal samples can determine parasites, but not all parasites. Pinworms require a nightly anal test, typically for three nights, where a sticky slide is placed on either side of the anus to pick up any eggs that have been laid. Analyzing the slide under a microscope can determine the presence of pinworm.

The majority of parasitic diseases are not dangerous. However, extreme cases may cause weight loss, dehydration from chronic diarrhea, symptoms which mimic pneumonia, anemia, fatigue, Lyme disease from ticks, Malaria from mosquitoes, or a host of uncomfortable bowel syndromes.



PARASITIC DISEASES TREATMENT

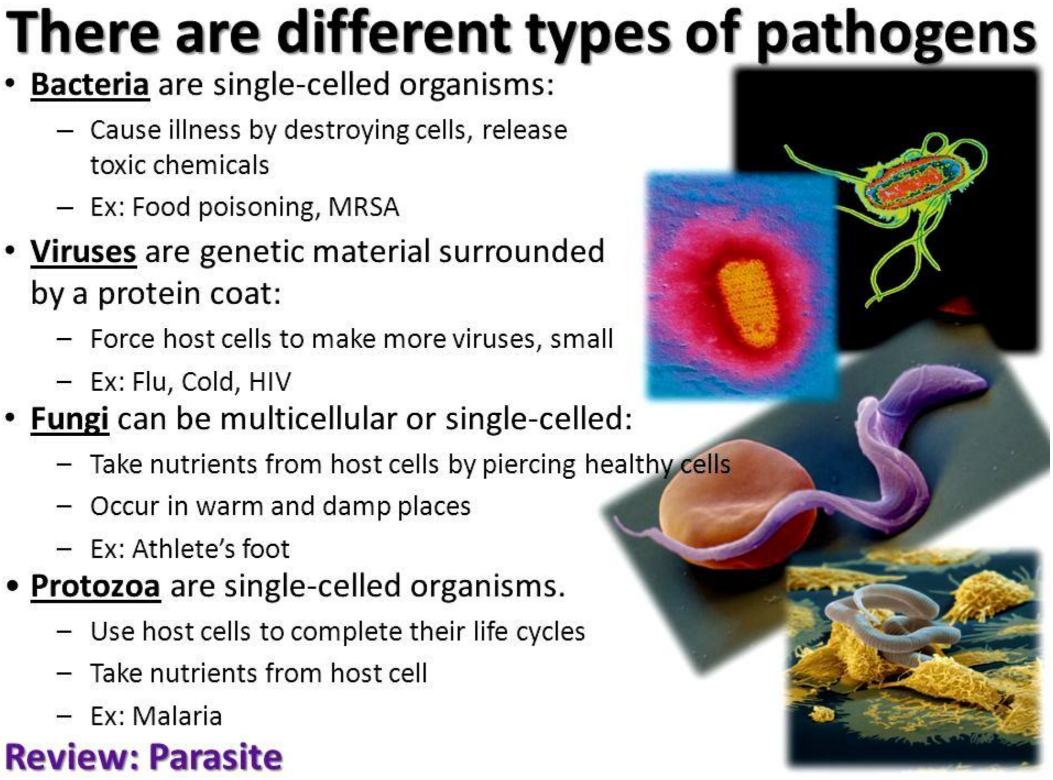
Treatment of parasitic disease is typically nothing. Most often there are no symptoms, or symptoms are so mild that there is no concern, and thus physicians are not told to consider the symptoms as a possible parasitic disease. Unless there are serious symptoms or the infestation is large enough to cause health problems, most parasitic diseases will clear up on their own.

For serious symptomatic cases, medication can be administered to kill the parasite or to relieve the symptoms caused by the parasite. Pinworm discomfort can be handled with an anti itch cream, while Lyme disease can only be treated by treating the symptoms. Medication such as mebendazole, pyrantel pamoate, and albendazole are effective medications in killing worm infestations.

When dealing an infestation of worms or other parasites, self care can be as simple as keeping clean. Frequent bathing, cleaning clothes and bed clothes, wearing clean underclothing to bed, and checking for parasites are the best ways to deal with a parasitic disease. Washing hands frequently, especially after outdoor activities can help reduce the chances of a parasitic disease.

PARASITIC DISEASES PREVENTION

Coping with a parasitic disease can be stressful, more so when the patient believes that parasites come from being dirty. Parasites can be contracted regardless of the cleanliness of the home. While hand washing and overall cleanliness are positive ways to prevent parasitic infections and diseases, they in now way guarantee that parasites won't infect a family member.



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.

i) Through air :- Common cold, Tuberculosis, Pneumonia etc.

ii) Through water :- Cholera, Amoebic dysentry etc.

iii) Through vectors :-

Mosquitoes :- Malaria, Dengue, Yellow fever etc.

Flies :- Typhoid, Tuberculosis, Diarrhoea, Dysentry etc.

iv) Through sexual contact :- Syphilis, AIDS.

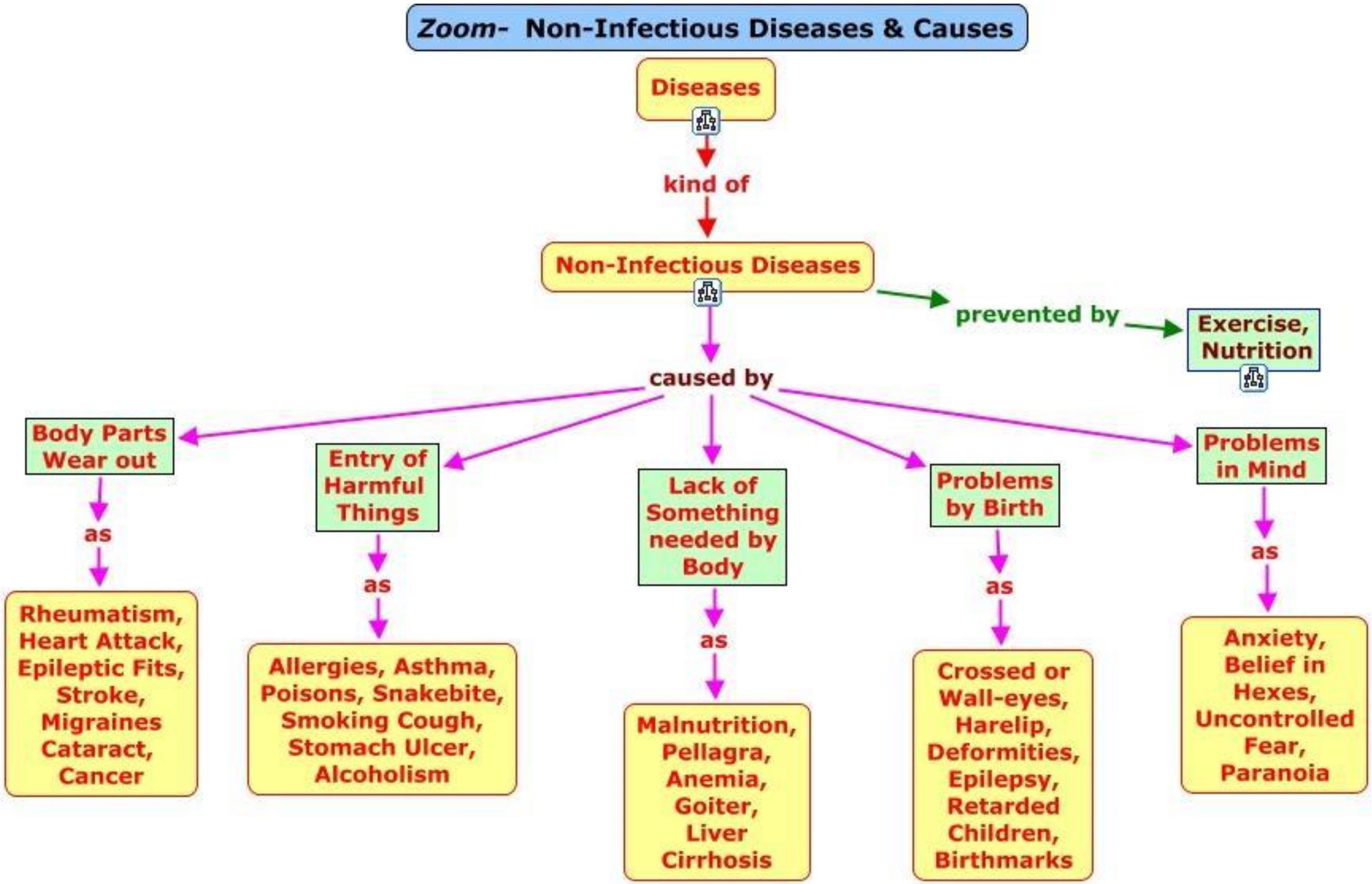
AIDS virus can also spread though blood transfusion and from the mother to her child during pregnancy and through breast feeding.

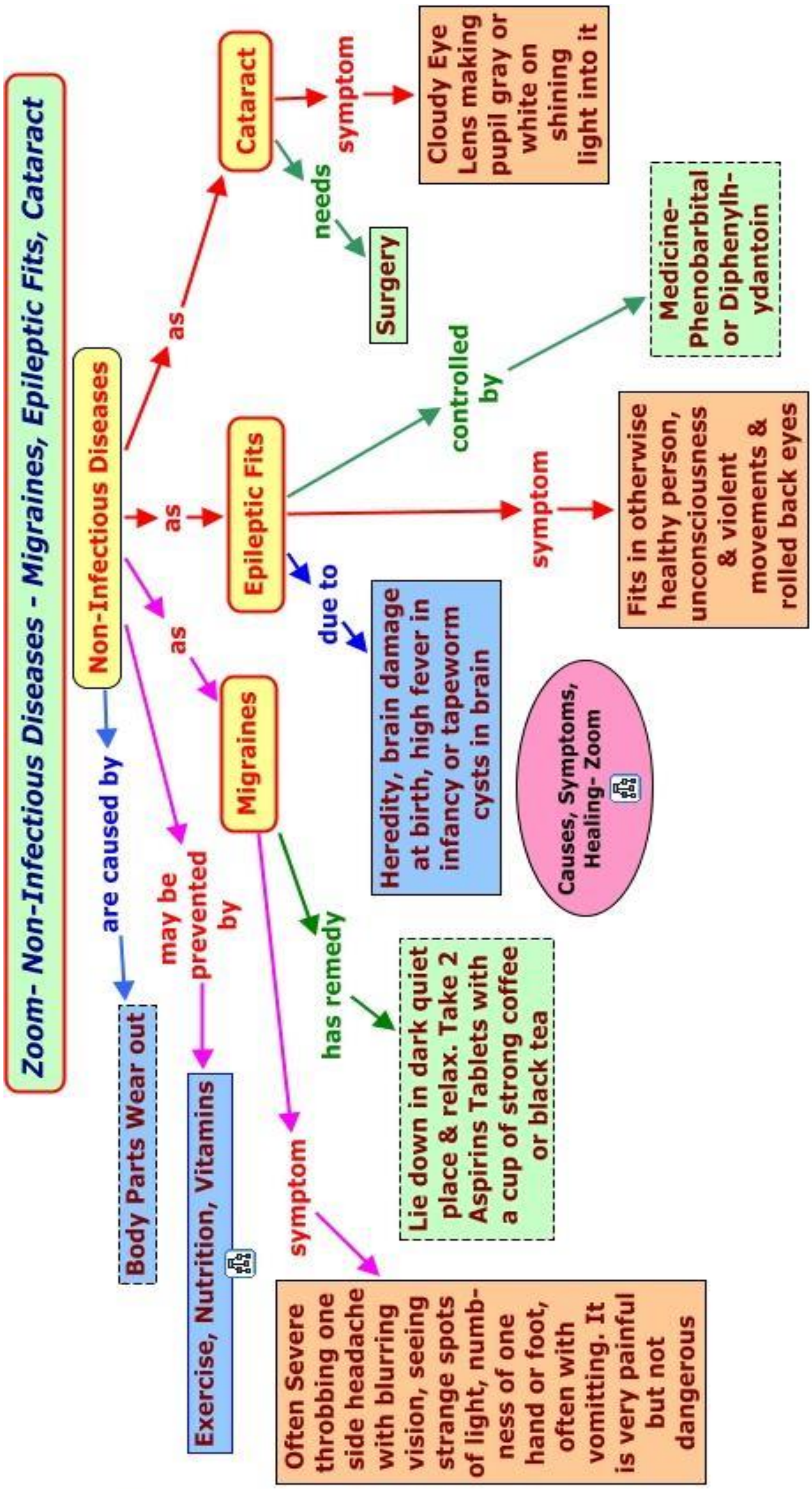
Infectious Diseases

Disease/ Infection	This disease is spread by ...	Time between exposure and sickness	Early signs	How long is the child infectious?	Exclusion of child from kindergartens, schools, etc
Influenza	Coughing and sneezing and direct contact with respiratory droplets.	1–4 days	Sudden onset of fever with cough, sore throat, muscular aches and headache.	From 1 day before, up to 7 days after illness onset.	Restrict contact activities until well.†
* Measles (Immunisation usually prevents this illness.)	Coughing and sneezing. Also direct contact with the nose/throat secretions of an infected person.	7–18 days, usually 10 days to onset and 14 days to rash	Running nose and eyes, cough, fever and a rash.	From the first day of illness until 4 days after the rash begins.	At least 4 days from onset of rash.
* Meningitis (Meningococcal)	Close physical contact, such as kissing. Sleeping in the same room.	2–10 days, usually 3–4 days	Generally unwell, fever, headache, vomiting, sometimes a rash. **Urgent treatment is required!**	For 24 hours after antibiotics are started.	Until well enough to return.
* Mumps (Immunisation usually prevents this illness.)	Contact with infected saliva, eg, coughing, sneezing, kissing and sharing food and drink.	12–25 days, usually 16–18 days	Pain in jaw, then swelling in front of ear and fever.	For one week before swelling appears until 9 days after.	Until 9 days after swelling develops, or until child is well, whichever is sooner.
Ringworm	Contact with infected person's skin, clothes or personal items. Also through contaminated floors and shower stalls.	10–14 days	Flat spreading ring-shaped lesions.	While lesions are present, and while fungus persists on contaminated material.	Restrict contact activities, eg, gym and swimming, until lesions clear.
* Rubella (Immunisation usually prevents this illness.)	Coughing and sneezing. Also direct contact with the nose/ throat secretions of an infected person.	14–23 days, usually 16–18 days	Fever, swollen neck glands and a rash on the face, scalp and body. Rubella during early pregnancy can cause abnormalities in the baby.	From 7 days before rash starts until at least 4 days after it has appeared.	7 days from appearance of rash.
* Salmonella	Undercooked food (eg, chicken and meat); food/water contaminated with faeces from infected person or animal; direct spread from infected person or animal.	6–72 hours, usually 12–36 hours	Stomach pain, nausea, fever and diarrhoea.	Until well, and possibly weeks or months after.	Until well with no further diarrhoea.†
Scabies	Direct skin contact with the infected person, and sharing sheets and clothes.	Days–weeks	Itchy rash in places such as forearm, around waist, between fingers and buttocks and under armpits.	Until 24 hours after treatment is started.	24 hours after treatment is started.
Slapped cheek (Human parvovirus infection)	Coughing and sneezing. The virus may be passed from mother to child during pregnancy.	4–20 days	Red cheeks and lace-like rash on body.	For variable time up to appearance of rash.	Unnecessary unless child is unwell.
Streptococcal sore throat	Usually contact with the secretions of a strep sore throat. Sometimes through contaminated food.	1–3 days	Headache, vomiting, sore throat.	For 24 hours after antibiotics are started.	Until 24 hours after antibiotics started.
* Whooping cough (Pertussis) (Immunisation usually prevents this illness.)	Coughing. Adults and older children may pass on the infection to babies.	5–21 days, usually 7–10 days	Running nose, persistent cough followed by "whoop", vomiting or breathlessness.	From runny nose stage and for 3 weeks after onset of cough if not treated with antibiotics, or until 5 days of antibiotic treatment.	21 days from onset of coughing, or after 5 days of antibiotics.

Infectious Diseases

Disease/ Infection	This disease is spread by ...	Time between exposure and sickness	Early signs	How long is the child infectious?	Exclusion of child from kindergartens, schools, etc
* Campylobacter	Undercooked food (eg, chicken and meat); food/water contaminated with faeces from infected person or animal. Direct spread from infected person or animal.	1–10 days, usually 2–5 days	Stomach pain, fever and diarrhoea.	Until well, and possibly several weeks after.	Until well with no further diarrhoea.†
Chickenpox	Coughing and sneezing. Also direct contact with weeping blisters.	10–21 days, usually 14–16 days	Fever and spots with a blister on top of each spot.	From up to 5 days before appearance of rash until lesions have crusted (usually about 5 days).	For one week from date of appearance of rash.†
Conjunctivitis (viral or bacterial)	Direct contact with discharge from the eyes or with items contaminated by the discharge.	12 hours–12 days	Irritation and redness of eye. Sometimes there is a discharge.	While there is a discharge from the eyes, the child is infectious.	While there is a discharge from the eyes.†
* Cryptosporidium Giardia	Food or water contaminated with faeces from infected person or animal. Direct spread from infected person or animal.	Cryptosporidium 1–12 days, average about 7 days Giardia 3–25 days, usually about 7–10 days	Stomach pain and diarrhoea.	Until well, and possibly several weeks after. Giardia can be cleared by medication.	Until well with no further diarrhoea.†
Gastroenteritis (viral)	Food or water contaminated with faeces from infected person or animal. Direct spread from infected person.	1–3 days	Vomiting, diarrhoea and fever.	While vomiting and diarrhoea last, and up to 8 days after illness starts.	Until well with no further vomiting or diarrhoea.†
Glandular fever	Transfer of saliva.	4–6 weeks	Sore throat, swollen glands in the neck, fever. Vague ill health for some time.	Prolonged – possibly for one year or more.	Until well enough to return.
Hand, foot and mouth disease	Coughing or poor hand washing. Direct spread from an infected person.	3–5 days	Fever, rash on soles and palms and in mouth. Flu-like symptoms.	While the child is unwell and possibly longer, because virus is excreted in faeces for weeks after.	While the child is feeling unwell. Unnecessary if the child is well.†
* Hepatitis A	Food or water contaminated with faeces from infected person. Direct spread from infected person.	15–50 days, usually 28–30 days	Nausea, stomach pains, general sickness. Jaundice a few days later.	From about 2 weeks before signs appear until 1 week after jaundice starts.	7 days from the onset of jaundice.†
* Hepatitis B Immunisation usually prevents this illness.	Close physical contact with the blood or body fluids of an infected person.	6 weeks–6 months, usually 2–3 months	Similar to Hepatitis A.	Blood and body fluids may be infectious several weeks before signs appear, until weeks or months later. A few people are infectious for years.	Until well.†
Impetigo (School sores)	Direct contact with discharge from infected skin.	Usually a few days, variable	Scabby sores on exposed parts of body.	Until 24 hours after treatment with antibiotics has started or until sores are healed.	Until 24 hours after treatment has started.†


Zoom- Non-Infectious Diseases & Causes
Diseases
kind of
Non-Infectious Diseases
prevented by
Exercise, Nutrition
caused by
Body Parts Wear out
Entry of Harmful Things
Lack of Something needed by Body
Problems by Birth
Problems in Mind
as
Rheumatism, Heart Attack, Epileptic Fits, Stroke, Migraines Cataract, Cancer
Allergies, Asthma, Poisons, Snakebite, Smoking Cough, Stomach Ulcer, Alcoholism
Malnutrition, Pellagra, Anemia, Goiter, Liver Cirrhosis
Crossed or Wall-eyes, Harelip, Deformities, Epilepsy, Retarded Children, Birthmarks
Anxiety, Belief in Hexes, Uncontrolled Fear, Paranoia



Zoom- Non-Infectious Diseases - Migraines, Epileptic Fits, Cataract
Non-Infectious Diseases
are caused by
Body Parts Wear out
may be prevented by
Exercise, Nutrition, Vitamins
as
Cataract
symptom
Cloudy Eye Lens making pupil gray or white on shining light into it
needs
Surgery
as
Epileptic Fits
controlled by
Medicine- Phenobarbital or Diphenylh-ydantoin
symptom
Fits in otherwise healthy person, unconsciousness & violent movements & rolled back eyes
due to
Heredity, brain damage at birth, high fever in infancy or tapeworm cysts in brain
as
Migraines
has remedy
Lie down in dark quiet place & relax. Take 2 Aspirins Tablets with a cup of strong coffee or black tea
symptom
Often Severe throbbing one side headache with blurring vision, seeing strange spots of light, numb-ness of one hand or foot, often with vomitting. It is very painful but not dangerous
Causes, Symptoms, Healing- Zoom

INTEXT QUESTIONS PAGE NO. 178

Q1. State any two conditions essential for good health.
Answer:
Good health of a person depends on
(i) social environment.
(ii) public cleanliness.
(iii) good economic conditions and earnings.
(iv) social equality and harmony.

Q2. State any two conditions essential for being free of disease.
Answer:
The conditions essential for being free of diseases
(i) Taking good food (balanced diet)
(ii) Maintaining personal and public hygiene.

Q3. Are the answers to the above questions necessarily the same or different? Why?
Answer:
The answers are not same all the time. Because the meaning of health varies from person to person. For example, good health for a dancer may be being able to stretch his body into difficult but graceful positions. On the other hand, good health for a musician may mean having enough breathing capacity in his/her lungs to control his/her voice.
There is one similarity in both the cases. If the conditions essential for good health are maintained, then there are no chances of getting a disease.

INTEXT QUESTIONS PAGE NO. 180

Q1. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?
Answer:
When there is a disease, its symptoms and signs appear. These symptoms may be headache, cough, loose-motions, wound with pus, etc. These symptoms indicate disease but do not tell what the disease is. So, it is advisable to go to the doctor to diagnose any signs of a disease on the basis of these symptoms. The doctor will get laboratory tests done, if required for the confirmation of a particular disease.

Q2. In which of the following case do you think the long-term effects on your health are likely to be most unpleasant?
If you get jaundice,
If you get lice,
If you get acne.
Why?
Answer:
Lice and acne will not cause long lasting effects on our body. But in case of jaundice, there will be severe long lasting effects. For example:
(i) High temperature, headache and joint pains.
(ii) Feeling of nausea and vomiting.
(iii) Initiating rashes.
The patient will suffer from poor health and will recover by taking complete bed rest for sometime.

INTEXT QUESTIONS PAGE NO. 187

Q1. Why are we normally advised to take bland and nourishing food when we are sick?
Answer:
In case of illness, the normal functions of the body get disturbed. So, a nourishing food is required which is easily digestable and contains all the nutrients. Therefore, bland and nourishing food is advised to take during sickness.

Q2. What are the different means by which infectious diseases are spread?
Answer:
Infectious diseases spread by different means. These are:
(i) **Through air** An infected person when sneezes or coughs releases droplets containing germs. These droplets infect another healthy person through air and microbes enter a new body. Examples of such diseases are common cold, pneumonia and tuberculosis.
(ii) **Through water** If the water source is polluted by the excreta of infectious persons having gut diseases and this water is used by other people they will be infected by diseases. For example, cholera, amoebiasis, hepatitis spread through water.
(iii) **Through sexual contact** Some diseases like AIDS and syphilis, etc., are transmitted by sexual contact. Other than this, AIDS virus also spread through blood, infected syringes, infected mother to her baby during pregnancy and through breast feeding.
(iv) **Through vectors** There are some animals which act as intermediaries or vectors for a particular diseases. The vectors carry diseases from infected person to the healthy person. For example, mosquito spread malaria causing organism in humans, while sucking their blood.

Q3. What precautions can you take in your school to reduce the incidence of infectious diseases?
Answer:
To prevent the incidence of infectious diseases in school following precautions can be taken:
(i) Avoid contact of students suffering from air borne diseases like common cold, cough, eye, flu, etc.
(ii) By checking the availability of clean drinking water in school.
(iii) Clean surroundings in school will not allow the growth and multiplication of vectors.
(iv) Starting childhood immunisation programme in schools.

Q4. What is immunisation?
Answer:
Immunisation is a process of administration (injecting) of vaccine into a healthy person in order to develop immunity against a disease. Immunity means the ability of a body to recognise, destroy and eliminate external disease causing agents. This immunisation through administering vaccine is called vaccination. Vaccine contains disease-causing organisms in a diluted or weakened form or in living or dead form. It prevents further infection by microbes from causing the disease. The diseases like small pox, rabies, diphtheria chicken pox, polio, hepatitis are controlled by vaccination. Small pox is eliminated from the world through a world wide vaccination programme.

Q5. What are the immunisation programmes available at nearest health centre in locality? Which of these diseases are the major health problems in your area?
Answer:
The following immunisation programme is available at the nearest health centre in our locality
(i) Immunisation for infants—DPT, BCG, polio, measles and MMR.
(ii) For children—Typhoid, TT, DT, small pox and TAB.
(iii) For pregnant woman— TT and hepatitis-B.

The diseases like typhoid, polio, measles, tetanus are the major health problems in our locality. To prevent these diseases, our government have initiated expanded immunisation programme all over the country.

EXERCISE QUESTIONS PAGE NO. 188

Q1. How many times did you fall ill in the last one years? What were the illnesses?
(a) Think of one change you could make in your habits in order to avoid any of/most of the above illnesses.
(b) Think of one change you would wish for in your surroundings in order to avoid any of/most of the above illnesses.
Answer: I fell ill twice in the last one year. The disease, I first suffered from was diarrhoea and secondary the dengue fever.
(a) The changes I brought in my habits after suffering from these disease to protect myself in near future are
(i) I will always drink clean, pure water and wash hands before eating anything.
(ii) I will live in clean surroundings where disease spreading vectors could not mulitply. For example, mosquitoes.
(b) Pure drinking water should be available always. The intake of impure water is the main cause of many infectious diseases.

Q2. A doctor/nurse/health-worker is exposed to more sick people than others in the community. Find out how she/he avoids getting sick herself/himself.
Answer: A doctor/nurse/health-worker take following precautions to avoid become sick themselves
(i) Wear masks while diagnosing mouth or chest infections.
(ii) Clean their hands and wear gloves even while doing minor surgeries.
(iii) Get immunisation done against all the infectious diseases.
(iv) Take balanced diet (rich in proteins especially) to strengthen their immune system.
(v) Dispose off blood samples, urine or stool, sputum, etc., carefully.

Q3. Conduct a survey in your neighbourhood to find out what the three most common diseases are. Suggest three steps that could be taken by your local authorities to bring down the incidence of these diseases.
Answer: I conducted a survey in my neighbourhood and found following three most common diseases.

Diseases	**Symptoms**	Steps could be Taken by Local Authorities to Bring Down the Incidence
Typhoid	Headache and fever which remains high in the second week and then declines	➢ Proper hygiene in surrounding areas of living. ➢ Safe disposal of excreta and other wastes. ➢ Providing TAB and typhoid oral vaccine.
Cholera	Painless watery diarrhoea, effortless vomiting	➢ Good sanitary condition in community. ➢ Provision of clean, purified drinking water. ➢ Providing standard cholera vaccination in the locality.

Dengue fever	High fever with headache, weakness and joint pains	➢ Maintenance of hygienic conditions in community . ➢ Preventing the mosquito breeding sites. ➢ Public awarness programme against mosquito borne diseases.

Q4. A baby is not able to tell her/his caretakers that she/he is sick. What would help us to find out (a) that the baby is sicks? (b) What is the sickness?

Answer:

(a) Symptoms to help in finding out that the baby is sick are:

(i) continuous crying

(ii) drooping of eyes

(iii) redness of eyes

(iv) high temperature of body.

(b) Signs which help to indicate the sickness in baby

(i) loose motions, stomach pain indicate diarrhoea.

(ii) high fever, headache, muscular pain, feeling of shivering and cold indicate malaria.

(iii) redness and persistent rubbing of eyes indicate eye flu.

(iv) pale skin, yellow urine, yellowing of eyes indicate jaundice.

(v) doctors suggest for laboratory tests, if there is fever with no other symptoms to find out the kind of sickness.

Q5. Under which of the following conditions is a person most likely to fall sick?

(a) When she is recovering from malaria.

(b) When she has recovered from malaria and is taking care of someone suffering from chicken pox.

(c) When she is on a four-day fast after recovering from malaria and is taking care of someone suffering from chicken pox. Why?

Answer:

In condition (c), a person is most likely to fall sick. The reasons are:

(a) Due to malaria, the body becomes weak and loss of body fluids occur. In this condition, it she takes four days fast, her recovery from malaria related weakness will not occur and she will become more weak.

(b) Her immune system is already weak due to malaria and if she takes care of someone suffering from chicken pox, there is high probability that she may also suffer this diseases.

Q6. Under which of the following conditions are you most likely to fall sick?

(a) When you are taking examinations.

(b) When you have travelled by bus and train for two days.

(c) When your friend is suffering from measles. Why?

Answer:

In condition (c), Charles of falling sick are maximum. Measles is an infectious viral disease of young children which spreads through nasal or throat discharge.In contact of a friend suffering from measles can cause you sick.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 13
WHY DO WE FALL ILL

1. Which one of the following is an infectious disease?

(a) diptheria

(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 affect 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) Dipteria

(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) Tetanaus

(b) Diptheria

(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

12. Which of the following is a communicable disease?

(a) Rickets

(b) Scurvy

(c) Marasmus

(d) Cholera

13. The causative organism for malaria is a:

(a) bacteria

(b) protozoa

(c) virus

(d) fungi

14. Vaccination helps in controlling diseases because

(a) it develops resistance against the pathogen attack

(b) it kills the pathogens causing disease

(c) it blocks the food supplied to pathogens

(d) it does not allow pathogens to multiply in hosts

15. ORS is given in

(a) diarrhoea

(b) measeles

(c) typhoid

(d) tetanus

16. Which of the following is an example of nutritional deficiency disease?

(a) Hypertension

(b) Rickets

(c) Diabetes

(d) Gastroenteritis

17. Define Health? What do you interpret when we say a person is in good health?

18. State any two conditions essential for good health.

19. What are three dimensions of health? Are they interrelated?

20. Kidneys of a person do not filter urine properly. How does it affect physical, mental and social dimensions of that person?

21. State any two conditions essential for being free of disease.

22. Are the answers to the above questions (Q2 and Q5) and necessarily the same or different? Why?

23. What is a balanced diet?

24. A hefty boy of 12 years often picks fights with others. Do you think he is in good health? If so, then explain your answer.

25. How do you define 'disease'?

26. State and explain in brief the four major factors, which are the causes of disease.

27. Is there any difference between 'being healthy' and 'disease free'?

28. How do we identify a disease?

29. What is the difference between symptoms and signs of a disease?

30. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?

31. Based on duration or persistence, how diseases are categorised?

32. Give examples of Acute diseases.

33. Give four examples of Chronic diseases.

34. Differentiate between Acute Diseases and Chronic Diseases.

35. What are congenital diseases? Give two examples of such disease.

36. Name a disease which was earlier considered to be chronic but now can be treated in short duration?

37. A baby is not able to tell her/his caretakers that she/he is sick. What would help us to find out (a) that the baby is sick? (b) what is the sickness?

38. What are acquired diseases?

39. Write few common signs and symptoms of a disease if brain is affected.

40. List any two differences between infectious and non-infectious diseases. Write any one example of each disease.

41. What are infectious agents? What are the different infectious agents?

42. What is 'germ theory of disease'? Who proposed it?

43. What are Koch's Postulates?

44. List the diseases caused by viruses?

45. Give three examples of bacterial diseases.

46. Give examples of fungal diseases.

47. List three diseases caused by protozoans.

48. Name the pathogen causes peptic ulcer.

49. List the diseases caused by worms?

50. Name the the protozoan pathogen that causes kala-azar.

51. Name the microbe which causes acne.

52. What is the scientific name of roundworm? Where do we find it commonly in human body? Name the disease caused by it.

53. Why is it important that we think of these categories of infectious agents?

54. How do antibiotics (say Penicillin) work on bacteria but not on human beings?

55. Define antibiotic? Explain how it is able to control bacterial infections but not viral infections.

56. Explain why antibiotics are more effective in curing bacterial diseases than viral diseases.

57. Why taking an antibiotic is not effective in the common cold?

58. Give two examples of bacterial antibiotics.

59. Give an example of fungal antibiotic.

60. Why are we normally advised to take bland and nourishing food when we are sick?

61. What are the different means by which infectious diseases are spread?

62. If a person has persistent cough and breathlessness, most likely which of the following organ is affected

63. What is the alternate name of brain fever? Which vector is responsible for this disease?

64. Name the vector which causes malaria.

65. Name the vector which causes dengue, chikengunia and yellow fever.

66. Name the vector that can cause sleeping sickness.

67. Name the diseases that can spread through housefly.

68. Name the vectors which can cause rabies.

69. A doctor/nurse/health-worker is exposed to more sick people than others in the community. Find out how she/he avoids getting sick herself/himself.

70. What precautions can you take in your school to reduce the incidence of infectious diseases?

71. What do you mean by immunity?

72. What is immunisation?

73. What is antigen?

74. What are antibodies?

75. What is colostrum? Why is mothers milk strongly advised to new borns?

76. What are the immunisation programmes available at the nearest health centre in your locality? Which of these diseases are the major health problems in your area?

77. What are epidemic and endemic diseases?

78. Which organ is affected if a person is suffering from jaundice?

79. What do you mean by Phagocytosis?

80. Why is it not necessary to give Hepatitis A vaccine to children?

81. What are the basic principles involved in medical treatment for diseases?

82. Why it is advisable to breast feed the baby for first few several weeks? Why Colostrum is good for infants?

83. How do Skin, Hairs, Saliva form the first line of defense against diseases?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 13
WHY DO WE FALL ILL

1. What does the word health mean?
2. Name any two Symptoms of diseases………………………. (Cough& loose motions)
3. The disease which last for only a short period of time is called……………….(Acute Disease)
4. State whether Tuberculosis is aChronic Disease or Acute Disease…… (Chronic Disease)
5. Mention the causal organism for Sleeping sickness ………… (Trypanosoma)
6. Sleeping sickness is caused by……………………………………………
7. Elephantiasis is caused by…………………………………………………….
8. Mention two Air born diseases1…………………………..2………………….
9. Mention two Sexually Transmitted Diseaes1………………..2……………….
10. Mention two Viral Diseaes1………………..2……………….
11. What is called vector. Give one example.
12. Give two examples of Chronic diseases.
13. Distinguish between Infectious and Non-infectious diseases.
14. Write a short notes on Small Pox.
15. What is immunity? Write short notes on it.
16. What is Vaccination? Give the details, how it works in human body.
17. Write three reasons for Cancers.
18. What are the basic five principles of treatment for diseases.
19. How Hygiene could help you to maintain good health and mention five situations to take care about health.
20. How does the health of an organism depend upon the surroundings?
21. What do we mean by “disease”?
22. What are symptoms?
23. How do you distinguish between acute and chronic diseases?
24. What are the various causes of diseases?
25. Name some common infectious diseases
26. Explain the effect of antibiotic penicillin on bacterial cells.
27. Why are human cells not affected by penicillin?
28. Why are antibiotics ineffective against viruses?
29. How do communicable or infectious diseases spread?

30. How does AIDS spread?

31. What are vectors? Name some vector transmitted diseases.

32. The disease-causing microbes enter the body through different means. Where do they go then?. Do all microbes go to the same tissue or organ, or do they go to different ones?

33. The signs and symptoms of a disease depend upon the tissue or organ targeted. Explain.

34. How does HIV damage our body?

35. How do we kill microbes?

36. What feature of our body protects us from catching infectious diseases?

37. Describe the principle behind vaccination.

38. Name some diseases for which vaccines are available.

39. Who were awarded nobel prize for discovery of treatment of peptic ulcer?

40. List some general principles of prevention.

41. State any two conditions essential for good health.

42. State any two conditions essential for being free of disease.

43. Are the answers to the above questions necessarily the same or different? Why?

44. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?

45. In which of the following case do you think the long-term effects on your health are likely to be most unpleasant? a) if you get jaundice, b) if you get lice, c) if you get acne. Why?

46. Why we are normally advised to take bland and nourishing food when we are sick?

47. How are acute diseases different from chronic diseases?

48. What is the full form of AIDS? Name the causal organism.

49. State two conditions essential for keeping good health.

50. Define (a) health (b) disease.

51. Why are antibiotics not effective for viral disease?

52. Explain giving reasons –(a) Balanced diet is necessary for maintaining health body. (b) Health of an organism depends upon the surrounding environmental conditions.

53. Explain the Natural and acquired immunity?

54. What are the two ways to treat and infectious disease?

55. What do the sign and symptoms indicate if person is suffering from any disease? Based on the duration of diseases what are the difference between categories of diseases? Diffrentiate between them giving one example of each.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 13
WHY DO WE FALL ILL

1. Which one of the following is not a viral disease?

(a) Dengue

(b) AIDS

(c) Typhoid

(d) Influenza

2. Which one of the following is not a bacterial disease?

(a) Cholera

(b) Tuberculosis

(c) Anthrax

(d) Influenza

3. Which one of the following disease is not transmitted by mosquito?

(a) Brain fever

(b) Malaria

(c) Typhoid

(d) Dengue

4. Which one of the following disease is caused by bacteria?

(a) Typhoid

(b) Anthrax

(c) Tuberculosis

(d) Malaria

5. Which one of the following diseases is caused by protozoans?

(a) Malaria (b) Influenza

(c) AIDS (d) Cholera

6. Which one of the following has a long term effect on the health of an individual?

(a) Common cold

(b) Chicken pox

(c) Chewing tobacco

(d) Stress

7. Which of the following can make you ill if you come in contact with an infected person?

(a) High blood pressure

(b) Genetic abnormalities

(c) Sneezing

(d) Blood cancer

8. AIDS cannot be transmitted by

(a) sexual contact

(b) hugs

(c) breast feeding

(d) blood transfusion

9. Making anti-viral drugs is more difficult than making anti-bacterial medicines because

(a) viruses make use of host machinery

(b) viruses are on the border line of living and non-living

(c) viruses have very few biochemical mechanisms of their own

(d) viruses have a protein coat

10. Which one of the following causes kala-azar?

(a) *Ascaris*

(b) *Trypanosoma*

(c) *Leishmania*

(d) Bacteria

11. If you live in a overcrowded and poorly ventilated house, it is possible that you may suffer from which of the following diseases

(a) Cancer (b) AIDS

(c) Air borne diseases (d) Cholera

12. Which disease is not transmitted by mosquitoes?

(a) Dengue (b) Malaria

(c) Brain fever or encephalitis (d) Pneumonia

13. Which one of the following is not important for individual health?

(a) Living in clean space

(b) Good economic condition

(c) Social equality and harmony

(d) Living in a large and well furnished house

14. Choose the wrong statement

(a) High blood pressure is caused by excessive weight and lack of exercise.

(b) Cancers can be caused by genetic abnormalities

(c) Peptic ulcers are caused by eating acidic food

(d) Acne in not caused by staphylococci

15. We should not allow mosquitoes to breed in our surroundings because they

(a) multiply very fast and cause pollution

(b) are vectors for many diseases

(c) bite and cause skin diseases

(d) are not important insects

16. You are aware of Polio Eradication Programme in your city. Children are vaccinated because

(a) vaccination kills the polio causing microorganisms

(b) prevents the entry of polio causing organism

(c) it creates immunity in the body

(d) all the above

17. Viruses, which cause hepatitis, are transmitted through

(a) air

(b) water

(c) food

(d) personal contact

18. Vectors can be defined as

(a) animals carry the infecting agents from sick person to another healthy person

(b) microorganisms which cause many diseases

(c) infected person

(d) diseased plants

19. Give two examples for each of the following

(a) Acute diseases (b)

Chronic diseases (c)

Infectious diseases

(d) Non-infectious diseases

20. Name two diseases caused by Protozoans. What are their causal organisms?

21. Which bacterium causes peptic ulcers? Who discovered the above pathogen for the first time?

22. What is an antibiotic? Give two examples

23. Fill in the blanks

(a) Pneumonia is an example of ——— disease.

(b) Many skin diseases are caused by———.

(c) Antibiotics commonly block biochemical pathways important for the growth of ———.

(d) Living organisms carrying the infecting agents from one person to another are called ———.

24. Name the target organs for the following diseases

(a) Hepatitis targets———.

(b) Fits or unconsciousness targets ———.

(c) Pneumonia targets ———.

(d) Fungal disease targets ———.

25. Who discovered ‘vaccine’ for the first time? Name two diseases which can be prevented by using vaccines.

26. Fill in the blanks

(a) ——— disease continues for many days and causes——— on body.

(b) ———disease continues for a few days and causes no longer term effect on body.

(c) ——— is defined as physical, mental and social well-being and comfort.

(d) Common cold is——— disease.

(e) Many skin diseases are caused by———.

27. Classify the following diseases as infectious or non-infectious.

(a) AIDS

(b) Tuberculosis

(c) Cholera

(d) High blood pressure

(e) Heart disease

(f) Pneumonia

(g) Cancer

28. Name any two groups of micro-organisms from which antibiotics could be extracted.

29. Name any three diseases transmitted through vectors.

30. Explain giving reasons

(a) Balanced diet is necessary for maintaining healthy body.

(b) Health of an organism depends upon the surrounding environmental conditions.

(c) Our surrounding area should be free of stagnant water.

(d) Social harmony and good economic conditions are necessary for good health.

31. What is a disease? How many types of diseases have you studied? Give examples.

32. What do you mean by disease symptoms? Explain giving two examples?

33. Why is immune system essential for our health?

34. What precautions will you take to justify “prevention is better than cure”.

35. Why do some children fall ill more frequently than others living in the same locality?

36. Why are antibiotics not effective for viral disease?

37. Becoming exposed to or infected with an infectious microbe does not necessarily mean developing noticeable disease. Explain.

38. Give any four factors necessary for a healthy person.

39. Why is AIDS considered to be a ‘Syndrome’ and not a disease?

CHAPTER – 14

NATURAL RESOURCES

RESOURCES ON THE EARTH

Biosphere:

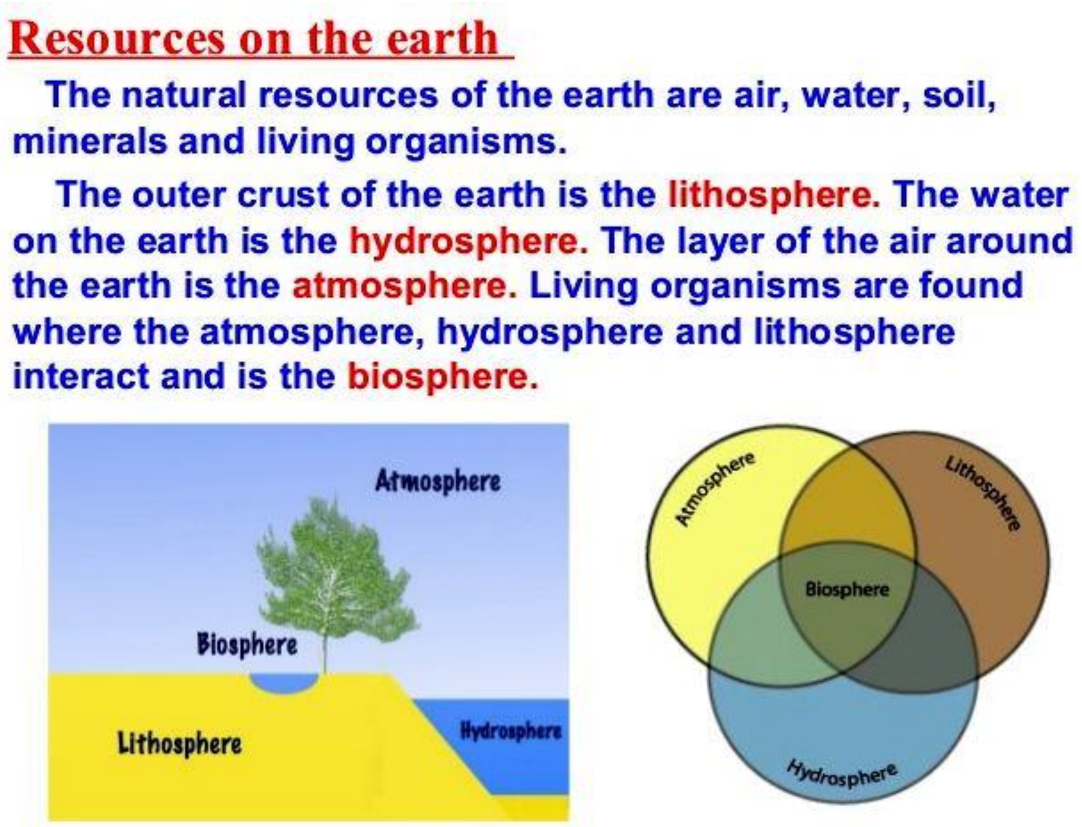
The whole combination of animals, plants and non-living beings which by their interaction make the planet earth a live and vibrant place is called biosphere.

Biotic Components:

Living things constitute the biotic component of the biosphere.

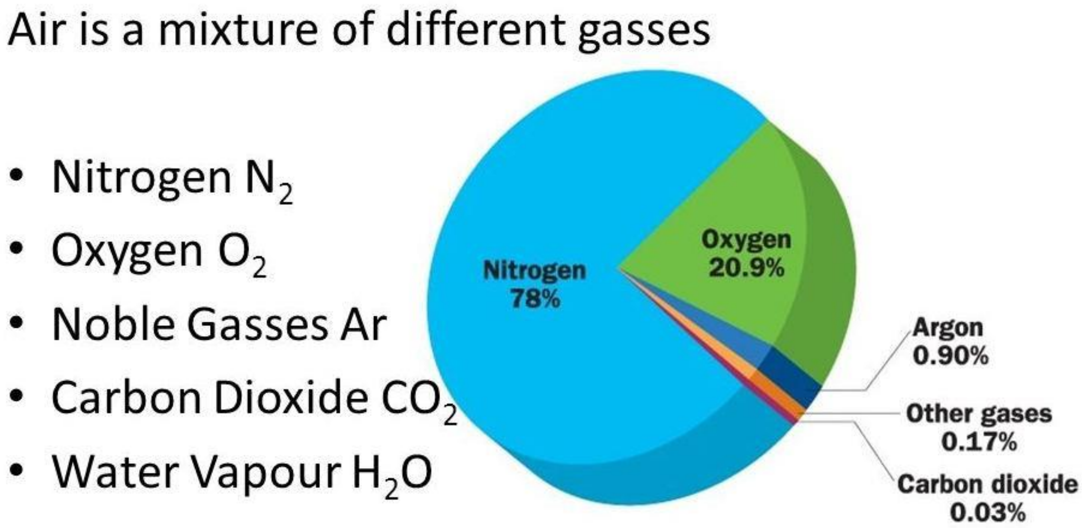
Abiotic Components:

The air, the water and the soil form the non-living or a biotic component of the biosphere. The air is called the hygrosphere, the water is hydrosphere and the soil is called lithosphere.



AIR

Air is a mixture of many gases like nitrogen, oxygen, carbon dioxide and water vapour. All living beings need oxygen to break down glucose molecules and get energy for their activities. This results in the production of carbon dioxide. Another process which results in the consumption of oxygen and the concomitant production of carbon dioxide is combustion. This includes not just human activities, which burn fuels to get energy, but also forest fires. Despite this, the percentage of carbon dioxide in our atmosphere is a mere fraction of a percent because of carbon dioxide fixation.

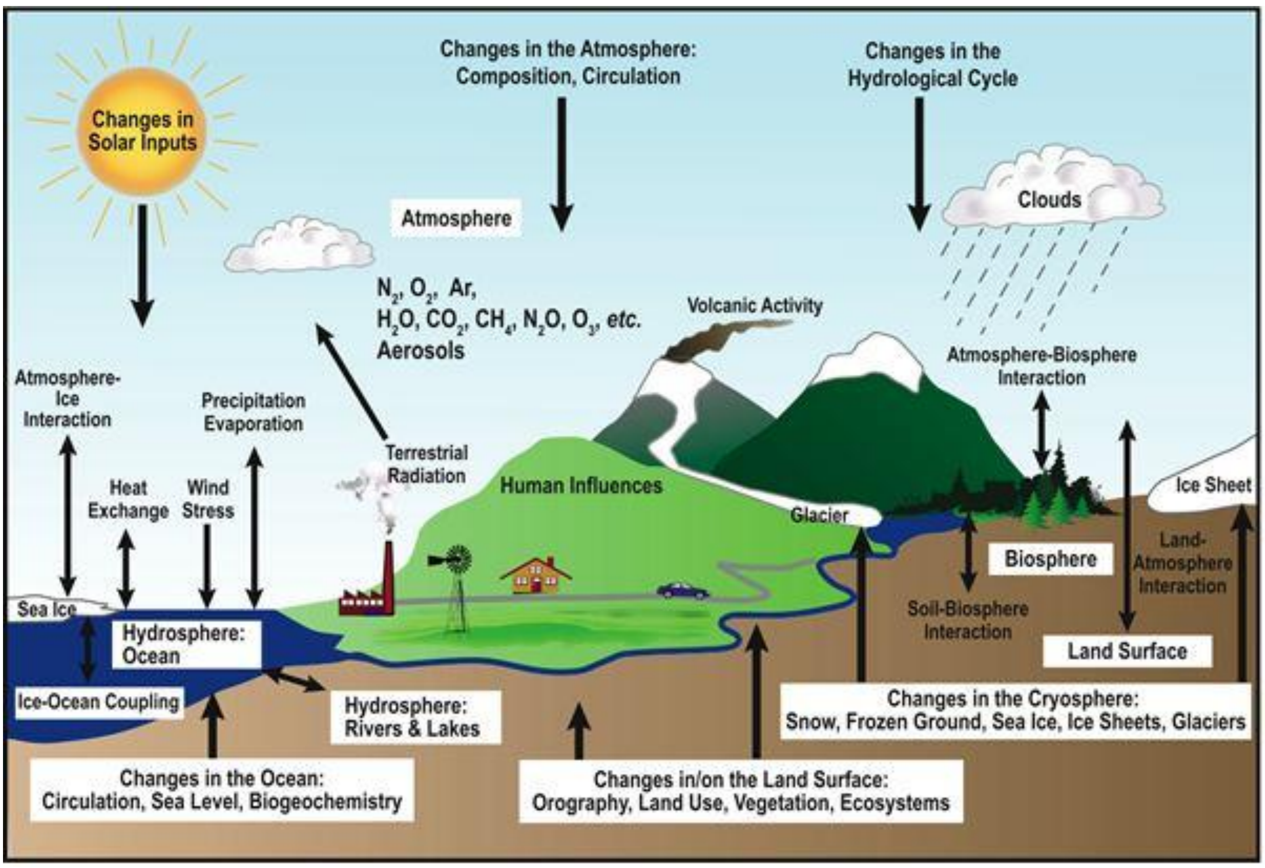


Carbon Dioxide Fixation

(i) Green plants convert carbon dioxide into glucose in the presence of Sunlight and
(ii) Many marine animals use carbonates dissolved in sea-water to make their shells.

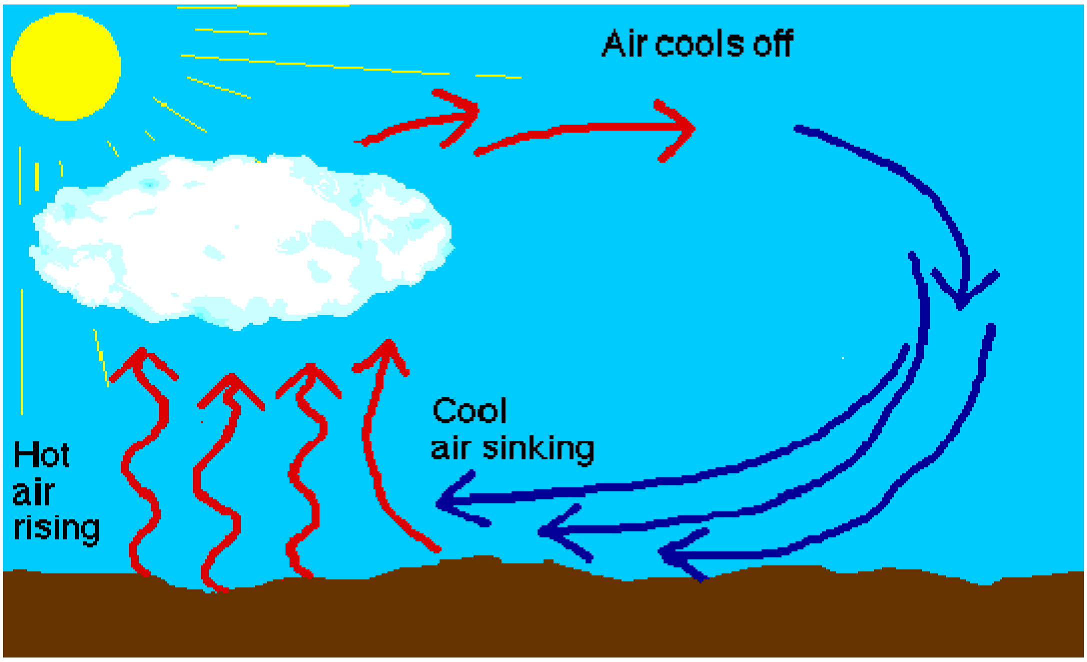
The Role of the Atmosphere in Climate Control:

Atmosphere covers the Earth, like a blanket. We know that air is a bad conductor of heat. The atmosphere keeps the average temperature of the Earth fairly steady during the day and even during the course of the whole year. The atmosphere prevents the sudden increase in temperature during the daylight hours. And during the night, it slows down the escape of heat into outer space. The moon, which is about the same distance from the Sun that the Earth is, with no atmosphere, the temperature ranges from –190º C to 110º C.



THE MOVEMENT OF AIR: WINDS

These phenomena are the result of changes that take place in our atmosphere due to the heating of air and the formation of water vapour. Water vapour is formed due to the heating of water bodies and the activities of living organisms. The rise in temperature creates a low pressure zone which attracts cool air from high pressure zone and pushes up the hot air. Thus the atmosphere can be heated from below by the radiation that is reflected back or re-radiated by the land or water bodies. On being heated, convection currents are set up in the air.

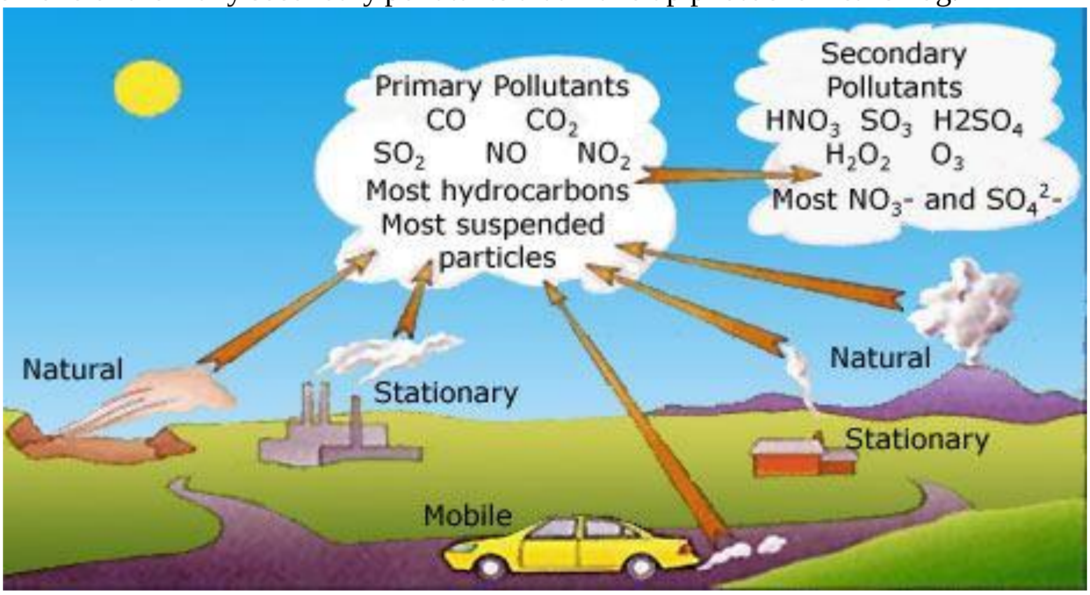


AIR POLLUTION

An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.

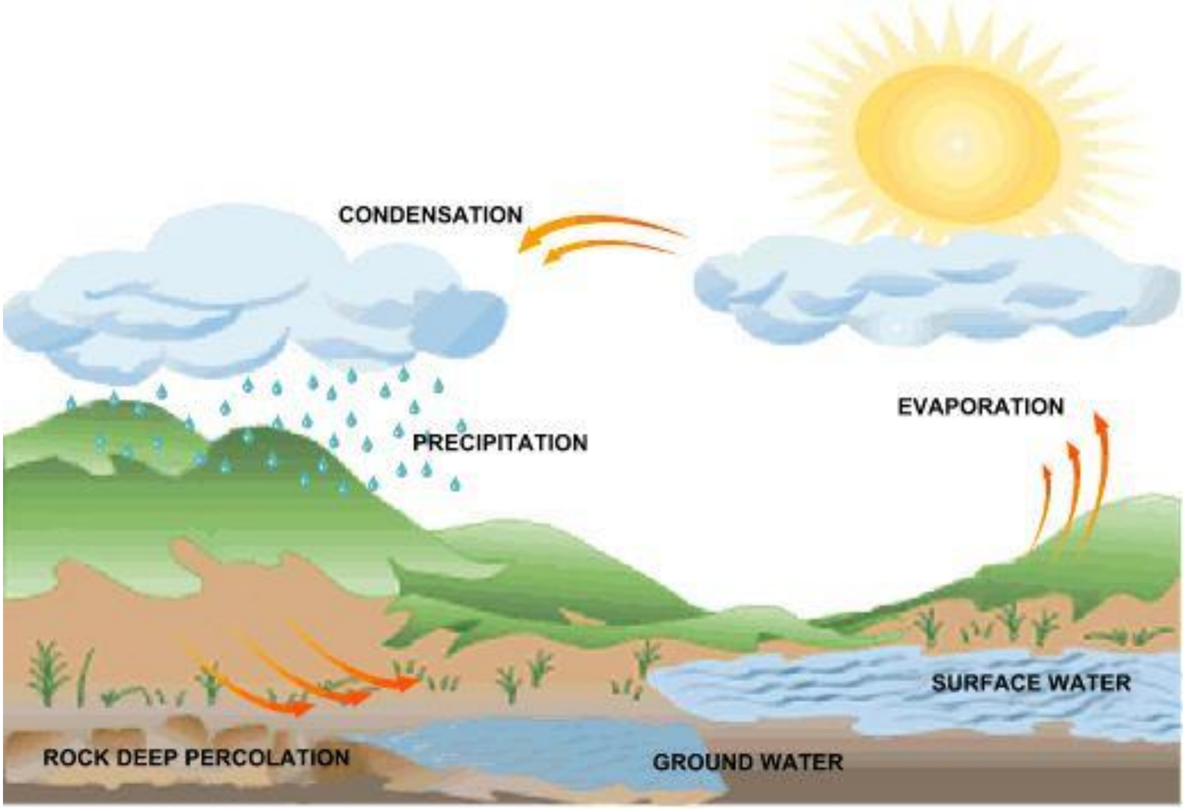
Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone - one of the many secondary pollutants that make up photochemical smog.



RAIN

When water bodies are heated during the day, a large amount of water evaporates and goes into the air. Some amount of water vapour also gets into the atmosphere because of various biological activities. This air also gets heated. The hot air rises up carrying the water vapour with it. As the air rises, it expands and cools. This cooling causes the water vapour in the air to condense in the form of tiny droplets. This condensation of water is facilitated if some particles could act as the 'nucleus' for these drops to form around. Once the water droplets are formed, they grow bigger by the 'condensation' of these water droplets. When the drops have grown big and heavy, they fall down in the form of rain.

Rainfall patterns are decided by the prevailing wind patterns. In large parts of India, rains are mostly brought by the southwest or north-east monsoons.



WATER: A WONDER LIQUID

Water occupies a very large area of the Earth's surface and is also found underground. Some amount of water exists in the form of water vapour in the atmosphere. Most of the water on Earth's surface is found in seas and ocean sand is saline. Fresh water is found frozen in the ice-caps at the two poles and on snow covered mountains. The underground water and the water in rivers, lakes and ponds is also fresh. However, the availability of fresh water varies from place to place. Practically every summer, most places have to face a shortage of water. And in rural areas, where water supply systems have not been installed, people are forced to spend considerable amounts of time in fetching water from faraway sources.

Importance of Water: All cellular processes take place in a water medium. All the reactions that take place within our body and within the cells occur between substances that are dissolved in water. Substances are also transported from one part of the body to the other in a dissolved form. Hence, organisms need to maintain the level of water within their bodies in order to stay alive. Terrestrial life-forms require fresh water for this because their bodies cannot tolerate or get rid of the high amounts of dissolved salts in saline water. Thus, water sources need to be easily accessible for animals and plants to survive on land.

WATER POLLUTION

Water pollution is the contamination of water bodies such as lakes, rivers, ocean and groundwater caused by human activities, which can be harmful to organisms and plants that live in these water bodies. Some of the causes of water pollution are shown in below figure:

We use the term water-pollution to cover the following effects:

1. The addition of undesirable substances to water-bodies. These substances could be the fertilizers and pesticides used in farming or they could be poisonous substances, like mercury salts which are used by paper-industries. These could also be disease-causing organisms, like the bacteria which cause cholera.

2. The removal of desirable substances from water-bodies. Dissolved oxygen is used by the animals and plants that live in water. Any change that reduces the amount of this dissolved oxygen would adversely affect these aquatic organisms. other nutrients could also be depleted from the water bodies.

3. A change in temperature. Aquatic organisms are used to a certain range of temperature in the water-body where they live, and a sudden marked change in this temperature would be dangerous for them or affect their breeding. The eggs and larvae of various animals are particularly susceptible to temperature changes.

SOIL

Soil is an important resource that decides the diversity of life in an area. The outermost layer of our Earth is called the crust and the minerals found in this layer supply a variety of nutrients to life-forms.

The factors or processes that make soil:

• **The 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 rock 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.

• **Water:** Water helps in the formation of soil in two ways. One, water could get into the cracks in the rocks formed due to uneven heating by the Sun. If this water later freezes, it would cause the cracks to widen. Two, flowing water wears away even hard rock over long periods of time. Fast flowing water often 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 and smaller particles. The water then takes these particles along with it and deposits it further down its path. Soil is thus found in places far away from its parent rock.

• **Wind:** In a process similar to the way in which water rubs against rocks and wears them down, strong winds also erode rocks down. The wind also carries sand from one place to the other like water does.

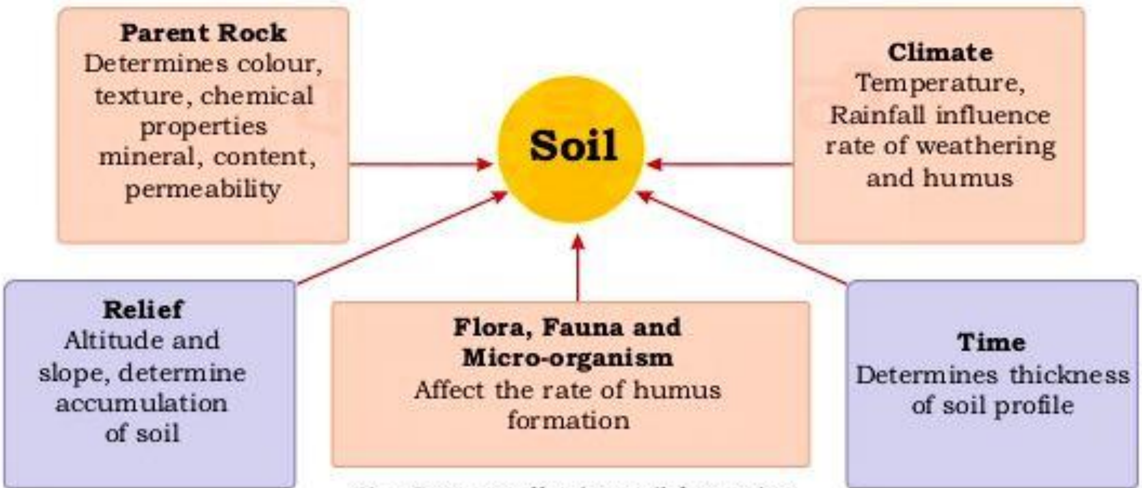


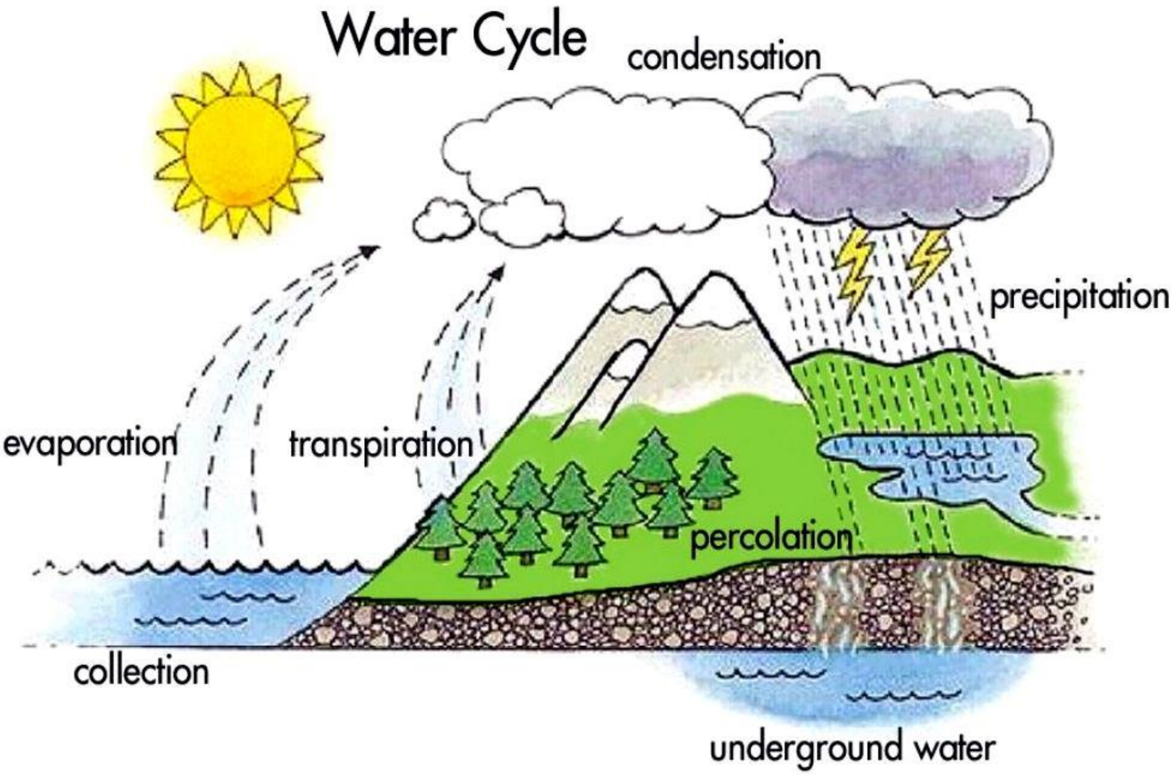
Fig. Factors affecting soil formation

BIOGEOCHEMICAL CYCLES

A constant interaction between the biotic and abiotic components of the biosphere makes it a dynamic, but stable system. These interactions consist of a transfer of matter and energy between the different components of the biosphere.

THE WATER-CYCLE

The water cycle, also known as the hydrologic cycle, describes the continuous movement of water on, above, and below the surface of the earth.

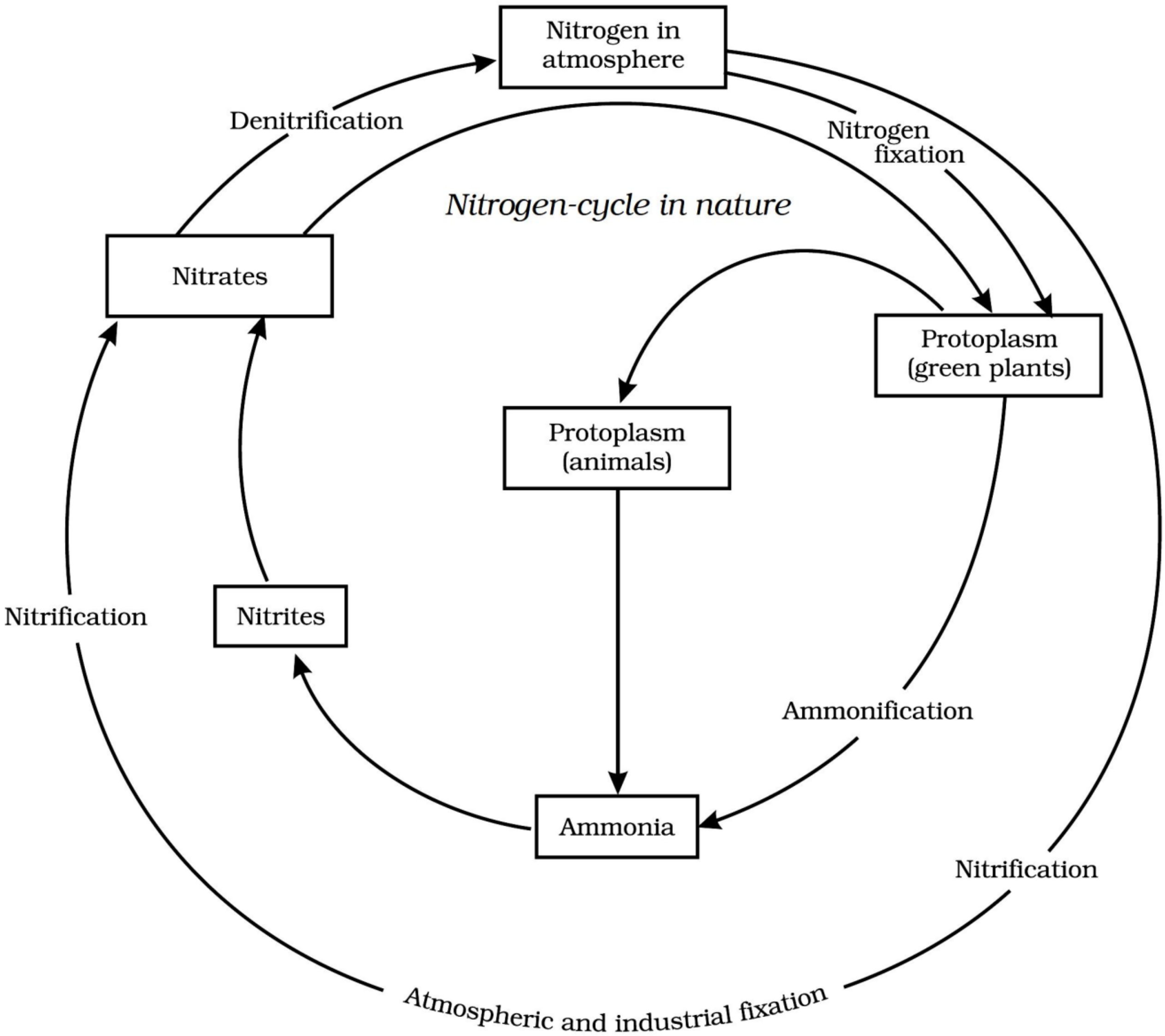


Water can change states among liquid, vapour and ice at various places in the water cycle. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go. The sun, which drives the water cycle, heats water in the oceans. Water evaporates as vapor into the air. Ice and snow can sublimate directly into water vapor. Rising air currents take the vapor up into the atmosphere where cooler temperatures cause it to condense into clouds. Air currents move clouds around the globe, cloud particles collide, grow, and fall out of the sky as precipitation. Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snow packs can thaw and melt, and the melted water flows overland as snowmelt. Most precipitation falls back into the oceans or onto land, where the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with stream flow moving water towards the oceans. Runoff and groundwater, are stored as freshwater in lakes.

Not all runoff flows into rivers. Much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers, which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as groundwater discharge. Some groundwater finds openings in the land surface and emerges as freshwater springs. Over time, the water reenters the ocean, where our water cycle started.

THE NITROGEN-CYCLE

The nitrogen cycle is the biogeochemical cycle that describes the transformations of nitrogen and nitrogen-containing compounds in nature. It is a cycle which includes gaseous components.



Earth's atmosphere is about 78% nitrogen, making it the largest pool of nitrogen. Nitrogen is essential for many biological processes; it is crucial for any life here on Earth. It is in all amino acids, is incorporated into proteins, and is present in the bases that make up nucleic acids, such as DNA and RNA. In plants, much of the nitrogen is used in chlorophyll molecules which are essential for photosynthesis and further growth.

Processing, or fixation, is necessary to convert gaseous nitrogen into forms usable by living organisms. Some fixation occurs in lightning strikes, but most fixation is done by free-living or symbiotic bacteria. These bacteria have the nitrogenase enzyme that combines gaseous nitrogen with hydrogen to produce ammonia, which is then further converted by the bacteria to make its own organic compounds. Some nitrogen fixing bacteria, such as Rhizobium, live in the root nodules of legumes (such as peas or beans). Here they form a mutualistic relationship with the plant, producing ammonia in exchange for carbohydrates. Nutrient-poor soils can be planted with legumes to enrich them with nitrogen. A few other plants can form such symbioses. Nowadays, a very considerable portion of nitrogen is fixated in ammonia chemical plants.

THE CARBON-CYCLE

The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.

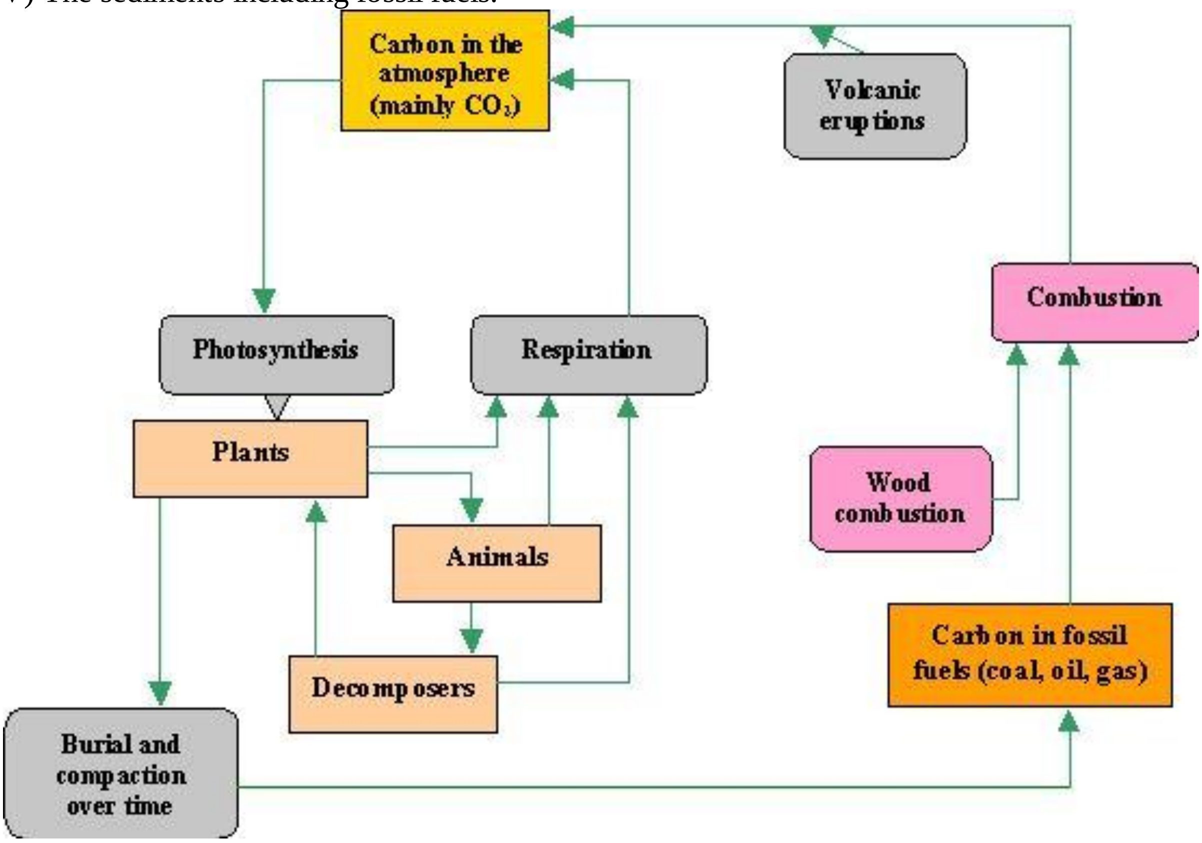
The cycle is usually thought of as four major reservoirs of carbon interconnected by pathways of exchange. These reservoirs are:

(I) The atmosphere.

(II) The terrestrial biosphere, which is usually defined to include fresh water systems and non-living organic material, such as soil carbon.

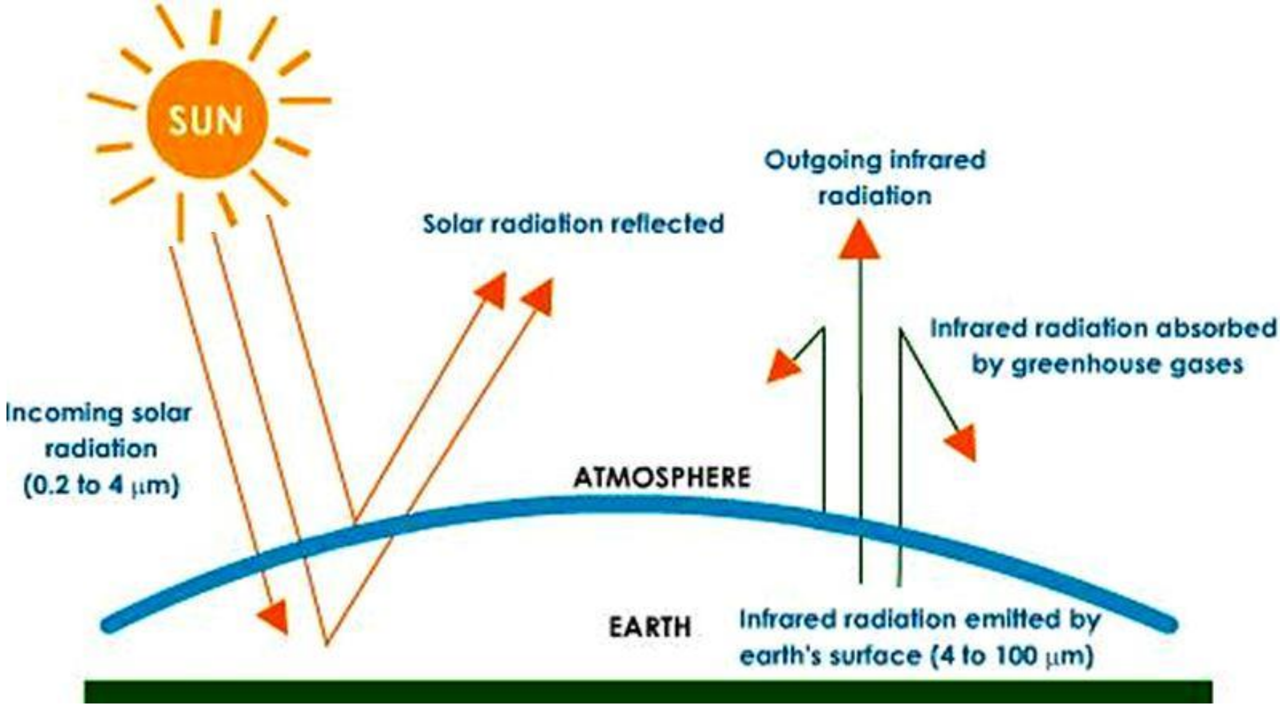
(III) The oceans, including dissolved inorganic carbon and living and non-living marine biota,

(IV) The sediments including fossil fuels.



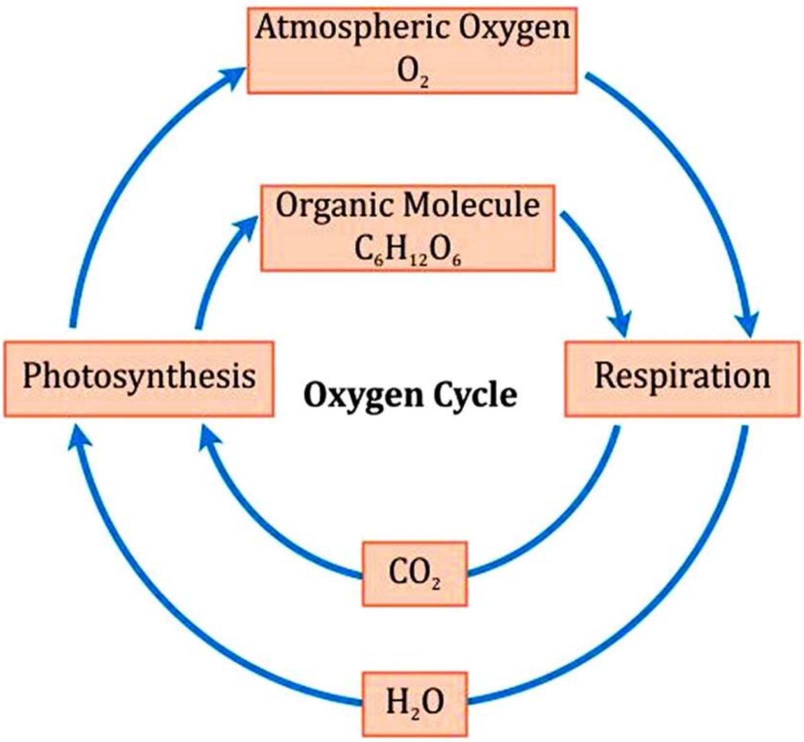
THE GREENHOUSE EFFECT

The greenhouse effect refers to the change in the steady state temperature of a planet or moon by the presence of an atmosphere containing gas that absorbs and emits infrared radiation.Greenhouse gases, which include water vapor, carbon dioxide and methane, warm the atmosphere by efficiently absorbing thermal infrared radiation emitted by the earth’s surface, by the atmosphere itself, and by clouds. As a result of its warmth, the atmosphere also radiates thermal infrared in all directions, including downward to the Earth’s surface. Thus, greenhouse gases trap heat within the surface-troposphere system. The greenhouse effect is one of several factors that affect the temperature of the Earth.



THE OXYGEN-CYCLE

The oxygen cycle is the biogeochemical cycle that describes the movement of oxygen within and between its three main reservoirs: the atmosphere (air), the biosphere (living things), and the lithosphere (earth’s crust). The main driving factor of the oxygen cycle is photosynthesis, which is responsible for the modern Earth's atmosphere and life.



Energy Cycle

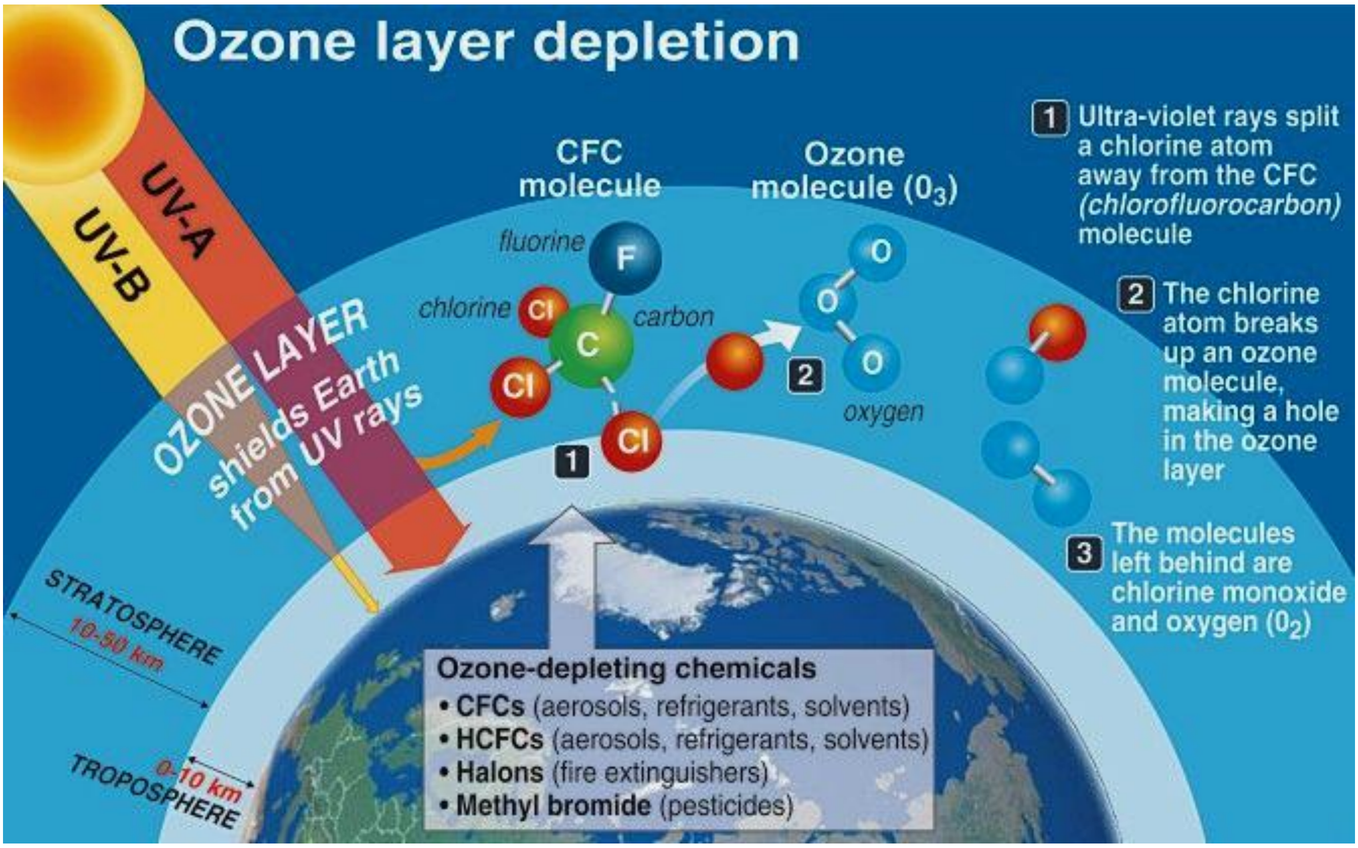
All the above mentioned cycle can be grouped or explained as energy cycle on this earth. In fact sun is the main source of energy for every activity on earth. This energy facilitates the everlasting cycle of all resources in the biosphere. This system ensures that whatever we take from earth and its atmosphere we return it in some way or other. A living organism is made of Carbon, Oxygen, Nitrogen and other elements. All living organisms need regular dose of these elements to continue life. During lifetime all these things are returned to the atmosphere in some way. For example we return oxygen in the form of carbon dioxide and return water in the form of sweat or urine.

Ultimately when a living being dies, then the body gets decomposed by decomposers, like bacteria. These decompose the body into basic elements out of which it was originally made. That is how the everlasting cycle of life goes on.

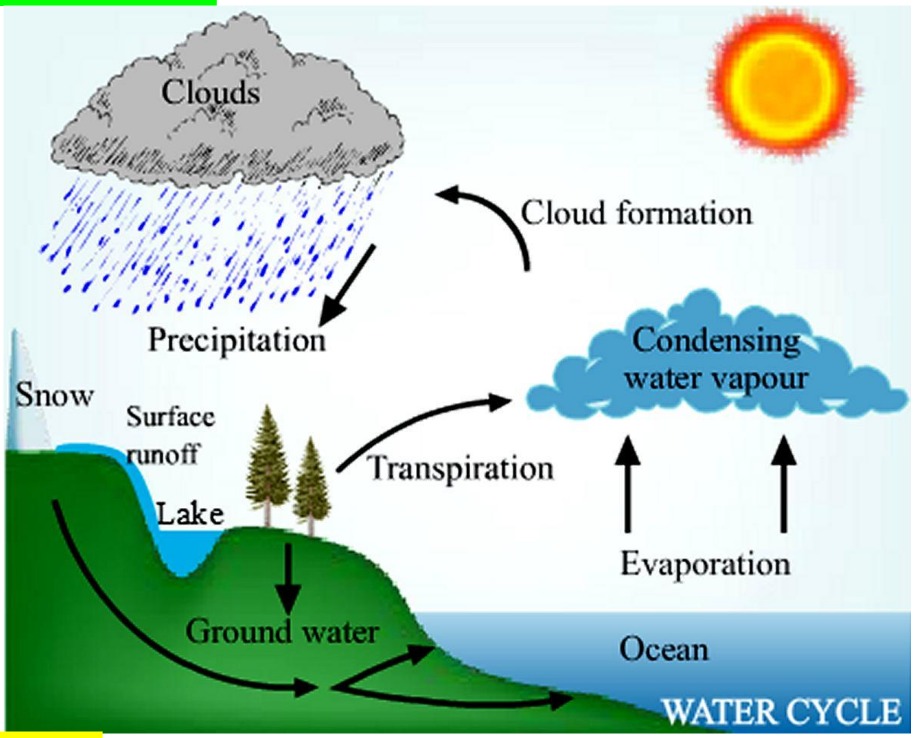
OZONE LAYER

The ozone layer is a layer in earth’s atmosphere which contains relatively high concentrations of ozone. This layer absorbs 93-99% of the sun’s high frequency ultraviolet light, which is potentially damaging to life on earth. Over 91% of the ozone in Earth's atmosphere is present here. It is mainly located in the lower portion of the stratosphere from approximately 10 km to 50 km above Earth's surface, though the thickness varies seasonally and geographically.

Because of heavy use of CFCs (Chlorofuorocarbons) in refrigerators and pressurized cans by human the ozone layer has broken at some places. This has caused an alarming rise in ultraviolet radiation leading to increased cases of skin cancers.

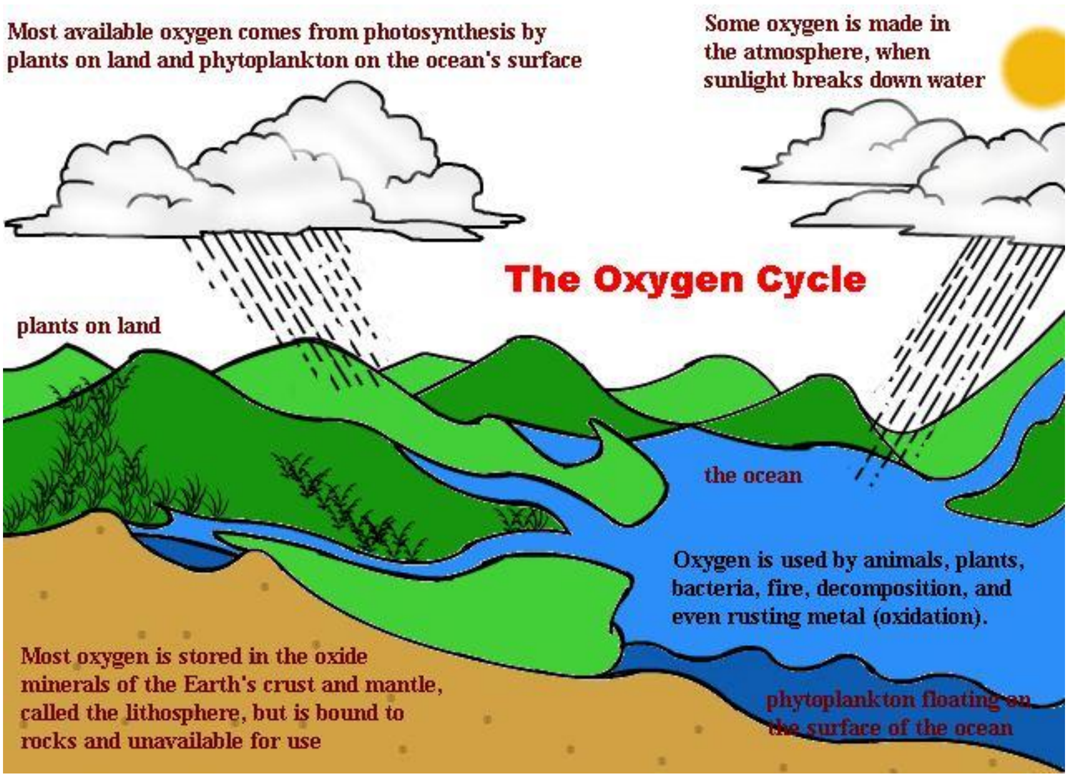


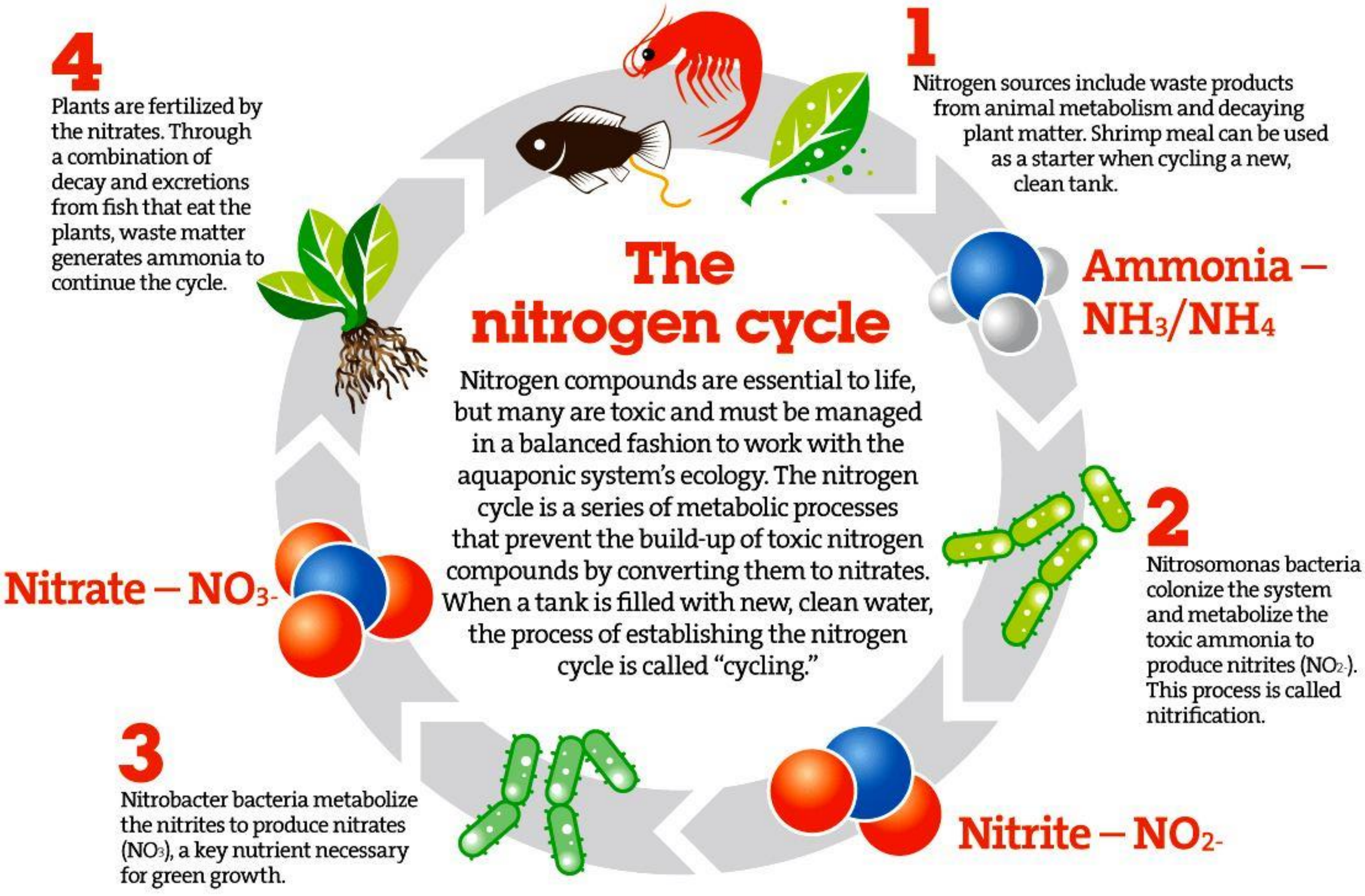
POINTS TO REMEMBER

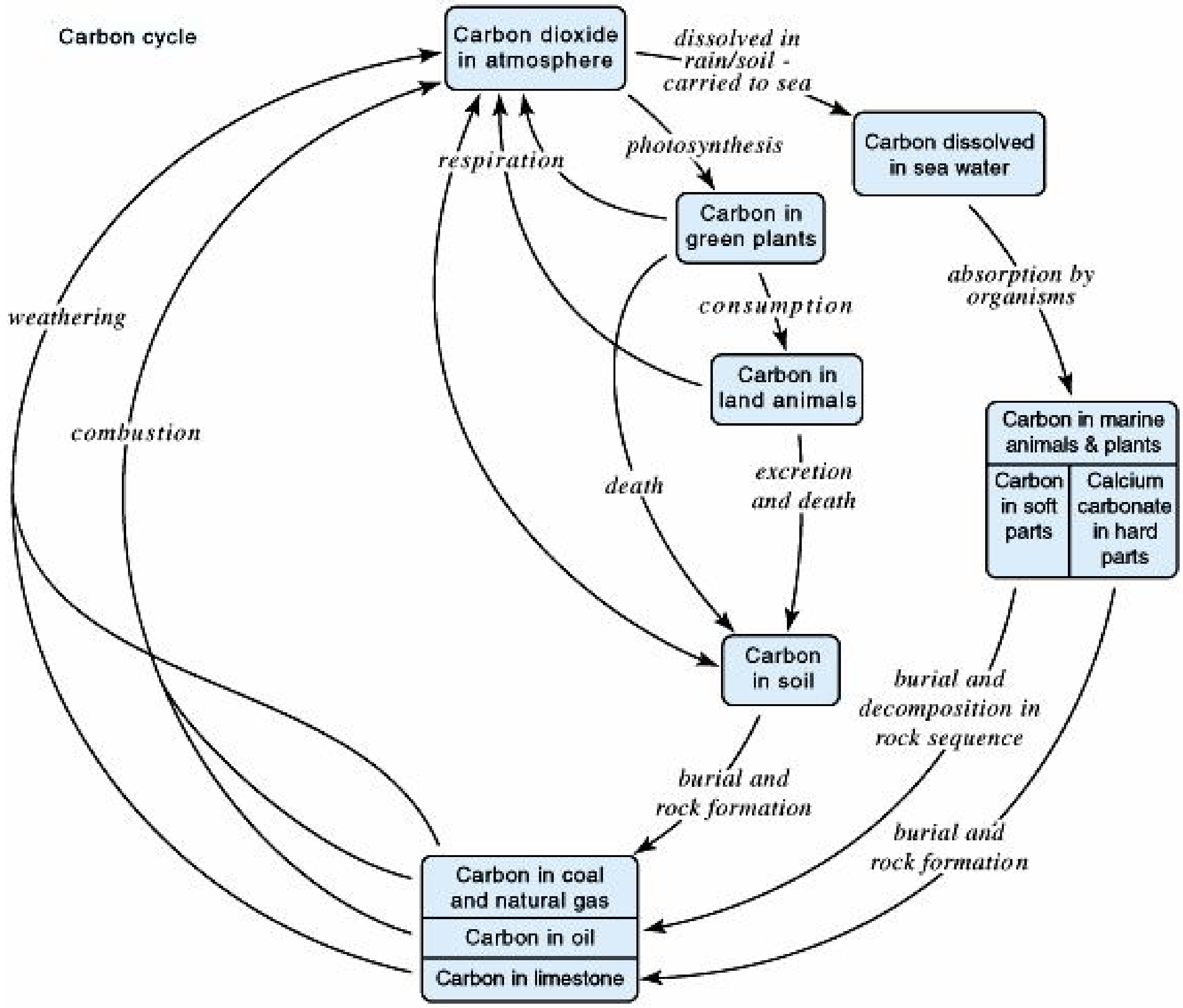


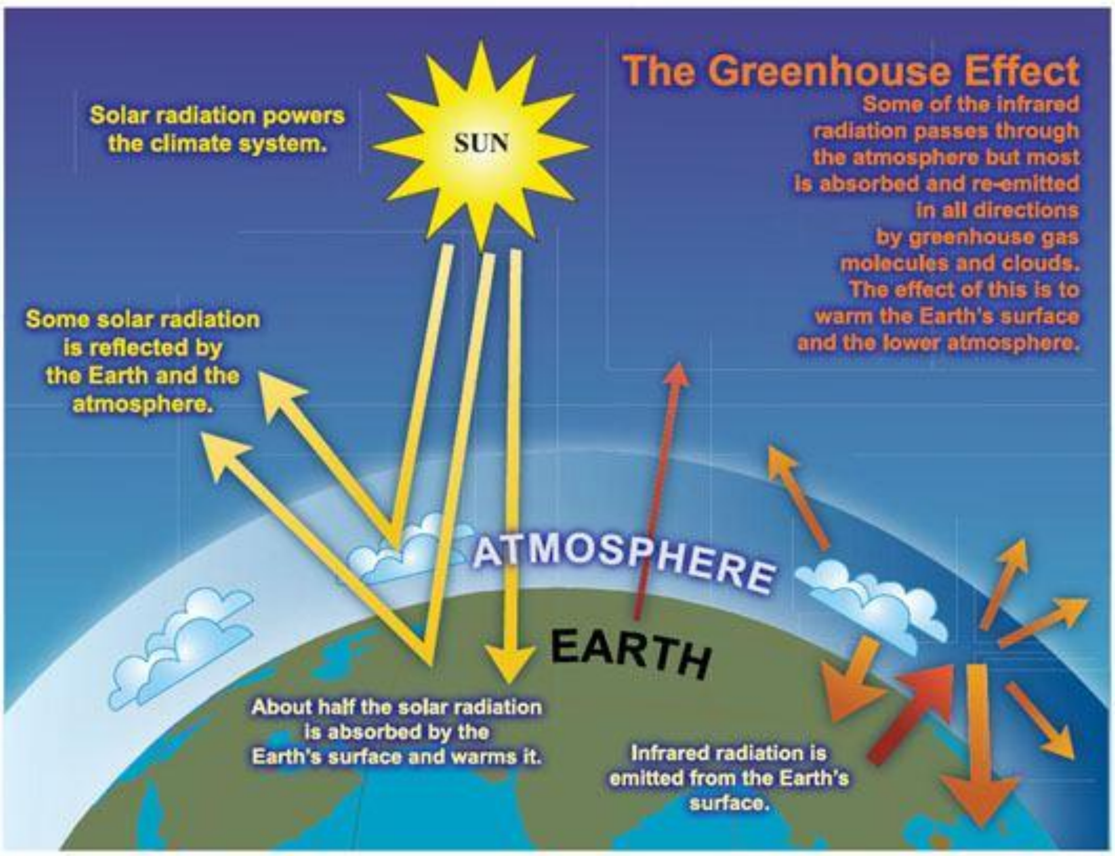
OXYGEN CYCLE

- The oxygen in the atmosphere is freed by the process of photolysis. The energy in the sunlight breaks the oxygen bearing oxygen to produce free oxygen. Oxygen molecule is broken down by UV rays from the sun. This cycle shields earth from harmful UV rays.
- In the biosphere, oxygen undergoes cycles of respiration and photosynthesis. Humans and animals breathe in oxygen. This oxygen is used in metabolic processes and carbon dioxide given out. Plants and phytoplanktons undergo process of photosynthesis where carbon dioxide is used in the prescence of sunlight to form carbohydrates and oxygen.
- In the lithosphere, oxygen is fixed in minerals like silicates and oxides. Oxygen from these minerals is freed by chemical weathering. When the mineral bearing oxygen is exposed to chemical reaction, the mineral wears down free oxygen is produced.


Most available oxygen comes from photosynthesis by plants on land and phytoplankton on the ocean's surface
Some oxygen is made in the atmosphere, when sunlight breaks down water
The Oxygen Cycle
plants on land
the ocean
Oxygen is used by animals, plants, bacteria, fire, decomposition, and even rusting metal (oxidation).
Most oxygen is stored in the oxide minerals of the Earth's crust and mantle, called the lithosphere, but is bound to rocks and unavailable for use
phytoplankton floating on the surface of the ocean


The nitrogen cycle
Nitrogen compounds are essential to life, but many are toxic and must be managed in a balanced fashion to work with the aquaponic system's ecology. The nitrogen cycle is a series of metabolic processes that prevent the build-up of toxic nitrogen compounds by converting them to nitrates. When a tank is filled with new, clean water, the process of establishing the nitrogen cycle is called "cycling."
1
Nitrogen sources include waste products from animal metabolism and decaying plant matter. Shrimp meal can be used as a starter when cycling a new, clean tank.
Ammonia – NH_3/NH_4
2
Nitrosomonas bacteria colonize the system and metabolize the toxic ammonia to produce nitrites (NO_{2-}). This process is called nitrification.
Nitrite – NO_{2-}
3
Nitrobacter bacteria metabolize the nitrites to produce nitrates (NO_3), a key nutrient necessary for green growth.
Nitrate – NO_{3-}
4
Plants are fertilized by the nitrates. Through a combination of decay and excretions from fish that eat the plants, waste matter generates ammonia to continue the cycle.


Carbon cycle
Carbon dioxide in atmosphere
dissolved in rain/soil - carried to sea
Carbon dissolved in sea water
photosynthesis
respiration
Carbon in green plants
consumption
Carbon in land animals
absorption by organisms
Carbon in marine animals & plants
Carbon in soft parts
Calcium carbonate in hard parts
weathering
combustion
death
excretion and death
Carbon in soil
burial and decomposition in rock sequence
burial and rock formation
burial and rock formation
Carbon in coal and natural gas
Carbon in oil
Carbon in limestone


The Greenhouse Effect
Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation powers the climate system.
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
ATMOSPHERE
EARTH
About half the solar radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

INTEXT QUESTIONS PAGE NO. 193

Q1. How is our atmosphere different from the atmosphere on Venus and Mars?
Answer: The atmosphere of Earth contains a mixture of many gases like nitrogen (78.08%), oxygen (20.95%), carbon dioxide (0.03%) and water vapour (in varying proportion). On the other hand, the atmosphere on Venus and Mars mainly contains carbon dioxide, *i.e.*, about 95-97%. It may be the reason that due to this, no life is known to exist in both Venus and Mars.

Q2. How does the atmosphere act as a blanket?
Answer: The atmosphere mainly contains air which is a bad conductor of heat. Due to this, the atmosphere keeps the average temperature of the Earth fairly balanced during the day and even throughout the year. The atmosphere prevents the sudden increase in temperature during the daylight hours and during the night, it slows down the escape of heat into the outer space. In this way, atmosphere acts as a blanket.

Q3. What causes winds?
Answer: Winds occur due to unequal heating of atmospheric air. The heat causes rising up of air along with water vapour. As the air rises, it expands and cools. This cooling causes the water vapour in the air to condense. The condensation of water occurs if some particles (like dust particles) act as the 'nucleus' for these drops to stick around. These tiny droplets grow bigger by more and more condensation of other water droplets and finally form the clouds.

Q4. How are clouds formed?
Answer: Water evaporates from water bodies and goes into the atmosphere. Air also becomes hot due to sunlight and starts rising up taking along with water vapour. As the air rises up, it expands and cools. This cooling of air causes water vapour in the air to condense. The process of condensation of water occurs, if some particles (like dust) act as the 'nucleus' for these drops to form around. None these small droplets grow and become big by more and more condensation of other droplets of water. These steps form the clouds.

Q5. List any three human activities that you think would lead to air pollution.
Answer: The following activities lead to air pollution:
(i) Excessive burning of fossil fuels, *i.e.*, coal and petroleum produces high amount of oxides of nitrogen and sulphur. These oxides mix with air and cause acid rain leading to many harmful effects.
(ii) Many industries release high amount of poisonous gases into the atmosphere causing air pollution.
(iii) Forest fires, excessive use of chlorofluorocarbons (CFCs) used in refrigerators, excessive mining and ore refining release harmful gases into the air leading to pollution.

INTEXT QUESTIONS PAGE NO. 194

Q1. Why do organisms need water?
Answer: Organisms need water because:
(i) Cellular processes need water for their functioning.
(ii) Substances dissolve in water for reactions to take place within the cells.
(iii) Transportation of substances within the body need water.
(iv) Water helps in digestion of food and its absorption in the blood.
(v) It helps to maintain body temperature.

Q2. What is the major source of freshwater in the city/town/village where you live?
Answer: In city/town/village, the major source of water is underground water. It is drawn with

the help of hand pumps and tube-wells. The other nearby sources are rivers, lakes and ponds.

Q3. Do you know of any activity which may be polluting this water source?
Answer: The activities which may be polluting the water bodies are:
(i) Disposal of garbage or sewage from cities/towns and from factories.
(ii) Hot water may be released from the industries which may disturb the temperature of water body leading to death of many aquatic organisms.

INTEXT QUESTIONS PAGE NO. 196

Q1. How is soil formed?
Answer: The formation of soil takes place in the following ways:
(i) Rocks near the surface of Earth are broken down by various physical, chemical and some biological processes. This process takes millions of years.
(ii) This weathering leads to the formation of fine particles called soil.
(iii) Some other factors also lead to the formation of soil. These are:
  (a) Sun causes heating of rocks that causes cracking and breaks down them into small particles.
  (b) Water dissolve rocks by freezing and fast flowing.
  (c) Wind causes erosion of rocks by fast blowing.
  (d) Liches and mosses grow on rock surfaces and break them into powder down and form a thin layer of soil. The big trees sometimes enter into cracks in the rocks and force them to break further during their growth.

Q2. What is soil erosion?
Answer: Soil erosion is the process of removal of top soil. It is rich in humus and nutrients. The agents of soil erosion are mainly flowing water or wind. If soil erosion is continued for a long time, the land becomes infertile and barren due to the loss of its valuable nutrients.

Q3. What are the methods of preventing or reducing soil erosion?
Answer: Preventive methods of soil erosion
(i) **Afforestation** Planting more trees reduces soil erosion.
(ii) **Contour Ploughing** Ploughing land in furrows across the natural slope of the land helps trap water and prevent the washing away of top soil along with it.
(iii) **Step (terrace) Farming** Farmers form a series of steps by making horizontal strips supported by walls to catch the descending water. It gives the water sufficients time to percolate into the soil and nourish the crop.
(iv) **Soil Cover** After harvesting a crop, soil is covered with dried vegetation to prevent its erosion.
(v) **Overgrazing** Grasses tend to bind soil particles to prevent their erosion. If overgrazing is allowed, the grasses are uprooted and soil gets eroded.

INTEXT QUESTIONS PAGE NO. 201

Q1. What are the different states in which water is found during the water cycle?
Answer: Water can be seen in water cycle in its all three different states.
These are:
(i) **Gaseous State** It occurs in the form of water vapour. It evaporates from the surface of water bodies and mixes with air.
(ii) **Liquid State** Water vapour condense high up in the atmosphere. It falls on the Earth in the form of rain.
(iii) **Solid State** It is formed by the freezing of liquid droplets in the upper layer of atmosphere.

These droplets fall on the Earth in the form of snow, hail or sleet.

Q2. Name two biologically important compounds that contain both oxygen and nitrogen.
Answer: The biologically important compounds that contain both oxygen and nitrogen are nitrates (NO_2^-) and nitrates (NO_3^-) . These are important forms of nitrogen to be utilized by the plants to synthesize biomolecules like proteins.

Q3. List any three human activities which would lead to an increase in the carbon dioxide content of air.
Answer: The human activities which would lead to an increase in CO_2 content of air are:
(i) **Respiration** is the natural way to release of CO_2 by both plants and animals. It is balanced by the release of oxygen by plants. So, it is not harmful for the environment.
(ii) **Deforestation** increases the level of CO_2 in the environment. Trees carry out photosynthesis and convert CO_2 into organic compounds such as glucose, starch, etc. In their absence, CO_2 cannot be utilized.
(iii) **Combustion of fuels** leads to increase in CO level in the atmosphere. Fuels are burnt to carryout activities like cooking, transportation and in industrial processes.

Q4. What is the greenhouse effect?
Answer: Some gases called greenhouse gases, *e.g.*, CO_2 prevent the escape of heat from the Earth. When the amount of such gases increases more than their normal levels, the average temperature of the Earth increases. This is called greenhouse effect.

Q5. What are the two forms of oxygen found in the atmosphere?
Answer: The two forms of oxygen found in the atmosphere are:
(i) Elemental oxygen is normally found in the form of diatomic molecule (O_2) in the lower part of atmosphere. It is about 21% in the air and non-poisonous.
(ii) Ozone is found in the stratosphere part of atmosphere. It contains three atoms of oxygen(O_3). It is the poisonous form of oxygen.
(iii) Some other forms of oxygen are also found in the combined state. In Earth's crust, it is found as the oxides of most metals and silicon and also as carbonate, sulphate, nitrate and other minerals. In other forms, it is the part of biological molecules like carbohydrates, proteins, fats and nucleic acids, etc.

EXERCISE QUESTIONS PAGE NO. 201, 202

Q1. Why is the atmosphere essential for life?
Answer: Atmosphere is important for life due to following reasons:
(i) It keeps the average temperature of the Earth steady during the day and even throughout the year.
(ii) It prevents the sudden increases in temperature during the daylight hours.
(iii) The gases it contains are required for sustaining life on Earth. These gases are:
(a) Oxygen which is required for respiration by all living organisms.
(b) Carbon dioxide is used in photosynthesis by plants to synthesize food.
(c) Nitrogen provides intert atmosphere and an important components of proteins.
(iv) A thick layer of ozone (in stratosphere) of atmosphere, filters the harmful UV radiations reaching the Earth. The UV rays produce harmful effects on all living organisms.

Q2. Why is water essential for life?
Answer: Water is essential for life because of these reasons:
(i) It provides medium to carryout all the cellular processes.
(ii) All the reactions that occur in our body and within cells occur between substances that are dissolved in water
(iii) It is required for the transportation of materials from one part of the body to the other.
(iv) It helps to maintain body temperature.

(v) Water makes up about 70% of body weight of all the living organisms.

Q3. How are living organisms dependent on soil? Are organisms that live in water totally independent of soil as a resource?

Answer: Living organisms depend on soil in the following ways:

(i) It provides natural habitat for various living organisms, *e.g.*, bacteria, fungi, algae, earthworms, etc. These help to maintain the fertility of soil.

(ii) Earthwrom performs all its activities in the soil. It maintains the fertility of soil by releasing nitrogen rich excreta.

(iii) Many animals like rats, rabbits, etc., make their home in the soil.

(iv) Soil helps to bind the roots of plants to provide them anchorage. The nutrients in soil are absorbed by the plants for their growth and development.

All organisms that live in water are totally dependent on soil because the mineral nutrients are present in water in the dissolved form. But, their recycling depends on the decomposers which are present in soil beds. For this, all water bodies have soil beds which contain decomposers for the recycling of nutrients.

Q4. You have seen weather reports on television and in newspapers. How, do you think we are able to predict the weather?

Answer: Meterologists collect information regarding the pattern of temperature, speed of wind, air pressure and all other features which influence weather. All these information are collected by remote sensing and weather forecast satellites. This information is then compiled in meterological departments which prepare a weather report that is displayed on the maps. This information is further transmitted through radio, television and newspaper.

Q5. We know that many human activities lead to increasing levels of pollution of the air, water-bodies and soil. Do you think that isolating these activities to specific and limited areas would help in reducing pollution?

Answer: Isolating human activities to specific and limited areas would definitely help in reducing pollution to some extent. For example,

(i) If sewage and garbage generated by homes and industries is treated properly before discharging into water sources, it will reduce water pollution and cause less harm to the aquatic life.

(ii) If hot water generated by the industries is collected at common place, allowed to cool and then discharged in water bodies, will not affect the breeding capacity of aquatic organisms.

(iii) If commercial areas, factories and industries are shifted to the isolated are a far away from residential areas, it can reduce the effect of air pollution on people.

Q6. Write a note on how forests influence the quality of our air, soil and water resources.

Answer: Forests influence the quality of air, soil and water resources in following ways:

(i) Influence of forests on air occurs in these ways:

(a) Forests help to maintain oxygen and carbon dioxide balance in the air. They reduce the level of CO_2 in the air and to prevent greenhouse effect.

(b) These maintain temperature of the environment.

(c) Forests increase the rate of photosynthesis in surrounding region.

(ii) Influence of forests in quality of soil:

(a) Trees spread their roots deep inside the Earth and bind the soil particles firmly. This reduces soil erosion.

(b) Forests help to maintain nutrient cycles (biogeochemical cycles) in the atmosphere.

(iii) Influence of forests in quality of water:

(a) Trees help to maintain water cycle.

(b) Forests conserve water and make them available on the surface of Earth as water sources.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 14
NATURAL RESOURCES

1. Hot air is ____________ than cold air.

2. Green plants convert carbon dioxide into glucose in the presence of _______________.

3. The life-supporting zone of the Earth where the atmosphere, the hydrosphere and the lithosphere interact and make life possible, is known as the _____________.

4. The space among the soil particles are filled with ________.

5. Dead remains of plants and animals is called ___________.

6. Water covers _____% of the Earth's surface.

7. On planets like Venus and Mars the major component of the atmosphere is ____________.

8. The fossil fuels like coal and petroleum contain small amounts of ___________ and ___________ which are primarily responsible for acid rain.

9. The substances that cause pollution are called ____________.

10. __________ is the region of atmosphere where ozone layer is present.

11. _________ is formed due to condensation of water vapours in the lower region of atmosphere.

12. ___________ is a major factor in deciding the soil structure because it causes the soil to become more porous and allows water and air to penetrate deep underground.

13. Ozone hole was first detected over _____________.

14. The eggs and larvae of various aquatic animals are particularly susceptible to ______________ changes.

15. Corbett National Park is famous for?

(a) Neel Gai

(b) Snakes

(c) Rhinoceros

(d) Tigers

16. Green plants of an ecosystem are called.

(a) Producers

(b) Decomposers

(c) Consumers

(d) None of these

17. Energy flow in the ecosystem is

(a) unidirectional

(b) bidirectional

(c) multidirectional

(d) none of these

18. Two important groups of detritivores are

(a) Animals and Plants

(b) Prokaryotes and Algae

(c) Prokaryotes and Fungi

(d) Plantae and Prokaryotes

19. Which of the following is a nonrenewable energy source?

(a) natural gas

(b) solar energy

(c) wind energy

(d) tidal energy

20. Which of the following organisms is incorrectly paired with its trophic level?

(a) cyanobacteria - primary producer

(b) honey bee - primary consumer

(c) zooplankton - primary producer

(d) eagle - tertiary consumer

21. Where do terracing help the most in soil conservation?

(a) Hill regions

(b) Wet areas

(c) Deserts

(d) Plains

22. Which trophic level is considered to be the most vulnerable to extinction?

(a) producer level

(b) primary consumer level

(c) secondary consumer level

(d) tertiary consumer level

23. In which sphere of the environment Ozone layer is located?

(a) Troposphere (b) Stratosphere

(c) Mesosphere (d) Thermosphere

24. Solar radiations heat up:

(a) Land faster than the water bodies

(b) Land slower than the water bodies

(c) Equally both land and water bodies

(d) Neither land nor water bodies

25. What is lithosphere?

26. What is hydrosphere?

27. What is atmosphere?

28. List the four zones of the atmosphere.

29. What is biosphere?

30. How is our atmosphere different from the atmosphere on Venus and Mars?

31. How does the atmosphere act as a blanket?

32. What causes winds?

33. How are clouds formed?

34. Which gets heated faster land or water?

35. Define air-pollution? (Short Answer Q)

36. List any three human activities that you think would lead to air pollution.

37. Name two diseases caused due to an increased content of pollutants in the air produced due to the burning of fossil fuels.

38. What is smog?

39. How do fossil fuel cause air pollution?

40. Meenakshi saw reduction in greenish layer of lichens at the bark of trees at the biology garden of the school. The garden was few metres away from diesel generator placed for electricity backup. She immediately informed the school authorities to check the pollution level of diesel and kerosene used in the generator. (a) How reduction in Lichens layer is related to pollution?(b) What measures should be taken by school authorities to check the reduction?(c) What qualities are shown by Meenakshi by informing school about the Lichens?

41. Give an example of fungi which are known as 'indicator of air pollution'.

42. Why do organisms need water?

43. Water is known as ‘A Wonder Liquid’. Justify this statement by giving any two reasons.

44. What are the effects of acid rain?

45. What are biogeochemical cycles? Names two examples.

46. In which regions is soil erosion very difficult to revert?

47. What is meant by depletion of ozone layer? Mention one important feature of ozone in atmosphere. Identify the factors responsible for the formation of ozone hole

48. Why is water essential for life?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 14
NATURAL RESOURCES

1. The atmosphere of the earth is heated by radiations which are mainly

(a) Radiated by the sun

(b) Re-radiated by land

(c) Re-radiated by water

(d) Re-radiated by land and water

2. If there were no atmosphere around the earth, the temperature of the earth will

(a) Increase

(b) Go on decreasing

(c) increase during day and decrease during night

(d) Be unaffected

3. What would happen, if all the oxygen present in the environment is converted to ozone?

(a) We will be protected more

(b) It will become poisonous and kill living forms

(c) Ozone is not stable, hence it will be toxic

(d) It will help harmful sun radiations to reach earth and damage many life forms.

4. One of the following factors does not lead to soil formation in nature

(a) The sun

(b) Water

(c) Wind

(d) Polythene bags

5. The two forms of oxygen found in the atmosphere are

(a) Water and ozone

(b) Water and oxygen

(c) Ozone and oxygen

(d) Water and carbon-dioxide

6. Name the process in which water vapour changes to a liquid.

7. Which gas is the chief component of Earth's atmosphere?

8. Name the substance that reduces the amount of dissolved oxygen in water.

9. Which gas is formed in the layers of Earth due to bacterial decomposition in the absence of oxygen?

10. Name the rays essential for formation of ozone in atmosphere.

11. Name the elements present in fossil fuels, which cause air pollution.

12. In a coastal region, what would be the direction of wind during the day?

13. When clouds cool down, water droplets fall to the land as rain, hail or snow. Name the phenomenon.

14. Name the organisms found to be very sensitive to the levels of contaminants like sulphur dioxide in the air.

15. What do you mean by humus?

16. Give two examples of exhaustible natural resources.

17. Name two atmospheric gases responsible for causing acid rain.

18. How would you define the term atmosphere?

19. What do you understand by the term ‘Natural resources’?

20. What is strip-cropping?

21. What portion of our country’s geographical area is covered by forest?

22. Name any two examples of inexhaustible natural resources.

23. How much air is required by a normal human being in one day?

24. What is conversion of ammonia into nitrates called?

25. State the role of the atmosphere in climate control?

26. How following factors contribute in formation of soil ? (a) wind (b) water (c) Sun

27. Acid rain and smog are said to be the consequences of air pollution. How are they caused? What are the ill effects of breathing polluted air on human health?

28. What is Smog?

29. What is green house effect? List two green house gases. State the ultimate effect of increase in green house gases in the environment.

30. What makes the biosphere dynamic but stable system ?

31. The atmosphere acts as a blanket. How ?

32. What is soil? How is it formed? State the major factor that decides the structure of a soil. What role does it play ?

33. Write the importance of ozone in the atmosphere.

34. (a) List two activities of man which lead to environmental pollution. (b) List any two uses of carbon in living organisms.

35. List two forms of oxygen found in the atmosphere. Name the process(s) by which (i) oxygen from the atmosphere is used up. (ii) oxygen is returned to the atmosphere

36. State various steps and processes involved in the nitrogen cycle in nature. Also show cycling of various nutrients in this cycle.

37. Write a note on how forests influence the quality of air, soil and water resources.

38. How is atmosphere on our Earth different from the atmosphere on Venus and Mars ? State two ways by which percentage of carbon dioxide is fixed on the earth.

39. "Urbanization and industrialisation is mainly responsible for the increase in environment pollution" Justify this statement and suggest ways and means to check it.

40. Why is the atmosphere essential for life?

41. Why is water essential for life?

42. How are living organisms dependent on the soil? Are organisms that live in water totally independent of soil as a resource?

43. You have seen weather reports on television and in news paper. How do you think we are able to predict the weather?

44. We know that many human activities lead to increasing levels of pollution of air, water bodies and soil. Do you think that isolating these activities to specific and limited areas would help in reducing pollution?

45. Write a note on how forests influence the air, soil and water resources.

46. What is 'Water Cycle' ? Explain the process of water cycle.

47. Write a short note on 'Nitrogen Fixation'

48. Explain the 'Nitrogen Cycle

49. Discuss the consequences of the increase in the concentration of Carbon Dioxide and other Green House gases in the atmosphere

50. What are the causes of Soil Erosion?

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 14
NATURAL RESOURCES

1. What is soil erosion ? List two activities which cause soil erosion.

2. What is green house effect ? How is it caused ?

3. Many municipal Corporations are trying water harvesting to improve the availability of water. Give reason.

4. Rain water sometimes contains traces of acid. Why ? Explain in brief.

5. Define the term 'Smog'. Name two types of diseases caused by regularly breathing the polluted air.

6. Give reasons of the following : (i) We are lucky that ozone is not stable near the earth's surface. (ii) The combustion of fossil fuels increases the amount of suspended particles in air.

7. Why is water so necessary for all living organisms ? Mention any two points in support of your answer.'Water is known as AWonder Liquid'. Justify this statement by giving any two reasons.

8. What is atmospheric fixation of Nitrogen ?

9. What is soil erosion ? State any one way by which it can be prevented.

10. What is humus ? What is the role of earth worms in increasing the quantity of humus ?

11. List two ways by which carbon dioxide is 'fixed' in the environment.

12. Name two diseases caused due to an increased content of pollutants in the air produced due to the burning of fossil fuels. [2011 (T-II)]

13. The heaps of solid waste are a menace. Give two reasons.

14. How addition of undesirable substances and change in temperature affect the water life.

15. State any two harmful effects each of : (a) Air pollution and (b) Water pollution

16. What is the role of atmosphere in climate control ?

17. What percentage of nitrogen and oxygen is present in air ?

18. Mention any two human activities which are responsible for water pollution.

19. Mention the role of ozone layer in the atmosphere.

20. Give reason Lichens do not grow in Delhi whereas they commonly grow in Manali or Darjeeling.

21. What causes acid rain? Mantion any damage caused by it on living organisms.

22. What is Green House Effect ? Name compounds causing depletion of Ozone layer ?

23. How do Sun and wind influence the formation of soil ?

24. List any two consequences of global warming.

25. Mention any four measures that should be taken to maintain the soil fertility.

26. Give the chemical formula of ozone. What is its role in atmosphere ?

27. How the presence of pollutants present in the air does affect our health ?

28. Name two air pollutants which when dissolve with water gives rise to acid rain.

29. Name two measures that can be taken to reduce water pollution.

30. Suggest two methods to control air pollution.

31. Differentiate between biodegradable and nonbiodegradable pollutants.

32. Name the process that returns oxygen to the atmosphere.

33. Write the condition responsible for poor visibility in cold weather.

34. Which symbiotic life forms can grow on stones and help in the formation of soil ? Write the mode of their action for making soil from rocks.

35. Why does moon have very cold and very hot temperature variations i.e. from –190°C to 110°C even though it is at the same distance from the sun as earth ?

36. Why does Mathura refinery pose problem to the Taj Mahal ?

37. Explain the role of atmosphere as a blanket. List the factors deciding the rainfall patterns.

38. State the effect of the following on aquatic organisms– (a) Removal of dissolved oxygen (b) Change in temperature

39. How do forest play an important role in maintaining water cycle.

40. Name the two gases given out by burning of fossil fuels which dissolve in rain water to form acid rain.

41. Why is atmosphere essential for life? Write two points in support of your answer.

42. List any four activities that you think would lead to air pollution.

43. How are clouds formed ?

44. Why do terrestrial forms require fresh water ?

45. Mention any two processes involved in water cycle.

46. How do fossil fuel cause air-pollution ?

47. What is top soil ? Mention any two factors that decide which plants will thrive on that soil.

48. How do the rivers from land, add minerals to sea water?

49. How can we prevent the loss of top soil?

50. Why does the percentage of gases like oxygen, nitrogen and carbon dioxide remain almost the same in the atmosphere?

51. Lichens are called pioneer colonisers of bare rock. How can they help in formation of soil? 5. Why do people love to fly kites near the seashore?

52. Why does water need conservation even though large oceans surround the land masses?

53. “Soil is formed by water.” If you agree to this statement then give reasons.

54. During summer, if you go near the lake, you feel relief from the heat. Why?

55. "The flow of energy is unidirectional whereas the biogeochemical transfer is cyclic". Explain why ?

56. Justify the statement "The nitrogen cycle is supposed to be an ideal cycle in the biosphere".

57. List three ways to control soil pollution.

58. In coastal area, wind current moves from the sea towards the land during day; but during night it moves from land to the sea. Discuss the reason.

59. Following are a few organisms (a) lichen (b) mosses (c) mango tree (d) actus. Which among the above can grow on stones; and also help in formation of soil? Write the mode of their action for making soil.

60. Why does moon have very cold and very hot temperature variations, eg. from –190°C to 110°C even though it is at the same distance from the Sun as the Earth is?

61. There is mass mortality of fishes in a pond. What may be the reasons?

62. Soil formation is done by both abiotic and biotic factors. List the names of these factors by classifying them as abiotic and biotic?

63. All the living organisms are basically made up of C, N, S, P, H and O. How do they enter the living forms? Discuss.

64. Why does the percentage of gases like oxygen, nitrogen and carbon dioxide remain almost the same in the atmosphere?

65. Why are root nodules useful for the plants?

66. Many human activities lead to increasing levels of pollutions of air, water bodies and soil. "Isolating these activities to specific and limited areas would not help in reducing pollution". Justify this statement giving at least five reasons.

67. Explain with the help of a labelled diagram carbon cycle in nature.

68. Describe green house effect. How the presence of green house gases would lead to global warming ? Explain.

69. Draw a neat labelled diagram of water cycle in nature.

70. With the help of a neat labelled diagram, depict the cycling of carbon in nature.

71. Mention the two ways in which carbon dioxide is fixed in the environment.

72. Make neat and labelled sketch of Nitrogen cycle in nature.

73. Describe in brief the role of Nitrogen fixing bacteria and of lightening in fixing atmospheric nitrogen.

74. In coastal area, wind current moves from sea towards the land during day; but during night it moves from land to sea. Discuss the reason.

75. How are CFCs harmful for the environment and living beings ?

76. What are the forms of oxygen found in the atmosphere ?

77. "Forests influence the quality of our air, soil and water resources". Justify the statement.

78. Mention the two forms of oxygen found in atmosphere.

79. Name the form of oxygen absorbing U.V. rays.

80. Draw flow diagram of oxygen cycle.

81. What do you understand by ozone layer depletion ?

82. What is air pollution ? How does air pollution affect animal and plant life ?

83. Draw a labelled diagram to show carbon cycle in nature.

84. What are the two ways by which CO_2 is returned to the atmosphere ?

85. What are the causes of increase in the concentration of carbon dioxide in the atmosphere? How is carbon dioxide converted into organic compounds? Justify with the help of a labelled diagram.

86. Why is circulation of water necessary in the environment ? Discuss any two human activities which are disturbing the water cycle.

87. With the help of a labelled diagram show the cycling of carbon in nature. What are the two ways in which carbon di-oxide is fixed in the environment.

88. With the help of diagram depict the oxygen cycle in nature. What is the % of oxygen present in atmosphere ? What is the role of ozone layer and how is it getting depleted ?

89. How do clouds formed in the sky ? Draw the biogeochemical cycle involved in it. What are the different states in which water is found in the water cycle ?

90. What are biogeochemical cycles ? Draw a labelled diagram to illustrate cycling of oxygen in nature. Write the means of returning oxygen to the atmosphere.

91. What is nitrogen fixation ? Why do plant need to fix nitrogen ? Draw a labelled diagram to illustrate nitrogen - cycle.

92. Draw a labelled diagram of carbon cycle in nature. Describe the role of photosynthesis and respiration in carbon cycle.

93. Study the given figure of Nitrogen cycle and mention what do A, B, C, D, E represents. What will happen if step A does not occur? Write the role of N_2 fixing bacteria in the

94. Biosphere. Name two biologically important compounds that contains both O_2 and N_2

95. What are the types of natural resources?

96. Why plants do not utilise nitrogen directly from atmosphere?

ASSIGNMENT QUESTIONS SET – 4
CHAPTER – 14
NATURAL RESOURCES

1. The atmosphere of the earth is heated by radiations which are mainly

(a) radiated by the sun (b) re-radiated by land

(c) re-radiated by water (d) re-radiated by land and water

2. If there were no atmosphere around the earth, the temperature of the earth will

(a) increase

(b) go on decreasing

(c) increase during day and decrease during night

(d) be unaffected

3. What would happen, if all the oxygen present in the environment is converted to ozone?

(a) We will be protected more

(b) It will become poisonous and kill living forms

(c) Ozone is not stable, hence it will be toxic

(d) It will help harmful sun radiations to reach earth and damage many life forms.

4. One of the following factors does not lead to soil formation in nature

(a) the sun (b) water

(c) wind (d) polythene bags

5. The two forms of oxygen found in the atmosphere are

(a) water and ozone (b) water and oxygen

(c) ozone and oxygen (d) water and carbon-dioxide

6. The process of nitrogen-fixation by bacteria does not take place in the presence of

(a) molecular form of hydrogen (b) elemental form of oxygen

(c) water (d) elemental form of nitrogen

7. Rainfall patterns depend on

(a) the underground water table

(b) the number of water bodies in an area

(c) the density pattern of human population in an area

(d) the prevailing season in an area

8. Among the given options, which one is not correct for the use of large amount of fertilisers and pesticides?

(a) They are eco-friendly

(b) They turn the fields barren after some time

(c) They adversally affect the useful component from the soil

(d) They destroy the soil fertility

9. The nitrogen molecules present in air can be converted into nitrates and nitrites by

(a) a biological process of nitrogen fixing bacteria present in soil

(b) a biological process of carbon fixing factor present in soil

(c) any of the industries manufacturing nitrogenous compounds

(d) the plants used as cereal crops in field

10. One of the following processes is not a step involved in the water-cycle operating in nature

(a) evaporation (b) transpiration (c) precipitation (d) photosynthesis

11. The term "water-pollution" can be defined in several ways. Which of the following statements does not give the correct definition?

(a) The addition of undesirable substances to water-bodies

(b) The removal of desirable substances from water-bodies

(c) A change in pressure of the water bodies

(d) A change in temperature of the water bodies

12. Which of the following is not a green house gas?

(a) Methane (b) Carbon dioxide

(c) Carbon monoxide (d) Ammonia

13. Which step is not involved in the carbon-cycle?

(a) Photosynthesis (b) Transpiration

(c) Respiration (d) Burning of fossil fuels

14. 'Ozone-hole' means

(a) a large sized hole in the ozone layer

(b) thinning of the ozone layer

(c) small holes scattered in the ozone layer

(d) thickening of ozone in the ozone layer

15. Ozone-layer is getting depleted because of

(a) excessive use of automobiles

(b) excessive formation of industrial units

(c) excessive use of man-made compounds containing both fluorine and chlorine

(d) excessive deforestation.

16. Which of the following is a recently originated problem of environment?

(a) Ozone layer depletion (b) Green house effect

(c) Global warming (d) All of the above

17. When we breathe in air, nitrogen also goes inside along with oxygen. What is the fate of this nitrogen?

(a) It moves along with oxygen into the cells

(b) It comes out with the CO2 during exhalation

(c) It is absorbed only by the nasal cells

(d) Nitrogen concentration is already more in the cells so it is not at all absorbed.

18. Top-soil contains the following

(a) Humus and living organisms only

(b) Humus and soil particles only

(c) Humus, living organisms and plants

(d) Humus, living organisms and soil particles.

19. Choose the correct sequences

(a) CO_2 in atmosphere → decomposers → organic carbon in animals → organic carbon in plants

(b) CO_2 in atmosphere → organic carbon in plants → organic carbon in animals → inorganic carbon in soil

(c) Inorganic carbonates in water → organic carbon in plants → organic carbon in animals → scavengers

(d) Organic carbon in animals → decomposers → CO_2 in atmosphere → organic carbon in plants

20. Major source of mineral in soil is the

(a) parent rock from which soil is formed (b) plants

(c) animals (d) bacteria

21. Total earth's surface covered by water is

(a) 75% (b) 60% (c) 85% (d) 50%

22. Biotic component of biosphere is not constituted by

(a) producers (b) consumers (c) decomposer (d) air

23. An increase in carbondioxide content in the atmosphere would not cause

(a) more heat to be retained by the environment

(b) increase in photosynthesis in plants

(c) global warming

(d) abundance of desert plants

24. Oxygen is returned to the atmosphere mainly by

(a) burning of fossil fuel (b) respiration

(c) photosynthesis (d) fungi

25. Low visibility during cold weather is due to

(a) formation of fossil fuel

(b) unburnt carbon particles or hydrocarbons suspended in air

(c) lack of adequate power supply

(d) none of these

26. Growth of Lichens on barren rocks is followed by the growth of

(a) moss (b) ferns

(c) gymnosperms (d) algae

27. Marked temperature changes in aquatic environment can affect

(a) breeding of animals

(b) more growth of aquatic plants

(c) process of digestion in animals

(d) availability of nutrients.

28. Soil erosion can be prevented by

(a) raising forests (b) deforestation

(c) excessive use of fertilizer (d) overgrazing by animals

29. What happens when rain falls on soil without vegetational cover?

(a) Rain water percolates in soil efficiently

(b) Rain water causes loss of surface soil

(c) Rain water leads to fertility of the soil

(d) Rain water does not cause any change in soil

30. Oxygen is harmful for

(a) ferns (b) nitrogen fixing bacteria

(c) chara (d) mango tree

31. Rivers from land, add minerals to sea water. Discuss how?

32. How can we prevent the loss of top soil?

33. How is the life of organisms living in water affected when water gets polluted?

34. During summer, if you go near the lake, you feel relief from the heat, why?

35. In coastal area, wind current moves from the sea towards the land during day; but during night it moves from land to the sea. Discuss the reason.

36. Following are a few organisms (a) lichen (b) mosses (c) mango tree *(d)* cactus
Which among the above can grow on stones; and also help in formation of soil? Write the mode of their action for making soil.

37. Soil formation is done by both abiotic and biotic factors. List the names of these factors by classifying them as abiotic and biotic?

38. All the living organisms are basically made up of C, N, S, P, H and O. How do they enter the living forms? Discuss.

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41. Why do people love to fly kites near the seashore ?

42. Why does Mathura refinery pose problems to the Taj Mahal?

43. Why do not lichens occur in Delhi whereas they commonly grow in Manali or Darjeeling?

44. Why does water need conservation even though large oceans surround the land masses?

45. There is mass mortality of fishes in a pond. What may be the reasons ?

46. Lichens are called pioneer colonisers of bare rock. How can they help in formation of soil?

47. “Soil is formed by water.” If you agree to this statement then give reasons

48. Fertile soil has lots of humus. Why?

49. Why step farming is common in hills?

50. Why are root nodules useful for the plants?

51. How do fossil fuels cause air pollution?

52. What are the causes of water pollution? Discuss how you can contribute in reducing water pollution.

53. 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?

54. Justify “Dust is a pollutant” ?

55. Explain the role of the Sun in the formation of soil.

56. Carbon dioxide is necessary for plants. Why do we consider it as a pollutant?

CHAPTER – 15

IMPROVEMENT IN FOOD RESOURCES

INTRODUCTION

There is a need to introduce production efficiency of crops and livestock because
1. rapid increase in population
2. No major scope of increasing area of land under cultivation.

Increase in food production without degrading our environment and disturbing the ecological balance i.e. **Sustainable Practices** are required in agriculture and animal husbandry.

TYPES OF CROPS

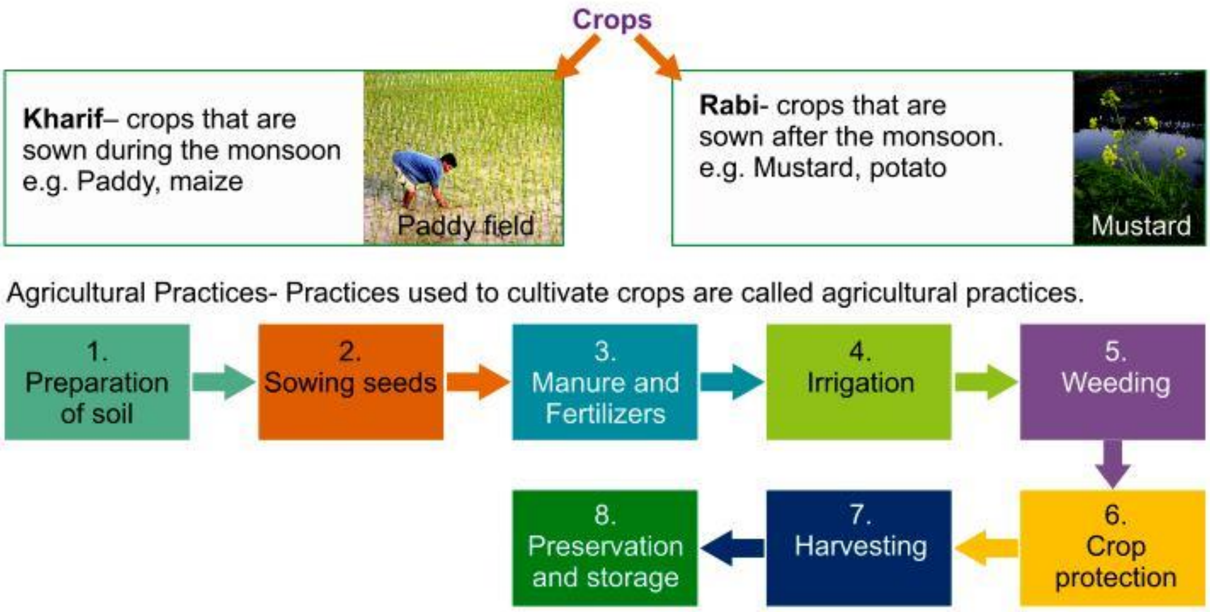
Cereals: wheat, rice, maize, millets and sorghum. Provide carbohydrates for energy requirements.

Pulses: pea, gram, black gram, green gram, pigeon pea and lentil. Provide proteins

Oilseeds: soya bean, ground nut, sesame, castor, mustard, linseed and sun flower. Provide necessary fats.

Vegetables, spices and fruits provide vitamins and minerals.

Crop means plants of same origin grown together in bulk. Every crop requires different climatic condition, while some crops grow together on one season. The climatic condition, warmth, photo-period for growth and completion is required for different crops.
Two seasonal change types :
a) Kharif crops
b) Rabi crops.



Main seasonal plants are divided into two broad categories. The crops that grow in monsoon period is called Kharif crops which is around June to October. The crops that are harvested in winter period are called Rabi crops which are around November to April.

RABI CROPS

Rabi crops or Rabi harvests are the crops in agriculture that are sown in winter or cold season. They are harvested in the spring. Rabi is Arabic word which in actual means “spring”. Thus the word “Rabi” is used frequently in subcontinent. Rabi is grown around the month of November to April in our subcontinent. The water collected from the rain in this season is the main source of water in these plants. Rabi crops require greater amount of irrigation. Thus heavy raining may ruin a Kharif crop but it is healthy and beneficial for Rabi crops. These crops are then taken out at departure of the monsoon rains. The harvesting may begin by April or may. Major Rabi crops that are harvested in subcontinents are wheat, grams, peas, mustard, linseed and barley. Most of the crops are under Rabi season. It is an integral crop in our area.

KHARIF CROPS

Kharif crop refers to the farming, plowing, reaping and harvesting of any household plant sown in the rainy season. It is derived from mochas words in subcontinent. In subcontinent they are popularly known as monsoon plants. They are cultivated for autumn harvest. By the beginning of first rain in July during south west rainy season in monsoon the crops are sown. Its begins at April 16 to October 15 in Pakistan, while in India Kharif season varies state to state in may and ending latest by January. Popularly in subcontinent it starts in June and ends by October. The Indian subcontinent is referred to areas covering India, Pakistan, Nepal and Srilanka. These crops are totally dependent on quantity of rain and water as well as its timings. Too much or too less will affect its growth and the whole effort can go wasted. The harvesting period coincides with the beginning of winter/ autumn in Indian subcontinent it is called Kharif period or Kharif crops. The major Kharif crops that are harvested in sub continent are paddy, soya-bean, maize, pigeon-pea, and cotton, green and black grams.

DIFFERENCE BETWEEN KHARIF AND RABI CROPS

- Kharif crops sown between April and May while Rabi crops are sown between September and October.
- Kharif crops are harvested after monsoon rains while Rabi crops are produced after winter.
- Kharif crops are popularly known as monsoon crops while Rabi crops are called winter or spring crops.
- Kharif crops are completely relying over the rain like if less or more in quantity while Rabi can deal with whatever water is present for irrigation. Rain has less impact over Rabi crops.
- The major examples that can be counted as Kharif crops are sunflower, rice, sugar cane, soya bean and tea while Rabi crops can be wheat, barley, pea, gram and mustard.

INTEXT QUESTIONS PAGE NO. 204

Q1. What do we get from cereals, pulses, fruits and vegetables?
Answer:
(i) Cereals provide us with carbohydrates. Also, they are a rich source of energy.
(ii) Pulses give us proteins.
(iii) Fruits and vegetables are a rich source of vitamins and minerals. A small amount of proteins, carbohydrates, and fats are also present in them.

IMPROVING CROP YIELD

The practices involved in farming are divided into three stages. They are

(a) Choice of seeds for planting
(b) Nurturing of the crop plants

(c) Protection of the growing and harvested crops from loss.

Hence the major activities for improving crop yields can be classified as

(i) Crop variety improvement
(ii) Crop production improvement
(iii) Crop protection improvement

CROP VARIETY IMPROVEMENT

This approach depends on finding a crop that can give a good yield. Some of the factors for which variety improvement is done are:

- **Higher yield**: for increasing the productivity per acre.
- **Improved quality**: quality considerations vary from crop to crop as per the requirements.
- **Biotic and abiotic resistance**: crops should have sufficient resistance to biotic factors (diseases, insects and nematodes) and abiotic stresses (heat, cold, frost etc.)
- **Change in maturity duration**: the shorter the duration, the more economical is the variety.
- **Wider adaptability**: it can be grown in different climatic conditions.
- **Desirable agronomic characteristics**: tallness and profuse branching for fodder crops. Dwarfness is desired for cereals.

Common factors for crop improvement

Higher Yield	To increase the productivity of the crop per acre.
Improved Quality	Quality of crop products vary from crop to crop. Baking quality in wheat, protein quality in pulses, oil quality in oil seeds, etc.
Biotic and abiotic resistance	Crop production is decreased due to biotic (diseases, insects, pests, etc.,) and abiotic factors (heat, cold, salinity and drought). Varieties resistant to these stresses can improve crop production.
Change in maturity pattern	Shorter maturity period; uniform maturity makes the harvesting process easy and reduces losses during harvesting.
Wider Adaptability	One variety can be grown under different climatic conditions in different areas. Developing varieties of wider adaptability helps in stabilizing crop production.
Desirable agronomic characters	Tallness and profuse branching are desirable characters for fodder crops. Dwarfness is desired in cereals. Developing varieties of desired agronomic characters give higher productivity.

This can be achieved by two methods; hybridisation and genetically modified crops.
1. **Hybridisation**
In genetics, hybridisation is the process of combining different varieties or species of organisms which are genetically dissimilar to create a hybrid. It can be inter varietal, inter specific, intergeneric.

2. **Genetically modified crops**
Here the crop is improved by introducing a gene that would provide desired characteristics.

INTEXT QUESTIONS PAGE NO. 205

Q1. How do biotic and abiotic factors affect crop production?
Answer:
A variety of biotic factors such as pests, nematodes, diseases, etc. can reduce the net crop production. A pest causes damage to agriculture by feeding on crops. For example, boll weevil is a pest on cotton. It attacks the cotton crop, thereby reducing its yield. Weeds also reduce crop productivity by competing with the main crop for nutrients, light, and space.

Similarly, abiotic factors such as salinity, temperature, etc. affect the net crop production. Some natural calamities such as droughts and floods are unpredictable. Their occurrence has a great impact on crops sometimes, destroying the entire crop.

Q2. What are the desirable agronomic characteristics for crop improvements?
Answer:
The desirable agronomic characteristics for crop improvements are:
(i) Tallness and profuse branching in any fodder crop.
(ii) Dwarfness in cereals.
These desirable agronomic characteristics help in increasing crop productivity.

CROP PRODUCTION MANAGEMENT

It involves different practices carried out by farmer to achieve higher standards of crop production. It includes the following:
1. NUTRIENT MANAGEMENT
2. IRRIGATION
3. CROPPING PATTERN

NUTRIENT MANAGEMENT

The higher yields of crops mainly depend upon input applications like improved seeds, fertilizers and modern techniques of sowing and harvesting. Plants require a number of nutrients for their growth and development.

Plants get nutrients from air, water and soil. Nearly 16 elements are essential for plant growth and reproduction.
On the basis of the requirement by the plants, they are further classified into Macro Nutrients and Micro Nutrients.

MACRO NUTRIENTS
Elements which are needed in large quantities for growth of the plants are called Macro Nutrients. They are Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorous, Sulphur, Potassium,

Calcium, Magnesium and Iron.

MICRO NUTRIENTS
Elements which are needed by the plants in very small quantities are called Micro Nutrients. They are Manganese, Copper, Molybdenum, Zinc, Boron and Chlorine.

Deficiency of these nutrients affects physiological processes in plants including reproduction, growth and susceptibility to diseases. To increase the yield, the soil can be enriched by supplying these nutrients in the form of manure and fertilizers.

INTEXT QUESTIONS PAGE NO. 206

Q1. What are macro-nutrients and why are they called macronutrients?
Answer:
Macro-nutrientsare nutrients required in relatively large quantities for growth and development of plants. They are six in number. Since they are required in large quantities, they are known as macro-nutrient. The six macro-nutrients required by plants are nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur.

Q2. How do plants get nutrients?
Answer:
Plants require sixteen essential nutrients from nature for their growth and development. All these nutrients are obtained from air, water, and soil. Soil is the major source of nutrients. Thirteen of these nutrients are available from soil. The remaining three nutrients (carbon, oxygen, and hydrogen) are obtained from air and water.

MANURE
Manure is an organic substance and is prepared by the decomposition of plant and animal wastes.

Advantages of Manure
- Manures helps in enriching the soil with organic matter and nutrients.
- It helps in increasing the soil fertility.
- Water holding capacity of soil is increased.
- Helps in improving soil texture.
- Save our environment from excessive use of fertilizers.

Manure is classified into **two types** according to the biological material used:

COMPOST AND VERMI-COMPOST
Composting: It is the process in which farm waste material (cow dung, domestic waste, sewage waste etc) is decomposed in pits. Compost is the aerobically decomposed remnants of organic matter which is rich in nutrients.
Vermicomposting: It is the process which involve use of earthworms to hasten the process of decomposition of plant and animal refuse.

GREEN MANURE
Leguminous plants like Sunn-hemp or Cluster Bean are grown and then mulched by ploughing them back into the soil. This helps in enriching the soil with Nitrogen and Phosphorous.

FERTILIZERS

Fertilizers are chemicals commercially produced in factories and used as plant nutrients. They supply Nitrogen, Phosphorous, Potassium, etc., They are used to ensure good vegetative growth giving rise to healthy plants.

Advantage: They help in good vegetative growth and produce healthy plants.
Disadvantage :
- Excessive use of fertilizer leads to pollution of water.
- Continuous use of fertilizer lead to decrease in soil fertility because organic matter of the soil cannot be replenished as microorganisms present in soil get harmed due to fertilizer.

Application of fertilizers results in higher yield of crops. At the same time, it increases the cost of farming. As the fertilizers are water soluble chemicals, large part of the fertilizers applied is washed away due to excessive irrigation. They are not fully absorbed by the plants.

This excess fertilizer is washed away into the ponds, lakes, canals and rivers, resulting in the growth of unwanted plants like Water Hyacinth, algae, etc. These plants disturb the water bodies and the flow of water. As a result, fishes and other living organisms do not get sufficient sunlight and oxygen and die.

DIFFERENCES BETWEEN MANURES AND FERTILIZERS

Manures	Fertilizers
1. Manure is a natural substance obtained by the decomposition of cattle dung, human waste and plant waste.	1. Fertilizer is a mineral or chemical compound containing nutrients like Sulphur, Phosphorous, Nitrogen, etc.
2. Manures are organic substances.	2. Fertilizers are inorganic compounds.
3. Manures can be prepared in fields.	3. Fertilizers are manufactured in factories.
4. Manures contain all nutrients but in small quantities.	4. They contain higher quantities of one or more specific nutrients.
5. Manures add plenty of humus to soil and improve the texture of the soil.	5. Fertilizers do not result in the addition of humus to the soil.
6. Manures are not easily absorbed because they are less soluble in nature.	6. Fertilizers are soluble in water and it is easily absorbed.
7. Manures are less soluble; they are not easily washed away from the soil and hence their effect is long lasting.	7. Fertilizers are easily washed away by water and hence their effect is of shorter duration and require repeated application.

☞ Fertilizers which are derived from living organisms are called Bio-fertilizers. The main source of bio-fertilizers are bacteria, cyanobacteria and fungi. Bio-fertilizers are renewable and nonpolluting sources of plant nutrients. They also improve the soil condition. Rhizobium and Cyanobacteria such as Anabaena and Nostoc are some common bio-fertilizers.

INTEXT QUESTIONS PAGE NO. 207

Q1. Compare the use of manure and fertilizers in maintaining soil fertility.
Answer:
Manures increase soil fertility by enriching the soil with organic matter and nutrients as it is prepared by the decomposition of animal excreta and plant wastes. On the other hand, fertilizers are mostly inorganic compounds whose excessive use is harmful to the symbiotic

micro-organisms living in soil. Their excessive use also reduces soil fertility. Hence, fertilizers are considered good for only short term use.

ORGANIC FARMING

It's a farming system in which use of chemicals such as fertilizers, herbicides, pesticides etc are reduced. It involves the use of following components:

a) Organic manure
b) Recycled farm waste
c) Bio-agents such as culture of blue green algae in preparation of bio fertilizers
d) Bio pesticides such as leaves of neem or turmeric for grain storage
e) Healthy cropping patterns such as mixed cropping, intercropping and crop rotation which will also help in controlling growth of weed, pest and insects.

IRRIGATION

Irrigation is necessary for crops to get water during their growing season.

Source of irrigation:

- **Wells:** There are two types of wells, namely dug wells and tube wells. In a dug well, water is collected from water bearing strata. Tube wells can tap water from the deeper strata. From these wells, water is lifted by pumps for irrigation.
- **Canals:** This is usually an elaborate and extensive irrigation system. In this system canals receive water from one or more reservoirs or from rivers. The main canal is divided into branch canals having further distributaries to irrigate fields.
- **River Lift Systems:** In areas where canal flow is insufficient or irregular due to inadequate reservoir release, the lift system is more rational. Water is directly drawn from the rivers for supplementing irrigation in areas close to rivers.
- **Tanks:** These are small storage reservoirs, which intercept and store the run-off of smaller catchment areas.
- **Rain water harvesting**
- **Watershed management:** building of small check dams which helps in increasing ground water level and helps in reducing soil erosion.

CROPPING PATTERNS

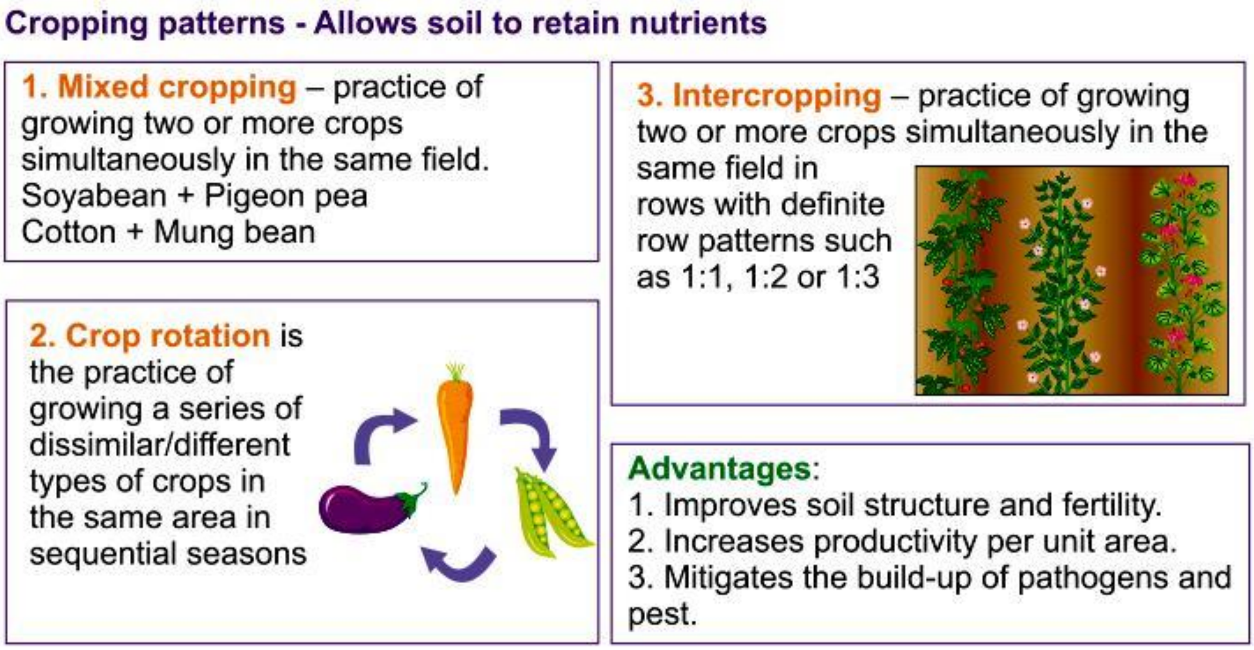
Different ways of growing crops can be used to give maximum benefit.

MIXED CROPPING

It is growing of two or more crops simultaneously on the same piece of land. It is also known as multiple cropping. This type of cropping leads to an improvement in the fertility of the soil and hence increase in crop yield because when the two crops are properly chosen, the products and refuse from one crop help in the growth of the other crop plant and vice-versa. Mixed cropping is an insurance against crop failure due to abnormal weather and plant pests.
Soyabean + pigeon pea, Maize + urad dal (black gram),Groundnut + sunflower ,Wheat + Chick Pea.

Advantages of Mixed cropping:

- No risk of crop failure ,
- Increase in yield,
- Improvement in soil fertility
- Minimizing Pest Damage.



INTER CROPPING

Intercropping is the agricultural practice of cultivating two or more crops in the same space at the same time in a definite pattern. Row- type intercropping cropping involves the component crops arranged in alternate rows. This may also be called **alley cropping**. A variation of row cropping is strip cropping, where multiple rows (or a strip) of one crop are alternated with multiple rows of another crop. Intercropping also uses the practice of sowing a fast growing crop with a slow growing crop, so that the fast growing crop is harvested before the slow growing crop starts to mature.

DIFFERENCE BETWEEN INTER CROPPING AND MIXED-CROPPING

Sr. No	*Inter Cropping*	*Mixed Cropping*
1	*The main object is to utilize the space left between two rows of main crop*	*To get at least one crop under favorable conditions*
2	*More emphasis is given to the main crop*	*All crops are cared equally*
3	*There is no competition between both crops*	*There is competition between all crops growing*
4	*Inter crops are of short duration & are harvested much earlier than main*	*The crops are almost of the same duration*
5	*Sowing time may be same or different*	*It is same for all crops*
6	*Crops are sown in different rows without affecting the population of main crop when sown as sole crop*	*Either sown in rows or mixed without considering the population of either hope so this help uh thumbs up plz..*

SELECTION OF CROPS FOR MIXED CROPPING AND INTERCROPPING:

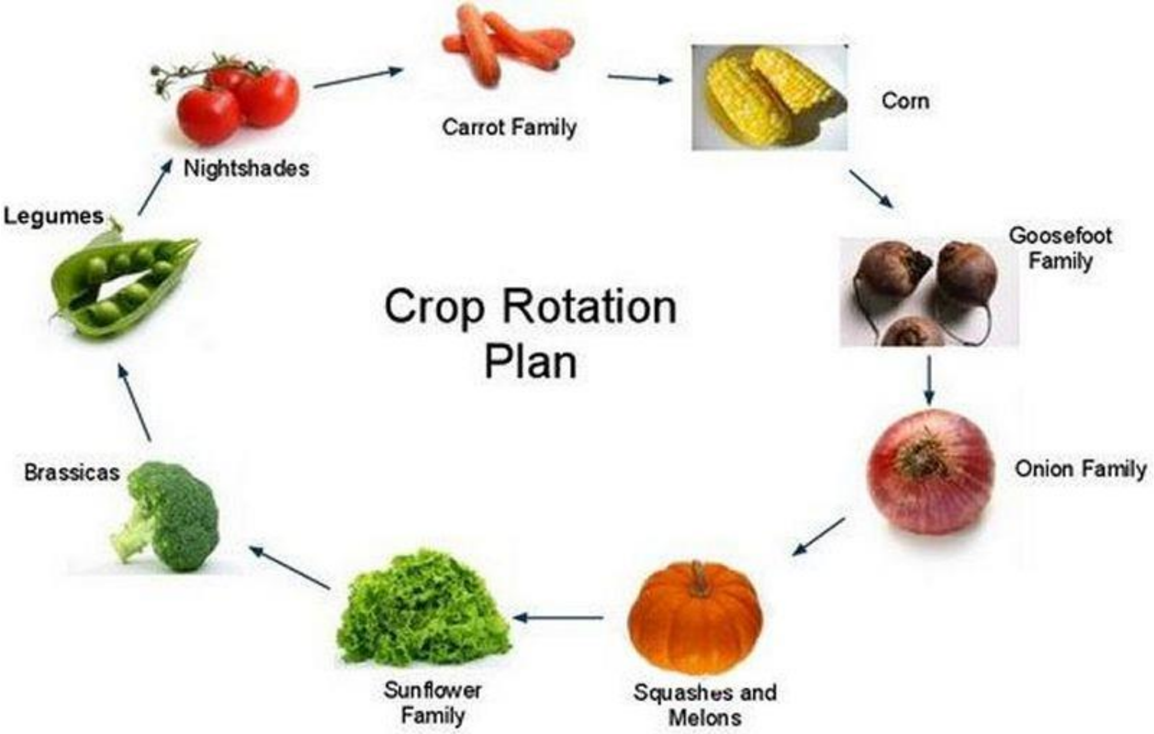
Crops are chosen whose nutrient requirements are different so that maximum utilisation of the soil nutrients takes place. Also, their water needs, rooting patterns etc are different. Besides the advantages mentioned for mixed cropping,

Intercropping has the following additional advantages:

- Application of pesticides and fertilizers is more convenient due to well defined patterns of crops.
- Harvesting of crops is also easier.

CROP ROTATION

It is the practice of growing a series of dissimilar types of crops in the same area in sequential seasons for various benefits such as to avoid the buildup of pathogens and pests that often occurs when one species is continuously cropped. Crop rotation also seeks to balance the fertility demands of various crops to avoid excessive depletion of soil nutrients. A traditional component of crop rotation is the replenishment of nitrogen through the use of green manure in sequence with cereals and other crops. Crop rotation can also improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants.



Advantages:

Crop rotation avoids a decrease in soil fertility, as growing the same crop repeatedly in the same place eventually depletes the soil of various nutrients. A crop that leaches the soil of one kind of nutrient is followed during the next growing season by a dissimilar crop that returns that nutrient to the soil or draws a different ratio of nutrients, for example, rices followed by cottons. By crop rotation farmers can keep their fields under continuous production, without the need to let them lay fallow, and reducing the need for artificial fertilizers, both of which can be expensive. Rotating crops adds nutrients to the soil.

CROP PROTECTION MANAGEMENT

Field crops are infested by a large number of weeds, insect pests and diseases. If weeds and pests are not controlled at the appropriate time then they can damage the crops so much that most of the crop is lost. When the crop is in the field, it needs protection against:

- **Weeds** e.g.– Xanthium, Parthenium (weeds are considered to be harmful as they compete for food, space and light with the desired crop. They reduce crop production taking up the nutrients meant for the crops.

- **Insect Pests -** Insect pests attack the plants in three ways: (i) they cut the root, stem and leaf, (ii) they suck the cell sap from various parts of the plant, and (iii) they bore into stem and fruits. They thus affect the health of the crop and reduce yields.
- **Pathogens-** Microbes like bacteria, fungi and viruses cause diseases. Spores of these pathogens may be transmitted through soil, water and air.

To control these :
Herbicides, Pesticides, fungicides should be used.

Weed control methods also include mechanical removal. Preventive methods such as proper seed bed preparation, timely sowing of crops, intercropping and crop rotation also help in weed control. Some other preventive measures against pests are the use of resistant varieties, and summer ploughing, in which fields are ploughed deep in summers to destroy weeds and pests.

Prevention for preventing the growth of weeds,

- Proper seed bed preparation,
- timely growing of crops,
- intercropping , crop rotation,
- use of resistant varieties and
- summer ploughing is done.

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Q1. Which of the following conditions will give the most benefits? Why?
(a) Farmers use high-quality seeds, do not adopt irrigation or use fertilizers.
(b) Farmers use ordinary seeds, adopt irrigation and use fertilizer.
(c) Farmers use quality seeds, adopt irrigation, use fertilizer and use crop protection measures.
Answer:
(c)Farmers using good quality seeds, adopting irrigation, using fertilizers, and using crop protection measures will derive most benefits.
(i) The use of good quality seeds increases the total crop production. If a farmer is using good quality seeds, then a majority of the seeds will germinate properly, and will grow into a healthy plant.
(ii) Proper irrigation methods improve the water availability to crops.
(iii) Fertilizers ensure healthy growth and development in plants by providing the essential nutrients such as nitrogen, phosphorus, potassium, etc.
(iv) Crop protection measures include various methods to control weeds, pests, and infectious agents. If all these necessary measures are taken by a farmer, then the overall production of crops will increase.

STORAGE OF GRAINS

Factors responsible for such losses are biotic— insects, rodents, fungi, mites and bacteria, and abiotic— inappropriate moisture and temperatures in the place of storage.

Negative Effects of these factors on grains:

- Degradation in quality,
- loss in weight,
- poor germinabilty,
- discoloration of produce-
- Leads to poor marketability

PREVENTION AND CONTROL METHODS USED BEFORE GRAINS ARE STORED:

- Cleaning of produce before storage
- Drying of produce first in sunlight and then in shade to reduce moisture content
- Fumigation using chemicals (fumigants) to kill pests

INTEXT QUESTIONS PAGE NO. 209

Q1. Why should preventive measures and biological control methods be preferred for protecting crops?
Answer:
Preventive measures and biological control methods should be preferred for protecting crops because excessive use of chemicals leads to environmental problems. These chemicals are also poisonous for plants and animals. Preventive measures include proper soil and seed preparation, timely sowing of seeds, intercropping and mixed cropping, usage of resistant varieties of crops, etc. On the other hand, biological control methods include the usage of bio-pesticides that are less toxic for the environment. An example of bio-pesticides is Bacillus thuringenesis, which is an insect pathogen that kills a wide range of insect larvae. Therefore, both preventive measures and biological control methods are considered eco- friendly methods of crop protection.

Q2. What factors may be responsible for losses of grains during storage?
Answer:
During the storage of grains, various biotic factors such as insects, rodents, mites, fungi, bacteria, etc. and various abiotic factors such as inappropriate moisture, temperature, lack of sunlight, flood, etc. are responsible for losses of grains. These factors act on stored grains and result in degradation, poor germinability, discolouration, etc.

ANIMAL HUSBANDRY

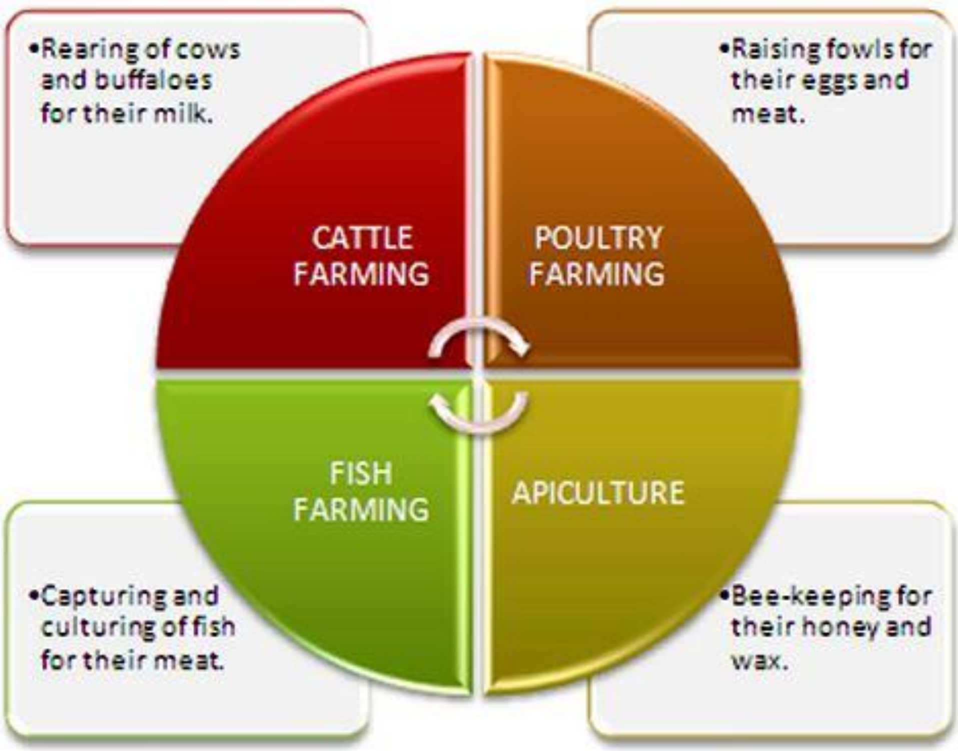
The branch of agriculture which deals with the feeding, shelter, health and breeding of domestic animals such as cattle, pigs, horses and fowls is called animal husbandry.

The various elements of animal husbandry are :
1. Proper feeding of animals.
2. Provision for clean drinking water for animals.
3. Proper shelter for animals.
4. Prevention and cure of animal diseases.
5. Proper breeding of animals.

ADVANTAGES OF ANIMAL HUSBANDRY

As animal husbandry is scientific management of farm animals, it serves many uses for human beings.

- It helps in enhancing milk production
- It increases egg production
- It increases meat production
- It increases fish production
- It helps in proper management of agricultural wastes.



The rearing of animals on large scale is called **animal husbandry. Food, shelter and health** are the most important aspect of animal husbandry.

Meat, egg, milk, honey, silk, lac, wool and leather are the products that we get from animals.

Useful animals can be divided into the following categories based on the products they give us.
Milk yielding animals - dairy animals - cows, buffalo and goat
Meat and egg yielding animals - sheep, pig, fish, poultry and duck
Draught animals - mule, donkey, horse, bullock
Wool and skin yielding animals - sheep, goat, cow, buffalo and camel
Animals yielding other products - honey from bees, silk from silk moth and pearls from oyster

CATTLE FARMING

A cattle farming is the practice of rearing cattle by providing facilities for raising livestock. Livestock includes domestication of cows, buffaloes, sheep, goats, pigs etc. A cattle farming is carried out to raise cows and buffaloes as important livestock. The two major species of Indian cattle are Bosindicus, or cows, and Bosbubalis, or buffaloes.

MILCH ANIMALS AND DROUGHT ANIMALS

On basis of their utility, cattle are classified into two types namely milch animals and drought animals.

- Milch animals or dairy animals produce milk. Males of this type are not useful for working on farm.
- Draught animals are used for carrying out agricultural work like tilling, irrigation and

carting. Cows belonging to this category are poor milk-yielding varieties.

Dairy Farming: On the other hand, near the first and last quarters of the moon, when the pulls of the sun and the moon act at right angles to each other, high tides are exceptionally low, and are called **neap tides**.

High milk yielding breeds.

Common diseases in cattle:
- Antrax
- Food and mouth disease
- Worms

MANAGEMENT PRACTICES FOR CATTLE FARMING

Management practices for cattle include cleaning, sheltering and feeding.

a) Cleaning involves periodic washing to get rid of dirt and loose hair.

b) Shelter facilities include well ventilated roof sheds which protect cattle from rain, cold and sun.

c) Feeding of cattle includes supply of uncontaminated and balanced diet. Animal feed are of two types namely roughage feed and concentrate feed.

- Roughage feed contains high fibre content and provides energy. It comprises fodder grasses, silage and legumes rich in fibre.
- Concentrate feed is a mixture of cereals, seeds and oilseed cake rich in protein content. This type of feed is easily digestible and it helps the animal in increasing body weight.

d) Cattle should be protected from diseases. Diseases in cattle are caused by both external and internal parasites. External parasites live on the skin and cause skin diseases. Internal parasites affect the stomach and intestinal parts. Certain preventive measures of diseases in animals are listed.

- Proper disposal of dead animals and animal wastes.
- Shelters should be clean, dry and well ventilated.
- Periodic visit of veterinary physician to check the animals.
- Hygienic management of animals and animal products.

e) Infectious diseases are caused by pathogens like bacteria, viruses and fungi. Sheds should be cleaned and disinfected regularly. Vaccination against various diseases should be provided to farm animals. Vaccination should be given against various diseases.

f) Milk production centres should be maintained for the animals which give birth to young ones. Milk production depends on duration of lactation period. Lactation period is the period following the birth of a calf during which milk is produced by the animal. Lactation period can be enhanced by administering certain hormonal injections.

g) Cross-breeding is done between foreign and local breeds of animals to facilitate the growth of animals with desired qualities. e.g. Foreign breed like Jersey cow, with long lactation period, is crossed with local breed like Red Sindhi cow, with high resistance to disease, to obtain offspring of desired qualities like long lactation period and high resistance to diseases.

ADVANTAGES OF CROSS-BREEDING

Cross-breeding helps in the development of certain desired characteristics in animals.

- To increase milk production
- To increase resistance against diseases.
- To enhance the varieties with longer lactation period.
- To rely on less amount of quality feed.

INTEXT QUESTIONS PAGE NO. 210

Q1. Which method is commonly used for improving cattle breeds and why?
Answer:
Cattle farming is commonly used for improving cattle breeds. The purpose of cattle farming is to increase the production of milk and draught labour for agricultural work. Dairy animals (females) are used for obtaining milk and draught animals (males) are engaged in agricultural fields for labour work such as carting, irrigation, tilling, etc. Cross breeding between two good varieties of cattle will produce a new improved variety. For example, the cross between foreign breeds such as Jersey Brown, Swiss (having long lactation periods) and Indian breeds such as Red Sindhi, Sahiwal (having excellent resistance power against diseases) produces a new variety having qualities of both breeds.

POULTRY FARMING

Poultry farming is the practice of raising fowl for egg production and chicken meat. Fowls are used for producing eggs and broilers are used for producing meat.

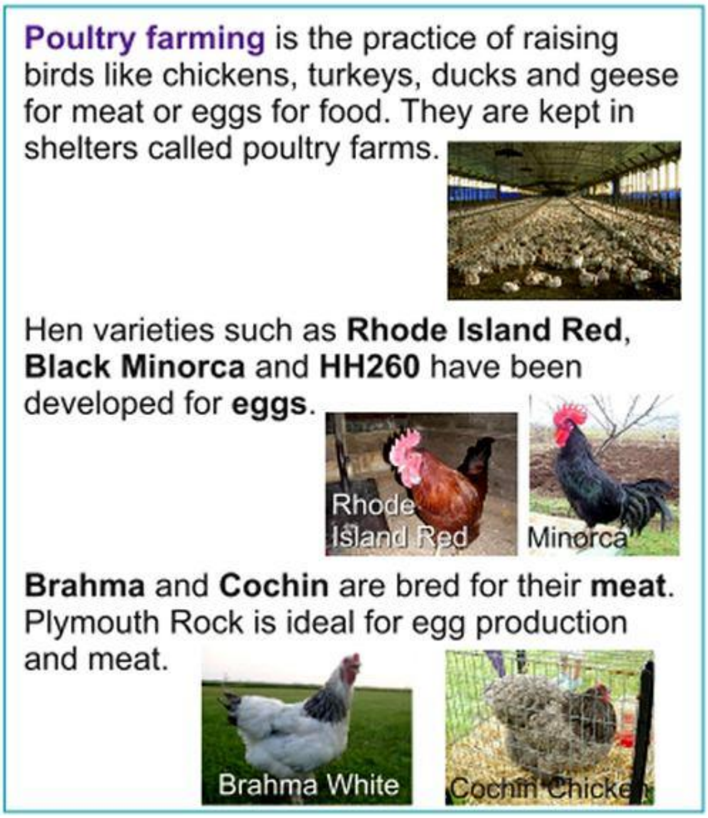
Cross –breeding is common in poultry to develop new varieties with the desirable traits. e.g Indian breed Aseel is cross-bred with the foreign breed Leghorn.

Cross-breeding is used to develop offspring with desirable traits. The desirable traits includes:

- number and quality of chicks;
- dwarf broiler parent for commercial chick production;
- summer adaptation capacity/ tolerance to high temperature;
- low maintenance requirements;
- reduction in the size of the egg-laying bird with ability to utilise more fibrous cheaper diets formulated using agricultural by-products.

Management practices for poultry farming are elucidated.

- Maintaining optimum temperature
- Providing hygienic housing conditions
- Providing a protein-rich diet with high levels of vitamin A and K, and
- Preventing and controlling pests and diseases.



INTEXT QUESTIONS PAGE NO. 211

Q1. Discuss the implications of the following statement:
"It is interesting to note that poultry is India's most efficient converter of low fibre food stuff (which is unfit for human consumption) into highly nutritious animal protein food."
Answer:
Poultry in India is the most efficient converter of low fibre food stuff into highly nutritious animal protein food. In poultry farming, domestic fowls are raised to produce eggs and chicken. For this, the fowls are given animal feeds in the form of roughage, which mainly consists of fibres. Thus, by feeding animals a fibre rich diet, the poultry gives highly nutritious food in the form of eggs and chicken.

Q1. What management practices are common in dairy and poultry farming?
Answer:
Common management practices in dairy and poultry farming are:
(i) Proper shelter facilities and their regular cleaning.
(ii) Some basic hygienic conditions such as clean water, nutritious food, etc.
(iii) Animals are kept in spacious, airy, and ventilated place.
(iv) Prevention and cure of diseases at the right time is ensured.

Q2. What are the differences between broilers and layers and in their management?
Answer:
Layersare meant for egg production, whereas broilers are meant for poultry meat. Nutritional, environmental, and housing conditions required by broilers are different from those required by egg layers. A broiler chicken, for their proper growth, requires vitamin rich supplements especially vitamin A and K. Also, their diet includes protein rich food and enough fat. They also require extra care and maintenance to increase their survival rate in comparison to egg

layers.

FISH FARMING

Fish farming is also called as aquaculture. This is culturing of fish for commercial purposes. Fish is a cheap source of animal protein.

TYPES OF FISHERY

a) Fin fishery and Shell fishery

Fish production involves fin fishery and shell fishery. Two main species of finned true fish are Catla and Rohu, and that of shellfish such as prawns and molluscs.

b) Capture fishery and culture fishery

Fish are obtained by capture fishing as an economic source for their meat.

- Capture fishing involves capturing of fish from sea water or fresh water. Culture fishing involves culturing the fish in small enclosures.
- Capture fishing is classified into marine fishery and inland fishery depending upon the resources used for fishing.

Culture fishery involves rearing of fish in small structures like wells.

- Fish farming can be done in the rice field where both grains and fish can be harvested from the farm.
- As feeding habits of fish differ from species to species, many varieties can be reared on the same farm. Composite fish farming is rearing of different varieties of fish in the same area. e.g. Composite fish farming includes Catla, the surface feeders, Rohu, feed in the middle zone of a pond, Mrigal and common carp, the bottom feeders, and grass carp, feeding on weeds. These species can co-exist in a single pond, and thus, increase the yield of fish from the pond.

c) Marine fishery and Inland fishery

- Mariculture is the culture of fish in marine water.
- Marine fishery involves fishing in salt water regions.
- Some examples of marine fish are Pomphret, Tuna and Mackerel.
- Fish are captured by locating large schools of fish, in the open sea, with the help of satellites and echo-sounders.
- Marine fish of high economic value are farmed in seawater. Shellfish, such as prawns, mussels and oysters are also farmed in seawater. Oysters are cultivated for their pearls.

Distinguishing features between Capture fishery, Mariculture and Aquaculture

CAPTURE FISHERY	MARICULTURE	AQUACULTURE
Fishes are caught from natural water resources.	Involves culturing and harvesting of fin fishes and shell fishes.	Involves culturing and harvesting of fish, prawns, crabs etc.
No seeding and rearing are required.	Fish seeds are introduced and fish are reared.	Fish and other organisms are seeded and reared.
This type of fishing is done both in marine and inland waters.	Fishing is done only in sea water.	Fishing is done both in fresh water and marine waters.

Inland fisheries involve fresh water canals, ponds, reservoirs, rivers from which fish are captured.

Estuaries are the regions where fresh water mixes with sea water. These are rich sources of fish.

Fish farming encounters the problem of lack of quality seed or eggs. Fish are bred in ponds by hormonal stimulation. Fish are injected with hormones that stimulate the production of eggs or seed. This ensures the supply of pure fish seed in desired quantities.

APICULTURE

The scientific method of rearing honeybees for honey and wax is called 'Apiculture' or 'Bee keeping'. Beehives are enclosed structures in which honey bees live and raise their young.

- The practice of maintaining honey bee colonies in beehives is called bee-keeping or apiculture. Apiaries or bee farms are established for commercial production of honey.
- Bee-keeping is a cheap and popular agricultural enterprise.
- Honey produced in bee-hives is the source of honey used in food and medicines. Taste and the quality of the honey depend upon the flowers the bees visit for nectar collection.
- Wax obtained from these hives is used in ointments, polishes etc.

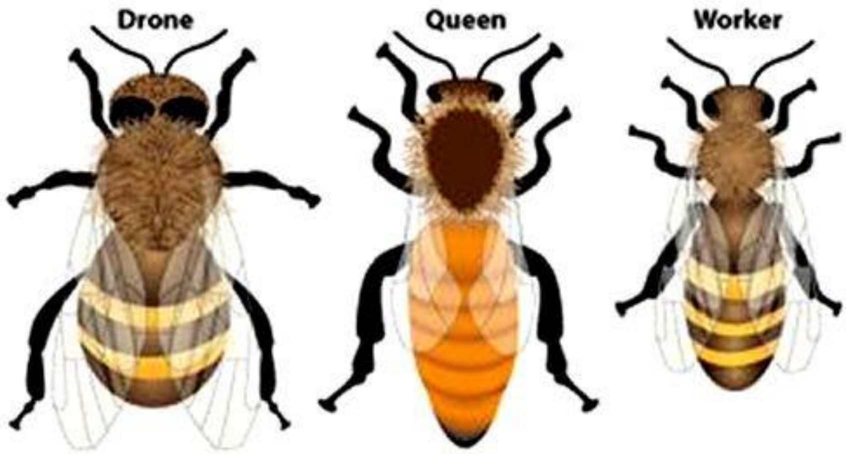
TYPES OF BEES

There are three types of bees in a colony.

a) **Queen** – The only fertile female in the hive and it's function is to lay eggs.

b) **Drones** – These are fertile male bees and it's function is to mate with queen bee and fertilize the eggs.

c) **Workers** – These are sterile females. They take care of the queen and young bees, collect nectar build honey combs and protect the bee hive.



HONEYBEE VARIETIES

a) Indigenous varieties

i. Apis Indica – Common Indian honey bee.
ii. Apis dorsata – Rock bee
iii. Apis florea – Little bee.

b) Exotic varieties

i. Apis mellifera (Italian bee)
ii. Apis adamsoni (South African bee)

ECONOMIC IMPORTANCE OF HONEY BEES

Honey bees are used in the production of honey and bee wax.

USES OF HONEY

1. Honey is an energy rich food. For eg. 1 Kg of honey contains 3200 calories of energy.
2. Honey contains sugars, minerals, vitamins, enzymes and pollen.
3. Honey is an antiseptic and contains formic acid as the preservative.
4. Honey is a blood purifier, a cure against cough, cold,sore throat, ulcers of tongue, stomach and intestine.
5. Honey is helpful in building up the haemoglobin content of the blood.
6. Honey is used in the preparation of bread, cakes and biscuits.

BEE WAX

It is utilized in the manufacture of cosmetics, lubricants, cold creams, shaving creams, polishes, candles, ointments and in medical preparations.

INTEXT QUESTIONS PAGE NO. 213

Q1. How are fish obtained?
Answer:
Fish can be obtained by two ways:
(i) Capture fishing: It is the process of obtaining fish from natural resources.
(ii) Culture fishery: It is the practice of farming fishes. Farming can be done in both freshwater ecosystem (which includes river water, pond water) and marine ecosystem.

Q2. What are the advantages of composite fish culture?
Answer:
An advantage of composite fish culture is that it increases the yield of fish. In a composite fish culture, five or six different species are grown together in a single fish pond. Fishes with different food habitats are chosen so that they do not compete for food among themselves. Also, this ensures a complete utilization of food resources in the pond. As a result, the survival rate of fish increases and their yield also increases.

Q1. What are the desirable characters of bee varieties suitable for honey production?
Answer:
Bee varieties having the following desirable characters are suitable for honey production:
(i) They should yield high quantity of honey.
(ii) They should not sting much.
(iii) They should stay in the beehive for long durations.
(iv) They should breed very well.

Q2. What is pasturage and how is it related to honey production?
Answer:
Pasturage is the availability of flowers from which bees collect nectar and pollen. It is related to the production of honey as it determines the taste and quantity of honey.

EXERCISE QUESTIONS PAGE NO. 12

Q1. Explain any one method of crop production which ensures high yield.
Answer:
Crop rotationis one of the methods of crop production that ensures high yield. It is the method of growing two or more varieties of crops on the same land in sequential seasons. A crop utilises some particular nutrients in larger quantities from the soil. Then, if the same crop is grown in subsequent seasons those nutrients will get depleted in the soil. Therefore, crops having different nutrient requirements are rotated. For example, legumes which have nitrogen-

fixing bacteria in their root nodules supply the soil with nitrogen. Therefore, these legumes are rotated with nitrogen requiring cereals such as wheat and maize. This method reduces the need of fertilizers, thereby increasing the overall yield of crops.

Q2. Why are manure and fertilizers used in fields?

Answer:

Manures and fertilizers are used in fields to enrich the soil with the required nutrients. Manure helps in enriching the soil with organic matter and nutrients. This improves the fertility and structure of the soil. On the other hand, fertilizers ensure a healthy growth and development in plants. They are a good source of nitrogen, phosphorus, and potassium. To get an optimum yield, it is instructed to use a balanced combination of manures and fertilizers in the soil.

Q3. What are the advantages of inter-cropping and crop rotation?

Answer:

Inter-cropping and crop rotation both play an important role in increasing the yield of crops. Inter-cropping helps in preventing pests and diseases to spread throughout the field. It also increases soil fertility, whereas crop rotation prevents soil depletion, increases soil fertility, and reduces soil erosion. Both these methods reduce the need for fertilizers. It also helps in controlling weeds and controls the growth of pathogens and pests in crops.

Q4. What is genetic manipulation? How is it useful in agricultural practices?

Answer:

Genetic manipulationis a process where the gene for a particular character is introduced inside the chromosome of a cell. When the gene for a particular character is introduced in a plant cell, a transgenic plant is produced. These transgenic plants exhibit characters governed by the newly introduced gene.

For example, let us assume there is a wild plant that produces small fruits. If the gene responsible for a larger fruit size is introduced in this plant, this plant becomes transgenic, and starts producing larger fruits. Similarly, genes for higher yield, disease resistance, etc. can be introduced in any desired plant.

Therefore, gene manipulation plays an important role in agricultural practices. It helps in improving crop variety. It ensures food security and insect resistant crops. It also improves the quality and yield of crops.

Q5. How do storage grain losses occur?

Answer:

There are various biotic and abiotic factors that act on stored grains and result in degradation, poor germinability, discolouration, etc. Biotic factors include insects or pests that cause direct damage by feeding on seeds. They also deteriorate and contaminate the grain, making it unfit for further consumption. Abiotic factors such as temperature, light, moisture, etc., also affect the seed. They decrease the germinating ability of the seeds and make them unfit for future use by farmers. Unpredictable occurrence of natural calamities such as droughts and floods also causes destruction of crops.

Q6. How do good animal husbandry practices benefit farmers?

Answer:

Cattle farming is one of the methods of animal husbandry that is most beneficial for farmers. Using this method, better breeds of draught animals can be produced. Such draught animals are engaged in agricultural fields for labour work such as carting, irrigation, tilling, etc.

Q7. What are the benefits of cattle farming?
Answer:
Benefits of cattle farming:
(i) Good quality and quantity of milk can be produced.
(ii) Draught labour animals can be produced for agricultural work.
(iii) New variety that are resistant to diseases can be produced by crossing two varieties with the desired traits.

Q8. For increasing production, what is common in poultry, fisheries and bee-keeping?
Answer:
The common factor for increasing production in poultry, fisheries, and bee keeping is the proper management techniques that are to be followed. Regular cleaning of farms is of utmost importance. Maintenance of temperature and prevention and cure of diseases is also required to increase the number of animals.

Q9. How do you differentiate between capture fishing, mariculture and aquaculture?
Answer:
Capture fishing: It is the method of obtaining fishes from natural resources.
Mariculture: It is the culture of marine fishes for commercial use.
Aquaculture: It involves the production of aquatic animals that are of high economic value such as prawns, lobsters, fishes, crabs, etc.

ASSIGNMENT QUESTIONS SET – 1

CHAPTER – 15

IMPROVEMENT IN FOOD RESOURCES

Fill In the Blanks

1. _______________and _______________are the main sources of nutrient supply to crops.

2. _______________and _______________provide us with all our animal and plant food.

3. The science of growing vegetables, fruits and ornamental plants is called _______________.

4. Composting done using earthworms is called _______________.

5. Cereals provide us _______________ (carbohydrates/proteins/fats).

6. Pulses give us _______________(carbohydrates/proteins/fats).

7. _______________and _______________ are a rich source of vitamins and minerals.

8. Pests, nematodes etc. are _______________ (biotic/abiotic) factors that affect crop production.

9. In order to get maximum returns, different crop combinations are grown on the same field in a pre-planned succession. This process is called _______________.

10. Apis dorsata and Apis florae are varieties of _______________(Indian/Italian) bee.

11. Apis mellifera is an _______________ (India/Italian) variety of honey bee used for commercial production of honey.

12. Crossing between genetically dissimilar plants is called _______________.

13. Nutrients required by plants in large quantities are called _______________.

14. Organic substances of animal or plant origin that is added to the soil to increase its fertility and structure are called _______________.

15. The practice of growing two or more crops simultaneously on the same field is called _______________.

16. Unwanted plants in the cultivated field are called _______________.

17. Cattle used for farm labour is called _______________.

18. Vitamin _____ and ____ (A, B, C, D , K) levels are kept high in the poultry feeds.

19. Bos indicus are the species of _______________.

20. Pomphret, mackerel, tuna, sardines, and Bombay duck are examples of _______________(marine/river) fish.

21. Marine fish capture is done by fishing nets guided by _______________ and _______________.

22. Micro-nutrients or Food additives strengthen _______________ system of the cattle and improve their _______________ and stimulate digestion.

23. The basic advantages of inter-cropping are that it maintains soil _______________and controls _______________.

24. Red Sindhi and Sahiwal are breeds of _______________.

25. Xanthium, Cyperinus rotundus and Parthenium plants generally grow along paddy plants. Such plants are called _______________.

26. What is domestication?

27. What are the major sources of food? Name the commercial practices we perform to obtain the food.

28. Name the revolution which led to better and efficient production and availability of milk.

29. Define animal husbandry.

30. Name the programmes executed in India to increase food production.

31. What are the various crops seasons in India?

32. Name the approaches used to enhance crop yield.

33. What are milch animals?

34. What are draught animals?

35. What is broiler?

36. Give examples of cereals that give us carbohydrates.

37. Name some pulses that give us proteins.

38. Give examples of oilseeds that provide us fats.

39. Give examples of fodder crops.

40. Name the biotic factors that affect on crop production.

41. Name the nutrients that plants take from air?

42. From where do plants acquire the following nutrients?

(i) Nitrogen

(ii) Hydrogen

43. List the nutrients that plants absorb from soil.

44. What are manures?

45. What is the full form of IARI?

46. What are the desirable agronomic characteristics for crop improvement?

47. What are Macro-nutrients?

48. List examples of Macro-nutrients for plants?

49. List the seven micro-nutrients taken by plants?

50. Based on kinds of biological material used, how many types of manures are there?

51. What are fertilizers? Give two examples.

52. Out of manures and fertilizers, which one is nutrient specific?

53. What is the most common source of irrigation in India?

54. Give examples of commonly used irrigation systems in our country?

55. What is vermicompost?

56. Manures are useful for short term benefits or long-term benefits?

57. Fertilizers are useful for short term benefits or long-term benefits?

58. What is organic farming?

59. What is the full form of NPK?

60. What is lodging?

61. What is mixed cropping?

62. Give examples of mixed cropping?

63. Define inter-cropping.

64. Give examples of inter-cropping.

65. Name the two common weeds of wheat and rice crop.

66. What are weeds?

67. Give examples of Pesticides

68. Give examples of fumigants.

69. Give examples of two major weeds that grow during Kharif season.

70. Cereals largely fulfill which of the following energy requirement?

(a) Proteins

(b) Carbohydrates

(c) Fats

(d) Minerals

71. Which one is not a source of carbohydrate?

(a) Rice

(b) Millets

(c) Sorghum

(d) Gram

72. Which of the following is not included in 'organic farming'?

(a) compost and vermi-compost

(b) chemical fertilizers

(c) green manures

(d) crop rotation

73. Which one of the following species of honey bee is an Italian species?

(a) Apis dorsata

(b) Apis florae

(c) Apis cerana indica

(d) Apis mellifera

74. Which of the following is an incorrect statement regarding improvement in crop production?

(a) Tallness is desired in cereals.

(b) Profuse branching is good for fodder crops

(c) Variety resistance to biotic stress is a good factor to improve crops.

(d) Shorter duration of crop from sowing to harvesting is better option.

75. Which is the oldest breeding method?

(a) introduction

(b) hybridization

(c) mutation

(d) selection

76. Which of the following is not a type of biotic stress?

(a) diseases

(b) insect

(c) frost

(d) nematodes

77. Apiculture deals with

(a) Bee Keeping

(b) Rearing Pigs

(c) Rearing Cows and Buffaloes

(d) Rearing Silk Moths

78. Red Sindhi, Sahilwal, Jersey, Brown Swiss are breeds of

(a) Pigs

(b) Buffaloes

(c) Cows

(d) Fowl

79. Which of the following is not a marine fish?

(a) pomphret

(b) mackerel

(c) catla

(d) sardines

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 15
IMPROVEMENT IN FOOD RESOURCES

1. State one demerit with composite fish culture system.

2. State one importance of photoperiod in agriculture.

3. Name one micronutrient and one macronutrient which plants take from the soil.

4. List two desirable traits for fodder crops.

5. Distinguish between a mullet and a prawn.

6. Name two breeds of cows selected for long lactation period.

7. How does Bombay duck differ from common carp ?

8. How does catla differ from mrigal?

9. Name the two vitamins which are added in the poultry feed.

10. From where do plants acquire the following nutrients?

(a) Nitrogen

(b) Hydrogen

11. State the reason of introducing Italian bee variety in bee farms.

12. Mention any two activities for the improvement of crop yield.

13. Which nutrients are supplied by cereals and pulses ?

14. Name two fresh initiatives taken to increase the water availability for agriculture.

15. Mention any two advantages of using Italian bee variety in honey production.

16. Name any two weeds of crop field.

17. Define animal husbandry.

18. What are genetically modified crop?

19. Mention the components of food present in vegetable and fruits.

20. Name the cereals which provide us carbohydrate for energy requirement.

21. Give technical term for milk producing females and farm labour animals.

22. Why do we eat pea and groundnut?

23. Name two types of animal feed.

24. Give the full form of FYM.

25. Name two main factors responsible for loss during storage of grain.

26. How much damage to crops can be caused by insects, pests and diseases?

27. Name four macro nutients important for plants.

28. What is green revolution?

29. What was the aim of white revolution?

30. Name a marine fish.

31. Name the technique of culturing marine fish.

32. Which vitamins are found high in broilers?

33. Which Indian scientist is considered as the father of green revolution?

34. Name a fibres yielding crop.

35. Name four types of irrigation systems adopted in our country.

36. Name the members of a honey-bee family.

37. Give two hazards of using fertilizers.

38. Mention two examples of mixed cropping.

39. Name two factors responsible for losses of grains during storage?

40. Name an exotic variety of honey bee grown in India.

41. What is called the rearing of fish on a large scale?

42. List any two methods adopted in farming for the health of the cattle.

43. List the two types of food requirements of dairy animals.

44. What are rabi crops? State any two examples.

45. List two demerits of the continuous use of fertilizers.

46. List any two advantages of crop rotation.

47. List two characteristics each of roughage and concentrate in relation to animal feed.

48. Mention the two types of food requirements of dairy animals.

49. "Removal of weeds from cultivated fields during the early stages of growth of crops is essential for a good harvest". Justify the statement.

50. Farmers use bee-keeping as an additional income generating activity. Give two reasons.

51. Name any one bottom feeder that can be grown in composite fish culture.

52. What are the problems faced in such a culture ? How are they overcome?

53. The shorter the duration of the crop the more economical is the variety. Justify this statement.

54. What are the long term benefits of using manure in crop production?

55. What is the major problem is fish farming? How is this problem overcome?

56. How can insect/pests in crop plants and stored grains be controlled?

57. What is meant by the term 'green manure'? State its role in agriculture.

58. How is green manuring done? How is it useful for the soil?

59. What is pasturage and has how is it related to honey production?

60. What are Rabi and Kharif crops? Give two examples each.

61. Name two biotic and two abiotic factors that affects crop production.

62. What is meant by organic farming?

63. Compare the use of manure and fertilizers in maintaining soil fertility.

64. What is meant by sustainable agriculture?

65. What are macronutrients and why are they named so? Give examples also.

66. Which component of food is present in pulses ? Also mention its function in the body.

67. Define-green manure and vermicompost.

68. Differentiate between bee keeping and poultry farming.

69. Give two merits and two demerits of fish culture.

70. Suggest two preventive measures for the diseases of poultry birds.

71. List out four useful traits in improved crop?

72. What is a GM crop? Name any one such crop which is grown in India.

73. Define the term photoperiod.

74. Group the following and tabulate them as energy yielding, protein yielding, oil yielding and fodder crop.

75. What type of crops are generally raised in green fields?

76. Write four points on human dependence on plants and animals for food.

77. Distinguish between intercropping and mixed cropping. List any two advantages of intercropping over mixed cropping.

78. State three management practices that are common in dairy and poultry farming.

79. List any three desirable characters of bee varieties suitable for honey production?

80. List any three ways by which the insect/pests attack the plants.

81. List any three desirable characters of bee varieties suitable for honey production?

82. List any six factors for which variety improvement in crops is done.

ASSIGNMENT QUESTIONS SET – 3

CHAPTER – 15

IMPROVEMENT IN FOOD RESOURCES

1. Which one is an oil yielding plant among the following?

(a) Lentil

(b) Sunflower

(c) Cauliflower

(d) Hibiscus

2. Which one is not a source of carbohydrate?

(a) Rice

(b) Millets

(c) Sorghum

(d) Gram

3. Find out the wrong statement from the following

(a) White revolution is meant for increase in milk production

(b) Blue revolution is meant for increase in fish production

(c) Increasing food production without compromising with environmental quality is called as sustainable agriculture

(d) None of the above

4. To solve the food problem of the country, which among the following is necessary?

(a) Increased production and storage of food grains

(b) Easy access of people to the food grain

(c) People should have money to purchase the grains

(d) All of the above

5. Find out the correct sentence

(i) Hybridisation means crossing between genetically dissimilar plants

(ii) Cross between two varieties is called as inter specific hybridisation

(iii) Introducing genes of desired character into a plant gives genetically modified crop

(iv) Cross between plants of two species is called as inter varietal hybridisation

(a) (i) and (iii)

(b) (ii) and (iv)

(c) (ii) and (iii)

(d) (iii) and (iv)

6. Weeds affect the crop plants by

(a) killing of plants in field before they grow

(b) dominating the plants to grow

(c) competing for various resources of crops (plants) causing low availability of nutrients

(d) all of the above.

7. Which one of the following species of honey bee is an Italian species?

(a) *Apis dorsata*

(b) *Apis florae*

(c) *Apis cerana indica*

(d) *Apis mellifera*

8. Find out the correct sentence about manure

(i) Manure contains large quantities of organic matter and small quantities of nutrients.

(ii) It increases the water holding capacity of sandy soil.

(iii) It helps in draining out of excess of water from clayey soil.

(iv) Its excessive use pollutes environment because it is made of animal excretory waste.

(a) (i) and (iii)

(b) (i) and (ii)

(c) (ii) and (iii)

(d) (iii) and (iv)

9. Cattle husbandry is done for the following purposes

(i) Milk Production

(ii) Agricultural work

(iii) Meat production

(iv) Egg production

(a) (i), (ii) and (iii)

(b) (ii), (iii) and (iv)

(c) (iii) and (iv)

(d) (i) and (iv)

10. Which of the following are Indian cattle?

(i) *Bos indicus*

(ii) *Bos domestica*

(iii) *Bos bubalis*

(iv) *Bos vulgaris*

(a) (i) and (iii)

(b) (i) and (ii)

(c) (ii) and (iii)

(d) (iii) and (iv)

11. Which of the following are exotic breeds?

(i) Brawn

(ii) Jersey

(iii) Brown Swiss

(iv) Jersey Swiss

(a) (i) and (iii)

(b) (ii) and (iii)

(c) (i) and (iv)

(d) (ii) and (iv)

12. Poultry farming is undertaken to raise following

(i) Egg production

(ii) Feather production

(iii) Chicken meat

(iv) Milk production

(a) (i) and (iii)

(b) (i) and (ii)

(c) (ii) and (iii)

(d) (iii) and (iv)

13. Poultry fowl are susceptible to the following pathogens

(a) Viruses

(b) Bacteria

(c) Fungi

(d) All of the above

14. Which one of the following fishes is a surface feeder?

(a) Rohus

(b) Mrigals

(c) Common carps

(d) Catlas

15. Animal husbandry is the scientific management of

(i) animal breeding

(ii) culture of animals

(iii) animal livestock

(iv) rearing of animals

(a) (i), (ii) and (iii)

(b) (ii), (iii) and (iv)

(c) (i), (ii) and (iv)

(d) (i), (iii) and (iv)

16. Which one of the following nutrients is not available in fertilizers?

(a) Nitrogen

(b) Phosphorus

(c) Iron

(d) Potassium

17. Preventive and control measures adopted for the storage of grains include

(a) strict cleaning

(b) proper disjoining

(c) fumigation

(d) all of the above

18. Match the column A with the column B

(A)	(B)
(a) Catla	(i) Bottom feeders
(b) Rohu	(ii) Surface feeders
(c) Mrigal	(iii) Middle-zone feeders
(d) Fish farming	(iv) Culture fishery

19. Fill in the blanks

(a) Pigeon pea is a good source of ———.

(b) Berseem is an important———crop.

(c) The crops which are grown in rainy season are called———crops.

(d) ———are rich in vitamins.

(f) ——— crop grows in winter season.

20. What is a GM crop? Name any one such crop which is grown in India.

21. List out some useful traits in improved crop?

22. Why is organic matter important for crop production?

23. Why is excess use of fertilizers detrimental for environment?

24. Give one word for the following

(a) Farming without the use of chemicals as fertilizers, herbicides and pesticides is known as ———.

(b) Growing of wheat and groundnut on the same field is called as ———.

(c) Planting soyabean and maize in alternate rows in the same field is called as ———.

(d) Growing different crops on a piece of land in pre-planned succession is known as———.

(e) *Xanthium* and *Parthenium* are commonly known as———.

(f) Causal organism of any disease is called as ———.

25. Match the following A and B

(A)	(B)
(a) Cattle used for tilling and carting	(i) Milk producing female
(b) Indian breed of chicken	(ii) Broiler
(c) Sahiwal, Red Sindhi	(iii) Drought animals
(d) Milch	(iv) Local breed of cattle
(e) Chicken better fed for obtaining meat	(v) Aseel

26. If there is low rainfall in a village throughout the year, what measures will you suggest to the farmers for better cropping?

27. Group the following and tabulate them as energy yielding, protein yielding, oil yielding and fodder crop: Wheat, rice, berseem, maize, gram, oat, pigeon gram, sudan grass, lentil, soyabean, groundnut, castor and mustard.

28. Define the term hybridization and photoperiod.

29. Fill in the blanks

(a) Photoperiod affect the————.

(b) Kharif crops are cultivated from————to————.

(c) Rabi crops are cultivated from————to————.

(d) Paddy, maize, green gram and black gram are————crops.

(e) Wheat, gram, pea, mustard are————crops.

30. Cultivation practices and crop yield are related to environmental condition. Explain.

31. Fill in the blanks

(a) A total of———nutrients are essential to plants.

(b) ———and———are supplied by air to plants.

(c) ———is supplied by water to plants.

(d) Soil supply———nutrients to plants.

(e) ———nutrients are required in large quantity and called as———.

(f) ——— nutrients are needed in small quantity for plants and are called ———.

32. Differentiate between compost and vermicompost?

33. Arrange these statements in correct sequence of preparation of green manure.

(a) Green plants are decomposed in soil.

(b) Green plants are cultivated for preparing manure or crop plant parts are used.

(c) Plants are ploughed and mixed into the soil.

(d) After decomposition it becomes green manure.

34. An Italian bee variety *A. mellifera* has been introduced in India for honey production. Write about its merits over other varieties.

35. In agricultural practices, higher input gives higher yield. Discuss how?

36. Discuss the role of hybridisation in crop improvement.

37. Define (i) Vermicompost

(ii) Green manure

(iii) Bio fertilizer

38. Discuss various methods for weed control.

39. Differentiate between the following

(i) Capture fishery and Culture fishery

(ii) Mixed cropping and Inter cropping

(iii) Bee keeping and Poultry farming

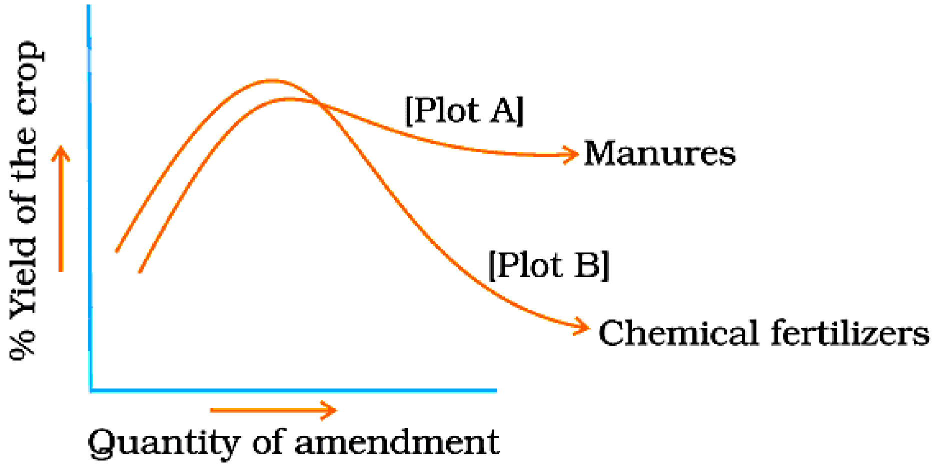
40. Give the merits and demerits of fish culture?

41. Below Figure shows the two crop fields [Plots A and B] have been treated by manures and chemical fertilizers respectively, keeping other environmental factors same. Observe the graph and answer the following questions.

(i) Why does plot B show sudden increase and then gradual decrease in yield?

(ii) Why is the highest peak in plot A graph slightly delayed?

(ii) What is the reason for the different pattern of the two graphs?



42. What do you understand by composite fish culture?

43. Why bee keeping should be done in good pasturage?

44. Write the modes by which insects affect the crop yield.

45. Discuss why pesticides are used in very accurate concentration and in very appropriate manner?

46. Name two types of animal feed and write their functions.

47. What would happen if poultry birds are larger in size and have no summer adaptation capacity? In order to get small sized poultry birds, having summer adaptability, what method will be employed?

48. Suggest some preventive measures for the diseases of poultry birds.

49. Complete the crossword puzzle:

		10							
	1			2			6		
8									7
				3		4			
9									
		5							

Across

1. Oil yielding plant (9)

3. Crop grown in winter season (4)

5. Fixed by *Rhizobium* (8)

9. Common honey bee (4)

Downward

2. Animal feed (6)

4. A micronutrient (5)

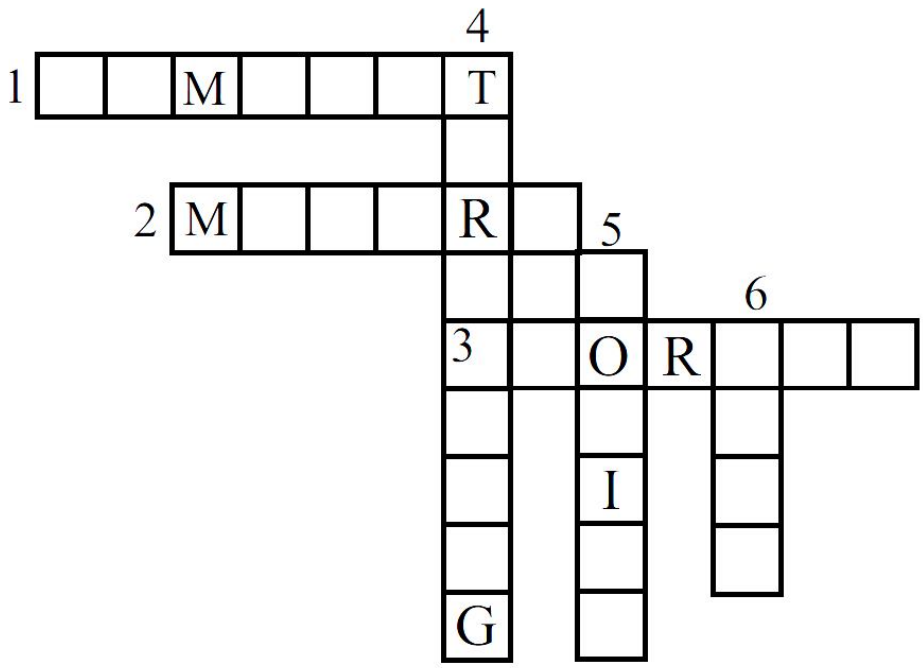
6. Unwanted plant in crop fields (4)

7. An exotic breed of chicken(7)

8. Bottom feeders in fish pond(7)

10. A marine fish (4)

50. Complete the crossword puzzle :



Across

1. It is prepared from rotten vegetable matter and animal refuse.

2. A major source of nutrients in fields and an organic substance.

3. The cereal grains are dried before___.

Downward

4. Removal of the grains from the chaff.

5. The process of putting the seeds in the soil.

6. The winter season crops like wheat, barley, gram, pea. etc are called.

CHEMISTRY

REFERENCE STUDY MATERIAL

for

CLASS – IX

2017 – 18

CHAPTER WISE CONCEPTS, FORMULAS AND QUESTIONS INLCUDING HOTS QUESTIONS

CHAPTER – 1

MATTER IN OUR SURROUNDINGS

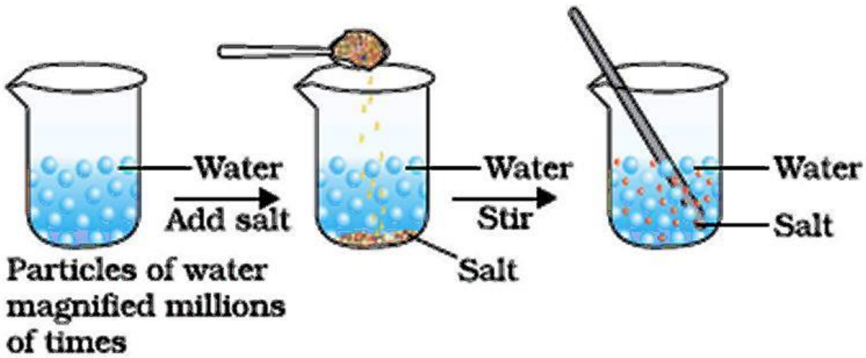
All matters in the universe exist in three states. There are two ways of classification of matter.
1. According to physical state as solid, liquid or gas.
2. According to its composition as element, compound or mixture.

CHARACTERISTICS OF PARTICLES OF MATTER

PARTICLES OF MATTER HAVE SPACE BETWEEN THEM- when we make tea, coffee or lemonade (nimbu paani), particles of one type of matter get into the spaces between particles of the other. This shows that there is enough space between particles of matter. Similarly particles of sugar, salt, Dettol, or potassium permanganate get evenly distributed in water.

PARTICLES OF MATTER ARE CONTINUOUSLY MOVING- Particles of matter are continuously moving, that is, they possess what we call the kinetic energy. As the temperature rises, particles move faster. So, we can say that with increase in temperature the kinetic energy of the particles also increases.

PARTICLES OF MATTER ATTRACT EACH OTHER- Particles of matter have force acting between them. This force keeps the particles together. The strength of this force of attraction varies from one kind of matter to another.



INTEXT QUESTIONS PAGE NO. 3

Q1. Which of the following are matter?
Chair, air, love, smell, hate, almonds, thought, cold, colddrink, smell of perfume.
Answer: Chair, air, smell, almonds, cold-drink and smell of perfume are matter because they have some weight and occupy space.

Q2. Give reasons for the following observation:
The smell of hot sizzling food reaches you several metres away, but to get the smell from cold food you have to go close.
Answer: Hot food evaporates easily. Its vapours diffuse between the air molecules and reach within a short time to a distant place. But the case is different with the cold food because it remains in solid form and does not mix with air molecules, so we have to go close to smell it.

Q3. A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?
Answer: The phenomena of cutting the water by the diver show that matter has space between its particles.

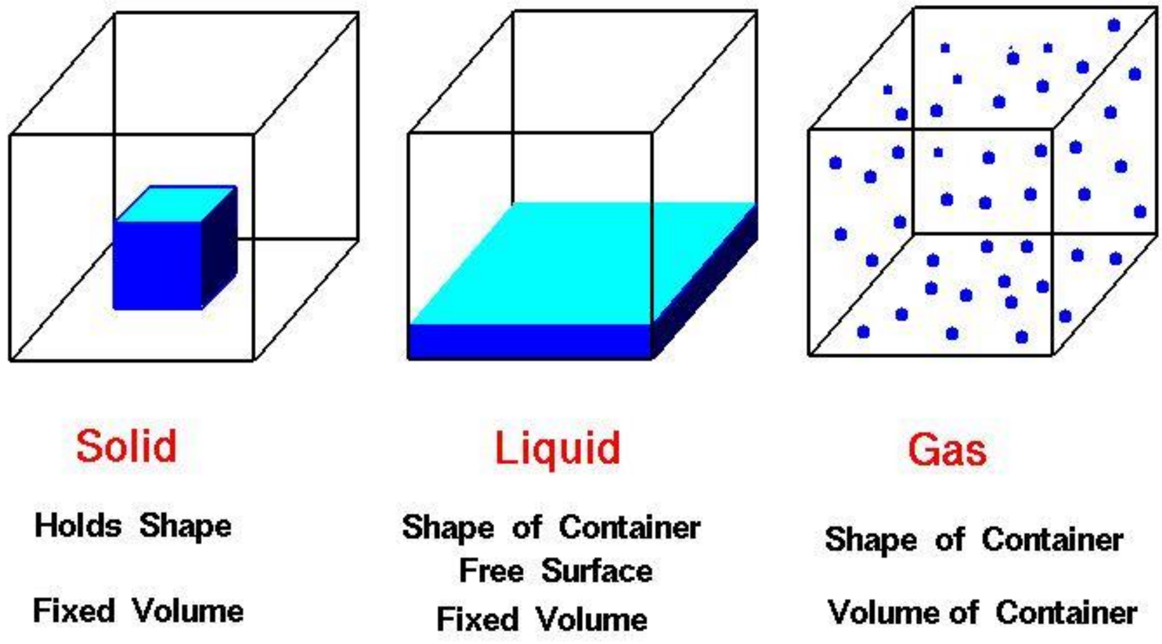
Q4. What are the characteristics of the particles of matter?
Answer: Characteristics of particles of matter :
1. Particles of matter have space between them.
2. Particles of matter are continuously moving.
3. Particles of matter have an attraction force between them.
4. Particles of matter are very small in size.

STATES OF MATTER

1. THE SOLID STATE- all solids have a definite shape, distinct boundaries and fixed volumes, that is, have negligible compressibility. Solids have a tendency to maintain their shape when subjected to outside force. Solids may break under force but it is difficult to change their shape, so they are rigid.

2. THE LIQUID STATE- Liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept. Liquids flow and change shape, so they are not rigid but can be called fluid. The rate of diffusion of liquids is higher than that of solids. This is due to the fact that in the liquid state, particles move freely and have greater space between each other as compared to particles in the solid state.

3. THE GASEOUS STATE- Gases are highly compressible as compared to solids and liquids. The liquefied petroleum gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders is compressed gas. In the gaseous state, the particles move about randomly at high speed. Due to this random movement, the particles hit each other and also the walls of the container.



INTEXT QUESTIONS PAGE NO. 6

Q1. The mass per unit volume of a substance is called density. (density = mass/volume). Arrange the following in order of increasing density – air, exhaust from chimneys, honey, water, chalk, cotton and iron.
Answer: The order of density is gas< liquid< solid. Thus,

$$\underbrace{\text{Air, exhaust from chimneys}}_{\text{Gas}}, \underbrace{\text{water, honey}}_{\text{Liquid}}, \underbrace{\text{cotton, chalk, iron}}_{\text{Solid}}$$

$$\xrightarrow[\text{Increasing order of density}]{\hspace{8cm}}$$

Q2. (a) Tabulate the differences in the characteristics of states of matter.
Answer:
(a) The differences in the characteristics of states of matter are given in the following table.

S. No.	Solids	Liquids	Gases
1	Definite shape and volume.	No definite shape. Liquids attain the shape of the vessel in which they are kept.	Gases have neither a definite shape nor a definite volume.
2	Incompressible	Compressible to a small extent.	Highly compressible
3	There is little space between the particles of a solid.	These particles have a greater space between them.	The space between gas particles is the greatest.
4	These particles attract each other very strongly.	The force of attraction between liquid particles is less than solid particles.	The force of attraction is least between gaseous particles.
5	Particles of solid cannot move freely.	These particles move freely.	Gaseous particles are in a continuous, random motion.

(b) Comment upon the following: rigidity, compressibility, fluidity, filling a gas container, shape, kinetic energy and density.
Answer:
(i) **Rigidity** The property due to which an object retains its shape and size is known as rigidity. Solids are rigid whereas liquids and gases are not.

(ii) **Compressibility** Compressibility is the property due to which a substance can be compressed, *i.e.*, its volume can be decreased. Gases are compressible whereas solids and liquids are not.

(iii) **Fluidity** The property due to which a substance tends to flow is called fluidity. Gases and liquids are fluids, solids are not.

(iv) **Filling a gas container** A gas can be filled in a gas container by compressing it under high pressure. The property of compressibility (of gases) helps them in this regard.

(v) **Shape** The property of having a definite geometry is called shape of a particular substance. Solids have a definite shape whereas gases and liquids do not have.

(vi) **Kinetic energy** The energy possessed by an object or by the molecules of an object due to its state of motion is called kinetic energy. Molecules of gases posses highest kinetic energy. Increasing the temperature also increases the kinetic energy of a substance (or its molecules).

(vii) **Density** The mass per unit volume of a substance is called density.

Q3. Give reasons

(a) A gas fills completely the vessel in which it is kept.

Answer: There is little attraction between particles of gas. Thus, gas particles movefreely in all directions. Therefore, gas completely fills the vessel in which it is kept.

(b) A gas exerts pressure on the walls of the container.

Answer: Particles of gas move randomly in all directions at high speed. As a result, theparticles hit each other and also hit the walls of the container with a force. Therefore, gas exerts pressure on the walls of the container.

(c) A wooden table should be called a solid.

Answer: A wooden table has a definite shape and volume. It is very rigid and cannot be compressed i.e., it has the characteristics of a solid. Hence, a wooden table should be called a solid.

(d) We can easily move our hand in air but to do the same through a solid block of wood we need a karate expert.

Answer: Particles of air have large spaces between them. On the other hand, wood has little space between its particles. Also, it is rigid. For this reason, we can easily move our hands in air, but to do the same through a solid block of wood, we need a karate expert.

Q4. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why.

Answer: The mass per unit volume of a substance is called density (density = mass/volume). As the volume of a substance increases, its density decreases. Though ice is a solid, it has large number of empty spaces between its particles. These spaces are larger as compared to the spaces present between the particles of water. Thus, the volume of ice is greater than that of water. Hence, the density of ice is less than that of water. A substance with lower density than water can float on water. Therefore, ice floats on water.

PROCESS OF CHANGE OF STATES OF MATTER:

• Vaporization
• Condensation
• Freezing
• Melting
• Sublimation
• Evaporation

VAPORIZATION:(CHANGE OF LIQUID INTO GAS):

The process of change of water into vapor is called vaporization. When water is heated after reaching at 100^0C water starts boiling. At this temperature water turns into vapour. Since, water boils at 100^0C, hence 100^0C is called the boiling point of water.

BOILING POINTS

The common definition of boiling point is, the temperature at which a liquid boils is called its boiling point. Different liquid boils at different temperatures.

CONDENSATION:(CHANGE OF GAS INTO LIQUID)-

The change of vapor into water because of decrease in temperature is called condensation. Condensation is the reverse process of vaporization. When the temperature of vapor decreases it changes into water, this process is known as condensation.

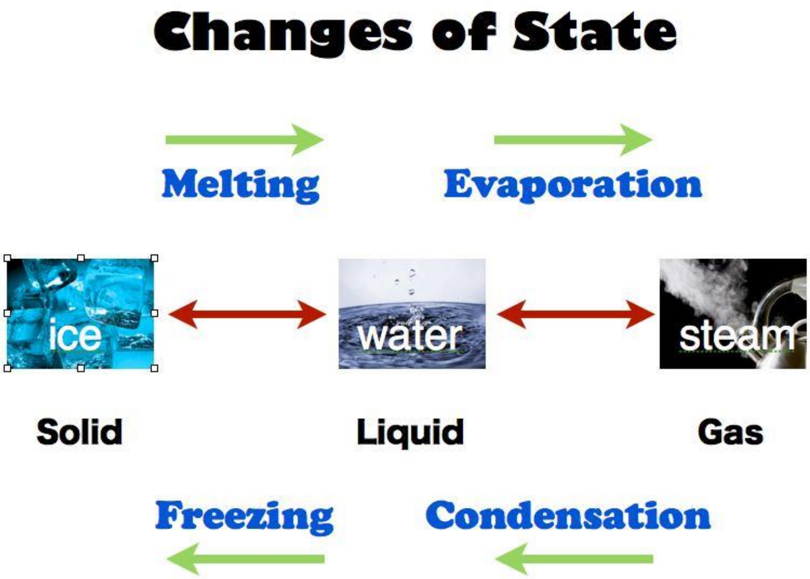
Distilled water is manufactured by the condensation of vapor. The process of making of distilled water is known as distillation. In distillation first water is boiled to vaporize and the vapor is cooled, i.e. condensed to get distilled water.

FREEZING:(CHANGE OF LIQUID INTO SOLID) -

The change of liquid into solid because of decrease in temperature is called freezing. Water change into ice because of decrease in temperature, in other words water freezes into ice because of decrease in temperature. Water freezes at 0^0C.

MELTING:(CHANGE OF SOLID INTO LIQUID)

The change of solid into liquid due to increase in temperature is known as melting. Ice, which is a solid melts, i.e. changes into water at 0^0C.



LATENT HEAT

When water is heated up-to 100^0C it starts boiling and changes into vapor. But we see that even after continuous supply of heat temperature does not rise above the 10^0C while boiling of water.

Temperature supplied after 10^0C to boiling water is used to change the water into vapor and temperature of water does not rise.

On the other hand we see that when heat is supplied to ice, temperature does not rise above the 0^0C, until all ice melts. In this process also the heat supplied to ice after 0^0C is used to change of ice into water and temperature of ice does not rise.

- Heat is used in these processes without rise in temperature is known as Latent Heat. The latent heat is used in change of states of matter, such as from solid to liquid or from liquid to gas without rising in temperature.
- Hence, Latent heat is the heat released or absorbed by a body during the process without change in temperature of the system. This happens while change of state of matter meaning a phase transition. Example - Melting of ice, boiling of water.

The particles of solid and liquid are bonded together with great force of attraction, because of which a matter exists in a particular state. When we supply heat to a solid or liquid, the heat is supplied without come in notice is used to break the force of attraction between particles and this heat is not used to increase the kinetic energy of particles. Since, kinetic energy of particles do not increase we do not see any rise in temperature of the system.

The word 'latent' is derived from the Latin word 'Latere" which means "to lie hidden". Joseph Black introduced the term Latent heat around 1762.

TYPES OF LATENT HEAT :
• Latent heat of fusion
• Latent heat of vaporization

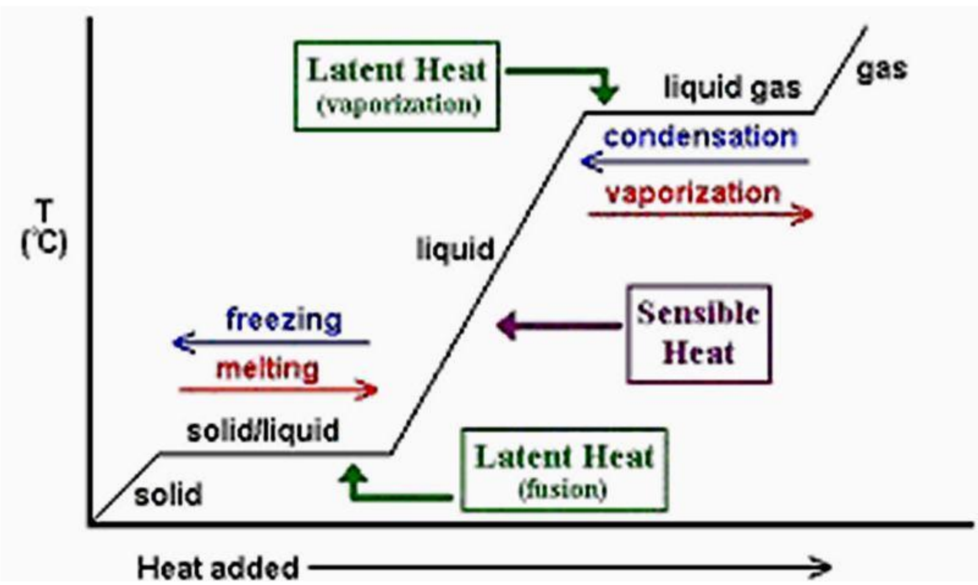
LATENT HEAT OF FUSION (MELTING OR FREEZING):
When solid changes into liquid, the head required changing the state without rising in temperature is called the Latent Heat of Fusion.
The change of solid to liquid state is an endothermic reaction as heat is required in it. The reaction in which heat is supplied or used is called endothermic reaction or process.
Let us take the example of melting of ice.
When heat is supplied to melt ice, temperature does not rise from 0^0C even after continuous supply of heat till all ice melts. After melting of all ice temperature starts rising. The additional heat is required to melt the ice without coming into notice is the latent heat of fusion.

- The latent heat of fusion of ice is the energy which is used to change the state of ice (solid) to water (liquid).
- The quantity of heat required to convert I kilogram of solid to liquid without any change in temperature is called Latent Heat of fusion.
- The heat required is measured in joules (J).

3.34×10^5 joules of heat is required to convert 1 kilogram of ice into water at its melting point. Thus, the heat of fusion of ice at its melting point = 3.34×10^5 joules.

LATENT HEAT OF VAPORIZATION:
When liquid changes into gas because of rise in temperature, the heat required changing the state without rising in temperature is called the Latent Heat of vaporization.
The change of liquid to gaseous state is an endothermic reaction as heat is required in it.
Let us take the example of boiling of water.
Water boils at 100^0C. When heat is supplied to water temperature does not rise after 100^0C even after continuous supply of heat. The heat supplied at this stage is used to change water into vapor and hence does not come into notice. The additional heat is required to change the water into vapor without coming into notice is the latent heat of vaporization.

- The latent heat of vaporization of water is the energy which is used to change the state of water (liquid) to vapor (gas).
- 22.5×10^5 J energy is required to convert 1 kilogram of water into vapor. Hence, the latent heat of water is equal to 22.5×10^5 J per kilogram or it is written as 22.5×10^5 J/kg.
- Different liquid has different latent heat of vaporization.



SUBLIMATION:

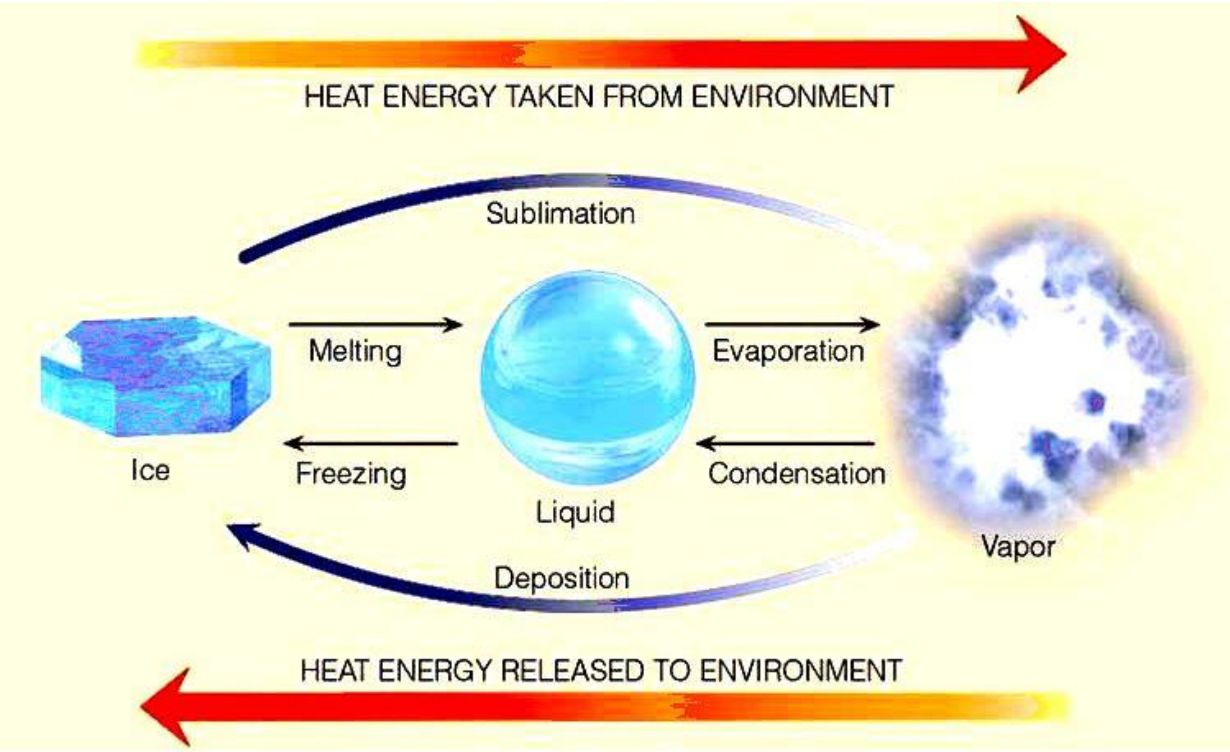
The process in which a solid changes into vapor without changing into liquid and from vapor changes into solid without changing into liquid is known as sublimation.

Generally solid first changes into liquid and then changes into gas because of rise in temperature. But there are many substances, which change into gas without changing into liquid and changes into solid from gas without changing into liquid. Such substances, which go under sublimation, are known as sublime.

For example – camphor, naphthalene balls, ammonium chloride, iodine, dry ice, etc.

The solid obtained after cooling of the gas of sublime is called Sublimate. The process of cooling of vapor of sublime to get sublimate is also known as 'sublimation' although it is also known as deposition.

When camphor is heated it changes into vapor without changing into liquid. When the vapor of camphor is cooled it changes into solid without changing into liquid.



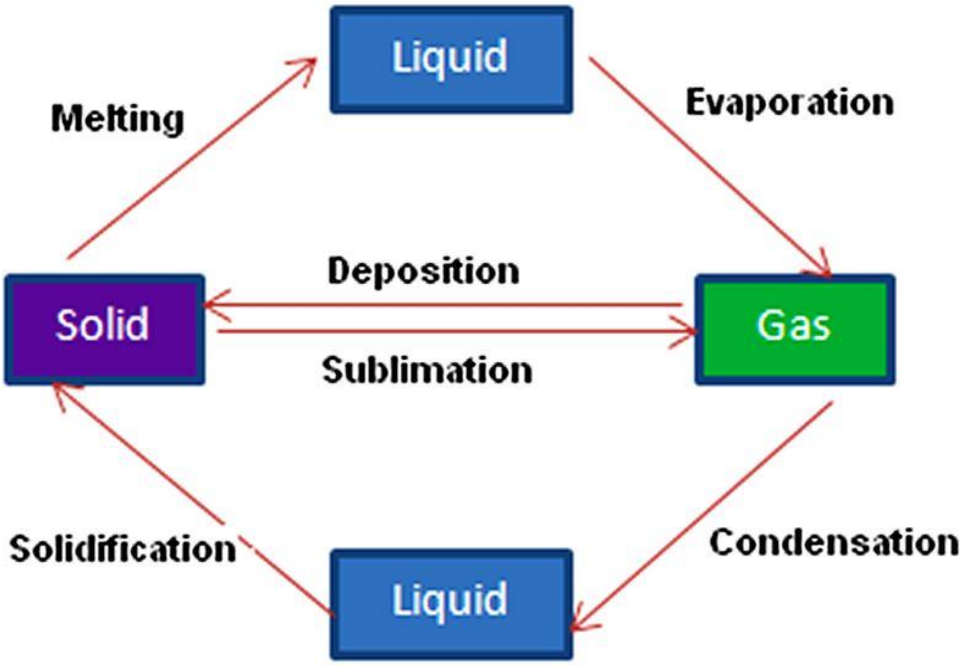
SUBLIMATION IN EVERYDAY LIFE:

The dry ice (solid carbon dioxide) turns into vapor without changing into liquid and is considered as sublime. Because of this property dry ice is used to give the illusion of smoke or cloud on the stage in movies and stage shows.

Naphthalene balls are kept with cloths and documents to protect them from insects. Since naphthalene balls go under sublimation, hence it changes into vapor without changing into liquid and its vapor prevent the insects to come or stay in cloths or documents. This protects the documents and cloths to get destroyed.

We usually see that the size of naphthalene balls decrease gradually and finally disappeared when they are kept in open. This happens because of sublimation of naphthalene.

Naphthalene balls are used in toilets also as disinfectant and air freshener.



Inter conversion of states of matter

INTEXT QUESTIONS PAGE NO. 3

Q1. Convert the following temperature to celsius scale:
a) 300 K b) 573 K.
Answer: (a) 300 K = (300 − 273)°C = 27°C
(b)573 K = (573 − 273)°C = 300°C

Q2. What is the physical state of water at:
a) 250^0C b) 100^0C ?
Answer:
(a) Water at 250°C exists in gaseous state.
(b) At 100°C, water can exist in both liquid and gaseous form. At this temperature, after getting the heat equal to the latent heat of vaporization, water starts changing from liquid state to gaseous state.

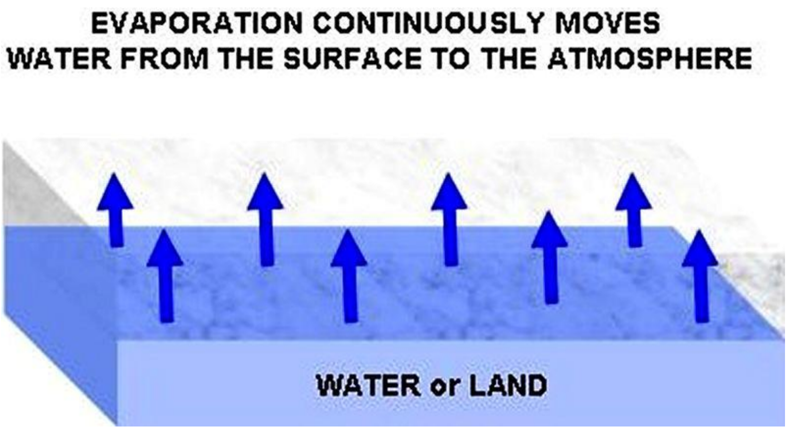
Q3. For any substance, why does the temperature remain constant during the change of state?
Answer: During a change of state, the temperature remains constant. This is because all the heat supplied to increase the temperature is utilised in changing the state by overcoming the forces of attraction between the particles. Therefore, this heat does not contribute in increasing the temperature of the substance.

Q4. Suggest a method to liquefy atmospheric gases.
Answer: Applying high pressure and cooling a gas to low temperature helps in the liquifaction of atmospheric gases. The reason is that under such conditions of temperature and pressure, the molecules of gases come closer, their kinetic energy becomes less and the gas is liquefied.

EVAPORATION
The change of liquid into vapor without reaching at its boiling point is called Evaporation. Evaporation takes place only at the surface of liquid while vaporization takes place on the whole mass of liquid.

Evaporation takes place even at room temperature also. Evaporation speeds up with rise in temperature.
When water or other liquid is left in open, gradually its volume decreases. If you left some water in a pot in open, after two or three days water disappears. If the water left in garden or in a open balcony, it disappears quickly than kept in a room. This happens because of evaporation.

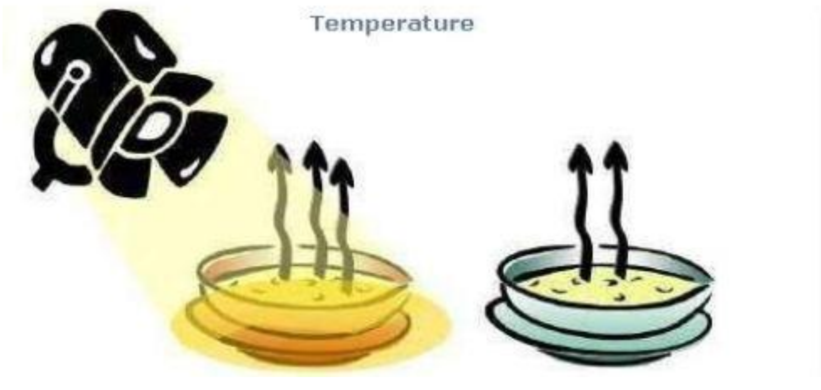
PROCESS OF EVAPORATION
Molecules at the surface of water, when exposed some temperature, their kinetic energy increases. Because of increase in kinetic energy those molecules become able to overcome the force of attraction between the particles of liquid. After getting required kinetic energy and decrease in force of attraction, they escape in the air in the form of vapor. Additionally those kinetic energy get some of the required kinetic energy from their neighboring molecules also because of which the temperature of the adjacent molecules decrease, which finally result in decrease of the temperature of surface of liquid.



FACTORS AFFECTING THE EVAPORATION

- Temperature
- Pressure
- Surface area
- Humidity in air
- Wind speed

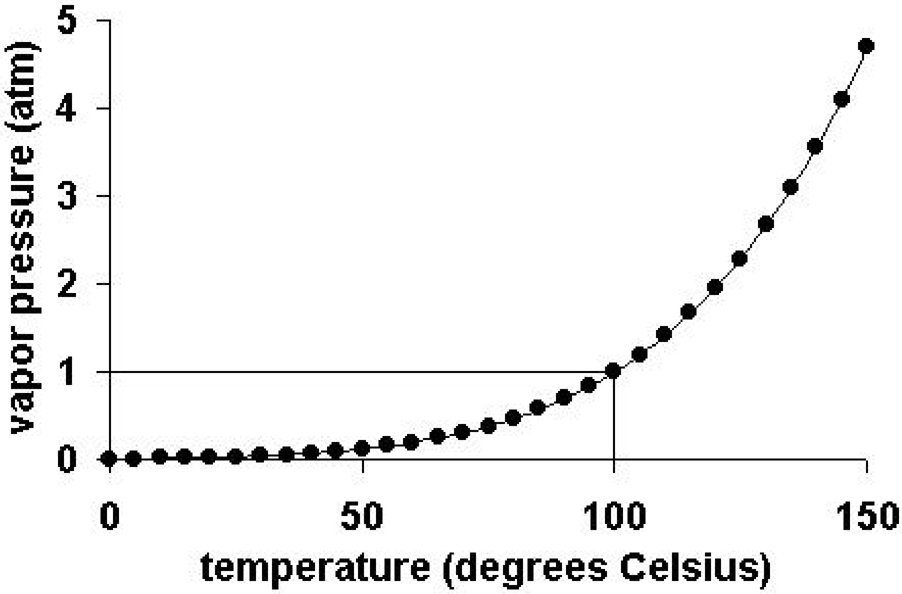
TEMPERATURE
Evaporation increases with increase in temperature and decreases with decrease in temperature. This means rate of evaporation is directly proportional to the temperature.
With increase in temperature the particles of liquid at surface get required kinetic energy to overcome the force of attraction and escape in air quickly. Hence, the increase in temperature increases the rate of evaporation.



PRESSURE

Evaporation decreases with increase in pressure and increases with decrease in pressure. This means the rate of evaporation is indirectly proportional to the pressure.

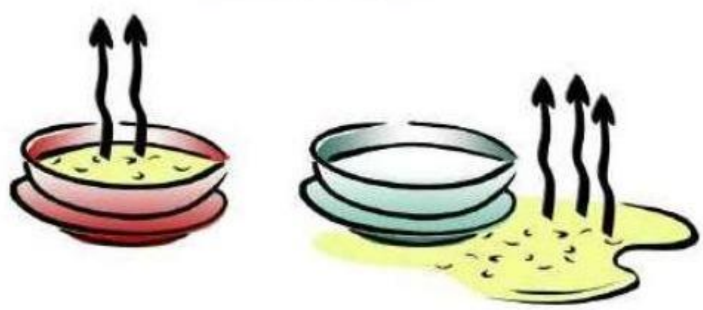
Particles at the surface of liquid require more kinetic energy to escape in air when there is more pressure over it and hence rate of evaporation will decrease. While if there is less pressure over the surface of liquid, the particles would require less kinetic energy to escape in air and hence rate of evaporation will increase. Therefore, increase in pressure slows down the rate of evaporation and decrease in pressure speeds up the rate of evaporation.



SURFACE AREA

Evaporation increases with increase in surface area and decreases with decrease in surface area.

Since evaporation takes place at the surface of liquid only, hence if the more surface of liquid is exposed to atmosphere more particles will receive the required temperature to get the required kinetic energy to escape in air. Therefore, evaporation takes place more rapidly with larger surface area. This means rate of evaporation increases with increase in surface area and decreases with decrease in surface area.

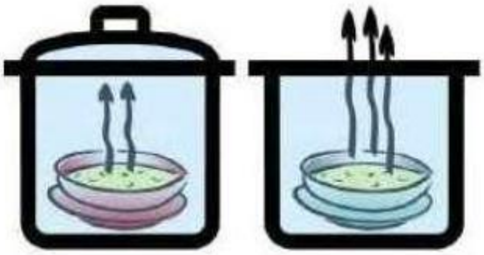


After rain roads are dried up quickly than pot holes. This happens because of increase in surface area of water. On roads water is spread over a large area, because of that large area of water exposed to atmosphere, and evaporation of water takes place quickly resulting in quickly drying of the roads. While in pot holes less water surface is exposed to air because of that less water area could come in contact with air and receives less temperature, resulting in delayed evaporation. That's why water dried from road quickly than in pot holes.

Wet clothes are spread up over the laundry line to get them dried up quickly. More surface area of water exposes to the air because of spreading of clothes this speeds up the rate of evaporation and clothes are dried up quickly. On the other hand if wet clothes are left even in the sun without spreading, they take more time to get dried because of less surface area

exposed to air. That's why wet clothes are kept spread over laundry line to get dried up quickly.
Water kept in a plate evaporates quickly than water kept in a tumbler (glass). This happens because in plate more surface area of water exposed to atmosphere which receives more heat and evaporates quickly. While in a glass less surface area of water exposed to atmosphere because of that less molecules of water receives heat from the atmosphere and evaporates slowly compare to the water exposed with large surface area.
Hence, rate of evaporation increases with increase in surface area and decreases with decrease the surface area.

HUMIDITY IN AIR AND EVAPORATION
Evaporation decreases with increase in humidity and increases with decrease in humidity present in air. This means rate of evaporation is indirectly proportional to the humidity present in air.
Humidity is the amount of water vapor present in air. In weather reports, which are published in news paper or given on the TVs channels, the humidity percent is given, which shows the percent of water vapor present in air.
Because of more water vapor present in air the water holding capacity of atmosphere decreases which decrease the rate of evaporation. If air is dry then it can holds more water and thus in dry air rate of evaporation increases.
This is the cause that our cloths get dried up quickly in summer and winter than in rainy season. Because in rainy season there is more water vapor present in air, which decrease the water holding capacity of atmosphere resulting in decrease the rate of evaporation and our cloths do not dry up quickly in the rainy season.
Our sweat does not dry up quickly in rainy season. Because of that we feel uneasiness because of damp. This is because of higher percent of humidity present in air decreases the rate of evaporation in rainy season and our sweat does not evaporate quickly and we feel uneasy because of damp.



WIND SPEED AND EVAPORATION
Evaporation increases with the increase in wind speed and decreases with decrease in wind speed. This means rate of evaporation is directly proportional to the speed of wind.
Speedy wind propelled away some of the particles of water with it which speeds up the rate of evaporation. That's why speedy wind speeds up the rate of evaporation.

We see that wet cloth is dried up quickly in a windy day since the wind speeds up the rate of evaporation.

The wet clothes are given jerks before hanging them on laundry line because by giving jerks some of the water droplets propelled out. This reduces the presence of water in the wet cloths and they dried up quickly.

EVAPORATION IN EVERYDAY LIFE:

(a) Water from the surface of oceans, seas and other large water bodies evaporate continuously as they are exposed to atmosphere. The water vapor because of evaporation rises up in air and cumulates in the form of cloud, which makes the rain. Hence, evaporation is one of the essential parts of water cycle. Thus we can say that evaporation is one of the most natural phenomena for us.

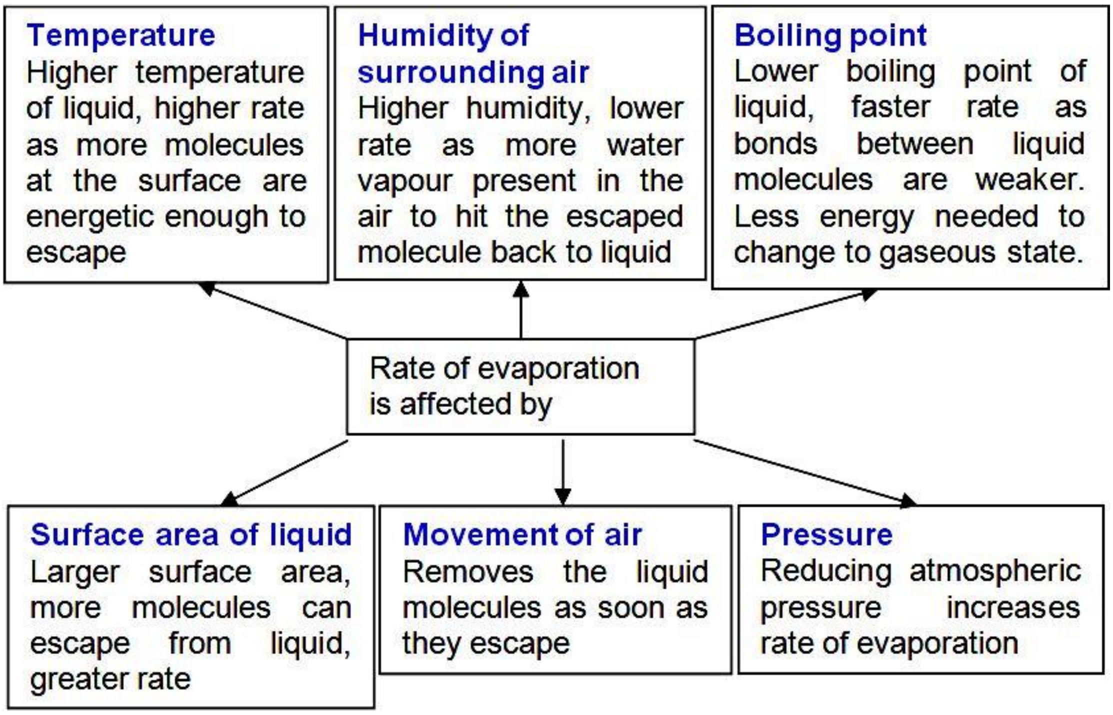
(b) In summer days sweats come out to regulate the temperature of our body. The sweat evaporates because of increase in surface area and getting the temperature from atmosphere. This is resulting in decrease in temperature of skin and finally our body, which gives relief to us in hot days. Sweating is a natural mechanism to keep cool the surface of our body in hot days. This is the cause that with increase in temperature our body sweats a lot especially in hot summer days.

(c) Water is kept in earthen pots to keep them cool. Earthen pot has lot of pores. Water kept in earthen pots evaporates from the pores of pots, which cools the neighboring molecules of water. This process continues and whole of the water kept in the earthen pots become cooler. Hence, water is kept in the earthen pot to keep them cool for drinking purpose.

(d) Wet clothes on the laundry lines are dried up because of evaporation.

(e) Sea water has lot of salt. Sea water is left in shallow pond. The water evaporates gradually because of heat of sun leaving the salt in the shallow pond. These salts are collected and used for with food after purification.

(f) Evaporative coolers are widely used in hot summer days. In evaporative coolers, dry air is blow over husk saturated of water. From the surface of husk water is evaporated resulted in cooling of husk. The water particles at the surface of wet husk evaporate and cool the rest portion of wet husk. Air blown from the cool husk is sent in the room, which cools the room.



INTEXT QUESTIONS PAGE NO. 6

Q1. Why does a desert cooler cool better on a hot dry day?
Answer: The rate of evaporation increases with increase in temperature and decrease in humidity. A desert cooler functions on the basis of evaporation. As evaporation increases when the day is hot and dry, so the desert cooler functions to a better extent.

Q2. How does the water kept in an earthen pot (matka) become cool during summer?
Answer: The surface of the earthen pot (matka) has tiny pores. The water stored in the earthen pot (matka) evaporates faster through these pores due to the increased exposed surface area. As the process of evaporation causes cooling, the stored water inside the earthen pot (matka) becomes cool.

Q3. Why does our palm feel cold when we put some acetone or petrol or perfume on it?
Answer: Acetone, petrol, perfume, etc., being volatile, evaporate very fast when exposed to larger surfaces. During the process they absorb the required latent heat of vaporisation from the palm (if kept on palm). So, the process causes cooling and the palm feels cool.

Q4. Why are we able to sip hot tea or milk faster from a saucer rather than a cup?
Answer: In a saucer, the exposed surface area of tea or milk is greater as compared to the cup. Therefore, the evaporation is faster and it is easier to sip colder tea or milk.

Q5. What type of clothes should we wear in summer?
Answer: We should wear cotton clothes in summers. During summers, we sweat more. On the other hand, cotton is a good absorber of water. Thus, it absorbs sweat from our body and exposes the liquid to the atmosphere, making evaporation faster. During this evaporation, particles on the surface of the liquid gain energy from our body surface, making the body cool.

<u>EXERCISE QUESTIONS PAGE NO. 12</u>

Q1. Convert the following temperatures to the Celsius scale.
(a) 300 K (b) 573 K.
Answer: Kelvin is an SI unit of temperature, where 0°C = 273 K
(a) 300 K = (300 − 273) °C = 27 °C
(b) 573 K = (573 − 273) °C = 300 °C

Q2. Convert the following temperatures to the Kelvin scale.
(a) 25°C (b) 373°C.
Answer: Kelvin is an SI unit of temperature, where 0°C = 273 K
(a) 25 °C = (25 + 273) K = 298 K
(b) 373 °C = (373 + 273) K = 646 K

Q3. Give reason for the following observations.
(a) Naphthalene balls disappear with time without leaving any solid.
(b) We can get the smell of perfume sitting several metres away.
Answer:
(a) Naphthalene undergoes sublimation easily i.e., the change of state of naphthalene from solid to gas takes place easily. Thus, naphthalene balls disappear with time without leaving any solid.
(b) Gaseous particles possess high speed and large spaces between them. Particles of perfume diffuse into these gaseous particles at a very fast rate and reach our nostrils. This enables us to smell the perfume from a distance.

Q4. Arrange the following substances in increasing order of forces of attraction between the particles—

water, sugar, oxygen.

Answer:

Sugar is a solid; the forces of attraction between the particles of sugar are strong. Water is a liquid; the forces of attraction here are weaker than sugar. Oxygen is a gas; the forces of attraction are the weakest in gases.

Thus, the increasing order of forces of attraction between the particles of water, sugar and oxygen is

Oxygen < Water < Sugar

Q5. What is the physical state of water at—

(a) 25°C (b) 0°C (c) 100°C ?

Answer:

(a) Water at 25°C is present in the liquid state.

(b) At 0 °C, water can exist as both solid and liquid. At this temperature, after getting the heat equal to the latent heat of fusion, the solid form of water i.e., ice starts changing into its liquid form i.e., water.

(c) At 100 °C, water can exist as both liquid and gas. At this temperature, after getting the heat equal to the latent heat of vaporization, water starts changing from its liquid state to its gaseous state, i.e., water vapours.

Q6. Give two reasons to justify—

(a) water at room temperature is a liquid.

(b) an iron almirah is a solid at room temperature.

Answer:

(a) At room temperature (25 °C), water is a liquid because it has the following characteristic of liquid:

i). At room temperature, water has no shape but has a fixed volume that is, it occupies the shape of the container in which it is kept.

ii). At room temperature, water flows.

(b) An iron almirah is a solid at room temperature (25 °C) because:

i). it has a definite shape and volume like a solid at room temperature.

ii). it is rigid as solid at room temperature.

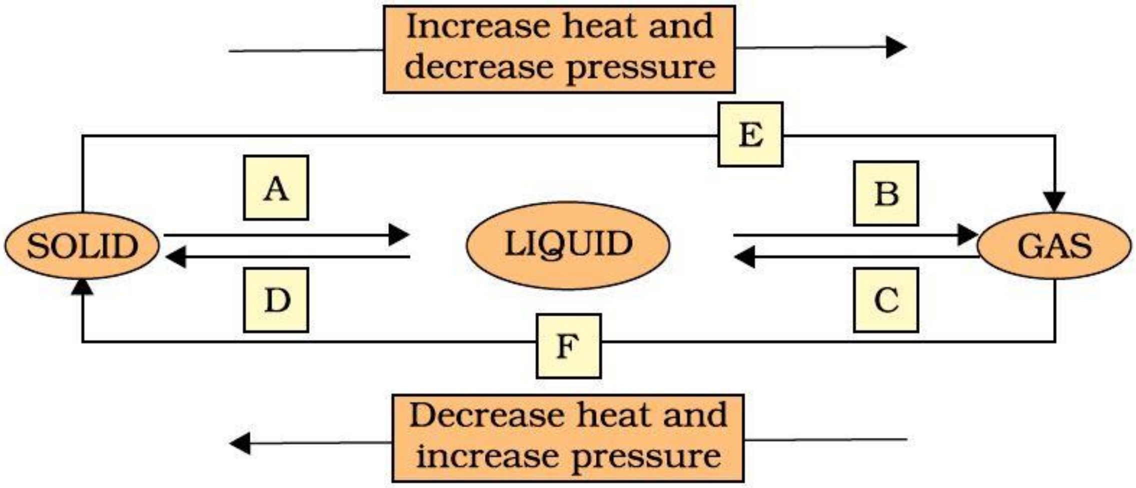
Q7. Why is ice at 273 K more effective in cooling than water at the same temperature?

Answer: When ice melts, it absorbs the energy equal to the latent heat of fusion too from the surroundings so it causes cooling more effectively than the water at same temperature (because water does not absorb energy from the surroundings).

Q8. What produces more severe burns, boiling water or steam?

Answer: Steam causes more severe burns than boiling water. The reason is that it releases the extra amount of heat (latent heat) which it has already taken during vaporisation (when the steam was formed from water).

Q9. Name A,B,C,D,E and F in the following diagram showing change in its state



Answer:

A = Melting or fusion, here the solid changes into liquid.

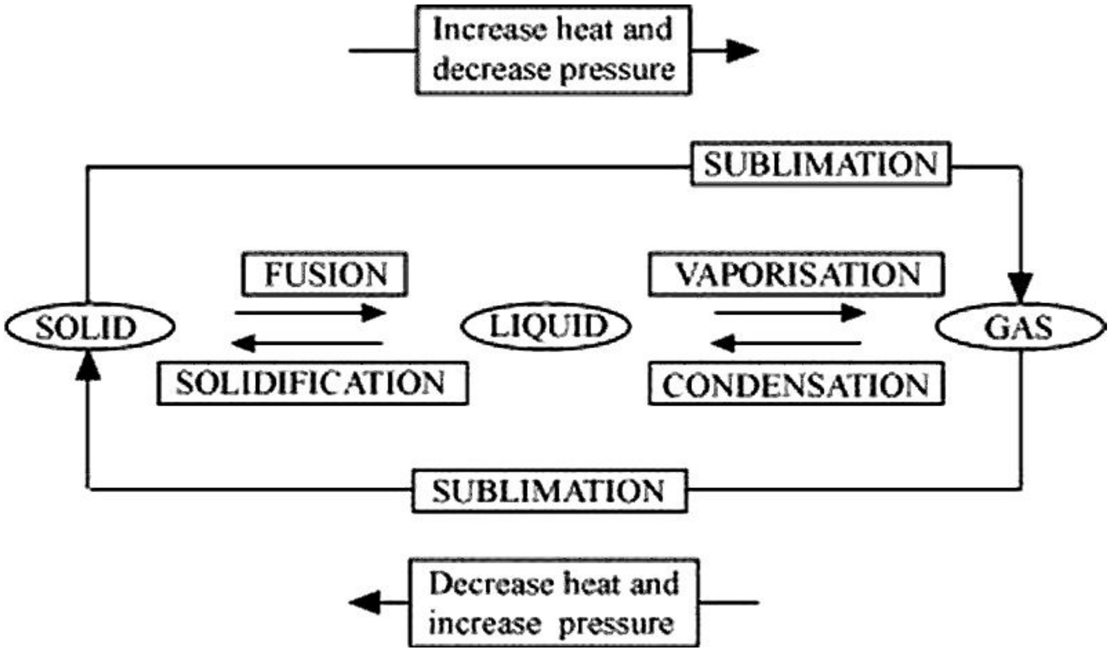
B = Evaporation or vaporisation, here the liquid changes into gas.

C = Condensation or liquification, here the gas changes into liquid.

D = Freezing or solidification, here the liquid changes into solid.

E = Sublimation, here solid directly changes into gas without coming in liquid state.

F = Sublimation, here gas changes into solid without coming to liquid state.



ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 1
MATTER IN OUR SURROUNDINGS

1. Fill in the blanks

a. The process of ________ causes cooling.

b. The process of cooling glass is known as ____.

c. Liquids have no fixed ______ but have fixed _____.

d. ____ exists in all three states of matter.

e. Carbon dioxide is a white solid called _____ at temperature below ______.

2. State True or False
a. Evaporation of water is a bulk phenomenon.
b. Diffusion takes place in haphazard and random way.
c. SI unit of pressure is Pascal.
d. A gas is highly incompressible fluid.
e. Solids and liquids can be identified from their characteristic melting and boiling points.

3. Zig-zag movement of the solute particle in a solution is known as
(a) Linear motion (b)
Circular motion (c)
Brownian motion (d)
Curved motion.

4. Gases can be liquified by
(a) increasing pressure
(b) decreasing temperature
(c) both (a) and (b)
(d) decreasing pressure

5. Density of a substance is defined as
(a) ratio of mass and volume
(b) product of mass and volume
(c) ratio of mass and temperature
(d) product of mass and temperature

6. Which of the following is not matter
(a) Blood
(b) Humidity
(c) Electron
(d) Moon rock

7. Which is more effective in cooling?
(a) Ice at 0° C
(b) Water at 0° C
(c) Water at 100° C
(d) Ice at 100° C

8. 0° C temperature is equal to
(a) 0 K
(b) 273 K
(c) -273 K
(d) 300 K

9. The process involving the change of state from solid to gas is called
(a) melting
(b) boiling
(c) sublimation
(c) fusion

10. A solid has
(a) definite volume and no definite shape
(b) no definite volume no definite shape
(c) definite shape and volume
(d) definite shape but no definite volume

11. A liquid has
(a) definite volume and no definite shape
(b) no definite volume no definite shape
(c) definite shape and volume
(d) definite shape but no definite volume

12. A gas has
(a) definite volume and no definite shape
(b) no definite volume no definite shape
(c) definite shape and volume
(d) definite shape but no definite volume

13. Which of the following is NOT a property of particles of a matter?
(a) The particles of matter are extremely small
(b) The particles of matter have spaces between them.
(c) The particles of matter are in stationery state.
(d) The particles of matter attract each other.

14. Which of the following has minimum spaces among the particles?
(a) Solids
(b) Liquids
(c) Gases
(d) None of these

15. During summer, water kept in an earthen pot becomes cool because of the phenomenon of
(a) diffusion
(b) transpiration
(c) osmosis
(d) evaporation

16. Rate of diffusion is the fastest in
(a) Solids
(b) Liquids
(c) Gases
(d) None of these

17. Thermal conduction takes places in
(a) solids only
(b) liquids only
(c) gases only
(d) solids, liquids and gases.

18. Evaporation always causes
(a) thermal expansion
(b) Liquification
(c) Cooling down
(d) all of these

19. A change of state directly from solid to gas without changing into liquid state (or vice versa) is called
(a) Evalopartion
(b) Sublimation
(c) Diffusion
(d) Condensation

20. The rate of evaporation decreases with
(a) increase in humidity
(b) increase of temperature
(c) increase in wind speed
(d) increase of surface area

21. Expand CNG and LPG.

22. Arrange the following substances in increasing order of force of attraction between the particles. (i) milk (ii) salt (iii) oxygen

23. Why is sponge a solid though compressible?

24. Write one important characteristic of matter.

25. Why does a desert cooler cool better in a hot dry day?

26. Convert: (a) 25°C into kelvin scale (b) 500 K into celsius scale

27. Why does the smell of hot sizzling food reach you several metres away but to get the smell from cold food you have to go close?

28. What is the term used for change of solid state to liquid state?

29. Name the temperature at which solid and liquid states of matter can coexist.

30. Define evaporation.

31. "The wool being knitted into a sweater is a physical change." Justify the statement.

32. Mention two ways to liquefy atmospheric gases.

33. What is the value of boiling point of water on Kelvin Scale of temperature?

34. What is dry ice?

35. (a) Dry ice is compressed at high pressure. What happens when pressure is released?
(b) Suggest a method to liquefy atmospheric gases.

36. (a) The melting points of 2 substances A & B are 280 K and 320 K respectively. Are these substances liquid at room temperature? Justify your answer.
(b) Give an example that shows the state of matter can be changed into another state by changing the temperature.

37. How will you show that matter is composed of tiny particles?

38. Define (i) Latent heat of fusion and (ii) latent heat of vapourisation.

39. Explain how the following factors affect the rate of evaporation of a liquid:
(i) temperature of the liquid.
(ii) area of the exposed surface.
(iii) moisture in the surrounding air.
(iv) increase in wind speed.

40. When a bottle of scent is opened in one corner of a room, it immediately spreads throughout the room. What property of matter is responsible for this observation? Explain.

41. (a) Conversion of solid to vapour is called sublimation. Name the term used to denote the conversion of vapour to solid.
(b) Conversion of solid state to liquid state is called fusion; what is meant by latent heat of fusion?

42. Both boiling and evaporation convert a liquid into vapours. What is the difference between the two processes?

43. A sample of water under study was found to boil at 102Â°C at normal pressure. Is the water pure? Will this water freeze at 0Â°C? Comment.

44. Why does the temperature of a substance remain constant during its m.pt. or boiling point?

45. Answer the following questions:
(i) Arrange the following substances in increasing order of force of attraction between the particles.
(i) water (ii) hydrogen (iii) sand

(ii) Why does the temperature remain constant at the melting point?

(iii) Which property of gases makes it possible to fill large volume of gases in small cylinders?

46. Answer the following questions:
(a) Why is ice at 273 K more effective in cooling than water at the same temperature?
(b) Name the two gases which are supplied in compressed form in homes and hospitals.

47. You want to wear your favourite shirt to a party but the problem is that it is still wet after a wash. What steps would you take to dry it fast?

48. Give reasons:
(a) Steam produces more severe burns than boiling water.
(b) We are able to sip hot tea faster from a saucer rather than from a cup.
(c) Water kept in an earthen pot becomes cool during summer.

49. Why do cotton clothes suit best in summer?

50. Classify the following into osmosis and diffusion:

(a) Swelling up of a resin on keeping in water.
(b) Spreading of virus on sneezing.
(c) Earthworm dying on coming in contact with common salt.
(d) Shrinking of grapes kept in thick sugar syrup.
(e) Preserving pickles in salt.
(f) Aquatic animals using oxygen dissolved in water during respiration.

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 1
MATTER IN OUR SURROUNDINGS

1. What is a matter?
2. Sodium chloride and sugar have same appearance. Are they same or different?
3. All substances around us are alike. How?
4. How can we say that air is a matter?
5. State the characteristics of matter?
6. What are the intensive properties of matter?
7. What are the extensive properties of matter?
8. State the characteristics of particles of matter.
9. What is the effect of temperature on a matter?
10. The smell of hot sizzling food reaches us several metres away. Why?
11. What is diffusion?
12. If a bottle of perfume is opened in one corner of a room, it immediately spreads throughout the room. Why?
13. Name the three states of matter with examples.
14. State the characteristics of solids.
15. What are the characteristics of liquids?
16. What are the characteristics of gases?
17. What are fluids?
18. Which of the following substances is most compressible?CO_2, H_2O, NaCl.
19. Which property of a gas results in steady pressure of the gas ?
20. In which of the following substances, weakest inter molecular force is expected: H_2O, CH_3OH,
21. One gas mixes with another gas easily. What is this property called ?
22. Describe briefly (i) Melting point and (ii) Boiling point.
23. How would you find out whether a sample of sodium chloride is pure or impure ?
24. How will you find out whether a sample of water is pure or impure ?
25. Why do solids have a fixed shape and gases have neither a fixed shape nor a fixed volume?
26. What is Vaporization ?
27. What is Sublimation ?
28. What is Condensation ?
29. What is Deposition ?
30. What is Liquefaction ?
31. What is Solidification ?

32. What is difference between vapour and gas.

33. Why do the three states of matter differ ?

34. Why does the temperature remain constant until whole of the solid changes into liquid, though the heat energy is constantly supplied ?

35. Why does the temperature remain constant during boiling though heat is constantly supplied ?

36. Why does a gas fill a vessel completely ?

37. How does the state of matter changes from solid to liquid and then to gas on heating ?

38. Why evaporation is called surface phenomenon?

39. List two processes from which it may be concluded that the particles of a gas move continuously.

40. At what temperature does solid ice and liquid water co-exist together?

41. What is common among the three states of matter?

42. Which property of gas is used in supplying oxygen cylinders to hospitals?

43. A substance x was highly compressible and could easily be liquefied. it could also take the shape of the container. Predict the nature of the substance

44. What is the state of water at 100 degree celsius, zero degree celsius and 4 degree celsius?

45. Can a liquid turn into vapor without heating?

46. What do you mean by Latent heat of Fusion?

47. What is compressibility? How it is negligible in solids?

48. Two cubes of ice are pressed hard between two palms. After releasing the pressure, the cubes join together. Why?

49. Explain why ice has lower density than water?

50. Give one similarity between a liquid and a gas and one dissimilarity.

51. What property of gas is utilized when natural gas is supplied for vehicles.

52. What are 'intermolecular forces'? How are these related to the three states of matter ?

53. Separate the following substances in groups of high and low intermolecular force: Ice, sulphur vapour, nitrogen, sugar, copper, air, salt, plastic.

54. Which of the following substances you expect strongest and in which weakest intermolecular force: Water, alcohol, sugar, sodium chloride, carbon dioxide.

55. Why are gases compressible but liquids not ?

56. Compare the process of boiling and vaporization.

57. How is pressure developed in a container full of a gas ?

58. What are the applications of interconversion of states of matter ?

59. What happens to a gas if its inter molecular space is reduced ?

60. Explain how lumps of ice are more effective cooling than water at 273K.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 1
MATTER IN OUR SURROUNDINGS

1. Conversion of solid to vapour is called sublimation. Name the term used to denote the conversion of vapour to solid.

2. Conversion of solid state to liquid state is called fusion; what is meant by latent heat of fusion?

3. Fill in the blanks:

(a) Evaporation of a liquid at room temperature leads to a——— effect.

(b) At room temperature the forces of attraction between the particles of solid substances are———than those which exist in the gaseous state.

(c) The arrangement of particles is less ordered in the ——— state. However, there is no order in the ——— state.

(d) ——— is the change of gaseous state directly to solid state without going through the ———state.

(e) The phenomenon of change of a liquid into the gaseous state at any temperature below its boiling point is called———.

4. Match the physical quantities given in column A to their S I units given in column B :

(A)	(B)
(a) Pressure	(i) cubic metre
(b) Temperature	(ii) kilogram
(c) Density	(iii) pascal
(d) Mass	(iv) kelvin
(e) Volume	(v) kilogram per cubic metre

5. The non S I and S I units of some physical quantities are given in column A and column B respectively. Match the units belonging to the same physical quantity:

(A)	(B)
(a) degree celsius	(i) kilogram
(b) centimetre	(ii) pascal
(c) gram per centimetre cube	(iii) metre
(d) bar	(iv) kelvin
(e) milligram	(v) kilogram per metre cube

6. Classify the following into osmosis/diffusion

(a) Swelling up of a raisin on keeping in water.
(b) Spreading of virus on sneezing.
(c) Earthworm dying on coming in contact with common salt.
(d) Shrinking of grapes kept in thick sugar syrup.
(e) Preserving pickles in salt.
(f) Spreading of smell of cake being baked through out the house.
(g) Aquatic animals using oxygen dissolved in water during respiration.

7. 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

8. Seema visited a Natural Gas Compressing Unit and found that the gas can be liquefied under specific conditions of temperature and pressure. While sharing her experience with friends she got confused. Help her to identify the correct set of conditions
(a) Low temperature, low pressure
(b) High temperature, low pressure
(c) Low temperature, high pressure
(d) High temperature, high pressure

9. 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

10. During summer, water kept in an earthen pot becomes cool because of the phenomenon of
(a) diffusion
(b) transpiration
(c) osmosis
(d) evaporation

11. 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

12. On converting 25°C, 38°C and 66°C to kelvin scale, the correct sequence of temperature will be
(a) 298 K, 311 K and 339 K
(b) 298 K, 300 K and 338 K
(c) 273 K, 278 K and 543 K
(d) 298 K, 310 K and 338 K

13. The boiling points of diethyl ether, acetone and *n*-butyl alcohol are 35°C, 56°C and 118°C respectively. Which one of the following correctly represents their boiling points in kelvin scale?
(a) 306 K, 329 K, 391 K
(b) 308 K, 329 K, 392 K
(c) 308 K, 329 K, 391 K
(d) 329 K, 392 K, 308 K

14. Which condition out of the following will increase the evaporation of water?
(a) Increase in temperature of water
(b) Decrease in temperature of water
(c) Less exposed surface area of water
(d) Adding common salt to water

15. Choose the correct statement of the following

(a) conversion of solid into vapours without passing through the liquid state is called vapourisation.

(b) conversion of vapours into solid without passing through the liquid state is called sublimation.

(c) conversion of vapours into solid without passing through the liquid state is called freezing.

(d) conversion of solid into liquid is called sublimation.

16. In which of the following conditions, the distance between the molecules of hydrogen gas would increase?

(i) Increasing pressure on hydrogen contained in a closed container

(ii) Some hydrogen gas leaking out of the container

(iii) Increasing the volume of the container of hydrogen gas

(iv) Adding more hydrogen gas to the container without increasing the volume of the container

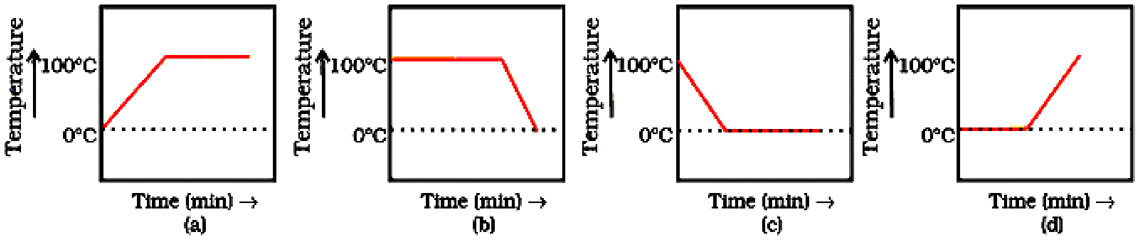
(a) (i) and (iii)

(b) (i) and (iv)

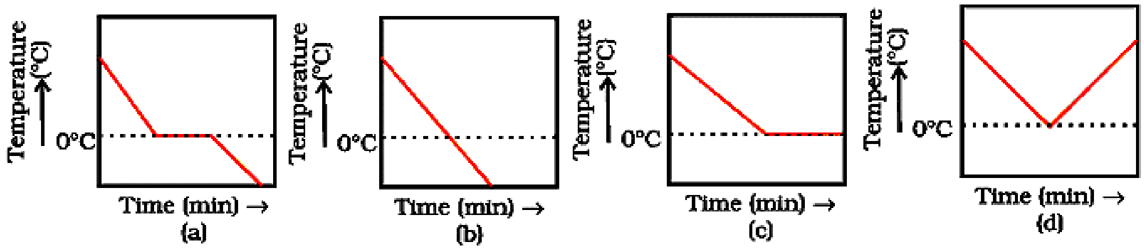
(c) (ii) and (iii)

(d) (ii) and (iv)

17. A student heats a beaker containing ice and water. He measures the temperature of the content of the beaker as a function of time. Which of the following graph would correctly represent the result? Justify your choice.



18. A glass tumbler containing hot water is kept in the freezer compartment of a refrigerator (temperature < 0°C). If you could measure the temperature of the content of the tumbler, which of the following graphs would correctly represent the change in its temperature as a function of time.



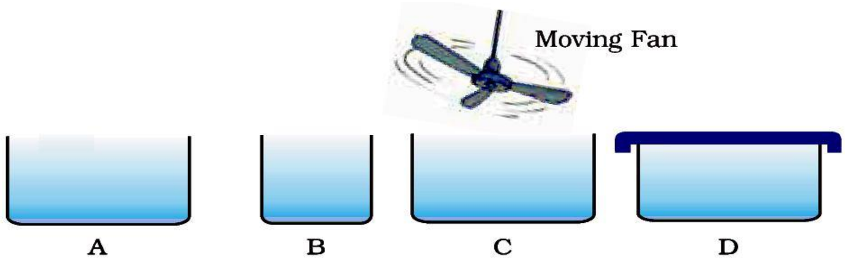
19. A sample of water under study was found to boil at 102°C at normal temperature and pressure. Is the water pure? Will this water freeze at 0°C? Comment.

20. 'Osmosis is a special kind of diffusion'. Comment.

21. Water as ice has a cooling effect, whereas water as steam may cause severe burns. Explain these observations.

22. Alka was making tea in a kettle. Suddenly she felt intense heat from the puff of steam gushing out of the spout of the kettle. She wondered whether the temperature of the steam was higher than that of the water boiling in the kettle. Comment.

23. Look at below figure and suggest in which of the vessels A,B, C or D the rate of evaporation will be the highest? Explain.



24. You are provided with a mixture of naphthalene and ammonium chloride by your teacher. Suggest an activity to separate them with well labelled diagram.

25. It is a hot summer day, Priyanshi and Ali are wearing cotton and nylon clothes respectively. Who do you think would be more comfortable and why?

26. You want to wear your favourite shirt to a party, but the problem is that it is still wet after a wash. What steps would you take to dry it faster?

27. Comment: Evaporation produces cooling.

28. Comment: Rate of evaporation of an aqueous solution decreases with increase in humidity.

29. Comment: Sponge though compressible is a solid.

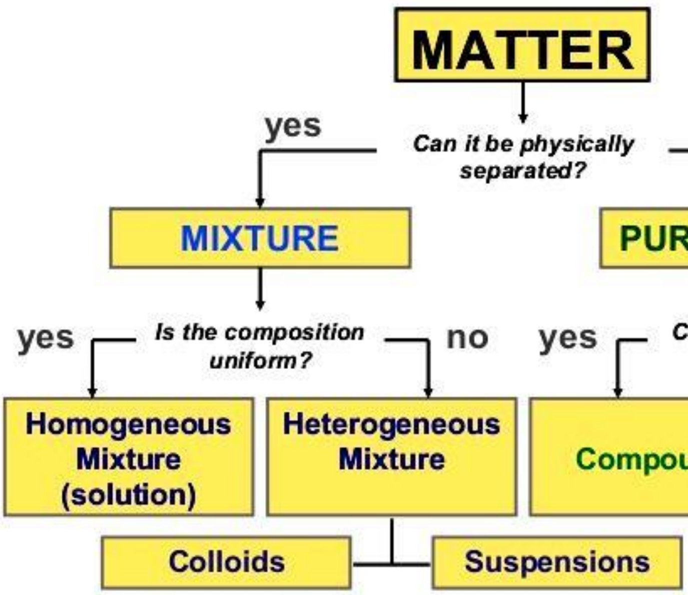
30. Why does the temperature of a substance remain constant during its melting point or boiling point?

CHAPTER – 2

IS MATTER AROUND US PURE

Matters can be classified into two types – Pure substances and Impure substances.
Pure substances – Pure substances are of two types – Elements and Compounds.
Impure substances – All mixture are considered as impure substances.

Colour, odour, density, melting point and boiling point are often treated as physical properties of matter. The physical properties of a substance can be observed or measured without changing its composition.
The term "impure" is different from adulteration. According to scientists, the term "pure" means single form of matter.



Most of the substances in our surroundings are not in their pure form and are called mixture. Substances which are made of two or more matters and which can be separated by physical methods are known as mixtures, such as mixture of salt and water, mixture of sugar and water, mixture of different gases, air, etc.
In a mixture, components do not combine chemically or through any chemical change. In a mixture, components do not lose their properties.
Mixtures are of two types on the basis of their composition - Homogeneous mixture and Heterogeneous mixture.

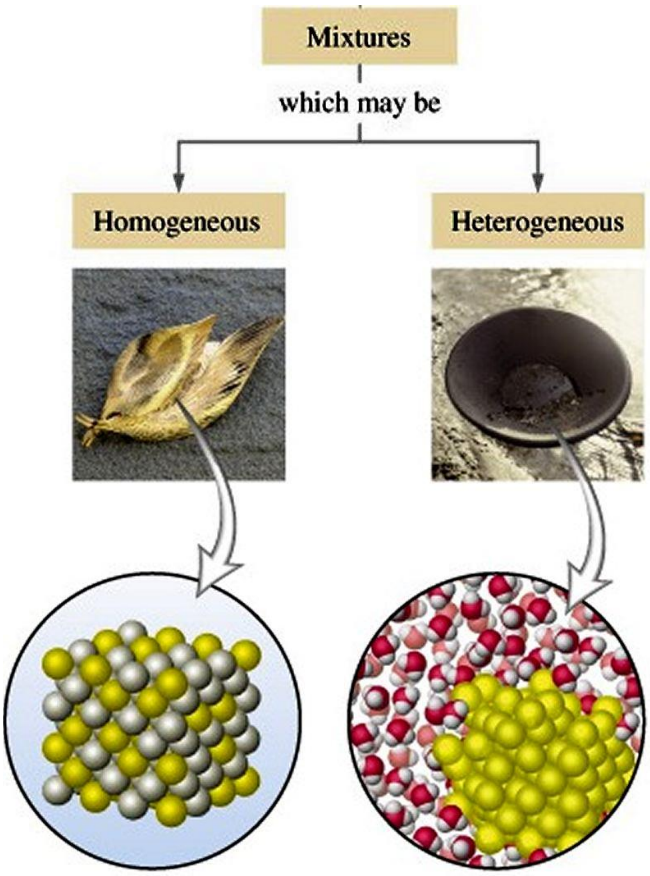
HOMOGENEOUS MIXTURE

Mixtures which have uniform composition throughout are called Homogeneous Mixture. For example – mixture of salt and water, mixture of sugar and water, air, lemonade, soda water, etc.
Mixture of salt in water is an example of homogeneous mixture. In this mixture, the boundary of salt and water cannot be differentiated. When a ray of light is passed through the mixture of salt and water, the path of light is not seen.

General Properties of Homogeneous Mixture:

- All solutions are the examples of homogeneous mixture.
- The particles of a homogeneous mixture are less the one nanometer.

- A homogenous mixture does not show Tyndall effect.
- The boundaries of particles cannot be differentiated.
- The constituent particles of homogenous mixture cannot be separated using centrifugation or decantation.
- Alloys are the examples of solution.



HETEROGENEOUS MIXTURE

Mixtures which do not have uniform composition throughout are called Heterogeneous Mixture. For example – mixture of soil and sand, mixture of sulphur and iron fillings, mixture of oil and water etc. The boundaries of constituent particles of a homogeneous mixture can be identified easily; as a homogeneous mixture has two or more distinct phases.

General Properties of Heterogeneous Mixture:

- Most of the mixtures are heterogeneous except solutions and alloys.
- The constituent particles are present uniformly in a heterogeneous mixture.
- The components of a heterogeneous mixture can be identified easily.
- Generally, two or more phases are present in a heterogeneous mixture.
- Particles of a heterogeneous mixture are sized between one nanometer and one micrometer or more.
- Heterogeneous mixtures show Tyndall effect.

INTEXT QUESTIONS PAGE NO. 15

Q1. What is meant by a pure substance?
Answer: A pure substance is the one that consists of a single type of particles, i.e., all constituent particles of the substance have the same chemical nature. Pure substances can be classified as elements or compounds.

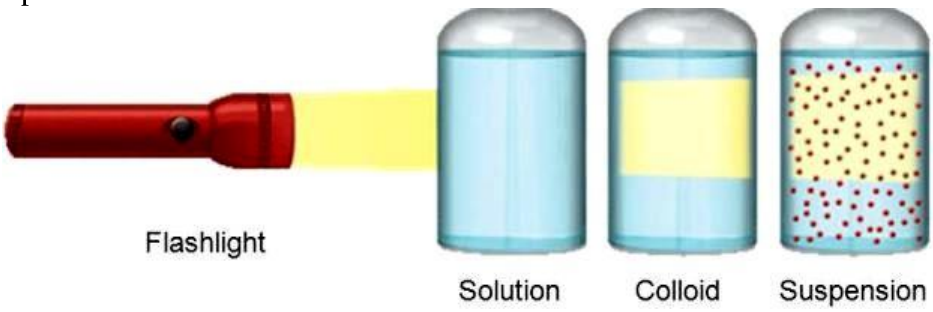
Q2. List the points of differences between homogeneous and heterogeneous mixtures.
Answer:

- A homogeneous mixture is a mixture having a uniform composition throughout the mixture. For example: salt in water, sugar in water, copper sulphate in water

- A heterogeneous mixture is a mixture having a non-uniform composition throughout the mixture. For example: sodium chloride and iron fillings, salt and sulphur, oil and water

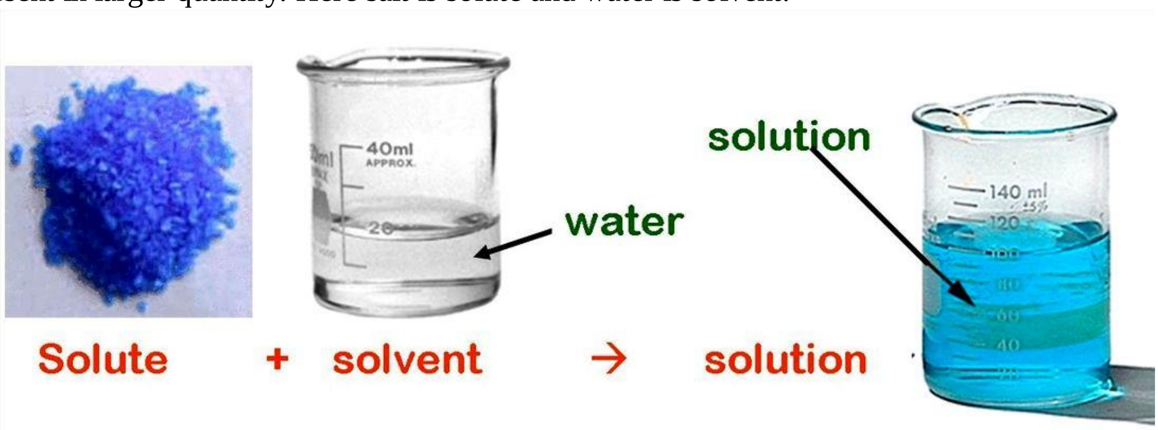
TYPES OF MIXTURE

Mixture can be categorised in three types on the basis of their particles' size. These are; solution, suspension and colloid.



SOLUTION

Mixture of two or more substances with one phase only, i.e. having no distinct boundary of constituent particles are called solution. For example, solution of sugar and water, solution of salt and water, lemonade, soft drinks, etc. Solution is a homogeneous mixture of two or more substances.
In a solution, components are mixed in such a way that they appear as only one phase. Seeing by naked eye, constituent particles of a solution cannot be identified because particles are mixed evenly throughout.
In a solution, there are two types of components – one is called solute and other is called solvent.
Solute – Substance which is present in smaller quantity in a mixture is called solute.
Solvent – Substance in a mixture which is present in larger quantity in a mixture is called solvent.
Example: In the solution of salt and water, salt is present in small quantity while water is present in larger quantity. Here salt is solute and water is solvent.



Solution of tincture iodine is made by dissolving iodine in alcohol. In this solution, iodine is solute and alcohol is solvent.

Air is mixture of many gases. Since air consists of only one phase, thus it is considered as solution. Air consists about 78% of nitrogen and 22% rest of other gases. Thus in the case of air, nitrogen can be called as solvent and rest other gases as solutes.
Solvent and solute can be solid, liquid or gas.

TYPES OF SOLUTION

Solid - solid solution – Solution of two or more solids are generally known as solid-solid solution. For example – alloys. Alloy is a homogeneous mixture of two or more metals and non metals or two metals or two non-metals. The components of an alloy cannot be separated by physical methods, their boundaries are not distinct and they can have variable compositions, thus alloy is considered as solution.

Solid – Liquid solution – Solution of solid and liquid is called solid-liquid solution. For example - solution of salt and water.

Liquid – liquid solution – Solution of two miscible liquids are called liquid-liquid solution, such as solution of water and acetic acid. The solution of acetic acid in water is known as vinegar.

Gas - liquid solution – Solution of gas into liquid is called gas-liquid solution. For example – Soft drink. In soft drink, carbon dioxide is usually dissolved in liquid, because of which a hiss sound comes while opening the cap of the bottle.

Gas-gas solution – Solution of two or more gas is called gas-gas solution. For example – air, which is the solution of many gases, such as hydrogen, oxygen, carbon dioxide, etc.

State of Solvent	State of Solute	State of Solution	Examples
Gas	Gas	Gas	Air, natural gas
Liquid	Liquid	Liquid	Alcoholic beverages, Antifreeze solution;
Liquid	Solid	Liquid	Seawater, sugar solution
Liquid	Gas	Liquid	Carbonated water (soda) Ammonia solution;
Solid	Solid	Solid	Metal alloys: brass, bronze,..
Solid	Gas	Solid	Hydrogen in platinum

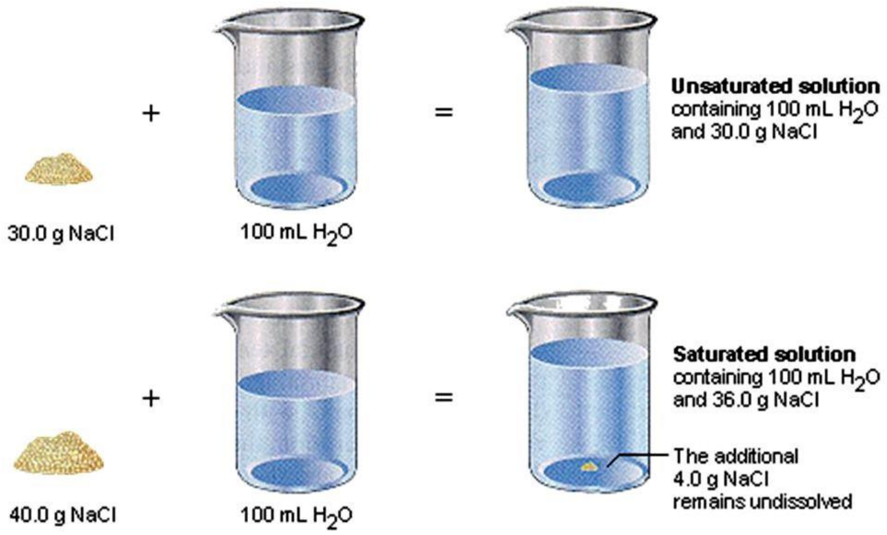
General Characteristics of Solution:

- Solutions are homogeneous mixture of two or more substances.
- Constituent particles of a solution are mixed evenly throughout.
- There is only one phase in a solution.
- Boundaries of constituent particles cannot be distinguished.
- The size of particles of solution is smaller than one nanometer.
- Solutions do not show Tyndall effect, because, small particles of solution do not scatter the ray of light.
- Solute cannot be separated by using filtration or decantation.
- Solutions are stable, since when left undisturbed the particles do not settle in bottom.

SATURATED AND UNSATURATED SOLUTIONS

Saturated Solution: When a solution cannot dissolve more solute at a given temperature, the point is called saturation point of the solution and solution is called saturated solution. This means, no more solute can be dissolved in a saturated solution at a given temperature.

Unsaturated Solution: Solution in which more solution can dissolved at a given temperature, is called unsaturated solution.



Solubility: Solubility is the amount of solute in a saturated solution at a given temperature. In other words, maximum capacity to dissolve a solute in a solution at a given temperature is called solubility.

Different solvents can dissolve different amount of solute. This means different solvents have different solubility Solubility increases with increase in temperature.

Concentration: Concentration is the amount of solute present in a given amount of solvent or solution.

$$\text{This means Concentration} = \frac{\text{Amount of solute}}{\text{Amount of Solvent}} \text{ or } \frac{\text{Amount of solute}}{\text{Amount of Solution}}$$

Thus, concentration is the ratio of amount of solute and amount of solvent.
Concentration can be expressed in mass percentage or volume percentage of a solution.
(a) Mass percentage of a solution

$$\text{Concentration} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

This means when concentration is expressed in mass percentage, it is called concentration by mass percentage.

(b) Volume percentage of a solution

$$\text{Concentration} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

This means when concentration is expressed in volume percentage, it is called concentration by volume percentage.

SUSPENSION

A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. Particles of a suspension are visible to the naked eye.

Properties of a Suspension

- Suspension is a heterogeneous mixture.
- The particles of a suspension can be seen by the naked eye.
- The particles of a suspension scatter a beam of light passing through it and make its path visible.
- The solute particles settle down when a suspension is left undisturbed, that is, a suspension is unstable. They can be separated from the mixture by the process of filtration.

COLLOIDAL SOLUTIONS

A colloidal solution, occasionally identified as a colloidal suspension, is a mixture in which a substances regularly suspended in a fluid. A colloid is a minutely small material that is regularly spread out all through another substance.

Properties of a colloid

- A colloid is a heterogeneous mixture.
- The size of particles of a colloid is too small to be individually seen by naked eyes.
- Colloids are big enough to scatter a beam of light passing through it and make its path visible.
- They do not settle down when left undisturbed, that is, a colloid is quite stable.
- They cannot be separated from the mixture by the process of filtration.

The components of a colloidal solution are the dispersed phase and the dispersion medium. The solute-like component or the dispersed particles in a colloid form the dispersed phase, and the component in which the dispersed phase is suspended is known as the dispersing medium. Colloids are classified according to the state (solid, liquid or gas) of the dispersing medium and the dispersed phase.

Colloidal solutions have three sub-classifications: **Foams, emulsions and sol. Foam** in this setting is created by ensnaring a gas in a liquid. The substance being dispersed would be the gas, triggering the fluid to become frothy and foamy. A sample of this would be shaving cream. **An emulsion** is a combination of liquids; it's basically when one liquid is consistently dispersed all through another liquid. A sample of this would be mayonnaise or milk. The third form is called **a sol**, which is when a solid is evenly dispersed throughout a fluid. Samples of sols include paint, blood and silver aquasols.

Common examples of colloids

Dispersed phase	Dispersing Medium	Type	Example
Liquid	Gas	Aerosol	Fog, clouds, mist
Solid	Gas	Aerosol	Smoke, automobile exhaust
Gas	Liquid	Foam	Shaving cream
Liquid	Liquid	Emulsion	Milk, face cream
Solid	Liquid	Sol	Milk of magnesia, mud
Gas	Solid	Foam	Foam, rubber, sponge, pumice
Liquid	Solid	Gel	Jelly, cheese, butter
Solid	Solid	Solid Sol	Coloured gemstone, milky glass

INTEXT QUESTIONS PAGE NO. 18

Q1. Differentiate between homogeneous and heterogeneous mixtures with examples.
Answer:

- A homogeneous mixture is a mixture having a uniform composition throughout the mixture. For example, mixtures of salt in water, sugar in water, copper sulphate in water, iodine in alcohol, alloy, and air have uniform compositions throughout the mixtures.

- On the other hand, a heterogeneous mixture is a mixture having a non-uniform composition throughout the mixture. For example, composition of mixtures of sodium chloride and iron fillings, salt and sulphur, oil and water, chalk powder in water, wheat flour in water, milk and water are not uniform throughout the mixtures.

Q2. How are sol, solution and suspension different from each other?
Answer:

- **Sol** is a heterogeneous mixture. In this mixture, the solute particles are so small that they cannot be seen with the naked eye. Also, they seem to be spread uniformly throughout the mixture. The Tyndall effect is observed in this mixture. For example: milk of magnesia, mud
- **Solution** is a homogeneous mixture. In this mixture, the solute particles dissolve and spread uniformly throughout the mixture. The Tyndall effect is not observed in this mixture. For example: salt in water, sugar in water, iodine in alcohol, alloy
- **Suspensions** are heterogeneous mixtures. In this mixture, the solute particles are visible to the naked eye, and remain suspended throughout the bulk of the medium. The Tyndall effect is observed in this mixture. For example: chalk powder and water, wheat flour and water

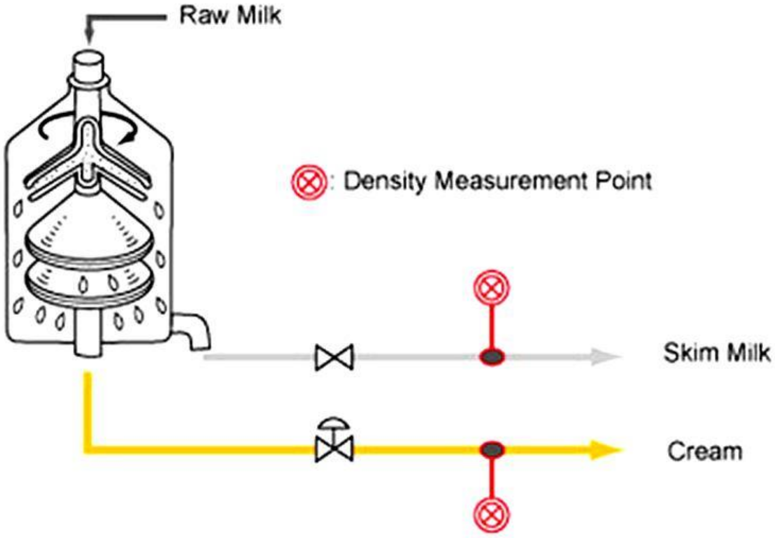
Q3. To make a saturated solution, 36 g of sodium chloride is dissolved in 100 g of water at 293 K. Find its concentration at this temperature.
Answer:
Mass of solute (sodium chloride) = 36 g (Given)
Mass of solvent (water) = 100 g (Given)
Then, mass of solution = Mass of solute + Mass of solvent = (36 + 100) g = 136 g
Therefore, concentration (mass by mass percentage) of the solution

$$= \frac{\text{Mass of solute}}{\text{Mass of solvent}} \times 100\% = \frac{36}{136} \times 100\% = 26.47\%$$

SEPARATION OF COMPONENTS OF MIXTURE

CENTRIFUGATION

In the method of centrifugation, the centripetal and centrifugal forces are used to separate lighter and heavier components of mixture of two immiscible liquids. This process is used to separate very small solids particles from a liquid mixture.
Example – Milk is the mixture of fat, water, and other constituents. Using the method of centrifugation, most of the fat can be separated from milk. In milk, fat is suspended throughout the milk which is separated out using the method of centrifugation.
When milk is churned rapidly, water which is heavier than fat, migrates away from the centre of centrifuge while fat is forced towards the bottom, which is drained out.

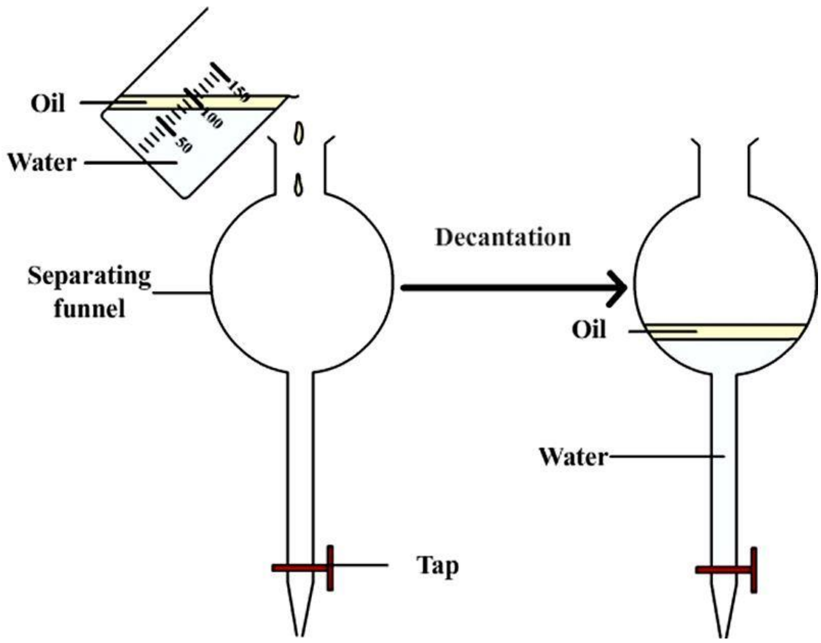


Application of centrifugation –

- In pathological test of blood and urine.
- In separation of fat from milk.
- In washing machines to squeeze the water from wet clothes.

DECANTATION

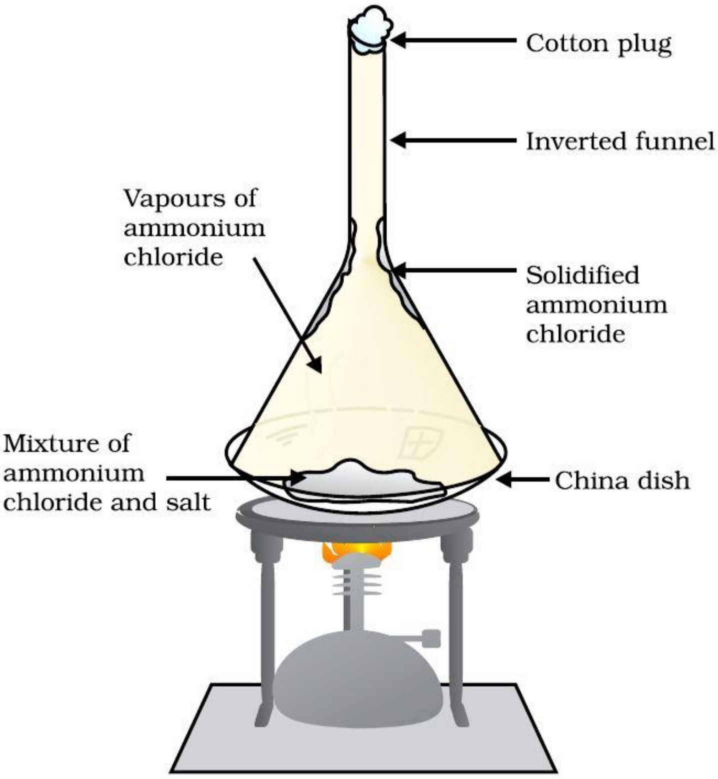
Decantation is used to separate the components from a mixture of two immiscible liquids, such as mixture of oil and water. In a mixture of two immiscible liquids, lighter one and heavier one form separate layer. The lighter one can be decanted after settling of mixture, carefully in other container.
In the process of decantation some of the heavier liquid also poured out with lighter one. Therefore, components from a mixture of two immiscible liquids; can be separated more easily and accurately using a separating funnel.
A separating funnel is usually made of glass with a stop cork with drain pipe at bottom. The heavier liquid which is settled at bottom is drained out from the mixture of two immiscible liquids by opening of stop cork from a separating funnel.



SUBLIMATION

There are many substances which are converted into gas from solid when heated, and converted from gas to solid when cooled without converting into liquid. Such substances are known as sublime. For example – ammonium chloride, naphthalene balls, camphor, etc. Therefore, mixture of one sublime and other substance can be separated using the method of sublimation.

The mixture of ammonium chloride and common salt can be separated out using the process of sublimation. For this, the mixture is heated in a China dish. The China dish is covered by an inverted funnel. Cotton is used for plugging the opening of the funnel. After heating, ammonium chloride is converted into vapour and gets deposited over the inner surface of funnel; due to cooling. This leaves the common salt in China dish. Ammonium chloride can be taken out by scratching from the inner wall of funnel.

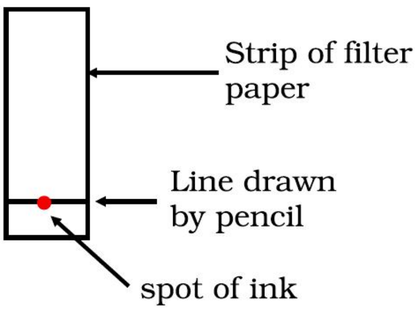


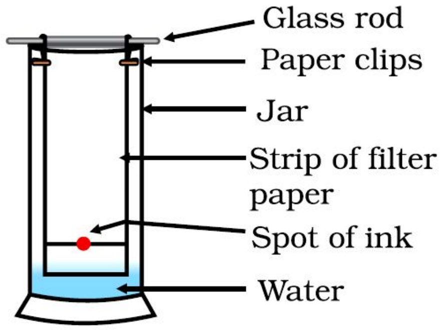
CHROMATOGRAPHY

Chromatography is a method of separation which works on the principle of travel speed of components of a mixture. This method is used for separating dyes and pigments from a mixture. Ink is the mixture of dyes of different colours.

There are many types of chromatography. The dyes from an ink can be separated using paper chromatography.

For this, a strip of filter paper is dipped in the ink. Particles of dye start rising on filter paper; along with water. Different dyes rise with different speed because of different types of solubility in water and go up to certain heights.



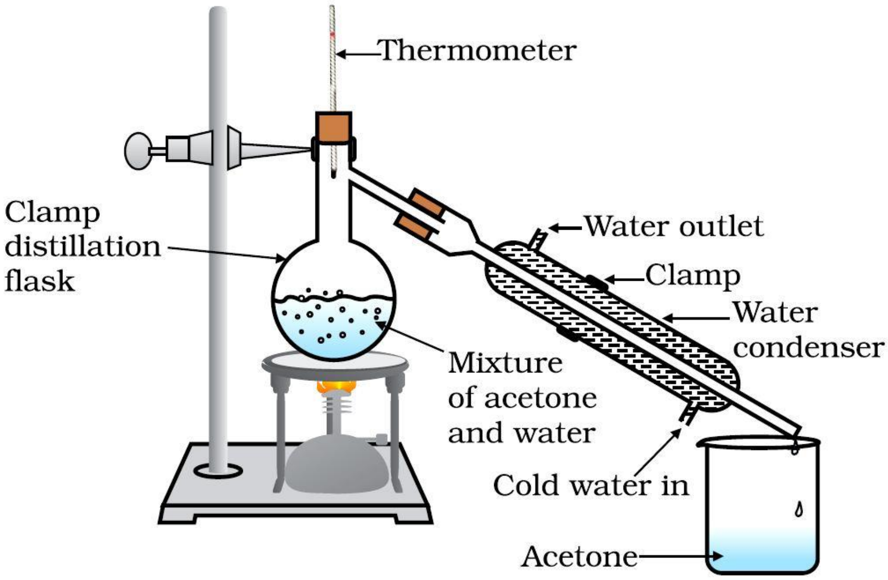


Application of chromatography -

- In the separation of colours from a dyes.
- In the separation of pigments from natural colours.
- In the separation of drugs from blood for pathological tests.

DISTILLATION

The process of distillation is used to separate two miscible liquids. The technique of distillation is based on the difference in boiling points of components of mixture of miscible liquids. Distillation is to separate the liquids which do not decompose even upto their boiling points and should boil at more than 25^0C.

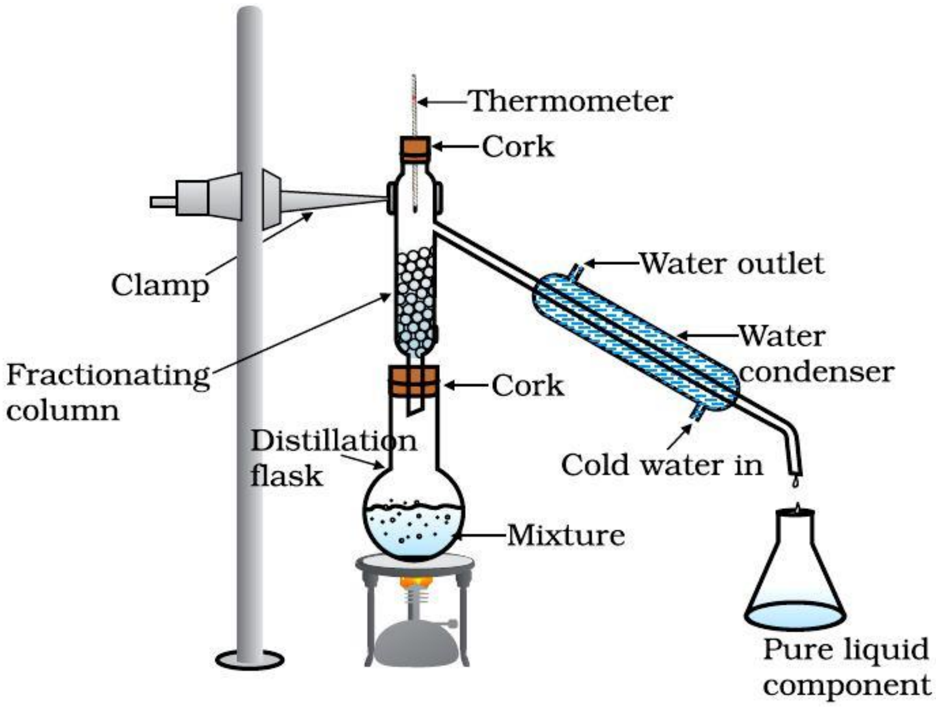


In the process of distillation, the mixture is heated after keeping in a retort or distillation flask. The liquid which boils at lower temperature is vaporized at lower temperature. The vapour so obtained is passed through a tube and gets condensed in a separate container; leaving liquid with higher boiling point in the retort or distillation flask.

Distillation is used to separate the components of the mixture of two miscible liquids that boils without decomposition and have sufficient difference in their boiling points.

The process of distillation is used to purify many liquids, such as water.

FRACTIONAL DISTILLATION



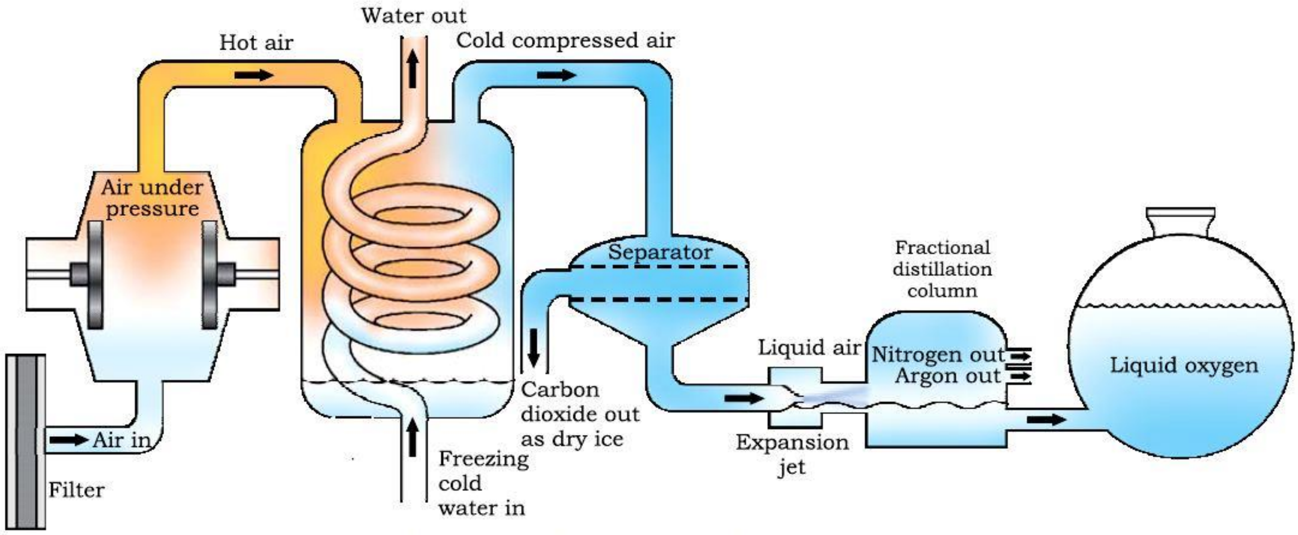
Fractional distillation is the process of separation of components of mixture into parts or fraction on the basis of fractional differences in their boiling points.
Fractional distillation is done when the difference in boiling points of the components of miscible liquids is less than 25^0C. In the process of fractional distillation, a fractional column is used along with retort or distillation flask.
Fractional column is a tube which contains glass beads, which facilitate surface for the vapour to cool and condense repeatedly.
Example – Ethanol and water are separated from their mixture using fractional distillation. The boiling point of water is 100^0C while the boiling point of ethanol is 78.4^0C. Since the difference of their boiling point is less than 25^0C, thus they are separated using fractional distillation.

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 process of organic juice.
- In the separation of oxygen, liquid nitrogen and argon from air.

SEPARATION OF DIFFERENT GASES FROM AIR
Air comprises of nitrogen, oxygen, carbon dioxide and argon as major components. Since air is the cheapest source of these gases, thus these are extracted from air at large scale
After liquefaction of air by repeated compression and cooling; nitrogen, oxygen, carbon dioxide and argon are extracted using fractional distillation.
Liquid nitrogen has boiling point equal to - 190^0C and thus turns into gas first and separated from air.
The boiling point of argon is - 186^0C, therefore it is extracted after argon.
The boiling point of oxygen is - 183^0C, thus it is collected after the extraction of argon.
Carbon dioxide turns into solid at a temperature of - 97^0C, therefore, it is removed while air is put under liquefaction.

USE
Nitrogen is used as fertilizers, oxygen is used in hospitals and argon is used in bulbs.



Separation of components of air

CRYSTALLIZATION

Crystallisation is a process that separates a pure solid in the form of its crystals from a solution. The crystallisation method is used to purify solids. For example, the salt we get from sea water can have many impurities in it. To remove these impurities, the process of crystallisation is used.

Crystallisation technique is better than simple evaporation technique as –

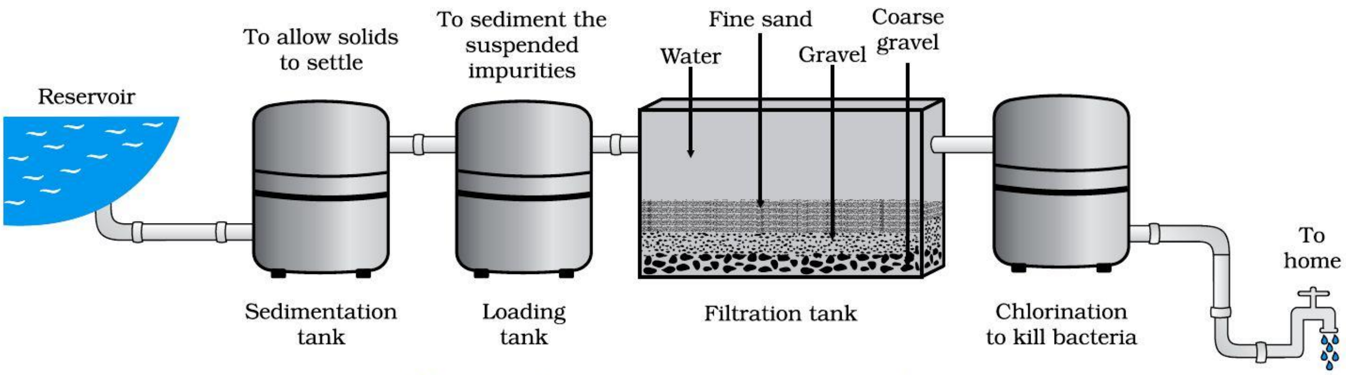
- some solids decompose or some, like sugar, may get charred on heating to dryness.
- some impurities may remain dissolved in the solution even after filtration. On evaporation these contaminate the solid.

APPLICATIONS

- Purification of salt that we get from sea water.
- Separation of crystals of alum (*phitkari*) from impure samples.

Thus, by choosing one of the above methods according to the nature of the components of a mixture, we get a pure substance. With advancements in technology many more methods of separation techniques have been devised.

In cities, drinking water is supplied from water works. A flow diagram of a typical water works is shown in below figure. From this figure write down the processes involved to get the supply of drinking water to your home from the water works and discuss it in your class.

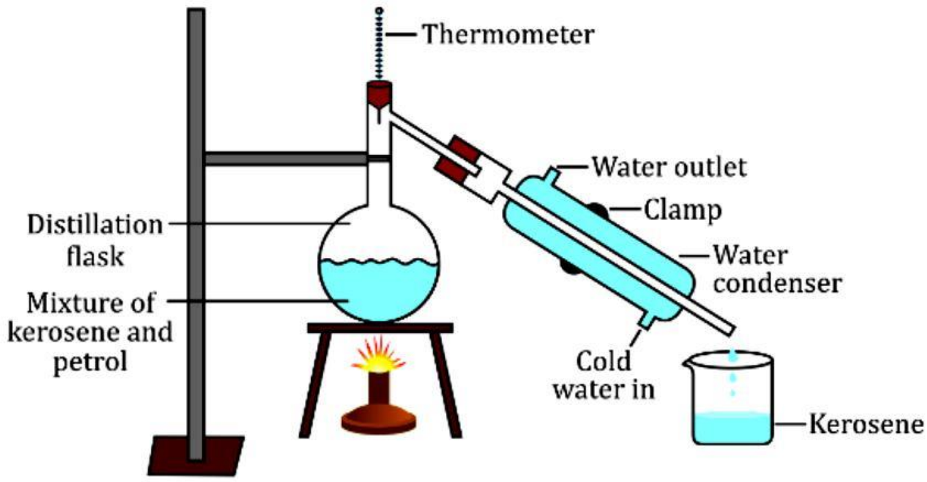


Water purification system in water works

INTEXT QUESTIONS PAGE NO. 24

Q1. How will you separate a mixture containing kerosene and petrol (difference in their boiling points is more than 25^0C), which are miscible with each other?

Answer:



A mixture of two miscible liquids having a difference in their boiling points more than 25°C can be separated by the method of distillation. Thus, kerosene and petrol can be separated by distillation.

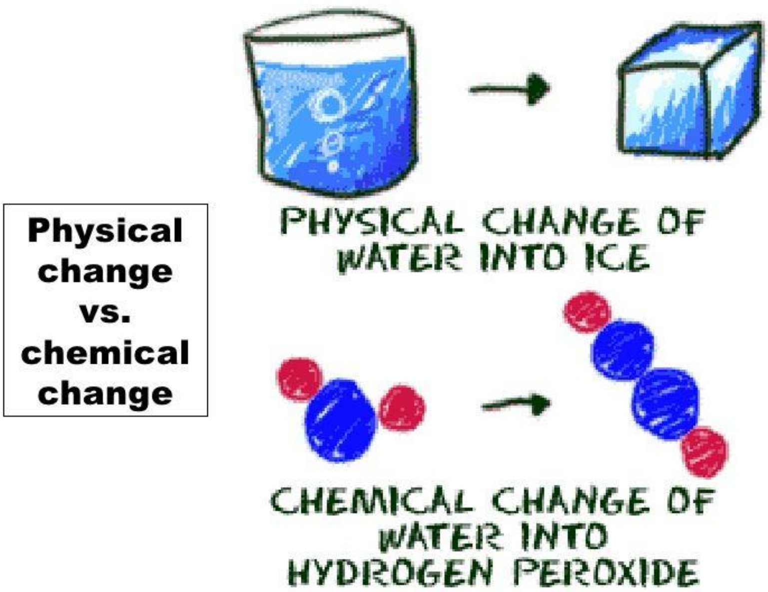
In this method, the mixture of kerosene and petrol is taken in a distillation flask with a thermometer fitted in it. We also need a beaker, a water condenser, and a Bunsen burner. The apparatus is arranged as shown in the above figure. Then, the mixture is heated slowly. The thermometer should be watched simultaneously. Kerosene will vaporize and condense in the water condenser. The condensed kerosene is collected from the condenser outlet, whereas petrol is left behind in the distillation flask.

Q2. Name the technique to separate
(i) butter from curd,
(ii) salt from sea-water,
(iii) camphor from salt.
Answer:
(i) Butter can be separated from curd by centrifugation.
(ii) Salt can be separated from sea-water by evaporation.
(iii) Camphor can be separated from salt by sublimation.

Q3. What type of mixtures are separated by the technique of crystallisation?
Answer:
By the technique of crystallization, pure solids are separated from impurities. For example, salt obtained from sea is separated from impurities; crystals of alum (Phitkari) are separated from impure samples.

PHYSICAL CHANGE: The change in which no new substance is formed is called a physical change. During a physical change, chemical properties do not change but physical properties do change.

CHEMICAL CHANGE: The change in which a new substance is formed is called a chemical change. During a chemical change, chemical properties change.



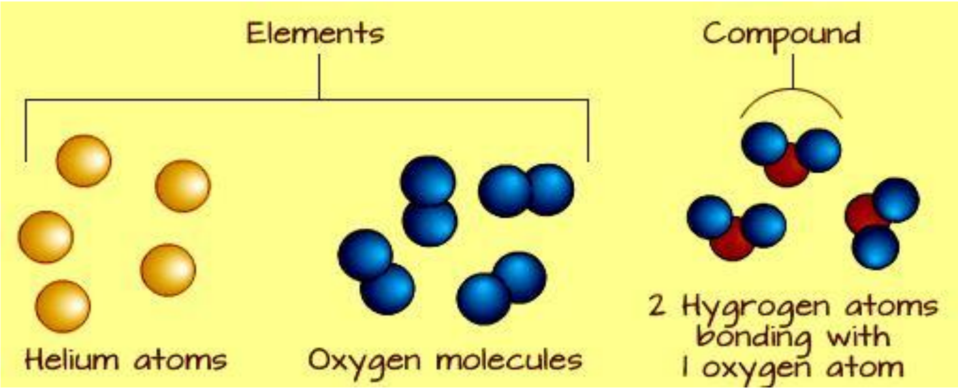
PURE SUBSTANCES
Elements and Compounds are considered as pure substances.

Elements – Substances that is made of only one element are called elements, such as hydrogen, carbon, oxygen, silver, gold, etc.

Elements can be normally divided into metals, non-metals and metalloids. Metals usually show some or all of the following properties:

- They have a lustre (shine).
- They have silvery-grey or golden-yellow colour.
- They conduct heat and electricity.
- They are ductile (can be drawn into wires).
- They are malleable (can be hammered into thin sheets).
- They are sonorous (make a ringing sound when hit).

Examples of metals are gold, silver, copper, iron, sodium, potassium etc. Mercury is the only metal that is liquid at room temperature.



Non-metals usually show some or all of the following properties:

- They display a variety of colours.
- They are poor conductors of heat and electricity.
- They are not lustrous, sonorous or malleable.

Examples of non-metals are hydrogen, oxygen, iodine, carbon (coal, coke), bromine, chlorine etc. Some elements have intermediate properties between those of metals and non-metals, they are called metalloids; examples are boron, silicon, germanium etc.

Compounds – Substances that is made of one or more elements by chemical combination are called compounds, such as water, carbon dioxide, copper oxide, hydrochloric acid, etc.

A compound does not contain the properties of its constituent elements and shows quite different characteristics.

COMPARISON BETWEEN COMPOUND AND ELEMENT

	Compound	Element
Distinguishing Feature	Compounds contain different elements in a fixed ratio arranged in a defined manner through chemical bonds.	Elements are distinguished by their atomic number (number of protons in their nucleus).
Ability to Breakdown	A compound can be separated into simpler substances by chemical methods/reactions.	Elements cannot be broken down into simpler substances by chemical reactions.
Types	The list of compounds is endless.	There are about 117 elements that have been observed. Can be classified as metal, non-metal or metalloid.
Representation	A compound is represented using a formula.	An element is represented using symbols.
Examples	Water (H_2O), Sodium chloride ($NaCl$), Sodium bicarbonate ($NaHCO_3$) etc.	Iron, copper, silver, gold, nickel etc.

COMPARISON BETWEEN MIXTURE AND COMPOUND

Mixture	Compound
Elements are physically mixed in any ratio and no new compound is formed.	Elements are chemically combined in a fixed ratio to form a new compound.
They have no sharp or definite melting point, boiling point, density etc.	They have definite melting point, boiling point, density etc.
A mixture exhibits the properties of its constituent or component elements.	Property of a compound is different from its constituent or component elements.
They are either homogeneous or heterogeneous in nature.	They are always homogeneous in nature.
Constituents of a mixture can be separated by physical methods like filtration, magnetic separation etc.	Constituents of a compound cannot be separated by physical methods.

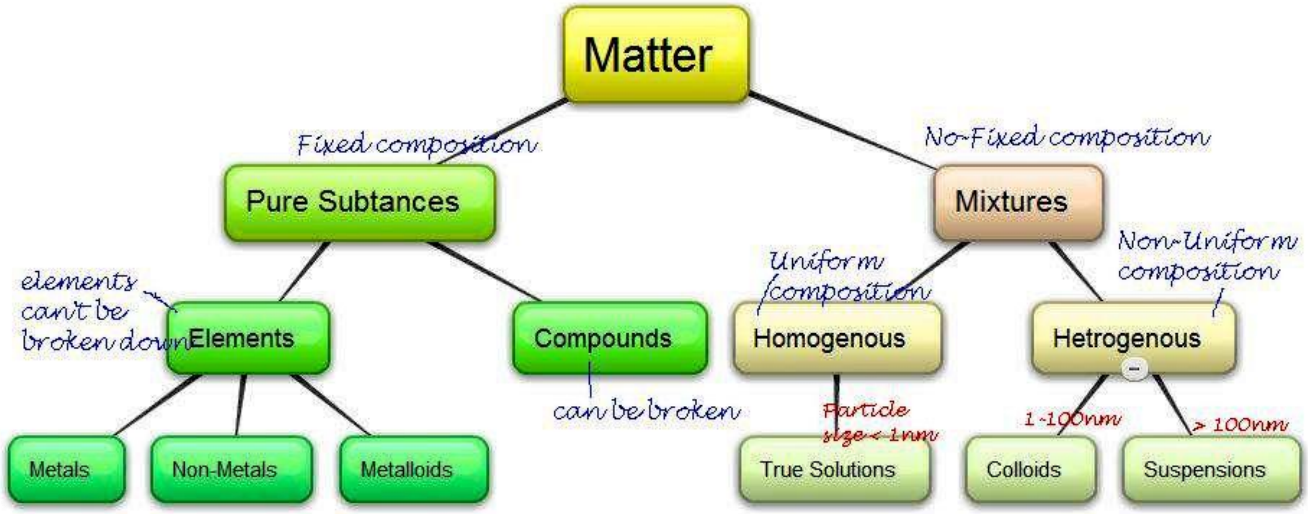
INTEXT QUESTIONS PAGE NO. 24

Q1. Classify the following as chemical or physical changes:
• cutting of trees,
• melting of butter in a pan,
• rusting of almirah,
• boiling of water to form steam,
• passing of electric current, through water and the water breaking down into hydrogen and oxygen gases,
• dissolving common salt in water,
• making a fruit salad with raw fruits, and
• burning of paper and wood.

Answer:
- Cutting of trees → Physical change
- Melting of butter in a pan → Physical change
- Rusting of almirah → Chemical change
- Boiling of water to form steam → Physical change
- Passing of electric current through water, and water breaking down into hydrogen and oxygen gas → Chemical change
- Dissolving common salt in water → Physical change
- Making a fruit salad with raw fruits → Physical change
- Burning of paper and wood → Chemical change

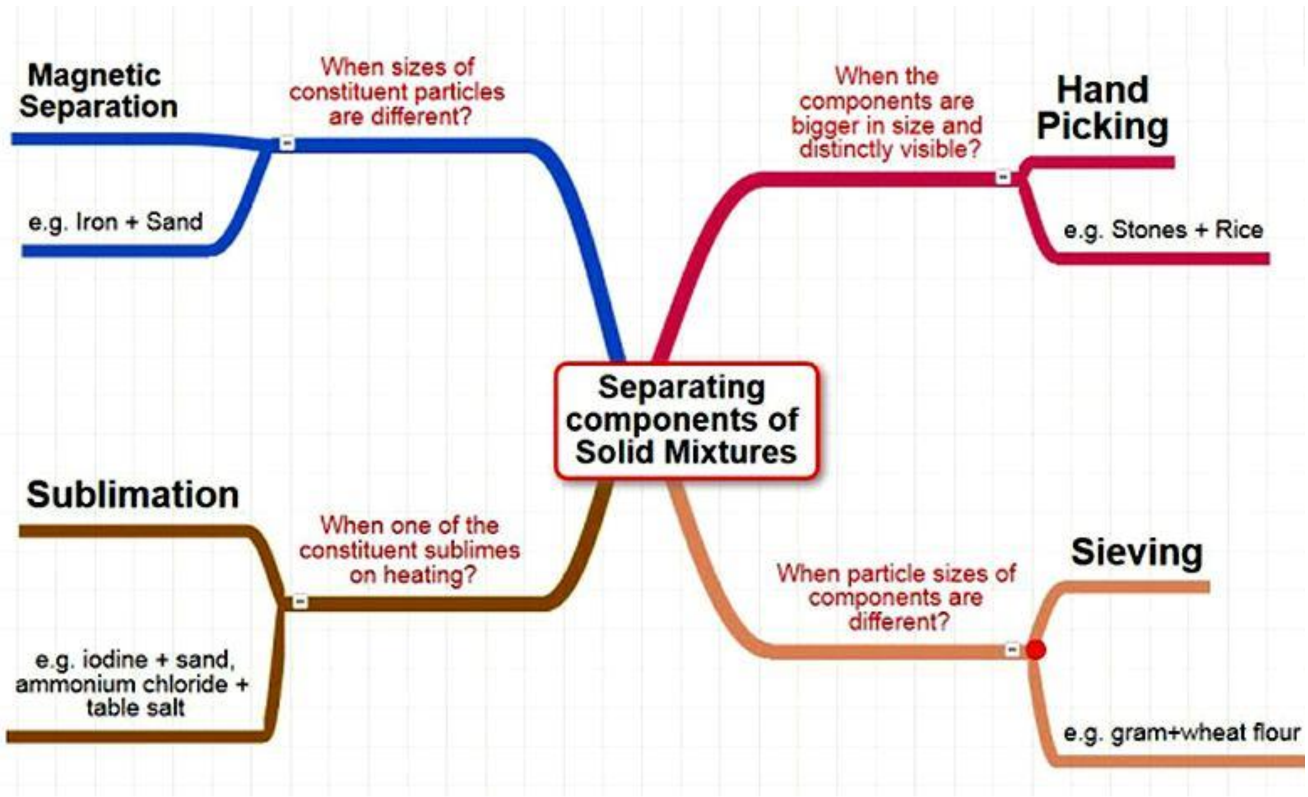
Q2. Try segregating the things around you as pure substances or mixtures.
Answer:
Pure substance: Water, salt, sugar
Mixture: Salt water, soil, wood, air, cold drink, rubber, sponge, fog, milk, butter, clothes, food

IMPORTANT CONCEPT MAPS



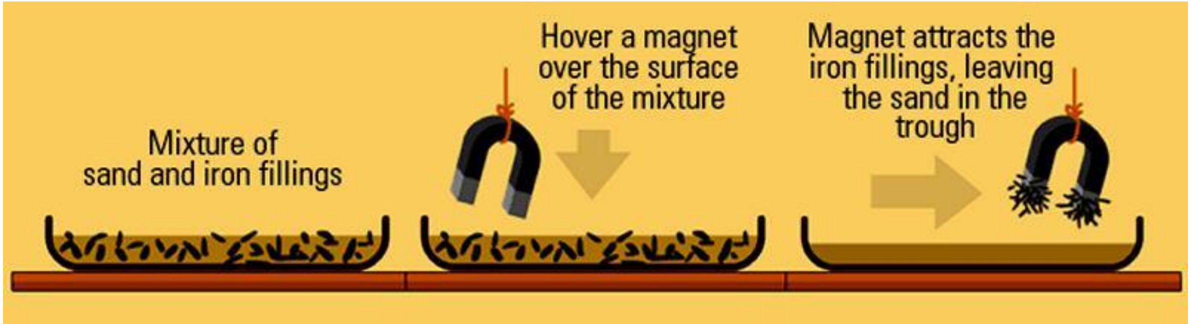
DIFFERENT WAYS TO SEPARATE SOLID MIXTURES

- Hand Picking
- Sieving
- Magnetic Separation Method
- Sublimation



MAGNETIC SEPARATION METHOD

Magnetic Separation Method is ideal for separating mixtures of two solids with one part having **magnetic** properties. Some metals like iron, nickel and cobalt have magnetic properties whiles gold, silver and aluminum do not. Magnetic elements are attracted to a magnet.



It works like this: Let us take a mixture of sand and iron filing for example.
To separate this, spread out the mixture on a flat surface. Run a magnet bar over the surface. You will notice that the magnetic elements (iron filings) will be attracted to the magnet over it. After a number of runs, all the sand will be free from any iron filing.

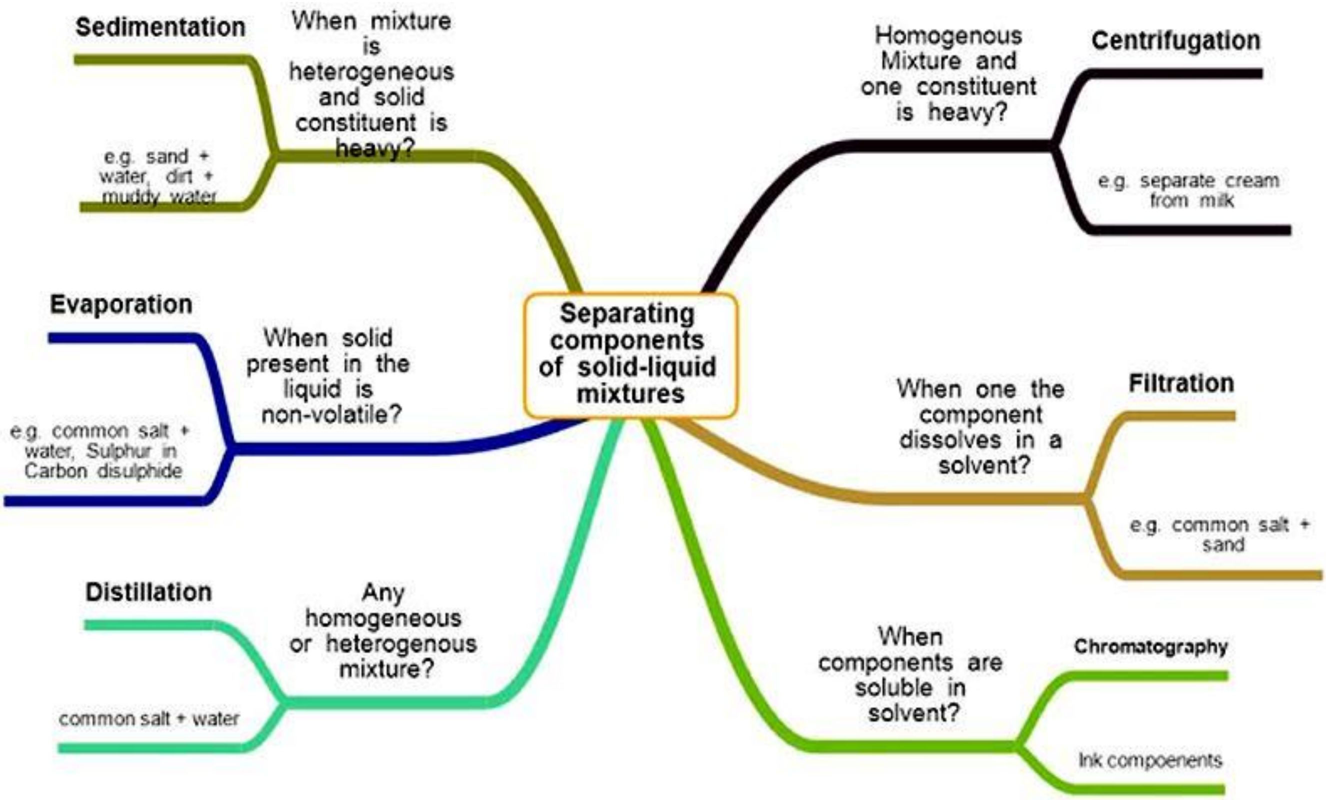
SIEVING METHOD

When the sizes of the components of a mixture are big enough, they can be separated with the help of sieve. A sieve is a simple mechanical device in which a mesh is attached to a frame. When the mixture is placed on the mesh and is stirred, particles of smaller size pass through the mesh while the bigger particles of the other component remain above the mesh. E.g. gram can be separated wheat, sieving of sand at construction site etc.

HAND PICKING METHOD

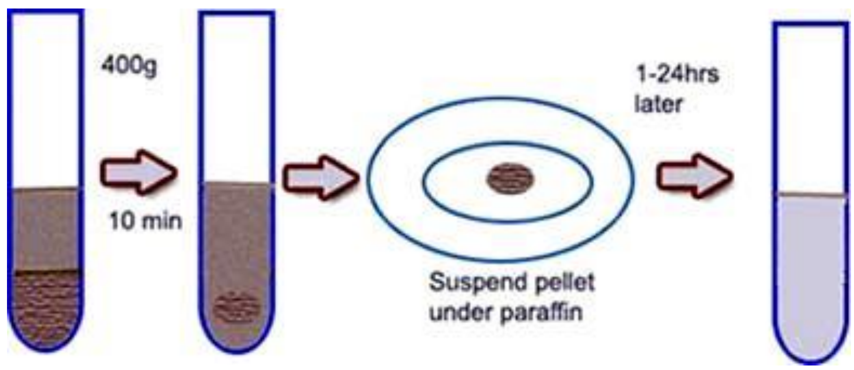
It involves simply picking out substances by hand and separating them from others. The substances being separated may be impurities that have to be thrown away or it may be that both the substances being separated are useful – such as if you separate green grapes from black ones from a mixture of the two.

DIFFERENT WAYS TO SEPARATE SOLID-LIQUID MIXTURES



SEDIMENTATION METHOD

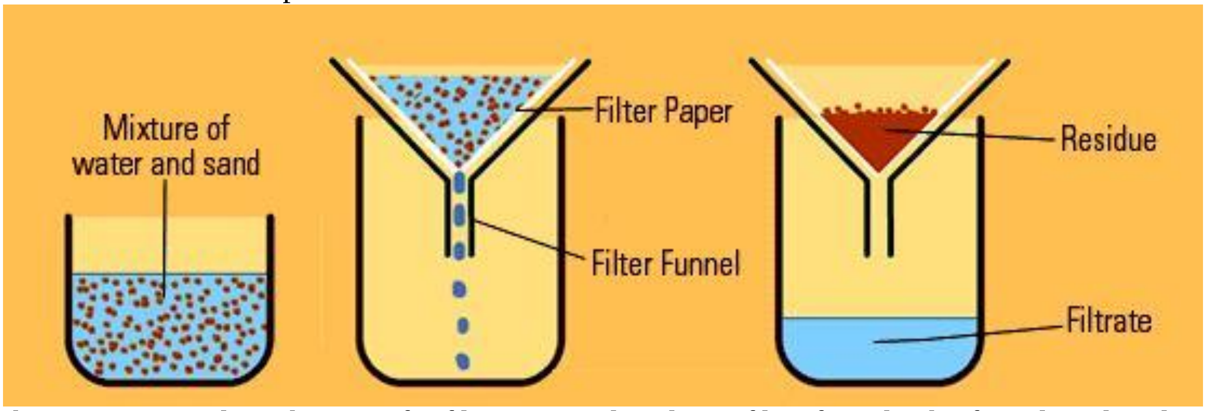
Sedimentation is the tendency for particles in suspension to settle out of the fluid in which they are entrained and come to rest against a barrier. This is due to their motion through the fluid in response to the forces acting on them: these forces can be due to gravity, centrifugal acceleration, or electromagnetism. In geology, sedimentation is often used as the opposite of erosion, i.e., the terminal end of sediment transport. In that sense, it includes the termination of transport by saltation or true bedload transport. Settling is the falling of suspended particles through the liquid, whereas sedimentation is the termination of the settling process.



FILTRATION METHOD

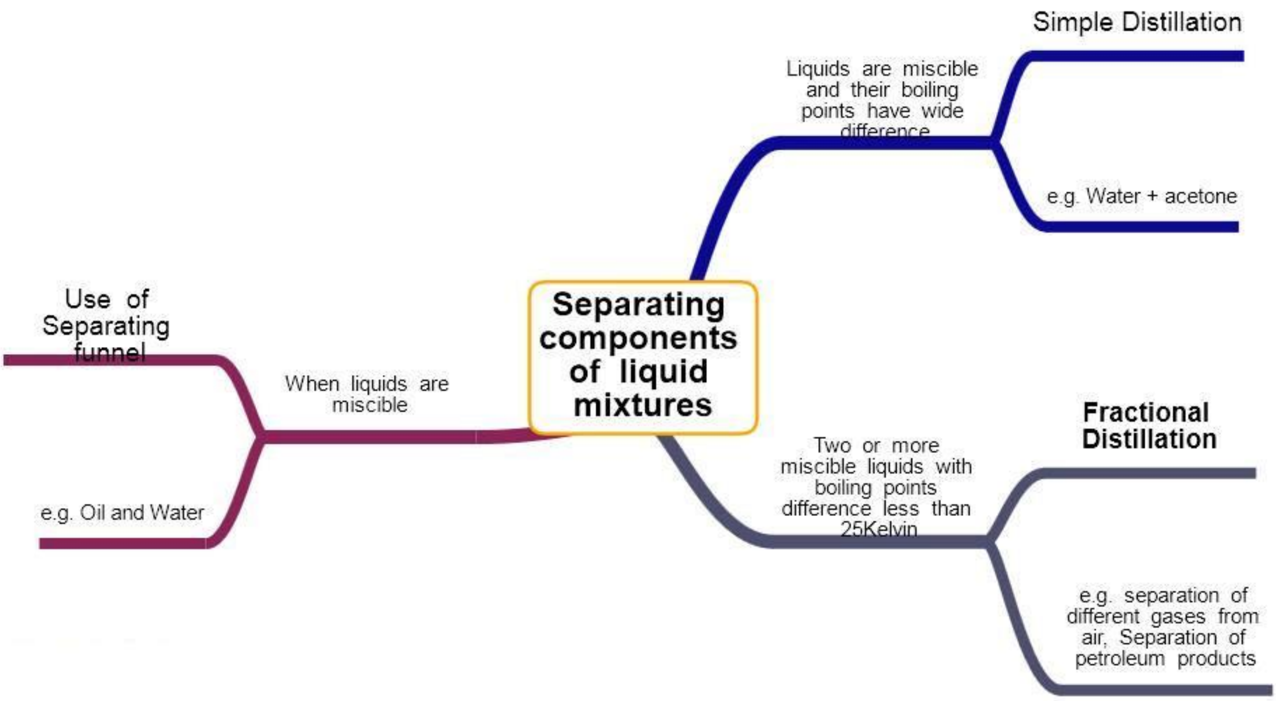
This is a more common method of separating an insoluble solid from a liquid. An example of such a mixture is sand and water. Filtration is used in water treatment plants, where water from the river is filtered to remove solid particles.

Here is a basic lab setup for filtration:



This process involves the use of a filter paper placed in a filter funnel. The funnel is placed in a beaker and the mixture of water and sand is poured into the funnel. The liquid part drains through the filter paper into the beaker, leaving the solid sand particles trapped on the filter. In filtration, the liquid part collected is called the filtrate and the solid bit that remained on the filter paper is called the residue.

DIFFERENT WAYS TO SEPARATE LIQUID-LIQUID MIXTURES



- Fractional distillation is the process of separating two or more miscible liquids by a modified distillation process, in which the distillates are collected as fractions having different boiling points. The separation of the liquids by this method is based on the difference in their boiling points.
- Fractional distillation makes use of a fractionating column or distillation column, a tube which provides different temperature zones inside it during distillation, the temperature decreasing from bottom to top. It provides surfaces on which condensations (of less volatile liquids) and vaporizations (of more volatile liquids) can occur before the vapours enter the condenser in order to concentrate the more volatile liquid in the first fractions and the less volatile components in the later fractions.
- Fractional distillation is very effective is separating mixtures of volatile components, and is widely used in laboratories and industries.

EXERCISE QUESTIONS PAGE NO. 28 to 30

Q1. Which separation techniques will you apply for the separation of the following?
(a) Sodium chloride from its solution in water.
(b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride.
(c) Small pieces of metal in the engine oil of a car.
(d) Different pigments from an extract of flower petals.
(e) Butter from curd.
(f) Oil from water.
(g) Tea leaves from tea.
(h) Iron pins from sand.
(i) Wheat grains from husk.
(j) Fine mud particles suspended in water.
Answer:
(a) Sodium chloride from its solution in water → Evaporation
(b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride → Sublimation
(c) Small pieces of metal in the engine oil of a car → Centrifugation or filtration or decantation
(d) Different pigments from an extract of flower petals → Chromatography
(e) Butter from curd → Centrifugation
(f) Oil from water → Using separating funnel
(g) Tea leaves from tea → Filtration
(h) Iron pins from sand → Magnetic separation
(i) Wheat grains from husk → Winnowing
(j) Fine mud particles suspended in water → Centrifugation

Q2. Write the steps you would use for making tea. Use the words solution, solvent, solute, dissolve, soluble, insoluble, filtrate and residue.
Answer: First, water is taken as a solvent in a saucer pan. This water (solvent) is allowed to boil. During heating, milk and tea leaves are added to the solvent as solutes. They form a solution. Then, the solution is poured through a strainer. The insoluble part of the solution remains on the strainer as residue. Sugar is added tothe filtrate, which dissolves in the filtrate. The resulting solution is the required tea.

Q3. Pragya tested the solubility of three different substances at different temperatures and collected the data as given below (results are given in the following table, as grams of substance dissolved in 100 grams of water to form a saturated solution).

Substance Dissolved	Temperature in K				
	283	**293**	**313**	**333**	**353**
Potassium nitrate	21	32	62	106	167
Sodium chloride	36	36	36	37	37
Potassium chloride	35	35	40	46	54
Ammonium chloride	24	37	41	55	66

(a) What mass of potassium nitrate would be needed to produce a saturated solution of potassium nitrate in 50 grams of water at 313 K?
(b) Pragya makes a saturated solution of potassium chloride in water at 353 K and leaves the solution to cool at room temperature. What would she observe as the solution cools? Explain.
(c) Find the solubility of each salt at 293 K. Which salt has the highest solubility at this temperature?
(d) What is the effect of change of temperature on the solubility of a salt?

Answer:

(a) At 313 K, 62 grams of Potassium nitrate dissolved in 100 grams of water. So to produce a saturated solution of potassium nitrate in 50 grams of water, we need $\frac{62}{100} \times 50 = 31$ grams of potassium nitrate

(b) Some soluble potassium chloride will separate out in the form of crystals at room temperature because the solubility of potassium chloride will decrease with decrease in temperature.

(c)

(i) Solubility of Potassium nitrate at 293 K is 32 grams.
(ii) Solubility of Sodium chloride at 293 K is 36 grams.
(iii) Solubility of Potassium chloride at 293 K is 35 grams.
(iv) Solubility of Ammonium chloride at 293 K is 37 grams.

The solubility of Ammonium chloride is highest at this temperature.

(d) The solubility of salt increases with increase in temperature.

Q4. Explain the following giving examples.
(a) saturated solution
(b) pure substance
(c) colloid
(d) suspension

Answer:

(a) Saturated solution

A saturated solution is a solution in which the maximum amount of solute has been dissolved at a given temperature. The solution cannot dissolve beyond that amount of solute at that temperature. Any more solute added will settle down at the bottom of the container as a precipitate.

Suppose 500 g of a solvent can dissolve a maximum of 150 g of a particular solute at 40°C. Then, the solution obtained by dissolving 150 g of that solute in 500 g of that solvent at 300 K is said to be a saturated solution at 300 K.

(b) Pure substance

A pure substance is a substance consisting of a single type of particles i.e., all constituent particles of the substance have the same chemical properties.

For example, salt, sugar, water are pure substances.

(c) Colloid

A colloid is a heterogeneous mixture. The size of the solutes in this mixture is so small that they cannot be seen individually with naked eyes, and seems to be distributed uniformly throughout the mixture. The solute particles do not settle down when the mixture is left undisturbed. This means that colloids are quite stable. Colloids cannot be separated by the process of filtration. They can be separated by centrifugation. Colloids show the Tyndall effect. For example, milk, butter, foam, fog, smoke, clouds.

(d) Suspension

Suspensions are heterogeneous mixtures. The solute particles in this mixture remain suspended throughout the bulk of the medium. The particles can be seen with naked eyes. Suspension shows the Tyndall effect. The solute particles settle down when the mixture is left undisturbed. This means that suspensions are unstable. Suspensions can be separated by the method of filtration. For example, mixtures of chalk powder and water, wheat flour and water.

Q5. Classify each of the following as a homogeneous or heterogeneous mixture. soda water, wood, air, soil, vinegar, filtered tea.
Answer:
Homogeneous mixtures: Soda water, air, vinegar
Heterogeneous mixtures: Wood, soil, filtered tea

Q6. How would you confirm that a colourless liquid given to you is pure water?
Answer: Every liquid has a characteristic boiling point. Pure water has a boiling point of 100°C (373 K) at 1 atmospheric pressure. If the given colourless liquid boils at even slightly above or below 100°C, then the given liquid is not pure water. It must boil at sharp 100°C. Thus, by observing the boiling point, we can confirm whether a given colourless liquid is pure water or not.

Q7. Which of the following materials fall in the category of a "pure substance"?
(a) Ice
(b) Milk
(c) Iron
(d) Hydrochloric acid
(e) Calcium oxide
(f) Mercury
(g) Brick
(h) Wood
(i) Air.
Answer: The following materials fall in the category of a "pure substance":
(a) Ice (c) Iron (d) Hydrochloric acid
(e) Calcium oxide (f) Mercury

Q8. Identify the solutions among the following mixtures.
(a) Soil
(b) Sea water
(c) Air
(d) Coal
(e) Soda water.
Answer: The following mixtures are solutions:
(b) Sea water (c) Air (e) Soda water

Q9. Which of the following will show "Tyndall effect"?
(a) Salt solution
(b) Milk
(c) Copper sulphate solution
(d) Starch solution.
Answer: Milk and starch solution will show the "Tyndall effect".

Q10. Classify the following into elements, compounds and mixtures.
(a) Sodium **(b) Soil** **(c) Sugar solution**
(d) Silver **(e) Calcium carbonate** **(f) Tin**
(g) Silicon **(h) Coal** **(i) Air**
(j) Soap **(k) Methane** **(l) Carbon dioxide**
(m) Blood
Answer:
Elements
(a) Sodium (d) Silver (f) Tin (g) Silicon

Compounds

(e) Calcium carbonate (k) Methane (l) Carbon dioxide

Mixtures

(b) Soil	(c) Sugar solution	(h) Coal
(i) Air	(j) Soap	(m) Blood

Q11. Which of the following are chemical changes?
(a) Growth of a plant
(b) Rusting of iron
(c) Mixing of iron filings and sand
(d) Cooking of food
(e) Digestion of food
(f) Freezing of water
(g) Burning of a candle.

Answer: The following changes are chemical changes:
(a) Growth of a plant
(b) Rusting of iron
(d) Cooking of food
(e) Digestion of food
(g) Burning of candle

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 2
IS MATTER AROUND US PURE

1. On the basis of composition, how matter is classified?

2. Mention whether the following statements are true or false. Correct the false statements.

   a) An aqueous solution of copper sulphate is homogeneous.

   b) Milk is a pure substance.

   c) A molecule of sulphur is monoatomic.

3. What is meant by a pure substance?

4. What are the characteristics exhibited by a pure substance?

5. What are different categories of pure substance?

6. Name two properties of a substance to check its purity?

7. Define mixture.

8. What are the kinds of mixture?

9. What are the characteristics of mixture?

10. List the points of differences between homogeneous and heterogeneous mixtures.

11. Identity which of the following is homogenous mixture or heterogeneous one. Also identify the type of constituents in mixture (e.g. gas in gas, gas in liquid, gas in solid etc.)

a. Air

b. Water and Oil (N_2 + O_2)

c. Hydrogen in Palladium

d. Aerated Water (CO_2 + H_2O)

e. Chalk in water

f. Ethyl Alcohol in Water

g. Alloys e.g. brass

h. Dust (e.g. fine sand) in water

i. Sand + iron fillings

j. Sand + ammonium chloride

h. milk

i. Mercury in amalgamated Zinc

12. What are the constituents of brass?

13. Alloys cannot be separated by physical means, though it is considered mixture, Why?

14. What are elements?

15. How elements are further classified?

16. What is a compound? Give an example.

17. State the differences between compounds and mixtures.

18. What is a solution? What are the properties of a solution?

19. What is meant by solute and solvent?

20. Identify solute and solvent in the following solutions. Also mention the physical state of solute and solvent.

(a) Sugar in water

(b) Urea in water

(c) Ammonium chloride in water

(d) Ethyl alcohol in water

(e) Carbon Di-Oxide in water (soda water)

21. What is meant by Solubility?

22. What factors affect the solubility of solvent and solute?

23. Why do fish go in deep waters during day light?

24. Based on the type of solvent, how solutions are classified?

25. Based on the amount of solute in the given solution, how solutions are classified?

26. What are aqueous solutions?

27. What are non-aqueous solutions?

28. When we open the cap of a cola drink (or any carbonated beverage), why does excess of bubbles come out?

29. Why air is a mixture not a compound? Give reasons.

30. What are the advantages of preparing solutions?

31. What is an unsaturated solution?

32. What is saturated solution? Explain with an example.

33. What is supersaturated solution?

34. What are suspensions? Explain with an example.

35. What are the properties of suspensions?

36. Explain with an example what is a colloid?

37. What are the physical states of dispersed phase and dispersion medium of a cloud?

38. What are the physical states of dispersed phase and dispersion medium of a fog?

39. What are the properties of a colloid?

40. How are sol, solution and suspension different from each other?

41. What is Tyndall effect? Doee true solution exhibit Tyndall effect.

42. "Tyndall effect can be observed when sunlight passes through the canopy of dense forest. or we see a rich red sunset." Explain how this occurs

43. What do you mean by strength of the solution?

44. What are the various methods to express concentration of a solution?

45. To make a saturated solution, 36 g of sodium chloride is dissolved in 100 g of water at 293K. Find its concentration at this temperature.

46. Calculate the mass of glucouse and mass of water required to make 200g of 25% solution of glucouse.

47. A solution contains 40 mL of ethyl alcohol mixed with 100mL of water. What is the concentration of the solution in terms of volume by volume percentage?

48. What are different ways to separate solid mixtures?

49. Describe sieving method.

50. Winnowing works on what property?

51. What are the reasons for separating the constituents of a mixture?

52. When it is useful to apply sedimentation and decantation? Give an example where these methods are used? Explain the process.

53. What principle is applied in centrifugation? Give examples where this method is applied to separate mixtures.

54. How crystallization is better than evaporation?

55. Name the technique to separate (i) butter from curd (ii) salt from sea-water (iii) camphor from salt

56. What is Chromatography?

57. A good method to separate alum (phitkari) from impure samples is (a) Filtration (b) Sedimentaion (c) Crystallization (d) Sublimation

58. A boy buys common salt from the market which is contaminated with Ammonium Chloride (NH4Cl) and sand. The procedure he should adopt to obtain pure NaCl is the following :

(a) to mix the sample in water and evaporate the solution

(b) to mix the sample in water and evaporate the decanted solution

(c) to mix the sample in acetone and evaporate the decanted solution

(d) to heat the sample, then mix in water and evaporate the decanted solution

59. Define Brownian movement in colloids.

60. Name the following :

(a) a lustrous liquid metal.

(b) a liquid non-metal

(c) a metal which can be cut with a knife

(d) a non-metal which is good conductor of electricity.

(e) an element which melts when kept on the palm.

(f) the best conductor of heat.

61. How many elements are there which are in gaseous state at room temperature?

62. Name the elements are in liquid state at room temperature.

63. Who used the term 'element' first time?

64. Who gave the first explanatory definition of 'element'?

65. Identify the following as mixture or compound. (i) blood (ii) common salt (iii) sugar (iv) brass

66. Sasha heats a container carrying Nitrogen and Oxygen. After heating at very high temperature, it gives Nitric oxide. Identify what are mixtures and/or compounds before and after the reaction.

67. In beaker A, sugar cubes are dissolved into water while in beaker B, crushed cubes are taken. In which beaker the rate of dissolution is faster?

68. Identify solute and solvent in the following solutions :

(i) aerated drinks

(ii) tincture of iodine

(iii) lemon water

69. State the principle of each of the following methods of separation of mixtures.

(i) centrifugation method.

(ii) separation using separating funnel.

70. Why solutions do not exhibit Tyndall effect?

71. What is an emulsion? Give examples

72. What are the differences and similarities between concentration and solubility?

73. Give examples of liquids that are

(i) completely miscible

(ii) partially miscible

(iii) practically immiscible

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 2
IS MATTER AROUND US PURE

1. Salt can be recovered from its solution by evaporation. Suggest some other technique for the same?

2. While diluting a solution of salt in water, a student by mistake added acetone (boiling point 56°C). What technique can be employed to get back the acetone? Justify your choice.

3. Classify the following as element, compound or mixture. i) Zinc amalgam (ii) Sea water (iii) Iodine vapour (iv) Gold coin (v) Water.

4. How would you separate a mixture of ammonia and hydrogen?

5. Give one example for each of the following mixtures: i) Solid/solid (homogeneous) ii) Solid/solid (heterogeneous) iii) Liquid/liquid (homogeneous) iv) Liquid/liquid (heterogeneous) v) Gas/liquid (homogeneous).

6. Explain why particles of a colloidal solution do not settle down when left undisturbed, while in the case of a suspension they do.

7. Smoke and fog both are aerosols. In what way are they different?

8. Name the process associated with the following

(a) Dry ice is kept at room temperature and at one atmospheric pressure.

(b) A drop of ink placed on the surface of water contained in a glass spreads throughout the water.

(c) A potassium permanganate crystal is in a beaker and water is poured into the beaker with stirring.

(d) A acetone bottle is left open and the bottle becomes empty. (e) Milk is churned to separate cream from it.

(e) Settling of sand when a mixture of sand and water is left undisturbed for some time.

(f) Fine beam of light entering through a small hole in a dark room, illuminates the particles in its paths.

9. The teacher instructed three students ‘A’, ‘B’ and ‘C’ respectively to prepare a 50% (mass by volume) solution of sodium hydroxide (NaOH). ‘A’ dissolved 50g of NaOH in 100 mL of water, ‘B’ dissolved 50g of NaOH in 100g of water while ‘C’ dissolved 50g of NaOH in water to make 100 mL of solution. Which one of them has made the desired solution and why?

10. Why is gold alloyed with copper or silver for the purpose of making ornaments?

11. Give some examples of Tyndall effect observed in your surroundings?

12. Calculate the mass of sodium sulphate required to prepare its 20% (mass percent) solution in 100g of water?

13. How would you separate a mixture of ammonia and hydrogen?

14. Action of heat on blue vitriol is a physical as well as chemical change. Justify.

15. How would you separate a mixture of NH_4Cl and I_2?

16. Describe a method for separation of the constituents of gunpowder.

17. Describe how you would obtain the substances mentioned below, from the given mixtures. a) Iodine from tincture of iodine. b) Lead chloride from a mixture of lead chloride and silver chloride

18. Write the characteristics of Suspension method of separation of mixture.

19. Briefly describe how to separate, i) Sulphur from a mixture of sulphur and sand. ii) Black CuO from a mixture of CuO and ZnO.

20. Fill in the blanks

(a) A colloid is a ——— mixture and its components can be separated by the technique known as ———.

(b) Ice, water and water vapour look different and display different —— properties but they are ——— the same.

(c) A mixture of chloroform and water taken in a separating funnel is mixed and left undisturbed for some time. The upper layer in the separating funnel will be of——— and the lower layer will be that of ———.

(d) A mixture of two or more miscible liquids, for which the difference in the boiling points is less than 25 K can be separated by the process called———.

(e) When light is passed through water containing a few drops of milk, it shows a bluish tinge. This is due to the ——— of light by milk and the phenomenon is called ——— . This indicates that milk is a ——— solution.

21. Which of the following is NOT true about colloids?
(a) Particles in a colloid can pass through filter paper.
(b) A colloid is a homogeneous solution.
(c) Colloidal particles exhibit Brownian motion.
(d) Colloidal particles exhibit electrophoresis.

22. Which of the following is a heterogeneous mixture?
(a) air
(b) brass
(c) sugar dissolved in water
(d) lime water

23. How can we separate cream from milk?
(a) Centrifugation

(b) Chromatography
(c) Sublimation
(d) Distillation

24. Removal of clear layer of the liquid without disturbing the settled solid is known as __________.
(a) Sedimentation
(b) Decantation
(c) Filtration
(d) Evaporation

25. A mixture of water and silver chloride can be separated by
(a) Centrifugation
(b) Sedimentation
(c) Filtration
(d) Sublimation

26. When two liquids in a mixture differ by their boiling points, which of the following is the best method to separate these liquids?
(a) Evaporation
(b) Distillation
(c) Chromatography
(d) Filtration

27. Solution which has uniform composition throughout is called ___________.
(a) homogeneous solution
(b) heterogeneous solution
(c) Colloidal solution
(d) none of these

28. The particles of a suspension will be of size ________
(a) less than 1nm (nm = nano metre)
(b) between 1nm to 100 nm
(c) greater than 100nm
(d) less than 0.1 nm

29. Which of the following is a chemical change?
(a) Melting of ice
(b) Dissolving salt in water
(c) Rusting of iron
(d) Boiling of water into steam

30. Which one of the following is TRUE for compounds?
(a) It shows properties of its constituents.
(b) It may be homogeneous or heterogeneous.
(c) It can be separated by physical methods.
(d) It has fixed melting and boiling point.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 2
IS MATTER AROUND US PURE

1. Which of the following statements are true for pure substances?
(i) Pure substances contain only one kind of particles
(ii) Pure substances may be compounds or mixtures
(iii) Pure substances have the same composition throughout
(iv) Pure substances can be exemplified by all elements other than nickel
(a) (i) and (ii)
(b) (i) and (iii)
(c) (iii) and (iv)
(d) (ii) and (iii)

2. Why do we call sugar a pure substance?

3. What are saturated and unsaturated solutions?

4. Define a solution.

5. What is a suspension? Give its example and properties.

6. Define concentration of a solution.

7. What is Tyndall effect?

8. What is the difference between True solution and colloids?

9. What are alloys? Why are alloys called as mixture?

10. Write the characteristics of brass.

11. Define solute and solvent.

12. What is solubility?

13. Give properties of a true solution.

14. Rusting of an article made up of iron is called
(a) corrosion and it is a physical as well as chemical change
(b) dissolution and it is a physical change
(c) corrosion and it is a chemical change
(d) dissolution and it is a chemical change

15. A mixture of sulphur and carbon disulphide is
(a) heterogeneous and shows Tyndall effect
(b) homogeneous and shows Tyndall effect
(c) heterogeneous and does not show Tyndall effect
(d) homogeneous and does not show Tyndall effect

16. Tincture of iodine has antiseptic properties. This solution is made by dissolving
(a) iodine in potassium iodide
(b) iodine in vaseline
(c) iodine in water
(d) iodine in alcohol

17. Why do we need to separate mixtures?

18. How can we separate cream from milk?

19. 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)

20. 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), (iii) and (iv)
(d) (ii), (iii) and (iv)

21. 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
(a) (i) and (ii)
(b) (ii) and (iii)
(c) (iii) and (iv)
(d) (i) and (iv)

22. Two substances, A and B were made to react to form a third substance, A_2B according to the following reaction

$$2A + B \rightarrow A_2B$$

Which of the following statements concerning this reaction are incorrect?
(i) The product A_2B shows the properties of substances A and B
(ii) The product will always have a fixed composition
(iii) The product so formed cannot be classified as a compound
(iv) The product so formed is an element
(a) (i), (ii) and (iii),
(b) (ii), (iii) and (iv)
(c) (i), (iii) and (iv)
(d) (ii), (iii) and (iv)

23. Two chemical species X and Y combine together to form a product P which contains both X and Y

$$X + Y \rightarrow P$$

X and Y cannot be broken down into simpler substances by simple chemical reactions. Which of the following concerning the species X, Y and P are correct?
(i) P is a compound
(ii) X and Y are compounds
(iii) X and Y are elements
(iv) P has a fixed composition
(a) (i), (ii) and (iii),
(b) (i), (ii) and (iv)

(c) (ii), (iii) and (iv)
(d) (i), (iii) and (iv)

24. Suggest separation technique(s) one would need to employ to separate the following mixtures.

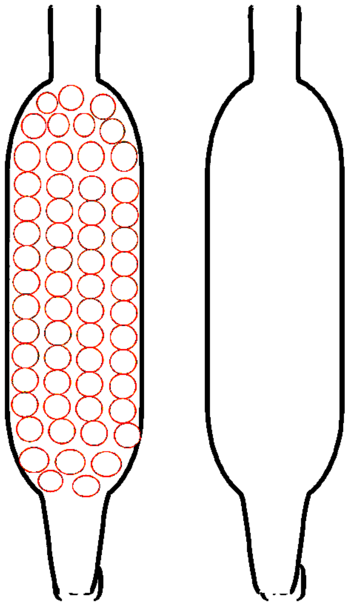
(a) Mercury and water

(b) Potassium chloride and ammonium chloride

(c) Common salt, water and sand

(d) Kerosene oil, water and salt

25. Which of the tubes in the below figure (a) and (b) will be more effective as a condenser in the distillation apparatus?



26. Salt can be recovered from its solution by evaporation. Suggest some other technique for the same?

27. The 'sea-water' can be classified as a homogeneous as well as heterogeneous mixture. Comment.

28. While diluting a solution of salt in water, a student by mistake added acetone (boiling point 56°C). What technique can be employed to get back the acetone? Justify your choice.

29. What would you observe when (a) a saturated solution of potassium chloride prepared at 60°C is allowed to cool to room temperature. (b) an aqueous sugar solution is heated to dryness. (c) a mixture of iron filings and sulphur powder is heated strongly.

30. Explain why particles of a colloidal solution do not settle down when left undisturbed, while in the case of a suspension they do.

31. Smoke and fog both are aerosols. In what way are they different?

32. Classify the following as physical or chemical properties

(a) The composition of a sample of steel is: 98% iron, 1.5% carbon and 0.5% other elements.

(b) Zinc dissolves in hydrochloric acid with the evolution of hydrogen gas.

(c) Metallic sodium is soft enough to be cut with a knife.

(d) Most metal oxides form alkalis on interacting with water.

33. The teacher instructed three students 'A', 'B' and 'C' respectively to prepare a 50% (mass by volume) solution of sodium hydroxide (NaOH). 'A' dissolved 50g of NaOH in 100 mL of water, 'B' dissolved 50g of NaOH in 100g of water while 'C' dissolved 50g of NaOH in water to make 100 mL of solution. Which one of them has made the desired solution and why?

34. Name the process associated with the following
(a) Dry ice is kept at room temperature and at one atmospheric pressure.
(b) A drop of ink placed on the surface of water contained in a glass spreads throughout the water.
(c) A potassium permanganate crystal is in a beaker and water is poured into the beaker with stirring.
(d) A acetone bottle is left open and the bottle becomes empty.
(e) Milk is churned to separate cream from it.
(f) Settling of sand when a mixture of sand and water is left undisturbed for some time.
(g) Fine beam of light entering through a small hole in a dark room, illuminates the particles in its paths.

35. Write the applications of centrifugation.

36. How can we separate a mixture of salt and ammonium chloride? Draw a diagram.

37. What is chromatography? Explain the process.

38. How can you separate copper sulphate from an impure sample?

39. You are given two samples of water labelled as 'A' and 'B'. Sample 'A' boils at 100°C and sample 'B' boils at 102°C. Which sample of water will not freeze at 0°C? Comment.

40. What are the favourable qualities given to gold when it is alloyed with copper or silver for the purpose of making ornaments?

41. An element is sonorous and highly ductile. Under which category would you classify this element? What other characteristics do you expect the element to possess?

42. Give an example each for the mixture having the following characteristics. Suggest a suitable method to separate the components of these mixtures
(a) A volatile and a non-volatile component.
(b) Two volatile components with appreciable difference in boiling points.
(c) Two immiscible liquids.
(d) One of the components changes directly from solid to gaseous state.
(e) Two or more coloured constituents soluble in some solvent.

43. Fill in the blanks
(a) A colloid is a ——— mixture and its components can be separated by the technique known as ———.
(b) Ice, water and water vapour look different and display different —— properties but they are ——— the same.
(c) A mixture of chloroform and water taken in a separating funnel is mixed and left undisturbed for some time. The upper layer in the separating funnel will be of——— and the lower layer will be that of ———.
(d) A mixture of two or more miscible liquids, for which the difference in the boiling points is less than 25 K can be separated by the process called———.

(e) When light is passed through water containing a few drops of milk, it shows a bluish tinge. This is due to the ——— of light by milk and the phenomenon is called ——— . This indicates that milk is a ——— solution.

44. Sucrose (sugar) crystals obtained from sugarcane and beetroot are mixed together. Will it be a pure substance or a mixture? Give reasons for the same.

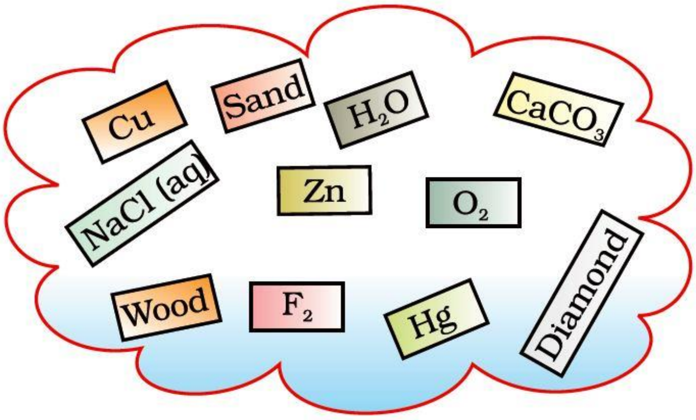
45. Give some examples of Tyndall effect observed in your surroundings?

46. Can we separate alcohol dissolved in water by using a separating funnel? If yes, then describe the procedure. If not, explain.

47. On heating calcium carbonate gets converted into calcium oxide and carbon dioxide.
(a) Is this a physical or a chemical change?
(b) Can you prepare one acidic and one basic solution by using the products formed in the above process? If so, write the chemical equation involved.

48. Non metals are usually poor conductors of heat and electricity. They are non-lustrous, non-sonorous, non-malleable and are coloured.
(a) Name a lustrous non-metal.
(b) Name a non-metal which exists as a liquid at room temperature.
(c) The allotropic form of a non-metal is a good conductor of electricity. Name the allotrope.
(d) Name a non-metal which is known to form the largest number of compounds.
(e) Name a non-metal other than carbon which shows allotropy.
(f) Name a non-metal which is required for combustion.

49. Classify the substances given in the below figure into elements and compounds



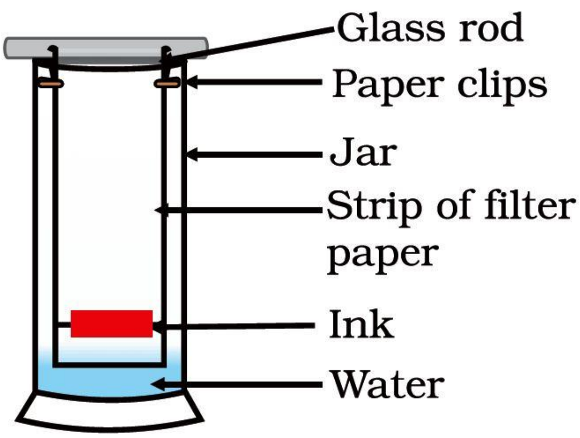
50. Which of the following are not compounds?
(a) Chlorine gas
(b) Potassium chloride
(c) Iron
(d) Iron sulphide
(e) Aluminium
(f) Iodine
(g) Carbon
(h) Carbon monoxide
(i) Sulphur powder

51. Fractional distillation is suitable for separation of miscible liquids with a boiling point difference of about 25 K or less. What part of fractional distillation apparatus makes it efficient and possess an advantage over a simple distillation process. Explain using a diagram.

52. (a) Under which category of mixtures will you classify alloys and why?
(b) A solution is always a liquid. Comment.
(c) Can a solution be heterogeneous?

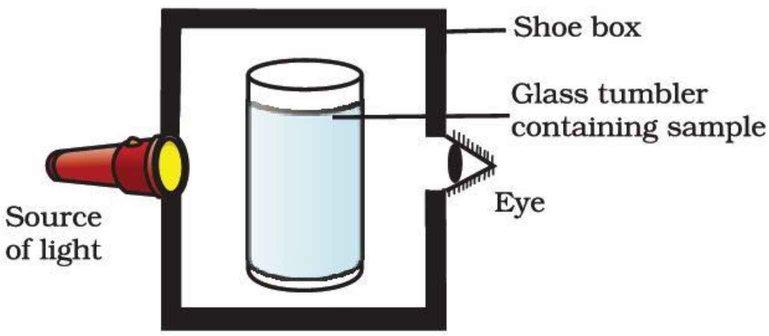
53. Iron filings and sulphur were mixed together and divided into two parts, 'A' and 'B'. Part 'A' was heated strongly while Part 'B' was not heated. Dilute hydrochloric acid was added to both the Parts and evolution of gas was seen in both the cases. How will you identify the gases evolved?

54. A child wanted to separate the mixture of dyes constituting a sample of ink. He marked a line by the ink on the filter paper and placed the filter paper in a glass containing water as shown in below figure. The filter paper was removed when the water moved near the top of the filter paper.



(i) What would you expect to see, if the ink contains three different coloured components?
(ii) Name the technique used by the child.
(iii) Suggest one more application of this technique.

55. A group of students took an old shoe box and covered it with a black paper from all sides. They fixed a source of light (a torch) at one end of the box by making a hole in it and made another hole on the other side to view the light. They placed a milk sample contained in a beaker/tumbler in the box as shown in the below figure. They were amazed to see that milk taken in the tumbler was illuminated. They tried the same activity by taking a salt solution but found that light simply passed through it?



(a) Explain why the milk sample was illuminated. Name the phenomenon involved.
(b) Same results were not observed with a salt solution. Explain.
(c) Can you suggest two more solutions which would show the same effect as shown by the milk solution?

56. Classify each of the following, as a physical or a chemical change. Give reasons.
(a) Drying of a shirt in the sun.
(b) Rising of hot air over a radiator.
(c) Burning of kerosene in a lantern.
(d) Change in the colour of black tea on adding lemon juice to it.
(e) Churning of milk cream to get butter.

57. During an experiment the students were asked to prepare a 10% (Mass/Mass) solution of sugar in water. Ramesh dissolved 10g of sugar in 100g of water while Sarika prepared it by dissolving 10g of sugar in water to make 100g of the solution.
(a) Are the two solutions of the same concentration
(b) Compare the mass % of the two solutions.

58. You are provided with a mixture containing sand, iron filings, ammonium chloride and sodium chloride. Describe the procedures you would use to separate these constituents from the mixture?

59. Arun has prepared 0.01% (by mass) solution of sodium chloride in water. Which of the following correctly represents the composition of the solutions?
(a) 1.00 g of NaCl + 100g of water
(b) 0.11g of NaCl + 100g of water
(c) 0.0l g of NaCl + 99.99g of water
(d) 0.10 g of NaCl + 99.90g of water

60. Calculate the mass of sodium sulphate required to prepare its 20% (mass percent) solution in 100g of water?

CHAPTER – 3

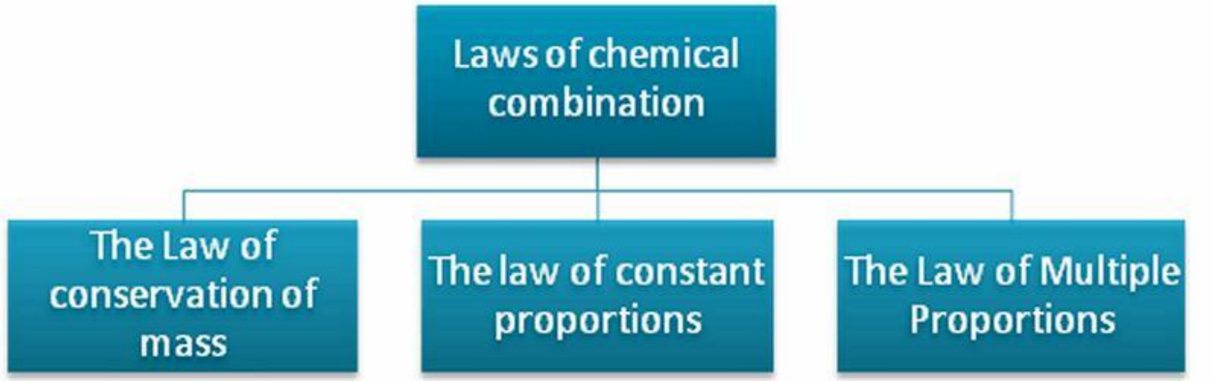
ATOMS AND MOLECULES

ATOMS AND MOLECULES

LAWS OF CHEMICAL COMBINATIONS

Before Dalton concept of atom was mere philosophical. Dalton explained about atom on the basis of Laws of Chemical Combinations.
There are three laws of chemical combination.

1. Law of Conservation of Mass
2. Law of Constant Proportions
3. Law of Multiple Proportions



LAW OF CONSERVATION OF MASS

Antoine L. Lavoisier, a French scientist, established the theory of Law of Conservation of Mass. The law of conservation of mass states, "**Mass can neither be created nor destroyed in a chemical reaction**".

All matters in the universe exist in three states. There are two ways of classification of matter.
1. According to physical state as solid, liquid or gas.
2. According to its composition as element, compound or mixture.

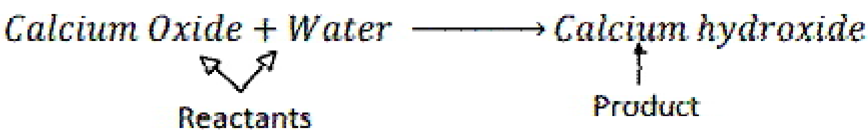
According to this law mass of an isolated system will remain constant over time. This means when mass is enclosed in a system and none is allowed in or out, its quantity will never change. That is mass will be conserved, and hence this is called Law of Conservation of Mass. This means total mass of products is always equal to the total mass of reactants. As there is no loss of mass of substances, i.e. mass is conserved, that's why Lavoisier called this the law of conservation of mass.

REACTANTS AND PRODUCTS:

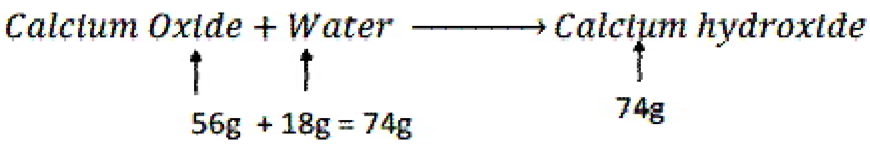
In a chemical reaction the substances that combine or react are known as reactants and the new substance/substances formed are called product or products.
A chemical reaction can be represented in general as follows:

$$Reactant + Reactant \longrightarrow Product$$

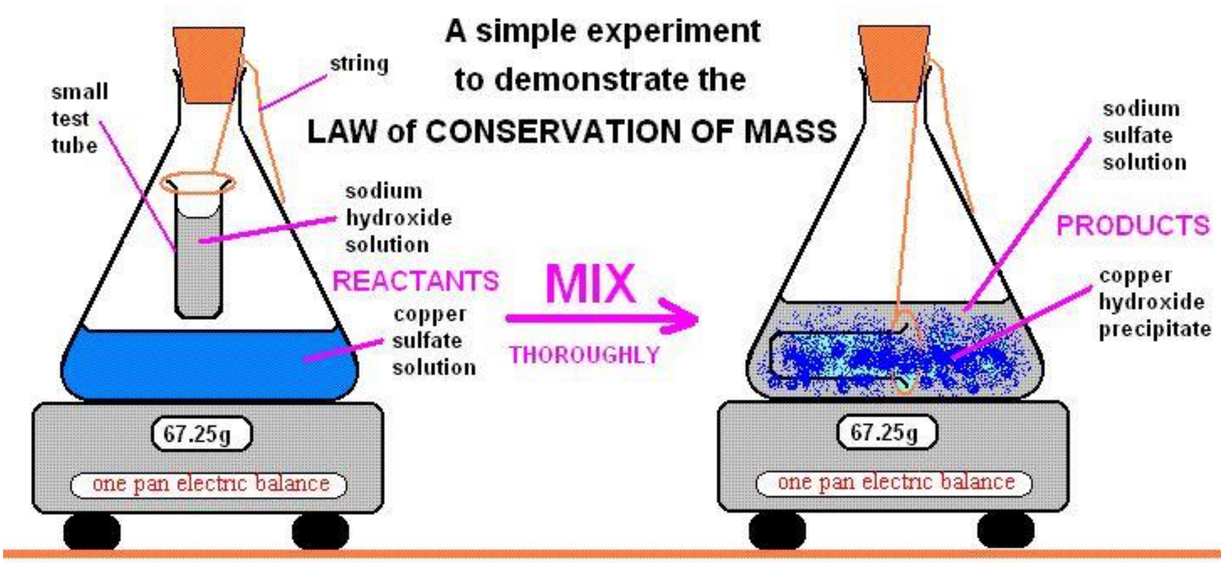
Example: When calcium oxide is dissolved in water calcium hydroxide is formed. The reaction involve in this can be written as:



In this reaction calcium oxide and water are reactants while calcium hydroxide is product.
In this reaction 74 g of calcium hydroxide is obtained when 56 g of calcium oxide reacts with 18 g of water, which is proved by experiment.



Here the total mass of reactants, i.e. calcium oxide and water is equal to 74 g. And the mass of product, i.e. calcium hydroxide is also equal to 74g. This proves that the total mass of reactants is always equal to the total mass of product, which proves the Law of Conservation of Mass.



LAW OF CONSTANT PROPORTIONS

Law of Constant Proportion states that **a chemical compound always contains exactly the same proportion of elements by mass.**
This law is also known as Law of definite proportions. Joseph Louis Proust gave this law hence, this law is also known as Proust's Law.

Explanation of the law:-

Compounds are formed by the combination of two or more elements. In a compound the ratio of the atoms or element by mass remains always same irrespective of the source of compound. This means a certain compound always formed by the combination of atoms in same ratio by mass. If the ratio of mass of constituent atoms will be altered the new compound is formed.

Examples:-

Water is formed by the combination of hydrogen and oxygen. The ratio of masses of hydrogen and oxygen is always in 1:8 in water irrespective of source of water. Whether you collect the water from a well, river, pond or from anywhere the ratio of their constituent atoms by mass will always same.

$$2H_2 + O_2 \rightarrow 2H_2O$$

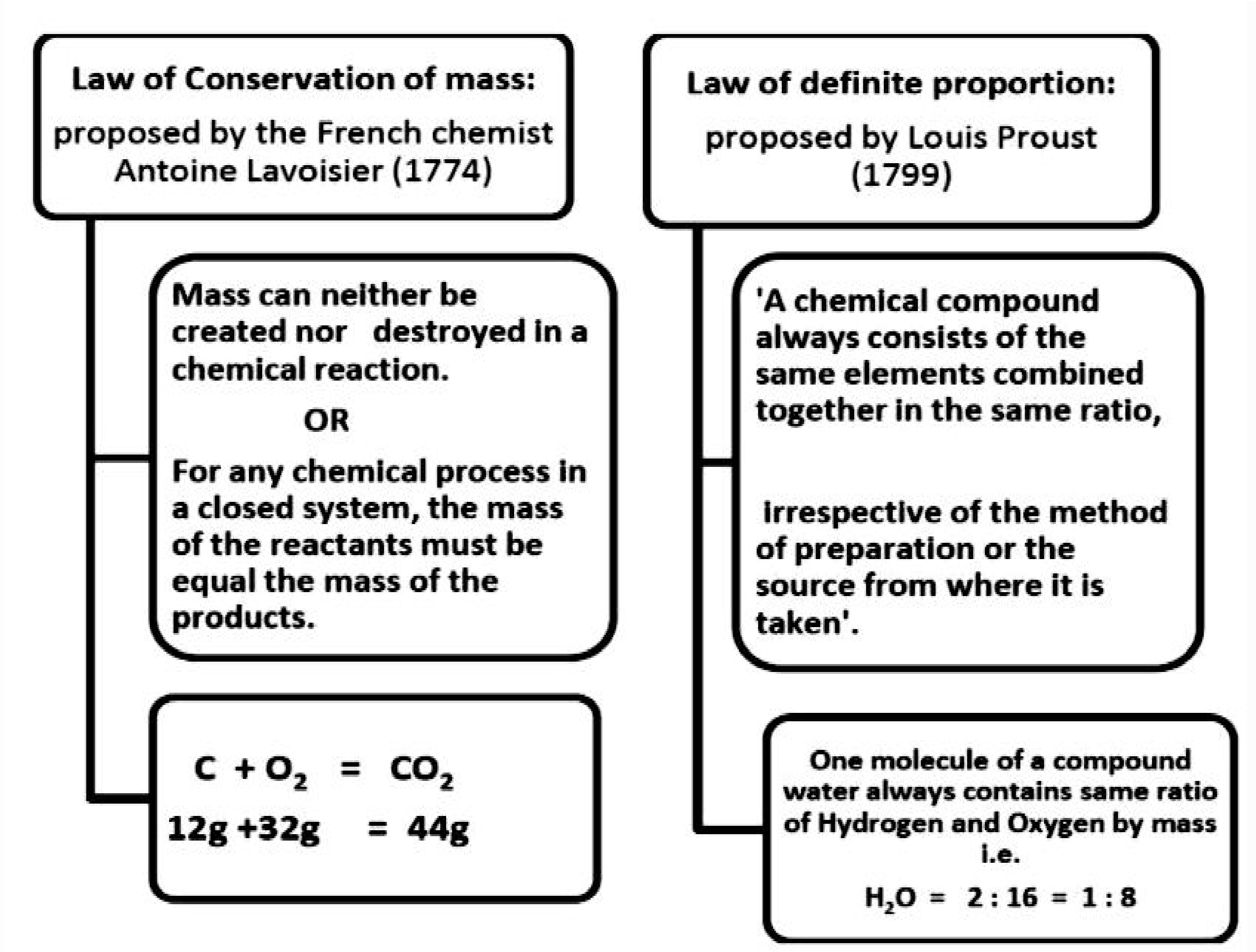
$$\begin{array}{ccc} \downarrow & & \downarrow \\ 4 & & 32 \\ \downarrow & & \downarrow \\ 1 & : & 8 \end{array} \text{ (By Mass)}$$

Nitrogen dioxide is a compound, which is formed by the combination of nitrogen and oxygen. The ratio of nitrogen and oxygen by mass in nitrogen dioxide is in 7:16.

Nitrous oxide is a compound which is also formed by the combination of nitrogen and oxygen. The ratio of nitrogen and oxygen in nitrous oxide is in 28:16.

Nitric oxide is a compound, which is also formed by the combination of nitrogen and oxygen. The ratio of nitrogen and oxygen in nitric oxide is in 7:8.

From the above three examples it is clear that if the ratio of the atoms by mass is altered then the new compound is formed, such as in the case of nitrogen dioxide, nitrous oxide, nitric oxide. These three compounds are formed by the combination of same atoms but because of combination of the constituent atoms in different ratios by mass new compound is formed.

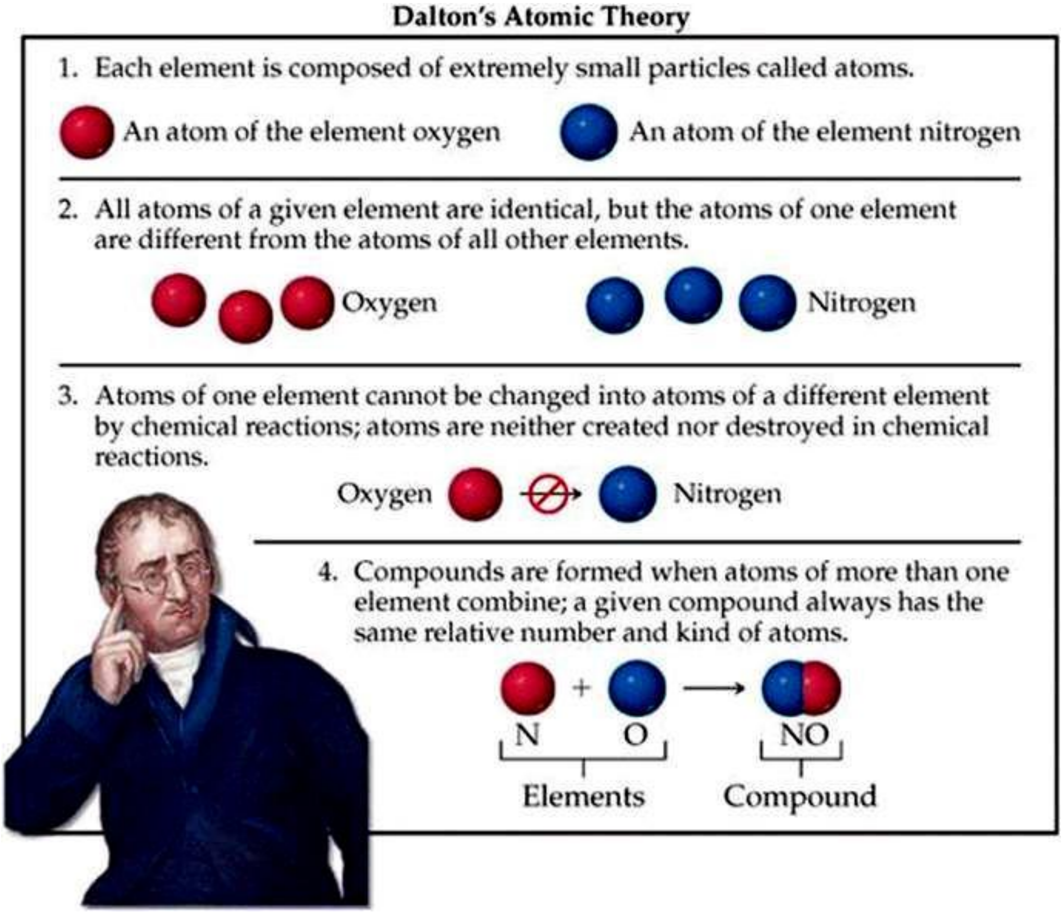


DALTON'S ATOMIC THEORY

John Dalton, a British Chemists and scientists gave the Atomic Theory in 1808. This theory is popularly known as Dalton's Atomic Theory in the honour of John Dalton. He gave the theory on the basis of Laws of Chemical Combination and explains them properly. In his theory he explains about atom.

Main postulates of Dalton's atomic theory

1. Elements are made of extremely small particles called atoms.
2. Atoms of a given element are identical in size, mass, and other properties;
3. Atoms of different elements differ in size, mass, and other properties.
4. Atoms cannot be subdivided, created, or destroyed.
5. Atoms of different elements combine in simple whole-number ratios to form chemical compounds.
6. In chemical reactions, atoms are combined, separated, or rearranged.



INTEXT QUESTIONS PAGE NO. 32

Q1. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

Answer:

In the given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.

sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

Mass of sodium carbonate = 5.3 g (Given)
Mass of ethanoic acid = 6 g (Given)
Mass of sodium ethanoate = 8.2 g (Given)
Mass of carbon dioxide = 2.2 g (Given)
Mass of water = 0.9 g (Given)
Now, total mass before the reaction = (5.3 + 6) g = 11.3 g
And, total mass after the reaction = (8.2 + 2.2 + 0.9) g = 11.3 g
Therefore, Total mass before the reaction = Total mass after the reaction

Hence, the given observations are in agreement with the law of conservation of mass.

Q2. 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 g of hydrogen gas?
Answer:
It is given that the ratio of hydrogen and oxygen by mass to form water is 1:8.
Then, the mass of oxygen gas required to react completely with 1 g of hydrogen gas is 8 g.
Therefore, the mass of oxygen gas required to react completely with 3 g of hydrogen gas is
8×3 g = 24 g.

Q3. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?
Answer:
The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is:
Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

Q4. Which postulate of Dalton's atomic theory can explain the law of definite proportions?
Answer:
The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is:
Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

ATOMS

On the basis of Dalton's Atomic On the basis of Dalton's Atomic Theory atom can be defined as the smallest particles of matter are called atoms.
Characteristics of atoms:

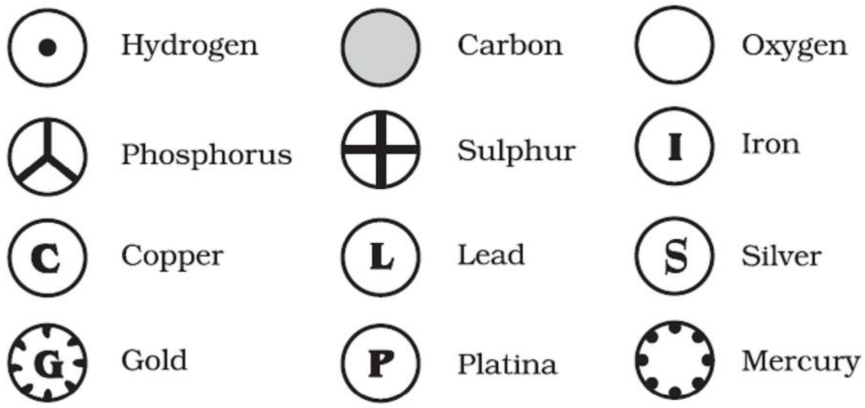
- Atom is the smallest particle of matter.
- All elements are made of tiny particles called atom.
- Atoms are very small in size and cannot be seen through naked eyes.
- Atom does not exist in free-state in nature. But atom takes part in a chemical reaction.
- The properties of a matter depend upon the characteristics of atoms.
- Atoms are the building block of an element similar to a brick which combine together to make a building.
- The size of atoms is indicated by its radius.
- In ancient time atoms was considered indivisible.

SYMBOLS OF ATOMS OF ELEMENTS

Dalton was the first scientist to use the symbols for elements in a very specific sense. When he used a symbol for an element he also meant a definite quantity of that element, that is, one atom of that element. Berzilius suggested that the symbols of elements be made from one or two letters of the name of the element.

Many of the symbols are the first one or two letters of the element's name in English. The first letter of a symbol is always written as a capital letter (uppercase) and the second letter as a small letter (lowercase).

For convenience elements are represented by unique symbols. For example: Hydrogen is represented by 'H'. Oxygen is represented 'O'. Nitrogen is represented by 'N'. Iron is represented by 'Fe'. ments are represented by unique symbols. For example: Hydrogen is represented by ‘H’. Oxygen is represented ‘O’. Nitrogen is represented by ‘N’. Iron is represented by ‘Fe’.



His worked proved as boon to science. For his marvelous work Berzilius, together with John Dalton, Antoine Lavoisier, and Robert Boyle is considered as the Father of Modern Chemistry.

Symbol and Name of some elements					
Element	**Symbol**	**Element**	**Symbol**	**Element**	**Symbol**
Hydrogen	H	Sodium	Na	Cromium	Cr
Helium	He	Magnesium	Mg	Mangese	Mn
Lithium	Li	Aluminium	Al	Iron	Fe
Beryllium	Be	Silicon	Si	Cobalt	Co
Boron	B	Phosphorous	P	Nickel	Ni
Carbon	C	Sulphur	S	Copper	Cu
Nitrogen	N	Chlorine	Cl	Zinc	Zn
Oxygen	O	Argon	Ar	Silver	Ag
Fluorine	F	Potassium	K	Gold	Au
Neon	Ne	Calcium	Ca	Mercury	Hg

Symbol of many elements are taken from their English name, while symbol of many elements are taken from their Greek or Latin names.

Symbol of some element which are derived from their Latin name

Several elements are named after the place where they discovered, such as ‘Copper’ which was taken from Cyprus. Some elements are named after their colour, such as ‘Gold’ which means yellow.

Symbols of some elements taken from their Latin Name		
English Name of Elements	Symbol	Latin Name of Elements
Sodium	Na	Natrium
Potassium	K	Kalium
Iron	Fe	Ferrum
Copper	Cu	Cuprum
Silver	Ag	Argentum
Gold	Au	Aurum
Mercury	Hg	Hydragyrum
Lead	Pb	Plumbum
Tin	Sn	Stannum

ATOMIC MASS

Mass of atom is called atomic mass. Since, atoms are very small consequently actual mass of an atom is very small. For example the actual mass of one atom of hydrogen is equal to 1.673 x 10^{-24} g. This is equal to 0.000000000000000000000001673 gram. To deal with such small nuber is very difficult. Thus for convenience relative atomic mass is used.
Carbon-12 is considered as unit to calculate atomic mass. Carbon-12 is an isotope of carbon. The relative mass of all atoms are found with respect to C-12.
One atomic mass = 1/12 of the mass of one atom of C-12.

$$\textit{This means atomic mass unit} = \frac{1}{12}\textit{th of Carbon} - 12$$

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

Thus atomic mass is the relative atomic mass of an atom with respect to 1/12 th of the mass of carbon-12 atom. ‘amu’ is the abbreviation of Atomic mass unit, but now it is denoted just by ‘u’.

The atomic mass of hydrogen atom = 1u.
This means one hydrogen atom is 1 times heavier than 1/12th of the carbon atom.

The atomic mass of oxygen is 16u, this means one atom of oxygen is 16 times heavier than 1/12thof carbon atom.

Absolute mass or Actual atomic mass:
It is found that, the actual atomic mass of a carbon-12 atom is equal to 1.9926 X 10^{-23}g.

$$Therefore, 1u = \frac{1.9926 \times 10^{-23}}{12} g = 1.6605 \times 10^{-24} g$$

Thus by multiplying the relative atomic mass with 1.6605 × 10^{-24}g we can get the absolute or actual mass of an atom.

Example -1 - Find the absolute mass oxygen.
Solution:
The atomic mass of oxygen is 16u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of oxygen = 1.6605 x 10^{-24} x 16 g
= 26.568 x 10^{-24} = 2.6568 x 10^{-25} g

Example – 2 – Find the absolute mass of Sodium.
Solution:
The atomic mass of Sodium is 23u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of Sodium = 1.6605 x 10^{-24} x 23 g
= 38.191 x 10^{-24} = 3.8191 x 10^{-25} g

Example – 3 – Calculate the absolute mass of hydrogen atom.
Solution:
The atomic mass of hydrogen is 1u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of hydrogen = 1.6605 x 10^{-24} x 1 g = 1.6605 x 10^{-24} g

Example – 4 - Calculate the absolute or actual mass of Nitrogen atom.
Solution:
The atomic mass of Nitrogen is 14u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of hydrogen = 1.6605 x 10^{-24} x 14 g
= 23.247 x 10^{-24} g = 2.3247 x 10^{-25} g

EXISTENCE OF ATOMS

Atoms of most of the elements exist in the form of molecule or ion, since they are most reactive. For example, hydrogen, oxygen, chlorine, etc. However, atoms of some elements, which are non-reactive, exist in free-state in nature. For example helium, neon, argon, etc.
Usually atoms are exist in following two forms -
• In the form of molecules
• In the form of ions

INTEXT QUESTIONS PAGE NO. 35

Q1. Define the atomic mass unit.
Answer:
Mass unit equal to exactly one-twelfth $\left(\frac{1}{12^{th}}\right)$ the mass of one atom of carbon-12 is called one atomic mass unit. It is written as 'u'.

Q2. Why is it not possible to see an atom with naked eyes?
Answer:
The size of an atom is so small that it is not possible to see it with naked eyes. Also, the atom of an element does not exist independently.

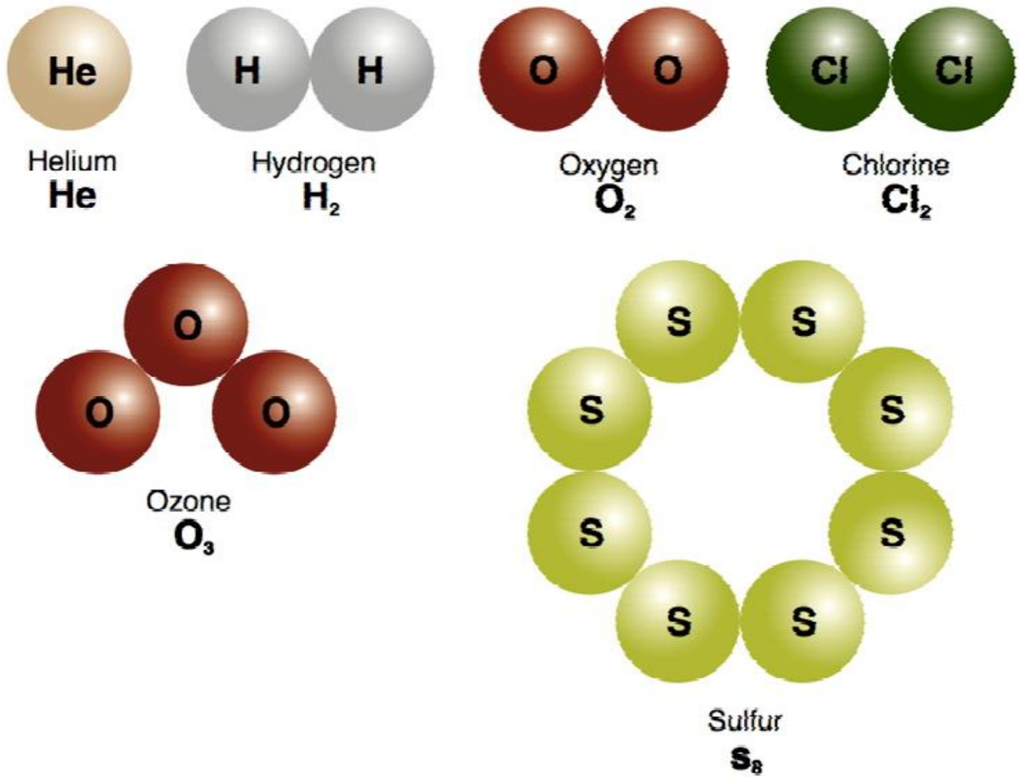
MOLECULE
Molecule is the smallest particle of a compound.
Atoms exist in free states in the form of molecule.

- A molecule may be formed by the combination of two or more similar atoms of an element, such asoxygen molecule is formed by the combination of two oxygen atoms, molecule of hydrogen which is formed by the combination of two hydrogen atoms.
- Molecules may be formed by the combination of atoms of two or more different elements. For example molecule of water. It is formed by the combination of two atoms of hydrogen and one atom of oxygen. Molecule of Nitric oxide or nitrogen monoxide. It is formed by the combination of one nitrogen atom and one oxygen atom.
- A molecule takes part in chemical reaction.

Most of the atoms exist in the form of molecule. Molecules are formed by the combination of two or more elements.
Example: Molecule of hydrogen (H_2, Molecule of oxygen (O_2), Molecule of nitrogen (N_2), etc.
• Molecules of elements
• Molecules of Compounds

MOLECULES OF ELEMENTS

When two of more atoms of same element combine to form a molecule these are called molecules of element.
Example:
Hydrogen molecule (H_2). Hydrogen molecule (H_2). Molecule of hydrogen is formed by the combination of two hydrogen atoms.
Oxygen molecule (O_2). Molecule of oxygen is formed by the combination of two oxygen atoms.
Sulphur molecule (S_8). Molecule of sulphur is formed by the combination of eight sulphur atoms.
Phosphorous molecule (P_4). Molecule of phosphorous is formed by the combination of four phosphorous atoms.



Molecules of some non-reactive elements are formed by single atom. For example – helium, neon, argon, etc. molecules: Molecules of metals formed as big cluster of atoms. They are represented by their symbols simply. For example: Iron (Fe), Copper (Cu), Zinc (Zn), etc. These molecules are known as giant molecules.

Carbon is a non-metal, but it also exists as giant molecule and represented by its symbol 'C'.

ATOMICITY

Monoatomic:
When molecule is formed by single atom only, it is called monoatomic molecule. Generally noble gas forms monoatomic molecules. For example: Helium (He), Neon (Ne), Argon (Ar), Kr (Krypton), Xenon (Xe), Randon (Rn).

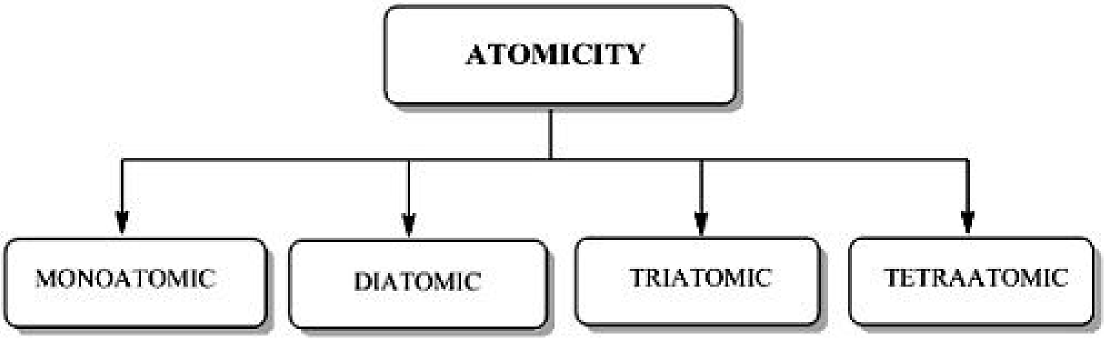
Diatomic
When molecule is formed by the cDiatomic: When molecule is formed by the combination of two atoms of it is called diatomic molecule. For example: Hydrogen (H_2), Oxygen (O_2) Nitrogen (N_2), Chlorine (Cl_2), etc.

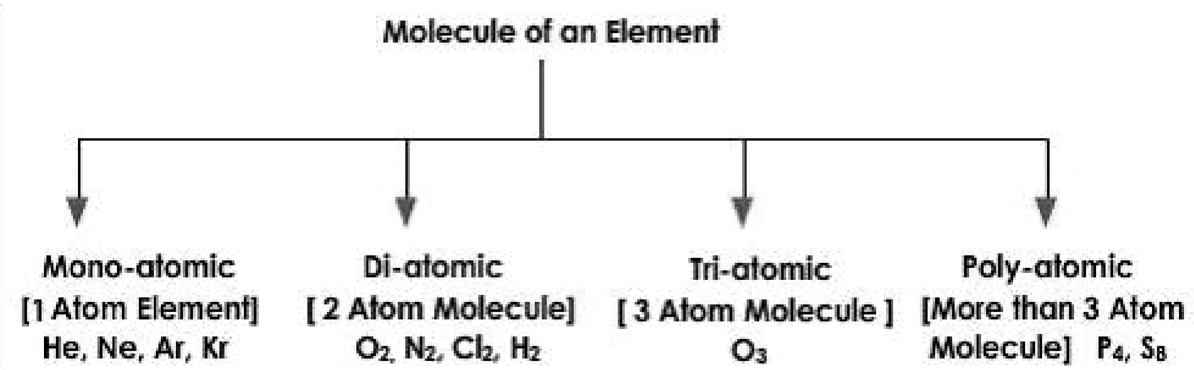
Triatomic
When moleucule is formed by the combination of three atoms it is called triatomic molecule. For example: molecule of ozone (O_3

Tetra-atomic
When molecule is formed by the combination of four atoms it is called tetra-atomic molecule. For example: Phosphorous molecule (P_4)

Polyatomic
When molecule is formed by the combination of more than two atoms, it is called polyatomic molecule. For example: Sulphur molecule (S_8)

Atomicity of some elements		
Name	**Atomicity**	**Formula**
Argon	Monoatomic	Ar
Helium	Monoatomic	He
Oxygen	Diatomic	O_2
Hydrogen	Diatomic	H_2
Nitrogen	Diatomic	N_2
Chlorine	Diatomic	Cl_2
Phosphorous	Tetra-atomic	P_4
Sulphur	Poly-atomic	S_8



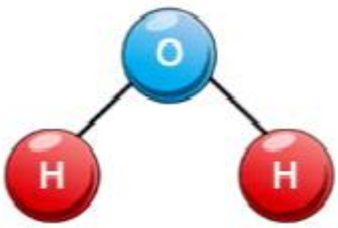


MOLECULES OF COMPOUNDS

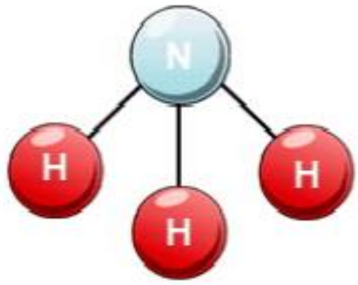
When molecule is formed by the combination of two or more atoms of different elements, it is called the molecule of compound.
Example:Molecule of water (H_2O). Molecule of water is formed by the combination of two hydrogen and one oxygen atoms.

Molecules of some compounds	
Compound	**Combining Elements**
Water (H_2O)	Hydrogen, Oxygen
Ammonia (NH_3)	Nitrogen, hydrogen
Carbon dioxide(CO_2)	Carbon, oxygen
Hydrogen Chloride (HCl)	Hydrogen, Chlorine
Methane (CH_4)	Carbon, Hydrogen
Ehtane (C_2H_6)	Carbon, hydrogen
Sodium chloride (NaCl)	Sodium, chlorine.
Copper oxide (CuO)	Copper and oxygen

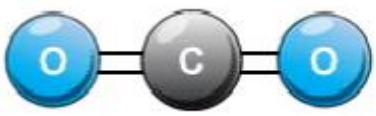
water



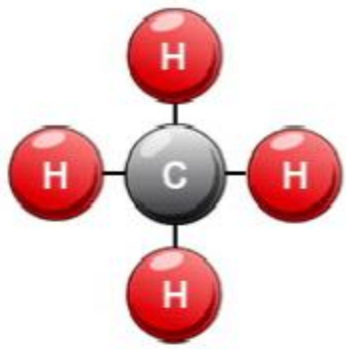
ammonia



carbon dioxide



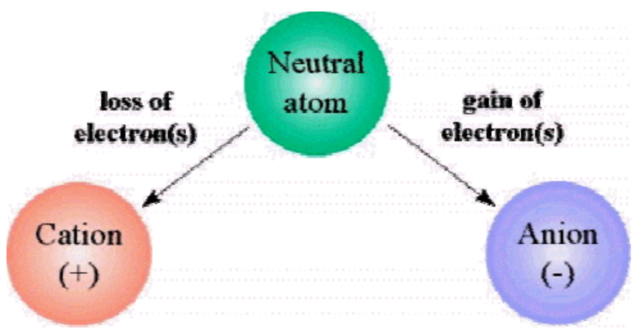
methane



IONS

Atoms of several elements exists in the form of ion. Atoms or molecule with negative or positive charge over them are called ions.

For example: Sodium ion (Na^+), postassiun ion (K^+), Chlorine ion (Cl^-), Fluoride ion (F^-)etc.



Cations:
Ions having positive charge over them are called cations.
For example: sodium ion (Na^+), potassium ion (K^+), etc

Anions:
Ions having negative charge over them are called anions.
For example: Chloride ion (Cl^-), Fluoride ion (F^-), etc

Monoatomic ions:
Ions formed by one atom are called monoatomic ions.
For example: sodium ion (Na^+), potassium ion (K^+), Chloride ion (Cl^-), Fluoride ion (F^-), etc.

Polyatomic ions:
Ions formed by two or more atoms are called polyatomic ions. These are group of atoms of different elements which behave as single units, and are known as polyatomic ions.
For example: Ammonium ion (NH_4^+), Hydroxide ion (OH^-), etc

Some Common ions					
Cations		Anions		Polyatomic ions	
Lithium ion	Li^+	Chloride ion	Cl^-	Hydroxide	OH^-
Sodium ion	Na^+	Fluorine	F^-	Ammonium	NH_4^+
Potassium ion	K^+	Iodide	I^-	Nitrate	NO_3^-
Silver ion	Ag^+	Hydride	H^-	Bicarbonate or Hydrogen carbonate	HCO_3^-
Copper ion	Cu^+	Oxide ion	O^{2-}		
Hydrogen Ion	H^+	Sulphide	S^{2-}		
Magnesium ion	Mg^{++}	Nitride	N^{3-}	Sulphate	SO_4^{2-}
Calcium ion	Ca^{++}			Carbonate	CO_3^{2-}
Iron Ion	Fe^{++}			Sulphite	SO_3^{2-}
Zinc ion	Zn^{++}			Phosphate	PO_4^{2-}
Copper ion	Cu^{++}				
Aluminium ion	Al^{+++}				

WRITING CHEMICAL FORMULA

Chemical formula of the compound is the symbolic representation of its composition. To write chemical formula of a compound, symbols and valencies of constituent elements must be known. The valency of atom of an element can be thought of as hands or arms of that atom.

Points to remember

- The symbols or formulas of the component radicals of the compound are written side by side.
- Positive radicals are written left and negative radicals on the right.
- The valencies of the radicals are written below the respective symbols.
- The criss-cross method is applied to exchange the numerical value of valency of each radical. It is written as subscript of the other radical.

- The radical is enclosed in a bracket and the subscript is placed outside the lower right corner.
- The common factor is removed.
- If the subscript of the radical is one, it is omitted.

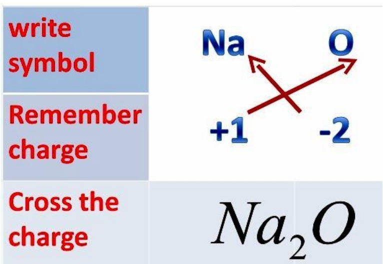
The rules that you have to follow while writing a chemical formula are as follows:
- the valencies or charges on the ion must balance.
- when a compound consists of a metal and a non-metal, the name or symbol of the metal is written first. For example: calcium oxide (CaO), sodium chloride (NaCl), iron sulphide (FeS), copper oxide (CuO) etc., where oxygen, chlorine, sulphur are non-metals and are written on the right, whereas calcium, sodium, iron and copper are metals, and are written on the left.
- in compounds formed with polyatomic ions, the ion is enclosed in a bracket before writing the number to indicate the ratio.

The simplest compounds, which are made up of two different elements are called binary compounds. While writing the chemical formulae for compounds, we write the constituent elements and their valencies as shown below. Then we must crossover the valencies of the combining atoms.

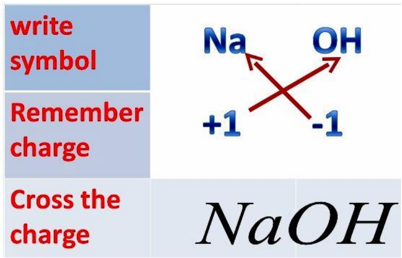
The formulae of ionic compounds are simply the whole number ratio of the positive to negative ions in the structure. For magnesium chloride, we write the symbol of cation (Mg^{2+}) first followed by the symbol of anion (Cl^{-}). Then their charges are criss-crossed to get the formula.

EXAMPLES

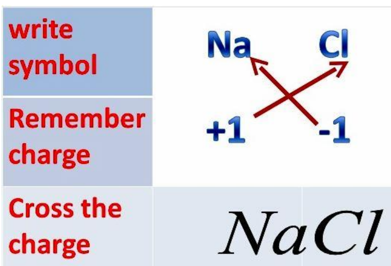
Formula of Sodium oxide



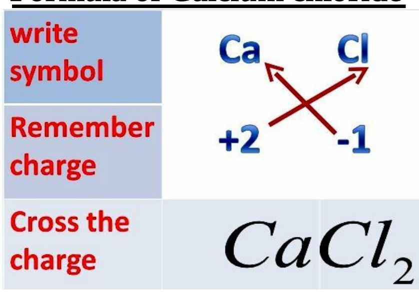
Formula of Sodium hydroxide



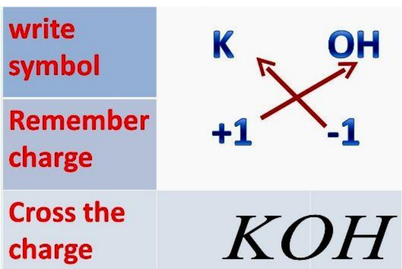
Formula of Sodium Chloride



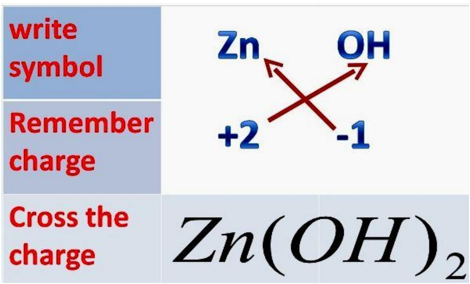
Formula of Calcium chloride



Formula of Potassium hydroxide



Formula of Zinc hydroxide



Formula of Zinc chloride

write symbol	Zn	Cl
Remember charge	+2	-1
Cross the charge	$ZnCl_2$	

Formula of Aluminium hydroxide

write symbol	Al	OH
Remember charge	+3	-1
Cross the charge	$Al(OH)_3$	

Formula of Calcium oxide

write symbol	Ca	O
Remember charge	+2	-2
Cross the charge	CaO	

Formula of Aluminium oxide

write symbol	Al	O
Remember charge	+3	-2
Cross the charge	Al_2O_3	

Formula of Silver oxide

write symbol	Ag	O
Remember charge	+1	-2
Cross the charge	Ag_2O	

Formula of Silver chloride

write symbol	Ag	Cl
Remember charge	+1	-1
Cross the charge	$AgCl$	

Formula of Ammonium Choride

write symbol	NH_4	Cl
Remember charge	+1	-1
Cross the charge	NH_4Cl	

Formula of Ammonium carbonate

write symbol	NH_4	CO_3
Remember charge	+1	-2
Cross the charge	$(NH_4)_2CO_3$	

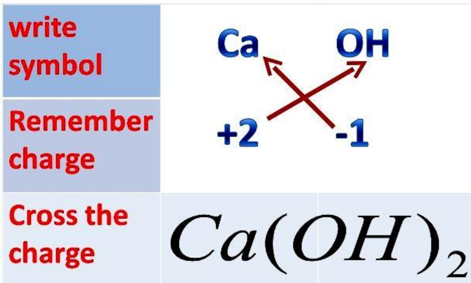
Formula of Silver Carbonate

write symbol	Ag	CO_3
Remember charge	+1	-2
Cross the charge	Ag_2CO_3	

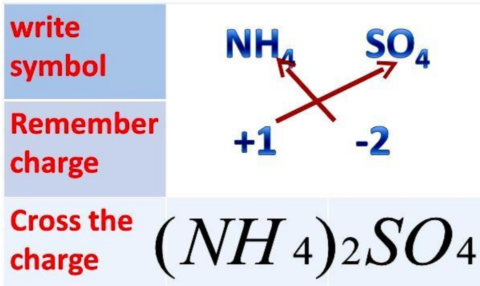
Formula of Silver Sulphate

write symbol	Ag	SO_4
Remember charge	+1	-2
Cross the charge	Ag_2SO_4	

Formula of Calcium hydroxide



Formula of Ammonium sulphate



INTEXT QUESTIONS PAGE NO. 39

Q1. Write down the formulae of
(i) sodium oxide
(ii) aluminium chloride
(iii) sodium suphide
(iv) magnesium hydroxide
Answer:
(i) Sodium oxide → Na_2O
(ii) Aluminium chloride → $AlCl_3$
(iii) Sodium sulphide → Na_2S
(iv) Magnesium hydroxide → $Mg(OH)_2$

Q2. Write down the names of compounds represented by the following formulae:
(i) $Al_2(SO_4)_3$
(ii) $CaCl_2$
(iii) K_2SO_4
(iv) KNO_3
(v) $CaCO_3$.
Answer:
(i) $Al_2(SO_4)_3$ →Aluminium Sulphate
(ii) $CaCl_2$ → Calcium Chloride
(iii) K_2SO_4 → Potassium sulphate
(iv) KNO_3 → Potassium nitrate
(v) $CaCO_3$. → Calcium carbonate

Q3. What is meant by the term chemical formula?
Answer:
The chemical formula of a compound means the symbolic representation of the composition of a compound. From the chemical formula of a compound, we can know the number and kinds of atoms of different elements that constitute the compound.
For example, from the chemical formula CO2 of carbon dioxide, we come to know that one carbon atom and two oxygen atoms are chemically bonded together to form one molecule of the compound, carbon dioxide.

Q4. How many atoms are present in a
(i) H_2S molecule and
(ii) PO_4^{3-} ion?
Answer:
(i) In an H_2S molecule, three atoms are present; two of hydrogen and one of sulphur.
(ii) In a PO_4^{3-} ion, five atoms are present; one of phosphorus and four of oxygen.

MOLECULAR MASS

Atomic mass: The atomic mass of an element is the mass of one atom of that element in atomic mass units or (u).

Atomic mass unit (amu): 1/12th of the mass of an atom of carbon-12 is called atomic mass unit. It is a unit of mass used to express atomic masses and molecular masses.

Molar mass: The molar mass of an element is equal to the numerical value of the atomic mass. However, in case of molar mass, the units change from 'u' to 'g'. The molar mass of an atom is also known as gram atomic mass.
For example, the atomic mass of carbon =12 atomic mass units. So, the gram atomic mass of carbon = 12 grams.

Molecular mass of the molecule: The sum of the atomic masses of all the atoms in a molecule of a substance is called the molecular mass of the molecule.

Molecular mass - calculation: Generally we use relative atomic masses of atoms for calculating the molecular mass of 1 mole of any molecular or ionic substances.
Example: Molecular mass of H_2SO_4
Atomic mass of Hydrogen = 1
Atomic mass of sulphur = 32
Atomic mass of oxygen = 16
Molecular mass of H_2SO4 = 2(Atomic mass of Hydrogen) + 1 (Atomic mass of sulphur) + 4 (Atomic mass of oxygen) = 2×1 + 32 + 4× 16 = 98 u.

Calculation of molecular mass of hydrogen chloride:
Atomic mass of hydrogen + Atomic mass of chlorine = 1 + 35.5 = 36.5 u.

FORMULA UNIT MASS

The formula unit mass of a substance is the sum of the atomic masses of all atoms in a formula unit of a compound. The term 'formula unit' is used for those substances which are made up of ions.

Formula unit mass of NaCl: 1 x Atomic mass of Na + 1 x Atomic mass of Cl
1 x 23 +1 x 35.5 = 58.5 atomic mass units.

Formula unit mass of ZnO:
= 1 x Atomic mass of Zn + 1 x Atomic mass O
= 1 x 65 + 1 x 16 = 81 u.

INTEXT QUESTIONS PAGE NO. 40

Q1. Calculate the molecular masses of H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.
Answer:
Molecular mass of O_2 = 2 × Atomic mass of O = 2 × 16 = 32 u
Molecular mass of Cl_2 = 2 × Atomic mass of Cl = 2 × 35.5 = 71 u
Molecular mass of CO_2 = Atomic mass of C + 2 × Atomic mass of O = 12 + 2 × 16 = 44 u
Molecular mass of CH_4 = Atomic mass of C + 4 × Atomic mass of H = 12 + 4 × 1 = 16 u
Molecular mass of C_2H_6 = 2 × Atomic mass of C + 6 × Atomic mass of H = 2 × 12 + 6 × 1 = 30 u
Molecular mass of C_2H_4 = 2 × Atomic mass of C + 4 × Atomic mass of H = 2 × 12 + 4 × 1 = 28 u

Molecular mass of NH_3 = Atomic mass of N + 3 × Atomic mass of H = 14 + 3 × 1 = 17 u
Molecular mass of CH_3OH = Atomic mass of C + 4 × Atomic mass of H + Atomic mass of O = 12 + 4 × 1 + 16 = 32 u

Q2. Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

Answer:

Formula unit mass of ZnO = Atomic mass of Zn + Atomic mass of O = 65 + 16 = 81 u
Formula unit mass of Na_2O = 2 × Atomic mass of Na + Atomic mass of O = 2 × 23 + 16 = 62 u
Formula unit mass of K_2CO_3 = 2 × Atomic mass of K + Atomic mass of C + 3 × Atomic mass of O = 2 × 39 + 12 + 3 × 16 = 138 u

MOLE CONCEPT

Mole: Mole is the measurement in chemistry. It is used to express the amount of a chemical substance.

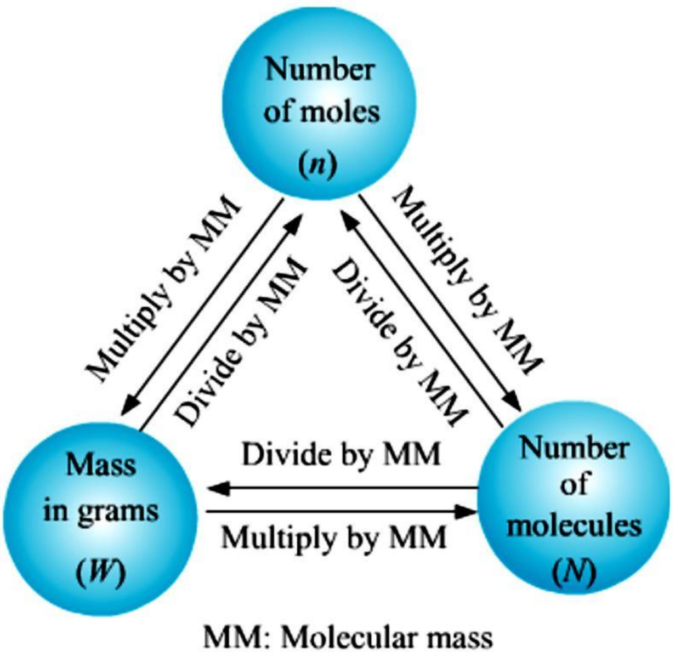
One mole is defined as the amount of substance of a system which contains as many entities like, atoms, molecules and ions as there are atoms in 12 grams of carbon - 12".

Avogadro number: The number of the particles present in one mole of any substance is equal to 6.022×10^{23}. This is called avogadro's number or avogadro's constant.

Number of particles in 1 mole:

1 mole of hydrogen atoms represents 6.022×10^{23} hydrogen atoms.
1 mole of hydrogen molecules represents 6.022×10^{23} hydrogen molecules.
1 mole of water molecules represents 6.022×10^{23} water molecules.

Conversion of moles to mass and vice-versa



The key concept used in these kind of problems is that a mole of any substance contains gram formula mass or molecular mass of that substance i.e. molecular mass of Hydrogen is 2 a.m.u.

so mass of 1 mole of hydrogen which is also known as molar mass will be 2 gram. Similarly if we have 2 moles of hydrogen, it will weigh 2*2 grams which is equal to 4 grams.

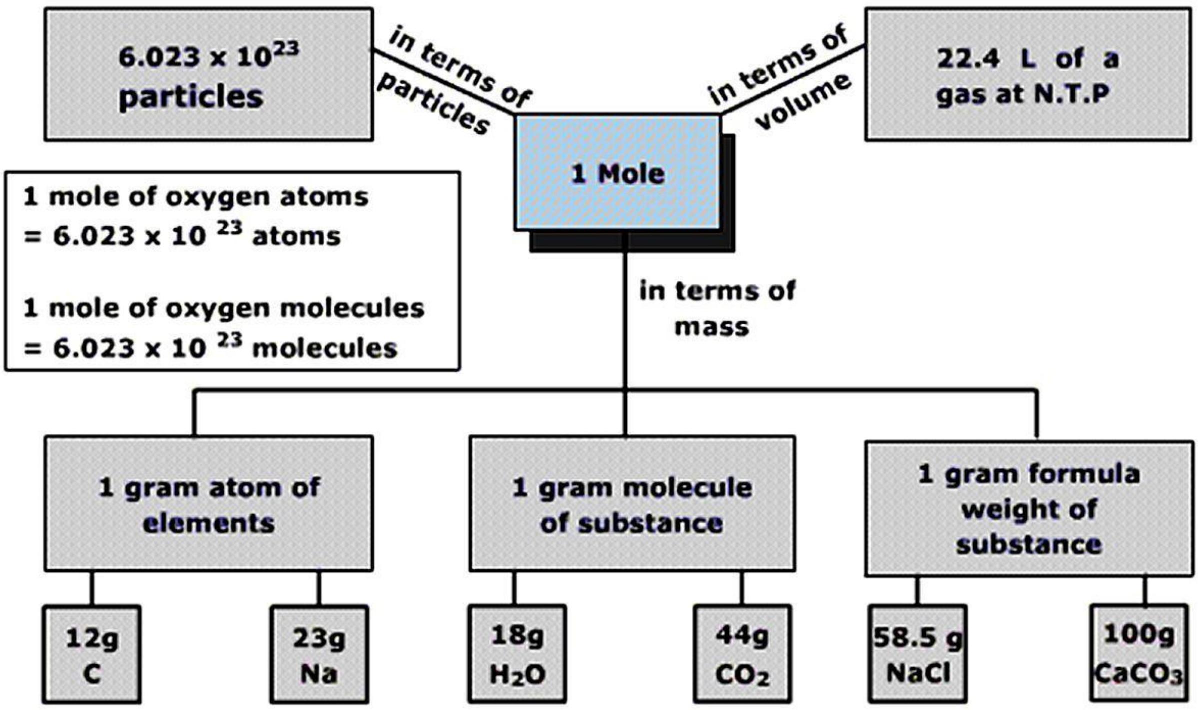
MOLE CONCEPT CALCULATION

This is the most basic and the most used calculation that a student comes across while solving a mole concept problem. Most of the times, moles or number of atoms or molecules are given in the question and the mass is needed to be calculated. In that case proceed as shown in the above example. In rest of the cases, mass will be given and moles or number will be needed to be calculated. In those questions also, proceed by:

STEP 1:- Establishing relationship between molar mass and the number (N_A) or moles of that particular entity (atom, molecule or ion).

STEP 2:- Use unitary method to calculate what is asked in the question.

NOTE: – When we say oxygen gas weighs 32 gram then we mean to say that 1 mole of oxygen molecule (O_2) weighs 32 grams and not 1 mole of oxygen atom which is O. This is because in natural form, oxygen exists as O_2 molecule.



PROBLEMS (BASED ON MOLE CONCEPT)

1. When the mass of the substance is given:

$$\text{Number of moles} = \frac{\text{given mass}}{\text{atomic mass}}$$

Example 1. Calculate the number of moles in 81g of aluminium

$$\text{Number of moles} = \frac{\text{given mass}}{\text{atomic mass}} = \frac{81}{27} = 3 \text{ moles of aluminium}$$

Example 2. Calculate the mass of 0.5 mole of iron
Solution: mass = atomic mass x number of moles
= 55.9 x 0.5 = 27.95 g

2. Calculation of number of particles when the mass of the substance is given:

$$\text{Number of particles} = \frac{\text{Avogadro number} \times \text{given mass}}{\text{gram molecular mass}}$$

Example 1. Calculate the number of molecules in 11g of CO_2
Solution: gram molecular mass of CO_2 = 44g

$$\text{Number of particles} = \frac{6.023 \times 10^{23} \times 11}{44} = 1.51 \times 10^{23} \text{molecules}$$

3. Calculation of mass when number of particles of a substance is given:

$$\text{Mass of a substance} = \frac{\text{gram molecular mass} \times \text{number of particles}}{6.023 \times 10^{23}}$$

Example 1. Calculate the mass of 18.069 x 10^{23} molecules of SO_2
Sol: Gram molecular mass SO_2 = 64g

$$\text{Mass of } SO_2 = \frac{64 \times 18.069 \times 10^{23}}{6.023 \times 10^{23}} = 192g$$

Example 2. Calculate the mass of glucose in 2 x 10^{24} molecules
Gram molecular mass of glucose = 180g

$$\text{Mass of glucose} = \frac{180 \times 2 \times 10^{23}}{6.023 \times 10^{23}} = 597.7g$$

4. Calculation of number of moles when you are given number of molecules:

$$\text{Number of moles of atom} = \frac{\text{Number of molecules}}{\text{Avogadro Number}}$$

Example 1. Calculate number of moles in 12.046 x 10^{22} atoms of copper

$$\text{Number of moles of atom} = \frac{\text{Number of molecules}}{\text{Avogadro Number}} = \frac{12.046 \times 10^{22}}{6.023 \times 10^{23}} = 0.2 \ moles$$

INTEXT QUESTIONS PAGE NO. 42

Q1. If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?
Answer:
One mole of carbon atoms weighs 12 g (Given)
i.e., mass of 1 mole of carbon atoms = 12 g
Then, mass of 6.022×10^{23} number of carbon atoms = 12 g

$$\text{Therefore, mass of 1 atom of carbon} = \frac{12}{6.022 \times 10^{23}} g = 1.9926 \times 10^{23} g$$

Q2. Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

Answer:
Atomic mass of Na = 23 u (Given)
Then, gram atomic mass of Na = 23 g
Now, 23 g of Na contains = 6.022×10^{23} number of atoms

Thus, 100 g of Na contains $= \dfrac{6.022 \times 10^{23}}{23} \times 100 \quad = 2.6182 \times 10^{24}$ number of atoms

Again, atomic mass of Fe = 56 u(Given)
Then, gram atomic mass of Fe = 56 g
Now, 56 g of Fe contains 6.022×10^{23} number of atoms

Thus, 100 g of Fe contains $= \dfrac{6.022 \times 10^{23}}{56} \times 100 \quad = 1.0753 \times 10^{24}$ number of atoms

Therefore, 100 grams of sodium contain more number of atoms than 100 grams of iron.

EXERCISE QUESTIONS PAGE NO. 43, 44

Q1. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.
Answer:
Mass of boron = 0.096 g (Given)
Mass of oxygen = 0.144 g (Given)
Mass of sample = 0.24 g (Given)

Thus, percentage of boron by weight in the compound $= \dfrac{0.096}{0.24} \times 100 = 40\%$

And, percentage of oxygen by weight in the compound $= \dfrac{0.144}{0.24} \times 100 = 60\%$

Q 2. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?
Answer:
Carbon + Oxygen → Carbon dioxide
3 g of carbon reacts with 8 g of oxygen to produce 11 g of carbon dioxide.
If 3 g of carbon is burnt in 50 g of oxygen, then 3 g of carbon will react with 8 g of oxygen.
The remaining 42 g of oxygen will be left un-reactive.
In this case also, only 11 g of carbon dioxide will be formed.
The above answer is governed by the law of constant proportions.

Q 3. What are polyatomic ions? Give examples.
Answer:
A polyatomic ion is a group of atoms carrying a charge (positive or negative). For example, ammonium ion (NH_4^+), hydroxide ion (OH^-), carbonate ion (CO_3^{2-}), sulphate ion(SO_4^{2-})

Q 4. Write the chemical formulae of the following.
(a) Magnesium chloride
(b) Calcium oxide
(c) Copper nitrate
(d) Aluminium chloride
(e) Calcium carbonate.
Answer:
(a) Magnesium chloride → $MgCl_2$

(b) Calcium oxide → CaO
(c) Copper nitrate → $Cu(NO_3)_2$
(d) Aluminium chloride → $AlCl_3$
(e) Calcium carbonate → $CaCO_3$

Q 5. Give the names of the elements present in the following compounds.
(a) Quick lime
(b) Hydrogen bromide
(c) Baking powder
(d) Potassium sulphate.
Answer:
(a) Quick lime
Chemical formula : CaO
Elements present: Calcium, Oxygen
(b) Hydrogen bromide
Chemical formula : HBr
Elements present: Hydrogen, Bromine

(c) Baking powder
Chemical formula : NaHCO3
Elements present: Sodium, Hydrogen, Carbon, Oxygen

(d) Potassium sulphate.
Chemical formula : K_2SO_4
Elements present: Potassium, Sulphur, Oxygen

Q 6. Calculate the molar mass of the following substances.
(a) Ethyne, C_2H_2
(b) Sulphur molecule, S_8
(c) Phosphorus molecule, P_4 (Atomic mass of phosphorus = 31)
(d) Hydrochloric acid, HCl
(e) Nitric acid, HNO_3
Answer:
(a) Molar mass of ethyne, $C_2H_2 = 2 \times 12 + 2 \times 1 = 26$ g
(b) Molar mass of sulphur molecule, $S_8 = 8 \times 32 = 256$ g
(c) Molar mass of phosphorus molecule, $P_4 = 4 \times 31 = 124$ g
(d) Molar mass of hydrochloric acid, HCl = 1 + 35.5 = 36.5 g
(e) Molar mass of nitric acid, $HNO_3 = 1 + 14 + 3 \times 16 = 63$ g

Q 7. What is the mass of ______
(a) 1 mole of nitrogen atoms?
(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?
(c) 10 moles of sodium sulphite (Na_2SO_3)?
Answer:
(a) The mass of 1 mole of nitrogen atoms is 14 g.
(b) The mass of 4 moles of aluminium atoms is (4×27) g = 108 g
(c) The mass of 10 moles of sodium sulphite (Na_2SO_3) is
$10 \times [2 \times 23 + 32 + 3 \times 16]$ g = 10×126 g = 1260 g

Q 8. Convert into mole.
(a) 12 g of oxygen gas
(b) 20 g of water
(c) 22 g of carbon dioxide.

Answer:
(a) 32 g of oxygen gas = 1 mole

Then, 12 g of oxygen gas $= \frac{12}{32}$ mole = 0.375 mole

(b) 18 g of water = 1 mole

Then, 20 g of water $= \frac{20}{18}$ mole = 1.11 moles (approx)

(c) 44 g of carbon dioxide = 1 mole

Then, 22 g of carbon dioxide $= \frac{22}{44}$ mole = 0.5 mole

Q 9. What is the mass of:
(a) 0.2 mole of oxygen atoms?
(b) 0.5 mole of water molecules?
Answer:
(a) Mass of one mole of oxygen atoms = 16 g
Then, mass of 0.2 mole of oxygen atoms = 0.2 × 16g = 3.2 g
(b) Mass of one mole of water molecule = 18 g
Then, mass of 0.5 mole of water molecules = 0.5 × 18 g = 9 g

Q 10. Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.
Answer:
1 mole of solid sulphur (S_8) = 8 × 32 g = 256 g
i.e., 256 g of solid sulphur contains = 6.022×10^{23} molecules

Then, 16 g of solid sulphur contains $= \frac{6.022 \times 10^{23}}{256} \times 16$ molecules

= 3.76×10^{22} molecules (approx)

Q 11. Calculate the number of aluminium ions present in 0.051 g of aluminium oxide. (*Hint:* The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u)
Answer:
1 mole of aluminium oxide (Al_2O_3) = 2 × 27 + 3 × 16 = 102 g
i.e., 102 g of Al_2O_3 = 6.022×10^{23} molecules of Al_2O_3

Then, 0.051 g of Al_2O_3 contains $= \frac{6.022 \times 10^{23}}{102} \times 0.051$ molecules

= 3.011×10^{20} molecules of Al_2O_3
The number of aluminium ions (Al^{3+}) present in one molecule of aluminium oxide is 2.
Therefore, the number of aluminium ions (Al^{3+}) present in 3.011×10^{20} molecules (0.051 g) of aluminium oxide (Al_2O_3) = $2 \times 3.011 \times 10^{20} = 6.022 \times 10^{20}$

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 3
ATOMS AND MOLECULES

Calculate the mass of one mole of these substances.

1. $AlCl_3$	14. $Ba(SCN)_2$	27. LiH	40. $Ba(BrO_3)_2$	53. $AlBr_3$	66. HCl
2. TeF_4	15. K_2S	28. CO	41. Hg_2Cl_2	54. P_2O_5	67. K_2SO_4
3. PbS	16. NH_4Cl	29. SnI_4	42. $Cr_2(SO_3)_3$	55. NH_4NO_3	68. NaCl
4. Cu_2O	17. KH_2PO_4	30. KOH	43. $Al(MnO_4)_3$	56. $Ba(OH)_2$	69. LiI
5. AgI	18. C_2H_5NBr	31. K_2O	44. $CoSO_4$	57. $PbSO_4$	70. Hg_2O
6. N_2O	19. $Ba(ClO_3)_2$	32. H_2SO_4	45. $Ca(NO_3)_3$	58. $Ba_3(PO_4)_2$	71. HF
7. $MoCl_5$	20. $Fe(OH)_3$	33. Hg_3N_2	46. NaH_2PO_4	59. $NaC_2H_3O_2$	72. $FeCl_3$
8. Hg_2Br_2	21. $(NH_4)_2S$	34. SiF_4	47. $(NH_4)_3PO_4$	60. $Ba(OH)_2$	73. $NaHSO_4$
9. Ta_2O_5	22. $CoCl_2$	35. NH_4OH	48. $KAl(SO_4)_2$	61. $NaHCO_3$	74. Ag_2O
10. HgF_2	23. $KMnO_4$	36. N_2O_5	49. Hg_2SO_4	62. $Al(OH)_3$	75. $Pb(ClO_2)_2$
11. KCl	24. $CaSO_4$	37. $SnCrO_4$	50. $Al_2(SO_4)_3$	63. NH_4MnO_4	76. CoF_3
12. KF	25. H_2CO_3	38. Al_2O_3	51. $FePO_4$	64. Fe_2O_3	77. $Al(C_2H_3O_2)_3$
13. ZnO	26. CO_2	39. $CuCO_3$	52. $Ca(C_2H_3O_2)_2$	65. $CaCO_3$	

78. $Na_2Al_2(SO_4)_4$
79. $(HOOCCH_2)_2NCH_2CH_2N(CH_2COOH)_2$
80. $(NH_4)_2CH(CH_2)_5COOH$

Answers (each answer has the units g/mol)

1. 133.34	14. 255.26	27. 7.95	40. 393.1314	53. 266.69	66. 36.461
2. 203.59	15. 110.26	28. 28.01	41. 472.09	54. 141.944	67. 174.25
3. 239.3	16. 53.49	29. 626.31	42. 344.1666	55. 80.04	68. 58.443
4. 143.09	17. 136.08	30. 56.106	43. 383.788	56. 171.34	69. 133.846
5. 234.77	18. 122.97	31. 94.20	44. 154.99	57. 303.26	70. 417.179
6. 44.01	19. 304.23	32. 98.07	45. 226.09	58. 601.93	71. 20.006
7. 273.20	20. 106.87	33. 629.78	46. 119.977	59. 82.03	72. 162.206
8. 560.98	21. 68.14	34. 104.08	47. 149.087	60. 171.34	73. 120.055
9. 441.89	22. 129.84	35. 35.046	48. 258.195	61. 84.007	74. 231.74
10. 238.59	23. 158.03	36. 108.01	49. 497.24	62. 78.00	75. 342.10
11. 74.55	24. 136.14	37. 234.68	50. 342.136	63. 136.97	76. 115.928
12. 58.10	25. 62.02	38. 101.96	51. 150.82	64. 159.69	77. 204.12
13. 81.38	26. 44.01	39. 123.555	52. 158.169	65. 100.09	

78. 484.173
79. 292.246
80. 164.248

1. Who established the two important laws of chemical combinations?

2. What are the laws of chemical combinations?

3. What is the law of conservation of mass?

4. Give an example to show Law of conservation of mass applies to physical change also.

5. Explain with example that law of conservation of mass is valid for chemical reactions.

6. The 2.8 g of nitrogen gas was allowed to react with 0.6 g of hydrogen gas to produce 3.4 g of ammonia. Show that these observations are in agreement with the law of Conservation of mass.

7. If 12 g of carbon is burnt in the presence of 32 g of oxygen, how much carbon dioxide will be formed?

8. Who proposed Law of Definite Proportions (or Law of Constant Composition)?

9. State Law of constant proportions. Explain with an example.

10. Show that water illustrates the law of constant proportions.

11. 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 g of hydrogen gas?

12. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

13. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

14. Magnesium and oxygen combine in the ratio of 3 : 2 by mass to form magnesium oxide. How much oxygen is required to react completely with 12 g of magnesium?

15. What are the postulates of Dalton's atomic theory?

16. Which of the following statements is NOT true about an atom?

(a) Atoms are the building blocks from which molecules and ions are formed.

(b) Atoms cannot exist independently.

(c) Atoms are neutral in nature

(d) Atoms combine together to form matter that we can see, feel or touch.

17. What is an atom?

18. Why is it not possible to see an atom with naked eyes?

19. Who proposed the chemical notation based on first two letters of the name of the element?

20. Name the international organization who approves names of elements.

21. What is the chemical symbol for iron?

22. Name five elements have single letter chemical symbol.

23. Name the element having following Latin names

(i) Stibium

(ii) Cuprum

(iii) Argentum

(iv) Natrium

(v) Stannum

(vi) Wolfram

(vii) plumbum

(viii) Kalium

24. Write the chemical symbols of the following:

(i) Gold

(ii) Iron

(iii) Chlorine

(iv) Mercury

25. How will you define chemical symbol?

26. What is the significance of a chemical symbol?

27. Can atoms of an element exist independently? Give examples of elements which exist in atomic form. Give examples of elements that do not exist in atomic form.

28. Why do atoms of the most of the elements not exist independently?

29. Which element has the smallest atom in size?

30. What is the atomic mass unit?

31. Magnesium is two times heavier than C-12 atom, what shall be the mass of Mg atom in terms of atomic mass units? (Given mass of C-12 atom = 12u)

32. What is relative atomic mass of an element? How it is related to atomic mass unit?

33. Define molecule. What are its important properties?

34. Based on type of substance, how molecules are classified?

35. What is atomicity?

36. Based on atomicity, how molecules are categorized?

37. Give three examples of monoatomic molecules.

38. Give four examples of diatomic molecules.

39. (i) What is the chemical formula of Water molecule? (ii) What is its atomicity? (iii) Calculate the ratio of masses of atoms of elements present in water molecule. (iv) Calculate the ratio by number of atoms of elements present in water molecule.

40. What is an ion?

41. What are polyatomic ions? Give examples?

42. Give examples of triatomic molecules.

43. What is valency of an element?

44. What is meant by the term chemical formula?

45. Write down the formulae of

(i) sodium oxide

(ii) aluminium chloride

(iii) sodium suphide

(iv) magnesium hydroxide

46. Write down the names of compounds represented by the following formulae:

(i) $Al_2(SO_4)_3$

(ii) $CaCl_2$

(iii) K_2SO_4

(iv) KNO_3

(v) $CaCO_3$

47. Write the chemical formulae of the following. Also identify the ions present.

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate.

48. Give the names of the elements present in the following compounds.

(a) Quick lime

(b) Hydrogen bromide

(c) Baking powder

(d) Potassium sulphate.

49. How many atoms are present in a (i) H_2S molecule and (ii) PO_4^{3-} ion?

50. (a) Write a chemical formula of a compound using zinc ion and phosphate ion. (b) Calculate the ratio by mass of atoms present in a molecule of carbon dioxide. (Given C =12, O =16)

51. What is the molecular mass of a substance?

52. What is Formula Unit Mass? How it is different from molecular mass?

53. Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

54. What are ionic compounds?

55. How do we know the presence of atoms if they do not exist independently for most of the elements?

56. An element 'Z' forms the following compound when it reacts with hydrogen, chlorine, oxygen and phosphorus.

ZH_3, ZCl_3, Z_2O_3 and ZP

(a) What is the valency of element Z?

(b) Element 'Z' is metal or non-metal?

57. Name one element each which forms diatomic and tetra atomic molecule.

58. Name one element which forms diatomic and triatomic molecule.

59. What is gram-atomic mass of an element?

60. What is gram-molecular mass of a substance?

61. Define mole. What is its significance?

62. What is molar mass?

63. Who introduced the term 'mole' in chemistry?

64. When 'mole' was chosen internationally standard way to express larger number of chemical units?

65. How many moles are there in 4.6 gms of Sodium(Na)?

66. If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

67. Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

68. What is the mass of

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

69. Convert into moles:

(a) 12 g of oxygen gas

(b) 20 g of water

(c) 22 g of carbon dioxide

70. What is the mass of: (a) 0.2 mole of oxygen atoms? (b) 0.5 mole of water molecules?

71. Find out number of atoms in 15 moles of He.

72. Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.

73. Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

(Hint: The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u)

74. Calculate the mass percentage of Carbon(C) , Hydrogen (H) and Oxygen (O) in one molecule of glucouse ($C_6H_{12}O_6$).

(Atomic mass of C = 12u, H = 1u and O = 16u)

75. Calculate the number of molecules of phosphorus (P_4) present in 31 gram of phosphorus.

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 3
ATOMS AND MOLECULES

MOLECULAR MASS AND MOLE CALCULATION PROBLEMS

1. Calculate the number of moles in i) 4.6g sodium ii) 5.1g of Ammonia iii) 90g of water iv) 2g of NaOH

2. Calculate the number of molecules in 360g of glucose.

3. Find the mass of 2.5 mole of oxygen atoms

4. Calculate the mass of 12.046 x 10^{23} molecules in CaO.

5. Calculate the number of moles in 24.092 x 10^{22} molecules of water.

6. Calculate the number of moles in a) 12.046 x 10^{23} atoms of copper b) 27.95g of iron c) 1.51 x 10^{23} molecules of CO_2

7. If 3.0115 x 10^{23} particles are present in CO_2. Find the number of moles.

8. Find the number of moles present in 24.088 x 10^{23} particles of carbon dioxide

9. Calculate the number of atoms in 48g of Mg

10. Calculate the number of molecules in 3.6 g of water

11. Calculate the number of atoms in 0.5 moles of carbon

12. Calculate the number of moles in 12g of oxygen gas

13. Calculate the number of moles present in 14g of carbon monoxide .

14. Find the mass of 5 moles of aluminium atoms?

15. Calculate the molar mass of sulphur.

16. Calculate the mass of 0.2 mole of water molecules.

17. Which has greater number of atoms, 100g of sodium or 100g of iron?

18. How many atoms of oxygen are present in 300 grams of $CaCO_3$?

19. The mass of one atom of an element 'A' is 2.65 x 10^{-23} g. Calculate its atomic mass and name the element.

20. Calculate the number moles of magnesium in 0.478g of magnesium ?

21. In which of the following cases the number of hydrogen atoms is more ? Two moles of HCl or one mole of NH_3.

22. Calculation of number of hydrogen atoms present in 1 mole of NH_3

23. Find the number of oxygen atoms in 88g of CO_2?

24. Calculate the number of water molecules contained in a drop of water weighing 0.06g ?

25. Find the number of aluminium ions present in 0.051g of aluminium oxide(Al_2O_3). (Atomic masses: Al= 27u;O= 16u)

26. Calculate the mass of 1.000 mole of $CaCl_2$

27. Calculate grams in 3.0000 moles of CO_2

28. Calculate number of moles in 32.0 g of CH_4

29. Determine mass in grams of 40.0 moles of Na_2CO_3

30. Calculate moles in 168.0 g of HgS

31. Calculate moles in 510.0 g of Al_2S_3

32. How many moles are in 27.00 g of H_2O

33. Determine the mass in grams of Avogadro number of $C_{12}H_{22}O_{11}$

34. Find mass in grams of 9.03 moles of H_2S

35. Determine grams in 1.204 mole of NH_3

Consider the molecule $CuNH_4Cl_3$ as you answer 11 - 19.

36. Name the elements present.

37. How many atoms form the molecule?

38. How many of each atom in the molecule?

39. How many hydrogen atoms in one mole of molecules?

40. How many chlorine atoms in six moles of molecules?

41. What is the molar mass of this molecule?

42. Name this molecule.

43. What is the mass in grams of one molecule?

44. How many moles would be in 6.84 g of this substance?

45. You need 0.0100 mole of lead (II) chromate. How much should you weigh on the scale?

46. Given 6.40 g of HBr. How many moles is this?

47. Write the correct formula for calcium acetate and then answer 23 - 25 based on it.

48. What is the mass of exactly one mole of calcium acetate?

49. How many moles are contained in 1.58 g of the substance in #23?

50. How much does 0.400 mole of #23 weigh?

51. Write the formula for oxygen gas.

52. How many atoms (and moles) are represented by the formula in #26?

53. What is the mass of Avogadro Number of oxygen molecules?

54. Calculate the molar mass of HNO_3. [N = 14, O = 16, H = 1]

55. Calculate the formula mass of $CaCl_2$. [Ca = 40, Cl = 35.5]

56. A certain non-metal X forms two oxides I and II. The mass percentage of oxygen in oxide I (X_4O_6) is 43.7, which is same as that of X in oxide II. Find the formula of the second oxide.

57. Calculate the mass of 0.2 moles of water (O=16, H=1).

58. What is the volume of 7.1 g of chlorine (Cl=35.5) at S.T.P.

59. The reaction between aluminium carbide and water takes place according to the following equation: $Al_4C_3 + 12H_2O \longrightarrow 3CH_4 + 4Al(OH)_3$. Calculate the volume of CH_4 released from 14.4 g of Al_4C_3 by excess water at S.T.P. (C = 12, Al = 27)

60. A compound of sodium, sulphur and oxygen has the following percentage composition. Na=29.11%, S=40.51%, O=30.38%. Find its empirical formula (O=16, Na=23, S=32).

61. Solid ammonium dichromate with relative molecular mass of 252 g decomposes according to the equation: $(NH_4)Cr_2O_7 \longrightarrow N_2 + Cr_2O_3 + 4H_2O$. (i) What volume of nitrogen at S.T.P will be evolved when 63 g of $(NH_4)_2Cr_2O_7$ is decomposed? (ii) If 63 g of $(NH_4)_2Cr_2O_7$ is heated above 100^0C, what will be the loss of mass? (H=1, N=14, O=16, Cr=52).

62. How many litres of ammonia are present in 3.4 kg of it? (N = 14, H = 1)

63. About 640 mL of carbon monoxide is mixed with 800 mL of oxygen and ignited in an enclosed vessel. Calculate the total volume of gases after the burning is completed. All volumes are measured at S.T.P.

64. Calculate the number of moles of ammonium sulphate present in 15.84 kg of it. (H=1, N=14, O=16, S=32)

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 3
ATOMS AND MOLECULES

1. Avogadro's number represents the number of atoms in
(a) 12g of $C1_2$ (b) 320g of sulphur
(c) 32g of oxygen (d) 12.7g of iodine

2. The number of moles of carbon dioxide which contain 8 g of oxygen is
(a) 0.5 mol (b) 0.20 mol
(c) 0.40 mol (d) 0.25 mol

3. The total no of ions present in 111 g of $CaCl_2$ is
(a) One mole (b) Two mole
(c) Three mole (d) Four moles

4. Which of the following weighs the most ?
(a) one g-atom of nitrogen (b) One mole of water
(c) One mole of sodium (d) One molecule of $H2SO_4$

5. 5.0 litre of 0.4 M H_2SO_4 Contains-
(a) 2.0 Mole Of H_2SO_4 (b) 0.4 mole H_2SO_4
(c) 5.0 mole H_2SO_4 (d) 2.0 moles H_2O

6. Which of the following correctly represents 360 g of water?
(i) 2 moles of H_20
(ii) 20 moles of water
(iii) 6.022 × 1023 molecules of water
(iv) 1.2044×1025 molecules of water
(a) (i) (b) (i) and (iv)
(c) (ii) and (iii) (d) (ii) and (iv)

7. Which of the following statements is not true about an atom?
(a) Atoms are not able to exist independently
(b) Atoms are the basic units from which molecules and ions are formed
(c) Atoms are always neutral in nature
(d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch

8. The chemical symbol for nitrogen gas is
(a) Ni (b) N2 (c) N+ (d) N

9. The chemical symbol for sodium is
(a) So (b) Sd (c) NA (d) Na

10. Which of the following would weigh the highest?
(a) 0.2 mole of sucrose (C_{12} H_{22} O_{11})
(b) 2 moles of CO_2
(c) 2 moles of $CaCO_3$
(d) 10 moles of H_2O

11. Which of the following has maximum number of atoms?
(a) 18g of H_2O
(b) 18g of O_2
(c) 18g of CO_2
(d) 18g of CH_4

12. Which of the following contains maximum number of molecules?
(a) 1g CO_2
(b) 1g N_2
(c) 1g H_2
(d) 1g CH_4

13. Mass of one atom of oxygen is
$(a)\frac{16}{6.023\times10^{23}}\,g$ $\quad (b)\frac{32}{6.023\times10^{23}}\,g$ $\quad (c)\frac{1}{6.023\times10^{23}}\,g$ $\quad (d)8u$

14. 3.42 g of sucrose are dissolved in 18g of water in a beaker. The number of oxygen atoms in the solution are
(a) 6.68×10^{23}
(b) 6.09×10^{22}
(c) 6.022×10^{23}
(d) 6.022×10^{21}

15. A change in the physical state can be brought about
(a) only when energy is given to the system
(b) only when energy is taken out from the system
(c) when energy is either given to, or taken out from the system
(d) without any energy change

16. Which of the following represents a correct chemical formula? Name it.
(a) CaCl (b) $BiPO_4$ (c) $NaSO_4$ (d) NaS

17. Write the molecular formulae for the following compounds
(a) Copper (II) bromide
(b) Aluminium (III) nitrate
(c) Calcium (II) phosphate
(d) Iron (III) sulphide
(e) Mercury (II) chloride
(f) Magnesium (II) acetate

18. Write the molecular formulae of all the compounds that can be formed by the combination of following ions
Cu^{2+}, Na^{+}, Fe^{3+}, $C1^{-}$, SO_4^{2-}, PO_4^{3-}

19. Write the cations and anions present (if any) in the following compounds
(a) CH_3COONa
(b) NaCl
(c) H_2
(d) NH_4NO_3

20. Give the formulae of the compounds 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

21. Which of the following symbols of elements are incorrect? Give their correct symbols
(a) Cobalt CO
(b) Carbon c
(c) Aluminium AL
(d) Helium He
(e) Sodium So

22. Give the chemical formulae for the following compounds and compute the ratio by mass of the combining elements in each one of them.
(a) Ammonia
(b) Carbon monoxide
(c) Hydrogen chloride
(d) Aluminium fluoride
(e) Magnesium sulphide

23. State the number of atoms present in each of the following chemical species
(a) CO_3^{2-}
(b) PO_4^{3-}
(c) P_2O_5
(d) CO

24. Find the ratio by mass of the combining elements in the compound – C_2H_5OH.

25. Give the formula of the compound formed by the elements calcium and fluorine.

26. What is the acid radical present in sodium peroxide?

27. Carbon and silicon have the same valency. What is the formula of sodium silicate?

28. What is the ratio by number of atoms in mercurous chloride?

29. Name the element whose Latin name is Stibium.

30. What is the valency of a sulphide ion?

31. How many atoms of oxygen are present in 50g of $CaCO_3$?

32. How many molecules are present in 1 ml of water?

33. What is the unit of measurement of atomic radius?

34. Name the international organization who approves names of elements.

35. How do we know the presence of atoms if they do not exist independently for most of the elements?

36. Give an example to show Law of conservation of mass applies to physical change also.

37. Explain with example that law of conservation of mass is valid for chemical reactions.

38. Is there any exception to law of conservation of mass?

39. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

40. If 12 g of carbon is burnt in the presence of 32 g of oxygen, how much carbon dioxide will be formed?

41. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

42. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

43. Magnesium and oxygen combine in the ratio of 3 : 2 by mass to form magnesium oxide. How much oxygen is required to react completely with 12 g of magnesium?

44. Why are Dalton's symbol not used in chemistry?

45. What is the fraction of the mass of water due to neutrons?

46. Does the solubility of a substance change with temperature? Explain with the help of an example.

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

(a) F_2	(b) NO_2	(c) N_2O	(d) C_2H_6	(e) P_4	(f) H_2O_2
(g) P_4O_{10}	(h) O_3	(i) HCl	(j) CH_4	(k) He	(l) Ag

48. You are provided with a fine white coloured powder which is either sugar or salt. How would you identify it without tasting?

49. Calculate the number of moles of magnesium present in a magnesium ribbon weighing 12 g. Molar atomic mass of magnesium is 24g mol–1.

50. Verify by calculating that

(a) 5 moles of CO_2 and 5 moles of H_2O do not have the same mass.

(b) 240 g of calcium and 240 g magnesium elements have a mole ratio of 3:5.

51. Find the ratio by mass of the combining elements in the following compounds.

(a) $CaCO_3$ (d) C_2H_5OH

(b) $MgCl_2$ (e) NH_3

(c) H_2SO_4 (f) $Ca(OH)_2$

52. Calcium chloride when dissolved in water dissociates into its ions according to the following equation.

$CaCl_2\ (aq) \rightarrow Ca^{2+}\ (aq) + 2Cl^{-}\ (aq)$

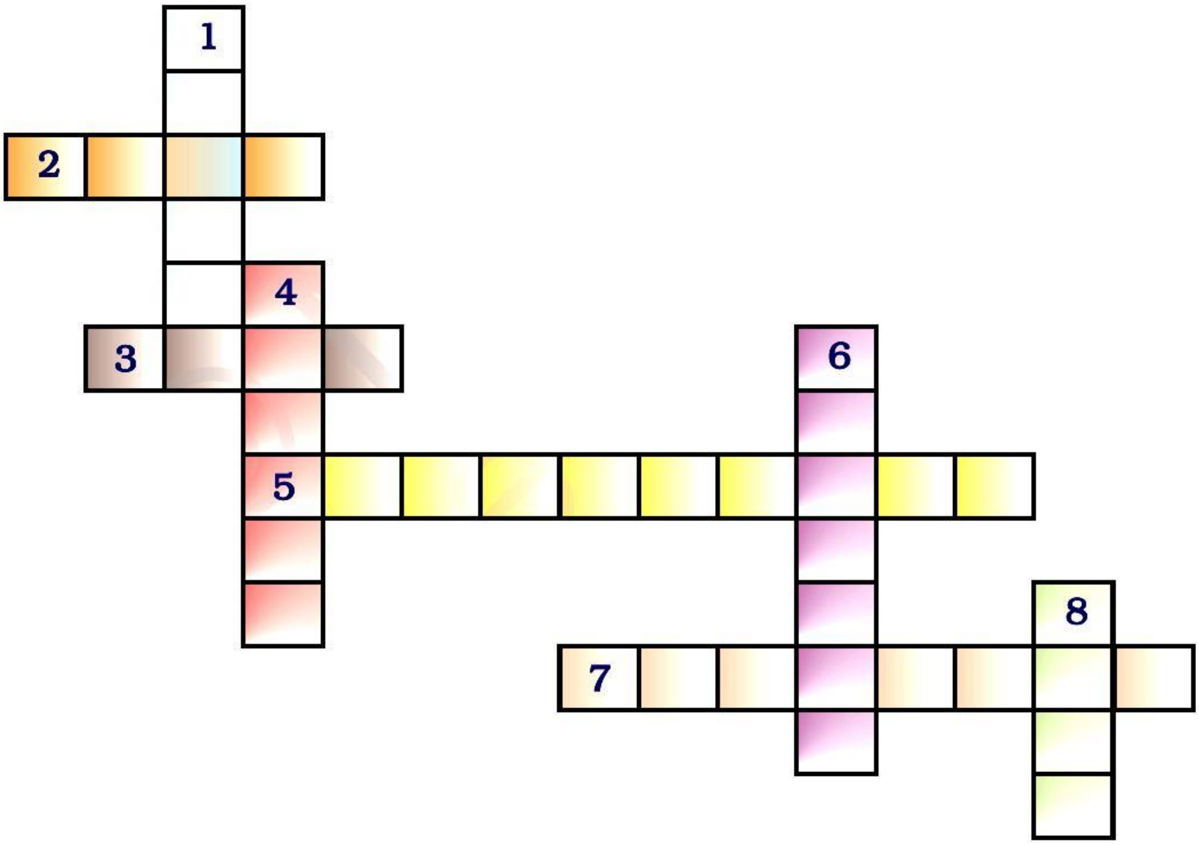
Calculate the number of ions obtained from $CaCl_2$ when 222 g of it is dissolved in water.

53. The difference in the mass of 100 moles each of sodium atoms and sodium ions is 5.48002g. Compute the mass of an electron.

54. Complete the following crossword puzzle (below Figure) by using the name of the chemical elements. Use the data given in below Table

Table 3.2

Across	Down
2. The element used by Rutherford during his α–scattering experiment 3. An element which forms rust on exposure to moist air 5. A very reactive non–metal stored under water 7. Zinc metal when treated with dilute hydrochloric acid produces a gas of this element which when tested with burning splinter produces a pop sound.	1. A white lustrous metal used for making ornaments and which tends to get tarnished black in the presence of moist air 4. Both brass and bronze are alloys of the element 6. The metal which exists in the liquid state at room temperature 8. An element with symbol Pb



55. Fill in the missing data in the below Table

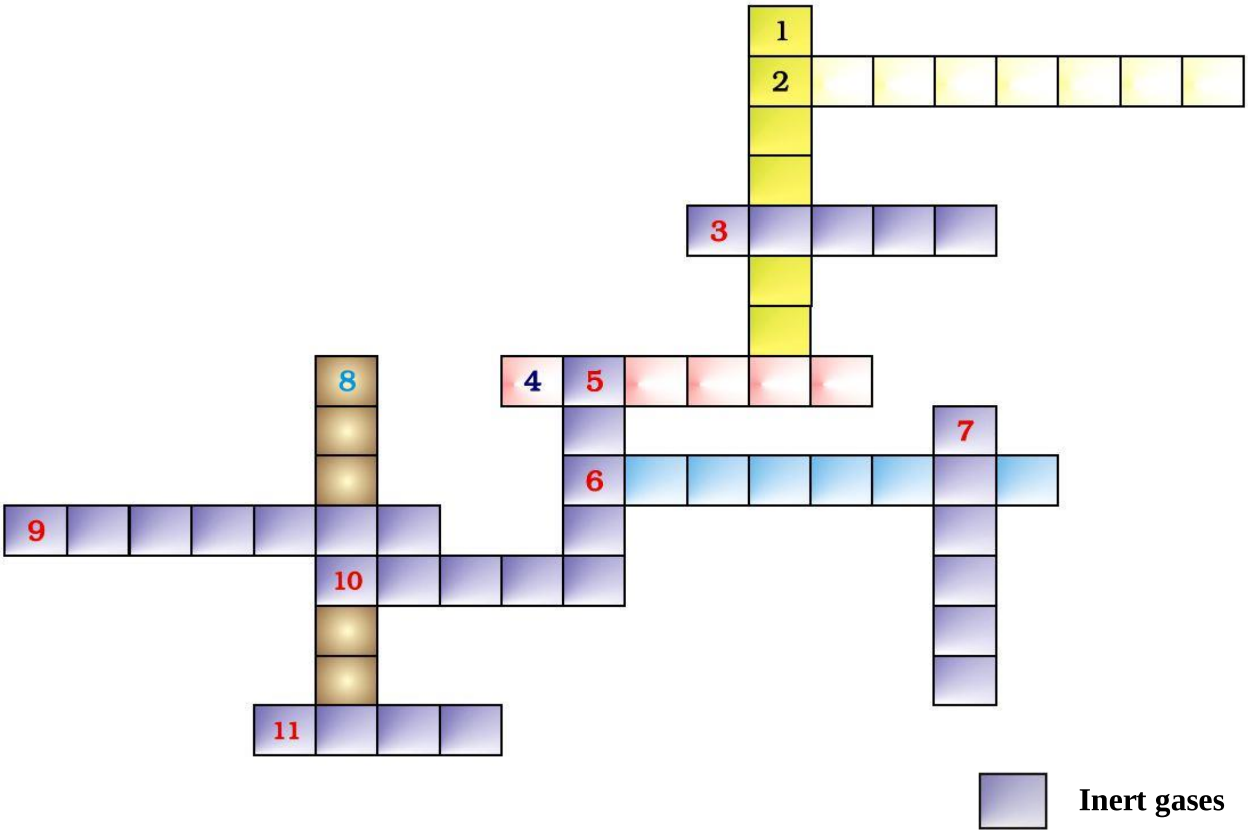
Species / Property	H_2O	CO_2	Na atom	$MgCl_2$
No of moles	2			0.5
No. of particles		3.011×10^{23}		
Mass	36g		115g	

56. The visible universe is estimated to contain 10^{22} stars. How many moles of stars are present in the visible universe?

57. What is the SI prefix for each of the following multiples and submultiples of a unit?
(a) 10^{3} (b) 10^{-1} (c) 10^{-2} (d) 10^{-6} (e) 10^{-9} (f) 10^{-12}

58. (a) In this crossword puzzle (Fig 3.2), names of 11 elements are hidden. Symbols of these are given below. Complete the puzzle.

1. Cl	7. He
2. H	8. F
3. Ar	9. Kr
4. O	10. Rn
5. Xe	11. Ne
6. N	



(b) Identify the total number of inert gases, their names and symbols from this cross word puzzle.

59. Express each of the following in kilograms

(a) 5.84×10^{-3} mg

(b) 58.34 g

(c) 0.584g

(d) 5.873×10^{-21}g

60. Compute the difference in masses of 103 moles each of magnesium atoms and magnesium ions. (Mass of an electron = 9.1×10^{-31} kg)

61. Which has more number of atoms? 100g of N_2 or 100 g of NH_3

62. Compute the number of ions present in 5.85 g of sodium chloride.

63. A gold sample contains 90% of gold and the rest copper. How many atoms of gold are present in one gram of this sample of gold?

64. Cinnabar (HgS) is a prominent ore of mercury. How many grams of mercury are present in 225 g of pure HgS? Molar mass of Hg and S are 200.6 g mol^{-1} and 32 g mol^{-1} respectively.

65. The mass of one steel screw is 4.11g. Find the mass of one mole of these steel screws. Compare this value with the mass of the Earth (5.98 × 1024kg). Which one of the two is heavier and by how many times?

66. A sample of vitamic C is known to contain 2.58 ×1024 oxygen atoms. How many moles of oxygen atoms are present in the sample?

67. Raunak took 5 moles of carbon atoms in a container and Krish also took 5 moles of sodium atoms in another container of same weight. (a) Whose container is heavier? (b) Whose container has more number of atoms?

68. What are ionic and molecular compounds? Give examples.

69. Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions. (Mass of an electron is 9.1×10–28 g). Which one is heavier?

70. A silver ornament of mass 'm' gram is polished with gold equivalent to 1% of the mass of silver. Compute the ratio of the number of atoms of gold and silver in the ornament.

71. A sample of ethane (C_2H_6) gas has the same mass as 1.5×10^{20} molecules of methane (CH_4). How many C_2H_6 molecules does the sample of gas contain?

72. Fill in the blanks

(a) In a chemical reaction, the sum of the masses of the reactants and products remains unchanged. This is called ————.

(b) A group of atoms carrying a fixed charge on them is called ————.

(c) The formula unit mass of $Ca_3 (PO_4)_2$ is ————.

(d) Formula of sodium carbonate is _____________and that of ammonium sulphate is ------------------------.

73. Write the formulae for the following and calculate the molecular mass for each one of them.

(a) Caustic potash

(b) Baking powder

(c) Lime stone

(d) Caustic soda

(e) Ethanol

(f) Common salt

74. In photosynthesis, 6 molecules of carbon dioxide combine with an equal number of water molecules through a complex series of reactions to give a molecule of glucose having a molecular formula C6 H12 O6. How many grams of water would be required to produce 18 g of glucose? Compute the volume of water so consumed assuming the density of water to be 1 g cm–3.

CHAPTER – 4

STRUCTURE OF THE ATOM

STRUCTURE OF THE ATOM

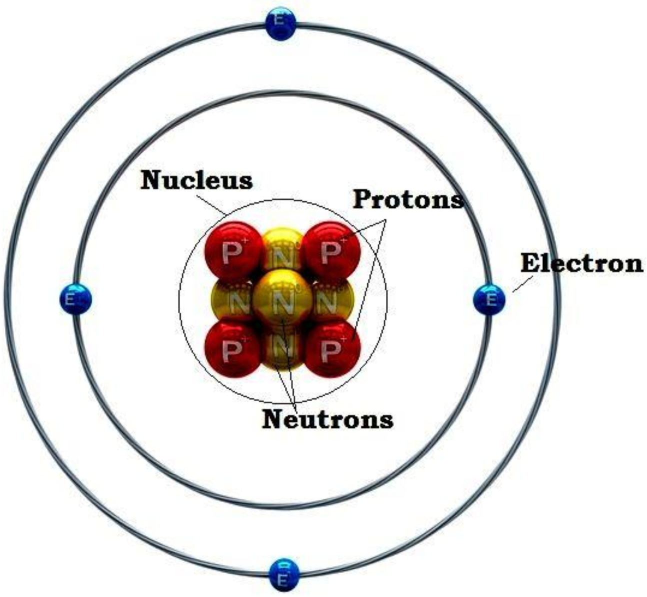
Atoms are the basic units of matter and the defining structure of elements. Matters are made of tiny particles called atom. Atom is made of three particles; electron, proton and neutron. These particles are called fundamental particles of an atom or sub atomic particles.

Electron (e^-) - Electron is denoted by 'e' and is a negatively charged particle. The absolute charge over an electron is equal to $1.6x10^{-19}$ of negative charge and is considered equal to – 1. The relative mass of electron is 1/1836. Since the mass of an electron is very small, thus it is considered equal to 0. Electrons revolve round the nucleus of atoms.

Proton (p^+) - Proton is denoted by 'p' and is positively charged particle. The absolute charge over proton is $1.6x10^{-19}$ coulomb of positive charge and it is considered as unit positive charge. Thus absolute charge over a proton is equal to +1.
The absolute mass of a proton is equal to $1.6x10^{-24}$ g and considered equal to 1 as it is equal to the mass of 1 hydrogen atom. Proton is present in the nucleus of atom.

Neutron (n) – Neutron is denoted by 'n' and is a neutral particle.

The absolute mass of neutron is 1.6×10^{-24} g. The relative mass of neutron is equal to 1. Neutron is presents in the nucleus of atom.
Nucleus – The centre of atom is called nucleus. Nucleus comprises of neutron and proton. Nucleus of an atom contains the whole mass of an atom.



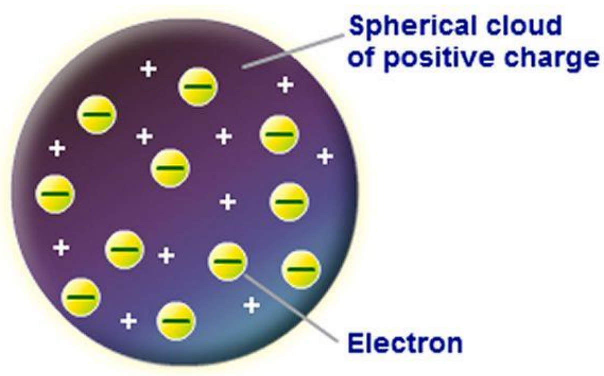
INTEXT QUESTIONS PAGE NO. 47

Q1. What are canal rays?
Answer:
Canal rays are positively charged radiations that can pass through perforated cathode plate. These rays consist of positively charged particles known as protons.

Q2. If an atom contains one electron and one proton, will it carry any charge or not?
Answer:
An electron is a negatively charged particle, whereas a proton is a positively charged particle. The magnitude of their charges is equal. Therefore, an atom containing one electron and one proton will not carry any charge. Thus, it will be a neutral atom.

Discovery of Electron
In 1897; J. J. Thomson, a British physicist, proposed that atom contains at least one negatively charged particle. Later this particle was named as electron. Thomson called those particles 'corpuscles'.
Discovery of Proton:
Ernest Goldstein in 1886 discovered the presence of new radiation in gas discharge tube even before the identification of electron. He called these rays as Canal Rays. His experiment led to the discovery of proton.
Discovery of Neutron:
In 1932 J. Chadwick discovered another subatomic particle called neutron. Neutron is present in the nucleus of all atoms.

THOMSON'S MODEL OF ATOM
J. J. Thomson proposed the model of atom similar to a Christmas Pudding or similar to a water melon. His model of atom is generally called plum and pudding model of atom.

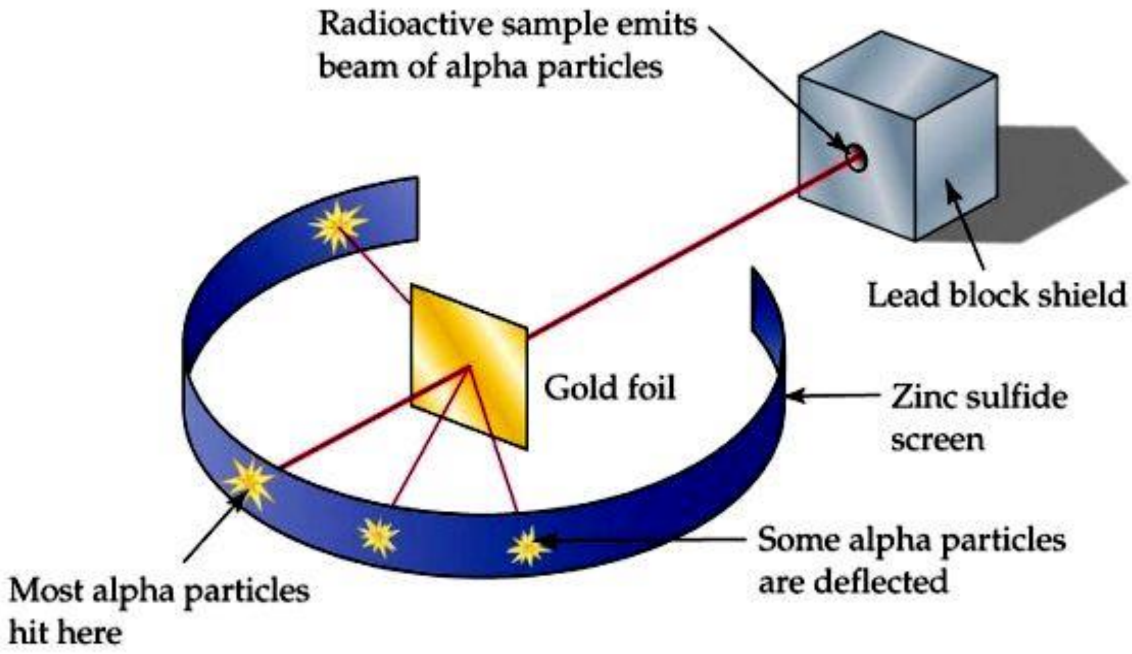


Thomson's Plum pudding model

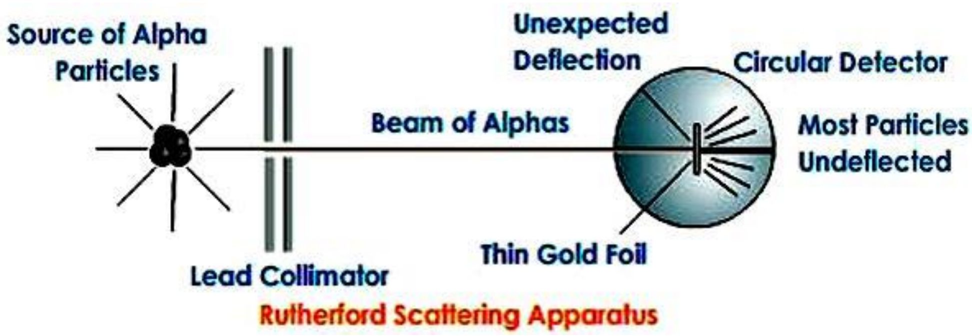
He proposed that electrons are embedded the way black seeds of water melon are embedded; in the sphere of positive charge. According to Thomson
(a) An atom consists of positively charged sphere in which electrons are embedded.
(b) The quanta of negative and positive charges are equal. The equal number of negative charge and positive charge makes an atom electrically neutral.

RUTHERFORD'S MODEL OF ATOM
Ernest Rutherford in 1909 with his team bombarded very thin gold foil with α – particles. He found that
(a) Most of the α – particles passed without any hindrance.
(b) Some of the α – particles deflected from their original path at noticeable angle.
(c) Very few of the α – particles bounced back at their original path.
On the basis of his observation, he proposed the model of atom. The Rutherford's Model of Atom is as follows:
(a) Most of the part in an atom is empty.
(b) There is a positively charged center in atom, which contains nearly the whole mass of atom. The centre is called nucleus.
(c) The size of nucleus is very small compared to an atom.

(d) Electrons revolve round the nucleus.



The Rutherford’s Experiment is also known as Geiger-Marsden Experiment.



DRAWBACKS OF RUTHERFORD MODEL

(a) According to Rutherford’s Model, electron revolves round the positively charged nucleus which is not expected to be stable. But a charged particle in an accelerated motion along a circular path would lose energy because of radiation and finally would fall into nucleus. This makes an atom unstable while atoms are quite stable.

If atoms were not stable no matter would exist in nature.

(b) Rutherford model could not solve the problem of atomic mass of atom as it proposed only the existence of protons in the nucleus.

However, the problem of atomic mass could be solved after the discovery of neutron.

BOHR’S MODEL OF ATOM

Neils Bohr, a Danish physicist, in 1913 proposed model of atom which rectified the problems left by Rutherford’s Model. He proposed that

(a) Electrons revolve round the nucleus in a fixed orbit.

(b) He called these orbits as ‘stationary orbit’.

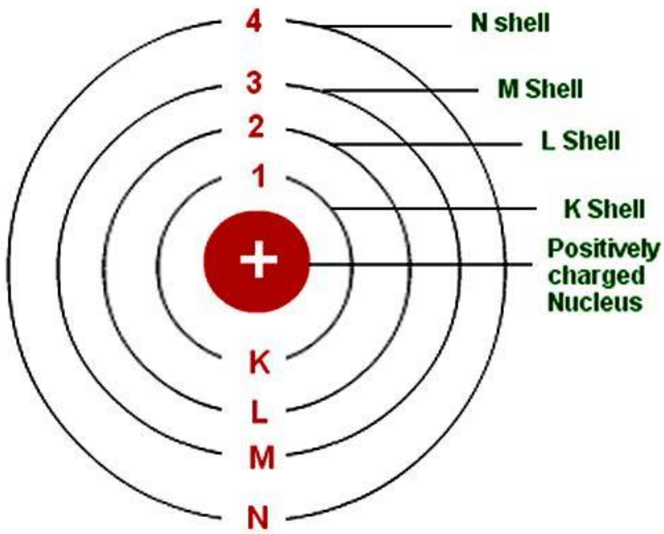
(c) Each stationary orbit is associated with fixed amount of energy, thus electrons do not radiate energy as long as they keep on revolving around the nucleus in fixed orbit.

The circular path around the nucleus is called orbit, energy level or shell. Energy level are represented by letter – K, L, M, N, …. and so on.

Therefore,

- 1^{st} orbit is denoted by – K
- 2^{nd} orbit is denoted by – L
- 3^{rd} orbit is denoted by – M, and so on.

The orbits are denoted by 1, 2, 3, …. and so on.

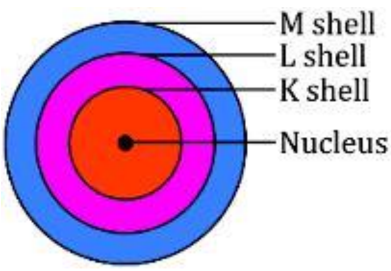


INTEXT QUESTIONS PAGE NO. 49

Q1. On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.
Answer:
As per Thomson's model of the atom, an atom consists both negative and positive charges which are equal in number and magnitude. So, they balance each other as a result of which atom as a whole is electrically neutral.

Q2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?
Answer:
On the basis of Rutherford's model of an atom, protons are present in the nucleus of an atom.

Q3. Draw a sketch of Bohr's model of an atom with three shells.
Answer:



Q4. What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?
Answer:
If α-particle scattering experiment is carried out using a foil of any metal as thin as gold foil used by Rutherford, there would be no change in observations. But since other metals are not so malleable so, such a thin foil is difficult to obtain. If we use a thick foil, then more α-

particles would bounce back and no idea about the location of positive mass in the atom would be available with such a certainty.

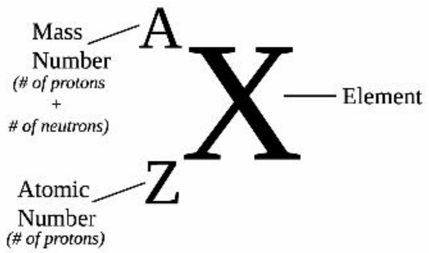
INTEXT QUESTIONS PAGE NO. 49

Q1. Name the three sub-atomic particles of an atom.
Answer:
The three sub-atomic particles of an atom are:
(i) Protons
(ii) Electrons, and
(iii) Neutrons

Q2. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?
Answer:
Number of neutrons = Atomic mass - Number of protons
Therefore, the number of neutrons in the atom = 4 - 2 = 2

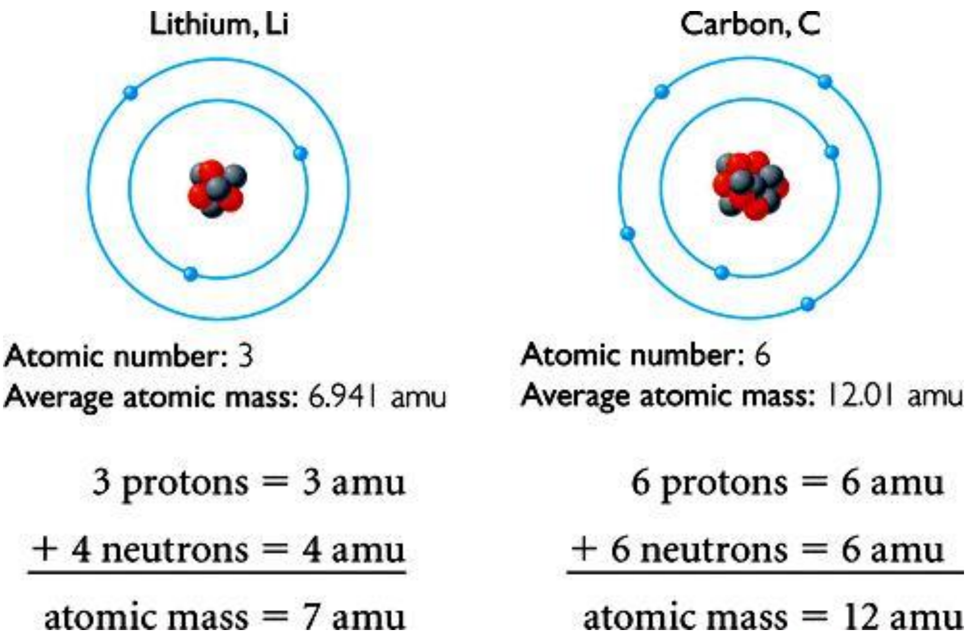
DISTRIBUTION OF ELECTRONS IN ORBIT OR SHELL:
The distribution of electrons in an orbit is obtained by $2n^2$, where 'n' is number of orbit.
Therefore,
Number of electrons in K-shell i.e. in 1st orbit.
Here n = 1
Therefore,
$2n^2 = 2 \times 1^2 = 2$
Thus, maximum number of electrons in K-shell i.e. 1st shell = 2
Number of electrons in L-shell, i.e. in 2nd orbit
Here n = 2, therefore,
$2n^2 = 2 \times 2^2 = 8$
Thus, maximum number of electrons in L-shell = 8
Number of electrons in M-shell, i.e. in 3rd orbit
Here n = 3, therefore,
$2n^2 = 2 \times 3^2 = 18$
Thus, maximum number of electrons in M-shell = 18
Number of electrons in N-shell, i.e. in 4th shell
Here n = 4, therefore,
$2n^2 = 2 \times 4^2 = 32$
Thus, maximum number of electrons in N-shell = 32
In similar way maximum number of electrons in any shell can be calculated.

ATOMIC NUMBER
Atomic number is the fundamental properties of an atom. Every atom is identified by its unique atomic number. Atomic number is denoted by 'z'.
Atomic number is equal to the number of protons present in an atom.
Since an atom is electrically neutral, thus number of protons and number of electrons are equal to make an atom electrically neutral.



Atomic number = Number of protons = Number of electrons
Example :–
The atomic number of Hydrogen is 1, helium is 2, lithium is 3, beryllium is 4, boron is 5, carbon is 6, nitrogen is 7, oxygen is 8, etc.
Sample exercise:
(1) Atomic number of calcium is 20. Calculate the number of electrons and protons in calcium.
Solution:
Since, Atomic number = Number of protons = Number of electrons
Therefore,
Number of electrons in calcium = 20
Number of protons in calcium = 20

(2) Number of protons in sodium atom is 11, find the atomic number and number of electrons in a sodium atom.
Solution,
Since, Atomic number = Number of protons = Number of electrons
Therefore,
Atomic number of sodium = 11
Number of electrons in sodium = 11



MASS NUMBER OR ATOMIC MASS

Mass number of an atom is defined as the sum of the number of protons and number of neutrons. Mass number is nearly equal to the atomic mass of an atom. Since, protons and neutrons reside in the nucleus, thus they are also known as nucleons.
This means
Mass number of an atom = Number of protons + Number of neutrons
Example
(1) Atomic mass of aluminium is 27 u and atomic number is 13, find the number of protons and number of neutrons in aluminium.
Solution:
Since,
Atomic number = 13
Therefore, number of proton = 13
We know that; Atomic mass (Mass number) = Number of protons + Number of neutrons

Therefore,
27 u = 13 + n
Or, n = 27 – 13 = 14
Therefore, number of proton = 13 and number of neutron = 14
(2) The atomic number of carbon is 6 and number of neutron is equal to 6. Find the atomic mass or mass number of carbon.
Solution:
Since atomic number of carbon = 6
Therefore, number of proton = 6
Now, Atomic mass = number of proton + number of neutron
Or, Atomic mass or mass number = 6 + 6 = 12 u
Thus, mass number or atomic mass of carbon = 12u

ARRANGEMENT OF ELECTRONS IN AN ATOM – ELECTRONIC CONFIGURATION

The maximum number of electrons can be obtained by $2n^2$; where 'n'is the orbit number. Thus after knowing the maximum number of electrons for a particular shell, the arrangement of electrons in an atom can be identified. It is called Bohr Bury Schemes.

Rules to write the electronic configuration of an atom

(a) Maximum number of electrons in an orbit is calculated by $2n^2$, where 'n' is number of orbit and may be equal to 1, 2, 3 , ...
(b) Electrons occupy the next orbit only after filling the inner orbit completely.
(c) The maximum number of electrons in outermost orbit will not be more than 8.

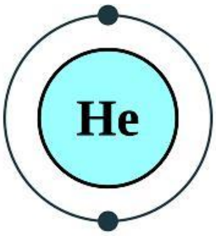
Electronic configuration of Hydrogen

Atomic number of hydrogen = 1
Therefore number of electrons = 1
Maximum number of electrons in 1st orbit = 2
Since, hydrogen has only one electron, therefore, it will reside in 1st orbit.
Thus electronic configuration of hydrogen

Number of orbit present in hydrogen = 1

Electronic configuration of Helium

Atomic number of helium = 2
Therefore number of electrons = 2
Therefore, electronic configuration of helium is

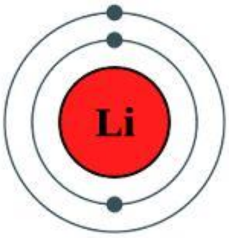


Number of orbit in helium atom = 1

Electronic configuration of Lithium

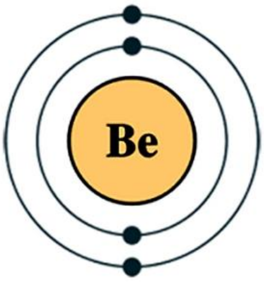
Atomic number of Lithium = 3

Therefore number of electrons = 3
Since the maximum number of electrons in 1st orbit is equal to 2, therefore, after accommodating 2 electrons in 1st orbit, the third electron will go in 2nd orbit.
Thus, electronic configuration of lithium is



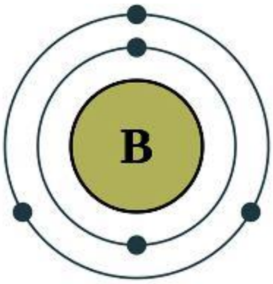
Number of orbit in Lithium atom = 3.

Electronic configuration of Beryllium
Atomic number of beryllium = 4.
Therefore number of electrons = 4.
Thus, electronic configuration of Beryllium is



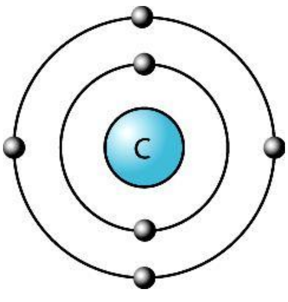
Number of orbit in beryllium = 2

Electronic configuration of Boron
Atomic number of boron = 5
Therefore number of electrons = 5
Thus, electronic configuration of boron is



Number of orbit in boron = 2

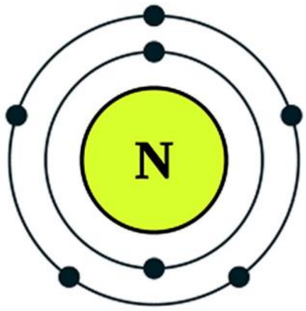
Electronic configuration of Carbon
Atomic number of carbon = 6
Therefore number of electrons = 6
Thus, electronic configuration of carbon is



Number of orbit in carbon = 2

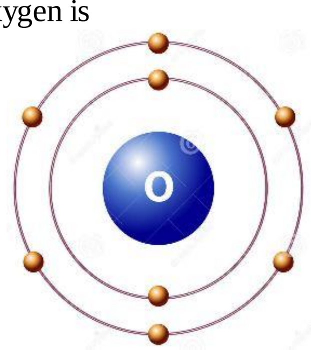
ELECTRONIC CONFIGURATION OF ELEMENTS – FROM NITROGEN (N) TO SODIUM (NA)

Electronic configuration of Nitrogen
Atomic number of nitrogen = 7.
Therefore number of electrons = 7
Thus, electronic configuration of nitrogen is



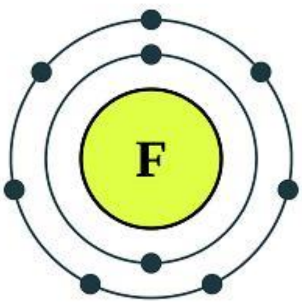
Number of orbit in nitrogen = 2

Electronic configuration of Oxygen
Atomic number of oxygen = 8.
Therefore number of electrons = 8.
Thus, electronic configuration of oxygen is



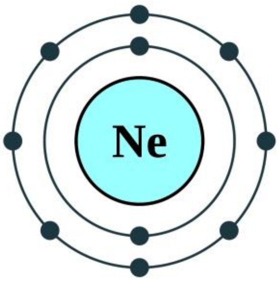
Number of orbit in oxgyen = 2

Electronic configuration of Fluorine
Atomic number of fluorine = 9
Therefore number of electrons = 9
Thus, electronic configuration of fluorine is



Number of orbit in fluorine = 2

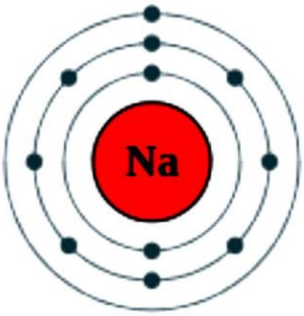
Electronic configuration of Neon
Atomic number of neon = 10
Therefore number of electrons = 10
Thus, electronic configuration of neon is



Number of orbit in Neon = 2

Electronic configuration of Sodium

Atomic number of sodium = 11
Therefore number of electrons = 11
Since, in 2nd orbit the maximum number of electrons is equal to 8 and there are 11 electrons in sodium atom, thus the eleventh electron will go in third orbit.
Thus, electronic configuration of sodium is

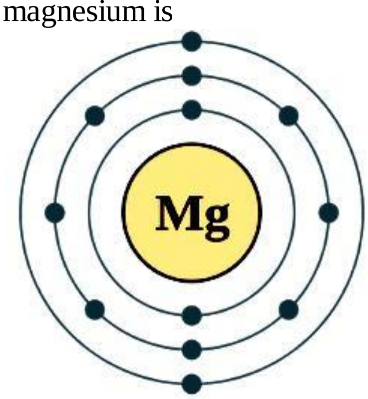


Number of orbit in sodium = 3

ELECTRONIC CONFIGURATION OF ELEMENTS – FROM MAGNESIUM TO CALCIUM

Electronic configuration of Magnesium

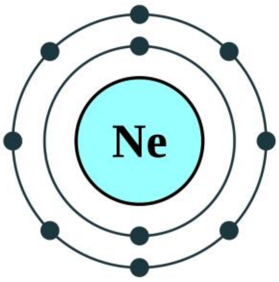
Atomic number of magnesium = 12
Therefore number of electrons = 12
Thus, electronic configuration of magnesium is



Number of orbit in magnesium = 3.

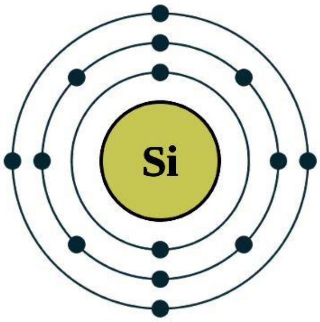
Electronic configuration of Aluminium

Atomic number of aluminium = 13.
Therefore number of electrons = 13.
Thus, electronic configuration of aluminium is



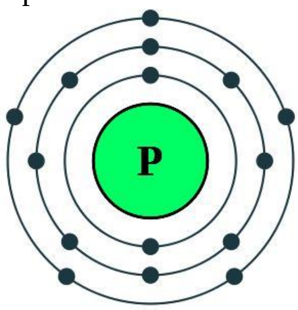
Number of orbit in aluminium = 3

Electronic configuration of Silicon
Atomic number of silicon = 14
Therefore number of electrons = 14
Thus, electronic configuration of silicon is



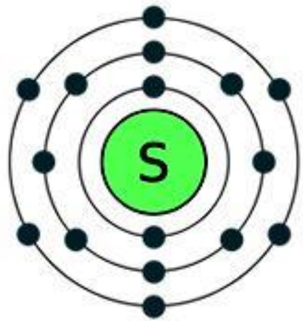
Number of orbit in silicon = 3

Electronic configuration of Phosphorous (P)
Atomic number of phosphorous = 15
Therefore number of electrons = 15
Thus, electronic configuration of phosphorous is



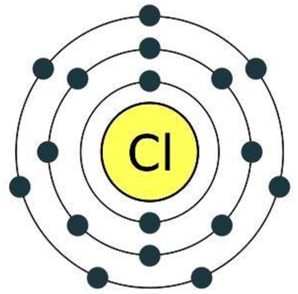
Number of orbit in phosphorous = 3

Electronic configuration of Sulphur (S)
Atomic number of sulphur = 16
Therefore number of electrons = 15
Thus, electronic configuration of sulphur is



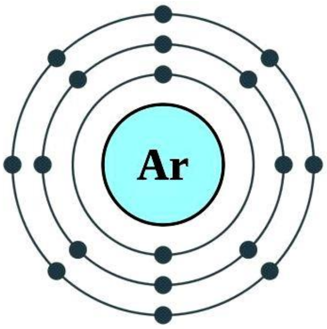
Number of orbit in sulphur = 3

Electronic configuration of Chlorine (Cl)
Atomic number of chlorine = 17
Therefore number of electrons = 17
Thus, electronic configuration of chlorine is



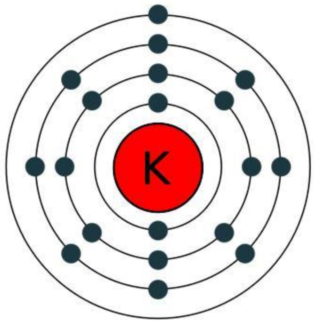
Number of orbit in chlorine = 3

Electronic configuration of Argon (Ar)
Atomic number of argon = 18
Therefore number of electrons = 18
Thus, electronic configuration of argon is



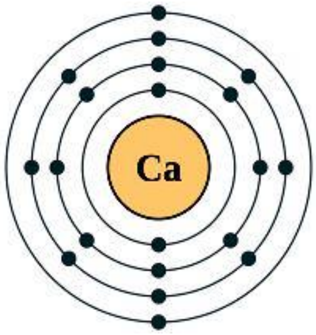
Number of orbit in argon = 3

Electronic configuration of Potassium (K)
Atomic number of potassium = 19
Therefore number of electrons = 19
Since, maximum number of electrons in outermost orbit will not be more than 8, thus the 19^{th} electron of potassium atom will reside in 4^{th} orbit.
Thus, electronic configuration of potassium is

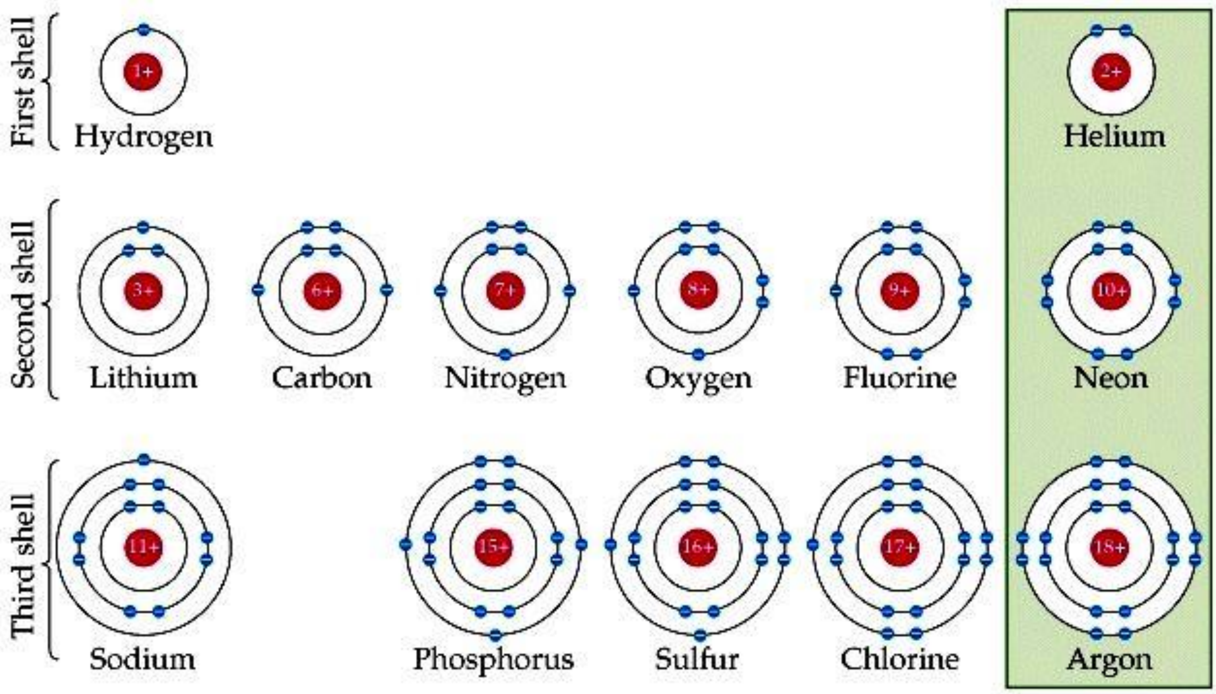


Number of orbit in potassium = 4

Electronic configuration of Calcium (Ca)
Atomic number of calcium = 20
Therefore number of electrons = 20
Thus, electronic configuration of calcium is



Number of orbit in calcium = 4



INTEXT QUESTIONS PAGE NO. 50

Q1. Write the distribution of electrons in carbon and sodium atoms.

Answer:

Carbon: The total number of electrons in a carbon atom is 6. The distribution of electrons in carbon atom is given by:
First orbit or K-shell = 2 electrons
Second orbit or L-shell = 4 electrons
Or, we can write the distribution of electrons in a carbon atom as 2, 4.

Sodium: The total number of electrons in a sodium atom is 11. The distribution of electrons in sodium atom is given by:
First orbit or K-shell = 2 electrons
Second orbit or L-shell = 8 electrons
Third orbit or M-shell = 1 electron
Or, we can write distribution of electrons in a sodium atom as 2, 8, 1.

Q2. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

Answer:

The maximum capacity of K shell is 2 electrons and L shell can accommodate maximum 8 electrons in it. Therefore, there will be ten electrons in the atom.

VALENCY

Noble gases have fully filled outermost shell. Due to this, they are stable and they do not react with other elements. Other elements also tend to attain stable configuration by completing the octet in their outermost orbit. This is important to note that, the number of electrons in the outermost orbit of an element is closer to octet. An element can lose or gain electron in order to complete the octet. This tendency of losing or gaining electrons imparts valency to an element.
Let us take example of hydrogen. Hydrogen can readily lose or gain an electron. So, its valency is one. Now, let us take example of Hydrochloric Acid (HCl). One atom of chlorine combines with one atom of hydrogen to form hydrochloric acid. In this case, hydrogen loses one electron and thus gets +1 charge. On the other hand, chlorine gains an electron and thus gets – 1 charge. So, valency of hydrogen and chlorine are one.

Valency can be defined as combining capacity of an atom.

Example :
Hydrogen molecule - Hydrogen has only one electron in its outermost orbit, thus it requires one more electrons to complete its outermost orbit. Therefore, in order to complete outermost orbit, hydrogen shares one electron with another hydrogen atom and form H_2 (hydrogen molecule).
In the case of LiCl (Lithium chloride) - Lithium has three electrons in its outermost orbit and chlorine has seven electrons in its outermost orbit. Thus in order to make outermost orbit completely filled lithium loses one electrons and chlorine gains one electron. After losing one electron, lithium has two electrons in its outermost orbit and after gaining one electron, chlorine has eight electrons in its outermost orbit. And they form LiCl (Lithium chloride)

Name, Symbol, Atomic number, Number of electrons, Distribution of electrons in shells (electronic configuration) and Valency of some elements (From Hydrogen to Calcium)

Elements	Symbol	Atomic Number	No. of electron	Distribution of electron K	L	M	N	Valency
Hydrogen	H	1	1	1				1
Helium	He	2	2	2				0
Lithium	Li	3	3	2	1			1
Beryllium	Be	4	4	2	2			2
Boron	B	5	5	2	3			3
Carbon	C	6	6	2	4			4
Nitrogen	N	7	7	2	5			3
Oxygen	O	8	8	2	6			2
Fluorine	F	9	9	2	7			1
Neon	Ne	10	10	2	8			0
Sodium	Na	11	11	2	8	1		1
Magnesium	Mg	12	12	2	8	2		2
Aluminium	Al	13	13	2	8	3		3
Silicon	Si	14	14	2	8	4		4
Phosphorous	P	15	15	2	8	5		3
Sulphur	S	16	16	2	8	6		2
Chlorine	Cl	17	17	2	8	7		1
Argon	Ar	18	18	2	8	8		0
Potassium	K	19	19	2	8	8	1	1
Calcium	Ca	20	20	2	8	8	2	2

INTEXT QUESTIONS PAGE NO. 52

Q1. How will you find the valency of chlorine, sulphur and magnesium?
Answer:
If the number of electrons in the outermost shell of the atom of an element is less than or equal to 4, then the valency of the element is equal to the number of electrons in the outermost shell. On the other hand, if the number of electrons in the outermost shell of the atom of an element is greater than 4, then the valency of that element is determined by subtracting the number of electrons in the outermost shell from 8.

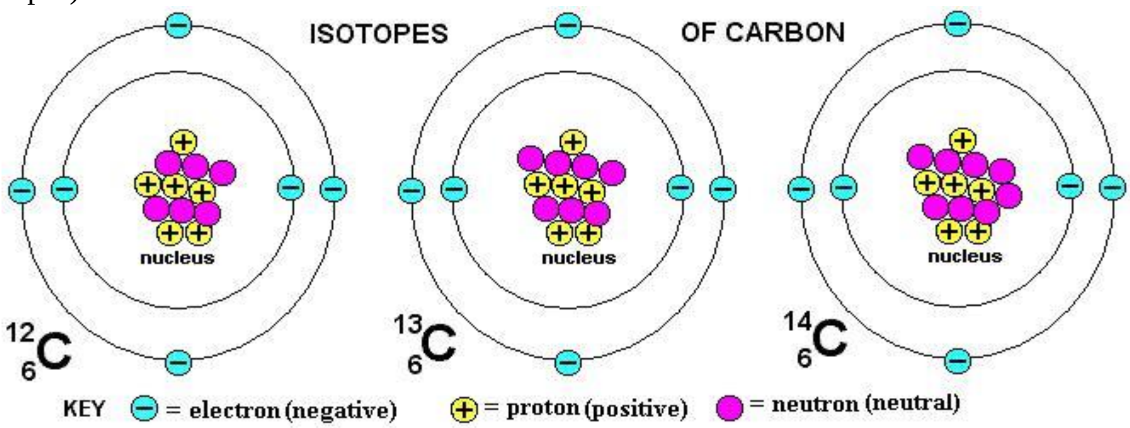
The distribution of electrons in chlorine, sulphur, and magnesium atoms are 2, 8, 7; 2, 8, 6 and 2, 8, 2 respectively.

Therefore, the number of electrons in the outer most shell of chlorine, sulphur, and magnesium atoms are 7, 6, and 2 respectively.
Thus, the valency of chlorine = 8 −7 = 1
The valency of sulphur = 8 − 6 = 2
The valency of magnesium = 2

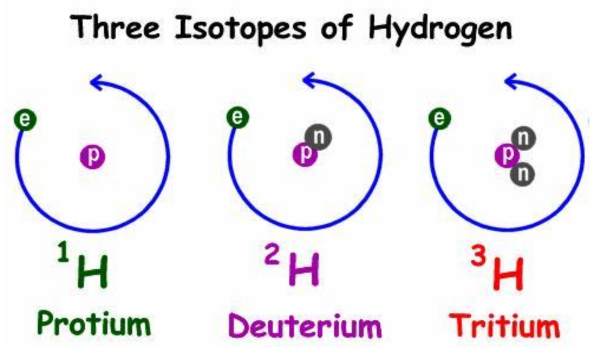
INTEXT QUESTIONS PAGE NO. 52
Q1. If number of electrons in an atom is 8 and number of protons is also 8, then (i) what is the atomic number of the atom? and (ii) what is the charge on the atom?
Answer:
(i) The atomic number is equal to the number of protons. Therefore, the atomic number of the atom is 8.
(ii) Since the number of both electrons and protons is equal, therefore, the charge on the atom is 0.

Q2. With the help of Table 4.1, find out the mass number of oxygen and sulphur atom.
Answer:
Mass number of oxygen = Number of protons + Number of neutrons = 8 + 8 = 16
Mass number of sulphur = Number of protons + Number of neutrons = 16 +16 = 32

ISOTOPES
Elements having same atomic number but different atomic masses are known as Isotopes.
Example –
Carbon-12, Carbon-13, Carbon-14 are thee isotopes of carbon atom. Here 12, 13 and 14 are the atomic masses of isotopes of carbon respectively. Since, atomic number is the unique property of an atom, thus the atomic number of carbon is 6 even in the case of three types of carbon (isotopes)



Hydrogen -1 , Deuterium – 2, Tritium -3 are three isotopes of hydrogen.
The isotopes of hydrogen are written as:



Use of Isotopes:
Carbon – 14 is used in carbon dating.
An isotope of uranium is used as fuel in nuclear reactor.
An isotope of cobalt is used in treatment of cancer.
An isotope of iodine is used in treatment of goitre.

ISOBARS

Atoms having same atomic mass and different atomic numbers are known as Isobars.

Example – ${}^{40}_{18}Ar$ (argon) and ${}^{40}_{20}Ca$ (calcium)
Both the elements have same atomic mass equal to 40 but different atomic numbers, i.e. argon has atomic number equal to 18 and calcium has atomic number equal to 20.

INTEXT QUESTIONS PAGE NO. 53

Q1. For the symbol H,D and T tabulate three sub-atomic particles found in each of them.
Answer:

Symbol	Proton	Neutron	Electron
H	1	0	1
D	1	1	1
T	1	2	1

Q2. Write the electronic configuration of any one pair of isotopes and isobars.
Answer:
${}^{12}C_6$ and ${}^{14}C_6$ are isotopes, have the same electronic configuration as (2, 4).
${}^{22}Ne_{10}$ and ${}^{22}Ne_{11}$ are isobars. They have different electronic configuration as given below:
${}^{22}Ne_{10}$ – 2, 8
${}^{22}Ne_{11}$ – 2, 8, 1

EXERCISE QUESTIONS PAGE NO. 55, 56

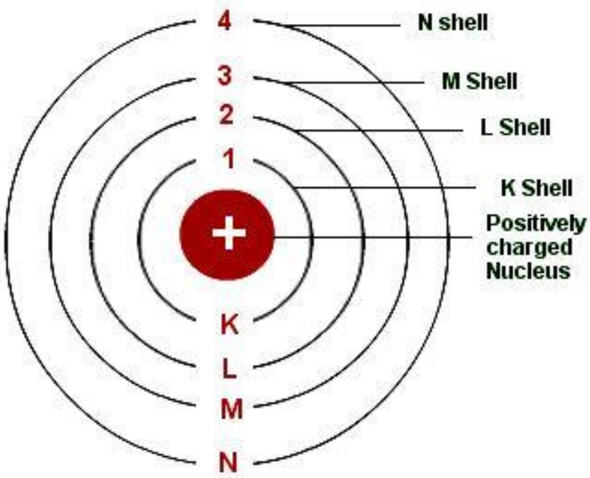
Q1. Compare the properties of electrons, protons and neutrons.
Answer:

Particle	Nature of Charge	Mass	Location
Electron	Electrons are negatively charged.	9 x 10^{-31} kg	Extra nuclear part distributed in different shell or orbits.
Proton	Protons are positively charged.	1.672 x 10^{-27} kg (1 μ) (approx. 2000 times that of the electron)	Nucleus
Neutron	Neutrons are neutral.	Equal to mass of proton	Nucleus

Q2. What are the limitations of J.J. Thomson's model of the atom?
Answer:
The limitations of J.J. Thomson's model of the atom are:
→ It could not explain the result of scattering experiment performed by rutherford.
→ It did not have any experiment support.

Q3. What are the limitations of Rutherford's model of the atom?
Answer:
The limitations of Rutherford's model of the atom are
→ It failed to explain the stability of an atom.
→ It doesn't explain the spectrum of hydrogen and other atoms.

Q4. Describe Bohr's model of the atom.
Answer:
→ The atom consists of a small positively charged nucleus at its center.
→ The whole mass of the atom is concentrated at the nucleus and the volume of the nucleus is much smaller than the volume of the atom.
→ All the protons and neutrons of the atom are contained in the nucleus.
→ Only certain orbits known as discrete orbits of electrons are allowed inside the atom.
→ While revolving in these discrete orbits electrons do not radiate energy. These orbits or cells are represented by the letters K, L, M, N etc. or the numbers, n = 1, 2, 3, 4, . . as shown in below figure.



Q5. Compare all the proposed models of an atom given in this chapter.
Answer:

Thomson's model	Rutherford's model	Bohr's model
→ An atom consists of a positively charged sphere and the electrons are embedded in it. → The negative and positive charges are equal in magnitude. As a result the atom is electrically neutral.	→ An atom consists of a positively charged center in the atom called the nucleus. The mass of the atom is contributed mainly by the nucleus. → The size of the nucleus is very small as compared to the size of the atom. → The electrons revolve around the nucleus in well-defined orbits.	→ Bohr agreed with almost all points as said by Rutherford except regarding the revolution of electrons for which he added that there are only certain orbits known as discrete orbits inside the atom in which electrons revolve around the nucleus. → While revolving in its discrete orbits the electrons do not radiate energy.

Q6. Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.
Answer:
The rules for writing of the distribution of electrons in various shells for the first eighteen elements are given below.
→ If n gives the number of orbit or energy level, then $2n^2$ gives the maximum number of electrons possible in a given orbit or energy level. Thus,
First orbit or K-shell will have 2 electrons,
Second orbit or L-shell will have 8 electrons,
Third orbit or M-shell will have 18 electrons.
→ If it is the outermost orbit, then it should have not more than 8 electrons.
→ There should be step-wise filling of electrons in different orbits, i.e., electrons are not accompanied in a given orbit if the earlier orbits or shells are incompletely filled.

Q7. Define valency by taking examples of silicon and oxygen.
Answer:
The valency of an element is the combining capacity of that element. The valency of an element is determined by the number of valence electrons present in the atom of that element.
→ Valency of Silicon: It has electronic configuration: 2,8,4
Thus, the valency of silicon is 4 as these electrons can be shared with others to complete octet.
→ Valency of Oxygen: It has electronic configuration: 2,6
Thus, the valency of oxygen is 2 as it will gain 2 electrons to complete its octet.

Q8. Explain with examples (i) Atomic number, (ii) Mass number, (iii) Isotopes and iv) Isobars. Give any two uses of isotopes.
Answer:
(i) Atomic number
The atomic number of an element is the total number of protons present in the atom of that element. For example, nitrogen has 7 protons in its atom. Thus, the atomic number of nitrogen is 7.
(ii) Mass number
The mass number of an element is the sum of the number of protons and neutrons present in the atom of that element. For example, the atom of boron has 5 protons and 6 neutrons. So, the mass number of boron is 5 + 6 = 11.

(iii) Isotopes

Isotopes are atoms of the same element having the same atomic number, but different mass numbers. For example, hydrogen has three isotopes. They are protium ($^{1}_{1}H$), deuterium ($^{2}_{1}H$) and tritium ($^{3}_{1}H$).

(iv) Isobars

Isobars are atoms having the same mass number, but different atomic numbers i.e., isobars are atoms of different elements having the same mass number. For example, $^{40}_{20}Ca$ and $^{40}_{18}Ar$ are isobars.

Two uses of isotopes are:

(i) One isotope of uranium is used as a fuel in nuclear reactors.

(ii) One isotope of cobalt is used in the treatment of cancer.

Q9. Na^{+} has completely filled K and L shells. Explain.

Answer:

An atom of Na has a total of 11 electrons. Its electronic configuration is 2, 8, 1. But, Na+ ion has one electron less than Na atom i.e., it has 10 electrons. Therefore, 2 electrons go to K-shell and 8 electrons go to L-shell, thereby completely filling K and L shells.

Q10. If bromine atom is available in the form of, say, two isotopes $^{79}_{35}Br$ (49.7%) and $^{81}_{35}Br$ (50.3%), calculate the average atomic mass of bromine atom.

Answer:

It is given that two isotopes of bromine are $^{79}_{35}Br$ (49.7%) and $^{81}_{35}Br$ (50.3%). Then, the average atomic mass of bromine atom is given by:

$$79\times\frac{49.7}{100}+81\times\frac{50.3}{100}=\frac{3926.3}{100}+\frac{4074.3}{100}$$

$$=\frac{8000.6}{100}=80.006u=80u(approx)$$

Q11. The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes $^{16}_{8}X$ and $^{18}_{8}X$ in the sample?

Answer:

It is given that the average atomic mass of the sample of element X is 16.2 u.

Let the percentage of isotope $^{18}_{8}X$ be y%. Thus, the percentage of isotope $^{16}_{8}X$ will be (100 − y) %.

Therefore, $18\times\frac{y}{100}+16\times\frac{(100-y)}{100}=16.2$

$$\Rightarrow\frac{18y}{100}+\frac{16(100-y)}{100}=16.2$$

$$\Rightarrow\frac{18y+16(100-y)}{100}=16.2\Rightarrow\frac{18y+1600-16y}{100}=16.2$$

$$\Rightarrow 18y+1600-16y=1620$$

$$\Rightarrow 2y+1600=1620$$

$$\Rightarrow 2y=1620-1600=20$$

$$\Rightarrow y=10$$

Therefore, the percentage of isotope $^{18}_{8}X$ is 10%.

And, the percentage of isotope $^{16}_{8}X$ is (100 − 10) % = 90%.

Q12. If Z = 3, what would be the valency of the element? Also, name the element.
Answer:
By Z = 3, we mean that the atomic number of the element is 3. Its electronic configuration is 2, 1. Hence, the valency of the element is 1 (since the outermost shell has only one electron). Therefore, the element with Z = 3 is lithium.

Q13. Composition of the nuclei of two atomic species X and Y are given as under

	X	Y
Protons =	**6**	**6**
Neutrons =	**6**	**8**

Give the mass numbers of X and Y. What is the relation between the two species?
Answer:
Mass number of X = Number of protons + Number of neutrons = 6 + 6 = 12
Mass number of Y = Number of protons + Number of neutrons = 6 + 8 = 14
These two atomic species X and Y have the same atomic number, but different mass numbers. Hence, they are isotopes.

Q14. For the following statements, write T for True and F for False.
(a) J.J. Thomson proposed that the nucleus of an atom contains only nucleons.
(b) A neutron is formed by an electron and a proton combining together. Therefore, it is neutral.
(c) The mass of an electron is about $\frac{1}{2000}$ **times that of proton.**
(d) An isotope of iodine is used for making tincture iodine, which is used as a medicine.

Answer:
(a) False (b) False (c) True (d) False

Put tick (√) against correct choice and cross (X) against wrong choice in questions Q15, Q16 and Q17
Q15. Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) Atomic Nucleus (b) Electron
(c) Proton (d) Neutron
Answer: (a) Atomic nucleus

Q16. Isotopes of an element have
(a) the same physical properties
(b) different chemical properties
(c) different number of neutrons
(d) different atomic numbers.
Answer: (c) different number of neutrons

Q17. Number of valence electrons in Cl^- ion are:
(a) 16 (b) 8 (c) 17 (d) 18
Answer: (b) 8

Q18. Which one of the following is a correct electronic configuration of sodium?
(a) 2,8 (b) 8,2,1 (c) 2,1,8 (d) 2,8,1.
Answer: (d) 2, 8, 1

Q19. Complete the following table.

Atomic number	Mass number	No. of neutrons	No. of Protons	No. of electrons	Name of the Atomic Species
9		10			
16	32				Sulphur
	24		12		
	2		1		
	1	0	1	0	

Answer:

Atomic number	Mass number	No. of neutrons	No. of Protons	No. of electrons	Name of the Atomic Species
9	**19**	10	**9**	**9**	**Fluorine**
16	32	**16**	**16**	**16**	Sulphur
12	24	**12**	12	**12**	**Magnesium**
1	2	**1**	1	**1**	**Deuterium**
1	1	0	1	0	**Hydrogen ion**

ASSIGNMENT QUESTIONS SET – 1

CHAPTER – 4

STRUCTURE OF ATOMS

1. Plum pudding Model of atom was discovered by _______________

2. Combining capacity of an atom is called _______________

3. Alpha - particle scattering experiment of Rutherford led to discovery of _________

4. Number of neutrons in $^{81}_{35}Br$ is _____________

5. __________ are atoms having the same mass number but different atomic number.

6. The charge on the electron is found to be ________ coulombs.

7. The electronic configuration of silicon is ___. (Atomic number = 14)

8. _____ electrons are responsible for the chemical properties of an atom.

9. Rutherford's model of an atom was modified by _______.

10. ____ is an isotope of carbon used in determining the age of dead plants.

11. An atom with 3 protons and 4 neutrons will have a valency of _________.

12. What do you understand by valency of an element? What is valency of boron?

13. List the features of Rutherford's nuclear model of atom.

14. What are the postulates of Bohr Model of an atom?

15. Define Valency. What is the valency of chlorine, sulphur and magnesium?

16. Cl^- has completely filled K&L shells. Explain.

17. Na^+ is possible but Cl^+ is not possible. What is the reason?

18. What are isotopes? Give two examples .

19. What were the observations of Rutherford's Alpha particles scattering experiment?

20. What are the drawbacks of Rutherford's model of atom?

21. From what observations do you derive the following inferences?

(i) The most of the space inside the atom is empty.

(ii) The volume of the nucleus is very small.

(iii) Anode rays consist of positively charged particles.

22. Name the fundamental particle not present in the nucleus of hydrogen atom

23. Who discovered electrons?

24. Who discovered protons?

25. Who discovered neutrons?

26. Who discovered nucleus of an atom?

27. What are canal rays?

28. What are the properties of anode rays?

29. What are cathode rays?

30. Who discovered X-Rays?

31. If an atom contains one electron and one proton, will it carry any charge or not?

32. Complete the following table.

Particle	Electron	Proton	Neutron
(i) Symbol	________	________	________
(ii) Nature	________	________	________
(iii) Relative Charge	_______		
(iv) Absolute Charge	_______		
(v) Relative Mass	_______		
(vi) Absolute Mass	_______		

33. What is the mass of proton as compared to electron?

34. Describe briefly Thomson's model of an atom.

35. Write the limitations of J.J. Thomson's model of an atom.

36. What are α-particles?

37. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

38. Who is known as 'Father of Nucleus Physics'?

39. What were the observations of Rutherford's α-scattering experiment?

40. What were the important features of atomic model based on Rutherford's scattering experiment?

41. What are the limitations of Rutherford's model of the atom?

42. Draw a sketch of Bohr's model of an atom with three shells.

43. Describe Bohr's model of the atom.

44. What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?

45. Write a short note on Nucleus.

46. What is Atomic Number? Who coined this term?

47. What is mass number?

48. If A = 23 and Z = 11 for Na atom, how many protons, electrons and neutrons present in Na atom?

49. What is ionization energy?

50. In a sample of ethyl ethanoate ($CH_3COOC_2H_5$) the two oxygen atoms have the same number of electrons but different number of neutrons. What can be the reason for it?

51. In the atom of element X, 6 electrons are present in the outermost shell. If it requires an octet configuration by accepting requisite number of electrons, then what would be the charge on the ion so formed?

52. Why do helium, neon & argon have a zero valency?

53. Write the atomic number and the symbol of an element which has mass number 32 and the number of neutrons 16 in the nucleus.

54. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

55. If number of electrons in an atom is 8 and number of protons is also 8,then (i) what is the atomic number of the atom? (ii) what is the charge on the atom?

56. What are the limitations of J. J. Thomson's model of the atom?

57. Why was Thomson's model of atom discarded and replaced by Rutherford's model? Why is Rutherford's model also called the nuclear model of atom

58. The average atomic mass of a sample of an element X is 16.2u. What are the percentage of isotopes ${}^{16}_{8}X$ *and* ${}^{18}_{8}X$ in the sample?

59. What are the salient feautres of Bohr's Atomic Model? How is it advantageous over Rutherford's Nuclear Model?

60. What is the charge and mass of the anode rays emitted when, hydrogen gas is enclosed in the discharge tube experiment? What is the name of these particles?

61. Do the anode rays always consist of protons whatever be the gas enclosed in the discharge tube? Explain.

62. What is the other name of X-rays?

63. How are x-rays produced? Why was this name given?

64. How are x-rays made tools in diagnostic purposes in the medical field?

65. What is phosphorescence? How does it differ from fluorescence?

66. Who discovered the nuclear model of the atom?

67. Explain how Rutherford’s atomic structure cannot explain the stability of atom?

68. Explain how Bohr’s atomic model explains the emission and absorption of radiation.

69. What is the charge and mass of a β-particle? From which part of the atom are β-particles emitted?

70. The two elements, A and B have 17 electrons each in their atom. Element A has 35 nucleons while element B has 33 nucleons (nucleons are the total number of protons and neutrons in the nucleus). What is the relationship between these two elements? Explain. The element A reacts with hydrogen in diffused light. Does the element B also react with hydrogen?

71. One isotope of carbon with atomic mass 12, occupies group 14 in the 2nd period in the long form periodic Table. Predict the position of another radioactive isotope of carbon with atomic mass 14?

72. What is the name given to the rays, traveling from cathode to anode?

73. Do the cathode rays always consist of electrons only, whatever be the gas enclosed in the discourage tube?

74. Why are electrons in the outermost shell known as valence electrons?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 4
STRUCTURE OF ATOMS

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 (α) particles scattering experiment' resulted in to discovery of

(a) Electron (b) Proton (c) Nucleus in the atom (d) Atomic mass

3. 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

4. Elements with valency 1 are

(a) Always metals (b) always metalloids

(c) either metals or non-metals (d) always non-metals

5. The first model of an atom was given by

(a) N. Bohr (b) E. Goldstein

(c) Rutherford (d) J.J. Thomson

6. Is it possible for the atom of an element to have one electron, one proton and no neutron? If so, name the element.

7. Why did Rutherford select a gold foil in his α–ray scattering experiment?

8. Will Cl-35 and Cl-37 have different valences?

9. Calculate the number of neutrons present in the nucleus of an element X which is represented as 31 X15 .

10. The atomic number of calcium and argon are 20 and 18 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements?

11. Why do Helium, Neon and Argon have a zero valency?

12. In what way the Rutherford proposed atomic model?

13. In what way the Thomson proposed atomic model?

14. What were the drawbacks of Rutherford's model of an atom?

15. What are the limitations of J.J. Thomson's model of an atom?

16. In television picture tube which type of rays are used?

17. Which is heavier, neutron or proton?

18. If electrons move from K to L shell, will the energy be absorbed or evolved?

19. Helium atom has an atomic mass of 4u and two protons in its nucleus. How many neutrons does it have?

20. An ion X^{2+} contains 18 electrons and 20 neutrons. Calculate the atomic number and mass no. of element X. Name the element X.

21. Give one Achievement and one limitation of J.J Thomson's model of atom?

22. In a given electric field, β- particles are deflected more than α- particles inspite of the fact that α - particles have larger charge, why?

23. What are valence electrons? What is their significance?

24. What would be the observation if the α - particle scattering experiment is carried out using a foil of a metal other than gold?

25. Electronic configuration of Potassium is 2,8,8,1 and Calcium 2,8,8,2, when M shell can have maximum of 18 electrons then why next element Scandium has electronic configuration 2,8,9,2 and not 2,8,8,3 ?

26. What are isotopes and Isobars? What are two isotopes of chlorine? Calculate the average atomic mass of a chlorine atom?

27. What is present concept of an atom? Explain in detail? Why this model is considered to be the most appropriate model?

28. Explain the Rutherford's alpha particle scattering experiment. What were the main conclusions drawn from this experiment?

29. A naturally occurring sample of :-

(i) 69.2% of 53Cu& 30.8% of 65Cu. Find the average atomic mass of a naturally occuring sample of copper.

(ii)7.42% of 6Li & 92.58% of 7Li.Find the average atomic mass of a naturally occuring sample of Lithium.

30. Calculate the no. of atoms of each element persent in 9.8 g of sulphuric acid, H_2SO_4. (H=1, S=32, O=16)

31. How to calculate the atomicity and the atomic mass of an atom?

32. To weight $BaCl_2$ or Na_2SO_4

a) use a polythene bags and spring balance

b) use a watch glass and spring balance

c) use a polythene bags and physical balance

d) use a watch glass and physical balance

33. To weight sodium sulphate or barium chloride it should be in form of

a) saturated solution b) large crystals c) small crystals d) fine powder

34. What is the distribution of electrons in an atom of Phosphorus and how can it have two valencies

35. The maximum no. of electrons present in shell is given by the formula 2n2and the maximum no. of electrons filled in M shell is 18. But in the element calcium we only fill 8 electrons in the M shell and move on to the N shell. why ?

36. What are alpha particles?

37. Write ddifference between atomic mass and mass number?

38. An ion (M^{2+}) contain 10 electrons and 12 neutrons what is the atomic number and mass number of the element M.

39. An ion M^{3+} contains 10 electrons and 14 neutrons. What are the atomic mass and mass number of the element M ? Name the element.

40. 10 gm of silver nitrate solution is added to 10 gm of sodium chloride solution. What change in mass do you expect after the reaction and why?

41. Write the atomicity of the following molecules: (i) H_2SO_4 (ii) CCl_4

42. Define the term mole.

43. What is the law of constant proportions?

44. What is molar mass? What are its units?

45. Define atomicity.

46. Calculate the formula unit mass of Na_2CO_3.
[Atomic mass of Na = 23 u, C = 12 u, O = 16 u]

47. Give the definition of a cation and an anion.

48. An element X has a valency 3. Write the formula of its oxide.

49. Calculate the number of moles is 52 g of He (Helium)

50. If 12 gm of carbon is burnt in the presence of 32 gm of oxygen, how much carbon dioxide will be formed ?

51. Calculate the number of moles in 17 gm of H_2O_2. (Atomic weight of H = 1 u, O = 16 u).

52. Define and explain atomic mass of an element.

53. If one mole of carbon atoms weighs 12 g. What is the mass of 1 atom of carbon ?

54. Calculate the mass of 1 molecule of oxygen gas.

55. The mass of single atom of an element is 2.65×10^{-23} g. Calculate its atomic mass. [NA = 6.022×10^{23} mol^{-1}]

56. Calculate percentage composition of glucose ($C_6H_{12}O_6$).

57. John placed 10 moles of sulphur molecules (S_8) and 5 moles of glucose ($C_6H_{12}O_6$) in the two different pans of a physical balance. Find which pan of the balance would be heavier, support your answer with calculations.
(atomic mass : O = 16 u, C = 12 u, H = 1 u, S = 32 u)

58. What is Avogadro constant ?

59. Calculate the number of particles present in 56 gm of N_2 molecule.

60. Calculate the number of moles present in (a) 60 g of calcium. (b) 3.011 × 1023 number of oxygen atoms.
[Given that Ca = 40u; Avogadro number, NA = 6.022×10^{23} per mole]

61. Give an account of the ‘mole concept’.

62. Calculate the ratio by number of atoms for Magnesium sulphide.

63. (a) The average atomic mass of a sample of an element X is 35.5u. What are the percentages of isotopes $^{37}_{17}X$ *and* $^{35}_{17}X$ in the sample ?
(b) Write any two applications of isotopes.

64. Nitu presented a silver lamp to her mother on her birthday. The lamp contained 3.011×10^{23} atoms of silver in it. What is the mass of silver lamp and the cost of it if 1 gm silver costs Rs 60. Atomic mass of Ag = 108 u, $N_0 = 6.022 \times 10^{23}$ per mole.

65. Verify by calculating that 5 mole of CO2 and 5 mole of H_2S do not have the same mass. (Atomic mass of C = 12 u, O = 16 u, H = 1 u, S = 32 u)

66. A solution is made by dissolving sodium chloride in water and its concentration is expressed as 0.9% by mass. Calculate : (i) the number of moles, and (ii) number of molecules present in NaCl for this solution.

[Given : mass % = (Mass of solute×100)/ Mass of solution]

(Atomic mass of Na = 23.0 u, Cl = 35.5 u)

67. (i) What do the following symbols / formulae stand for :

(a) 2O (b) O_2 (c) O_3 (d) H_2O

(ii) Give the chemical formula of the following compounds :

(a) Potassium carbonate (b) Calcium chloride (iii)

Calculate the formula unit mass of $Al_2(SO_4)_3$. (Given :

Atomic mass of Al = 27 u, S = 32 u, O = 16 u)

68. An element ${}^{14}_{7}A$ exists as diatomic gas in nature which is relatively inert and forms 78% of earth's atmosphere.

(a) Identify the gas and write its molecular formula. Write the formulae of its nitrite and nitrate ions.

(b) How many moles of this gas would contain 12.044×10^{23} atoms of this element ?

(Avogadro's no. = 6.022×10^{23})

(c) Calculate the molecular mass of (a) $NH_4\ NO_3$ and (b) HNO_3

(Given atomic masses N = 14 u, O = 16 u, H = 1u)

69. (a) In ammonia, nitrogen and hydrogen are always present in the ratio 14 : 3 by mass. State the law which explains the above statement.

(b) During the formation of ammonia, what mass of hydrogen gas would be required to react completely with 42 g of nitrogen gas ?

70. (a) Calculate the number of moles in 112 g of iron.

(b) Calculate the mass of 0.5 moles of sugar ($C_{12}H_{22}O_{11}$).

(c) Define the term molecular mass.

(d) Determine the molecular mass of $ZnSO_4$.

[Atomic mass of Zn = 65 u, S = 32 u, O = 16 u]

(e) Calculate the number of molecules of carbon dioxide, present in 4.4 g of CO_2.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 4
STRUCTURE OF ATOMS

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 (α) 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?
$(a)^{31}_{15}X$ $(b)^{31}_{16}X$ $(c)^{16}_{15}X$ $(d)^{15}_{16}X$

4. Dalton's atomic theory successfully 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)

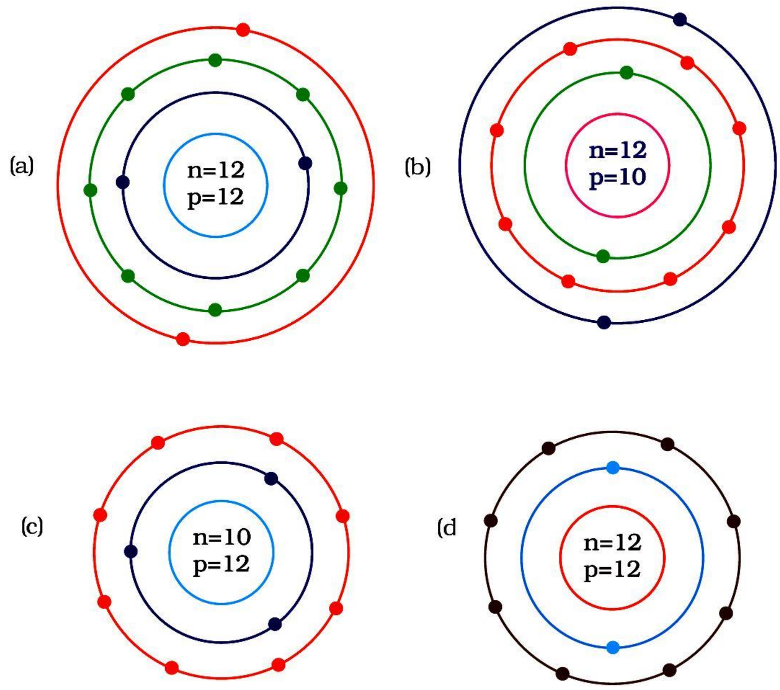
5. Which of the following statements about Rutherford's model of atom are correct?
(i) considered the nucleus as positively charged
(ii) established that the α–particles are four times as heavy as a hydrogen atom
(iii) can be compared to solar system
(iv) was in agreement with Thomson's model
(a) (i) and (iii)
(b) (ii) and (iii)
(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. In the Thomson's model of atom, which of the following statements are correct?
(i) the mass of the atom is assumed to be uniformly distributed over the atom
(ii) the positive charge is assumed to be uniformly distributed over the atom
(iii) the electrons are uniformly distributed in the positively charged sphere
(iv) the electrons attract each other to stabilise the atom
(a) (i), (ii) and (iii)
(b) (i) and (iii)
(c) (i) and (iv)
(d) (i), (iii) and (iv)

8. Rutherford's α –particle scattering experiment showed that
(i) electrons have negative charge
(ii) the mass and positive charge of the atom is concentrated in the nucleus
(iii) neutron exists in the nucleus
(iv) most of the space in atom is empty
Which of the above statements are correct?
(a) (i) and (iii)
(b) (ii) and (iv)
(c) (i) and (iv)
(d) (iii) and (iv)

9. Identify the Mg^{2+} ion from the Fig.4.1 where, n and p represent the number of neutrons and protons respectively



10. In a sample of ethyl ethanoate ($CH_3COOC_2H_5$) the two oxygen atoms have the same number of electrons but different number of neutrons. Which of the following is the correct reason for it?
(a) One of the oxygen atoms has gained electrons
(b) One of the oxygen atoms has gained two neutrons
(c) The two oxygen atoms are isotopes
(d) The two oxygen atoms are isobars.

11. 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

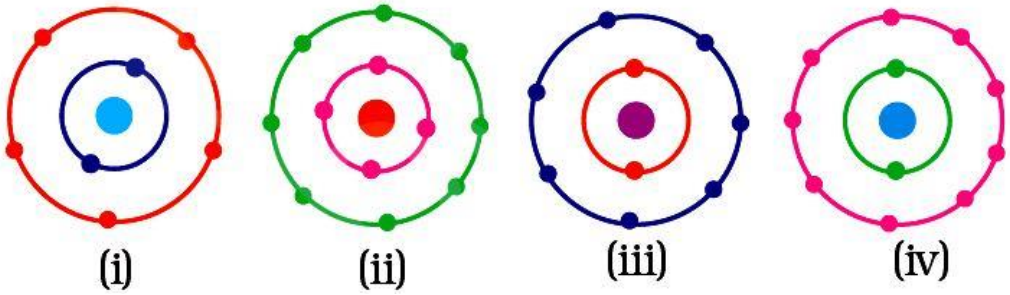
12. Elements with valency 1 are
(a) always metals
(b) always metalloids
(c) either metals or non-metals
(d) always non-metals

13. The first model of an atom was given by
(a) N. Bohr
(b) E. Goldstein
(c) Rutherford
(d) J.J. Thomson

14. An atom with 3 protons and 4 neutrons will have a valency of
(a) 3
(b) 7
(c) 1
(d) 4

15. The electron distribution in an aluminium atom is
(a) 2, 8, 3
(b) 2, 8, 2
(c) 8, 2, 3
(d) 2, 3, 8

16. Which of the following in Fig. 4.2 do not represent Bohr's model of an atom correctly?



(a) (i) and (ii)
(b) (ii) and (iii)
(c) (ii) and (iv)
(d) (i) and (iv)

17. Which of the following statement is always correct?
(a) An atom has equal number of electrons and protons.
(b) An atom has equal number of electrons and neutrons.
(c) An atom has equal number of protons and neutrons.
(d) An atom has equal number of electrons, protons and neutrons.

18. Atomic models have been improved over the years. Arrange the following atomic models in the order of their chronological order

(i) Rutherford's atomic model

(ii) Thomson's atomic model

(iii) Bohr's atomic model

(a) (i), (ii) and (iii)

(b) (ii), (iii) and (i)

(c) (ii), (i) and (iii)

(d) (iii), (ii) and (i)

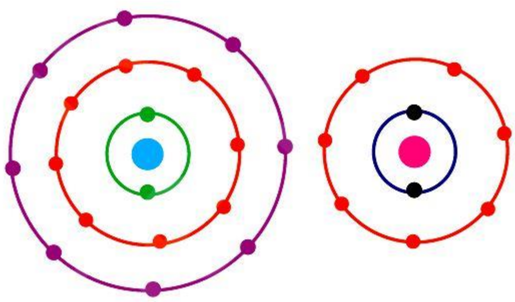
19. Is it possible for the atom of an element to have one electron, one proton and no neutron. If so, name the element.

20. Write any two observations which support the fact that atoms are divisible.

21. Will 35Cl and 37Cl have different valencies? Justify your answer.

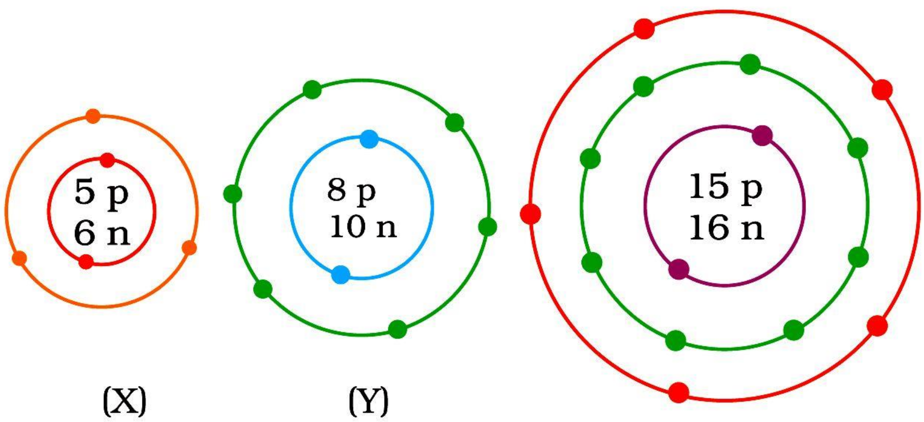
22. Why did Rutherford select a gold foil in his α –ray scattering experiment?

23. Find out the valency of the atoms represented by the Fig. 4.3 (a) and (b).



(a) (b)

24. What information do you get from the Fig. 4.4 about the atomic number, mass number and valency of atoms X, Y and Z? Give your answer in a tabular form.



(X) (Y) (Z)

25. In response to a question, a student stated that in an atom, the number of protons is greater than the number of neutrons, which in turn is greater than the number of electrons. Do you agree with the statement? Justify your answer.

26. Calculate the number of neutrons present in the nucleus of an element X which is represented as $^{31}_{15}X$

27. One electron is present in the outer most shell of the atom of an element X. What would be the nature and value of charge on the ion formed if this electron is removed from the outer most shell?

28. Write down the electron distribution of chlorine atom. How many electrons are there in the L shell? (Atomic number of chlorine is 17).

29. In the atom of an element X, 6 electrons are present in the outermost shell. If it acquires noble gas configuration by accepting requisite number of electrons, then what would be the charge on the ion so formed?

30. Match the names of the Scientists given in column A with their contributions towards the understanding of the atomic structure as given in column B

(A)	(B)
(a) Ernest Rutherford	(i) Indivisibility of atoms
(b) J.J.Thomson	(ii) Stationary orbits
(c) Dalton	(iii) Concept of nucleus
(d) Neils Bohr	(iv) Discovery of electrons
(e) James Chadwick	(v) Atomic number
(f) E. Goldstein	(vi) Neutron
(g) Mosley	(vii) Canal rays

31. The atomic number of calcium and argon are 20 and 18 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements?

32. Complete the Table 4.1 on the basis of information available in the symbols given below

$(a)\,^{35}_{17}Cl$ $\quad (b)\,^{12}_{6}C$ $\quad (c)\,^{81}_{35}Br$

Element	n_p	n_n

33. Helium atom has 2 electrons in its valence shell but its valency is not 2, Explain.

34. Fill in the blanks in the following statements

(a) Rutherford's α -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 ———.

35. An element X has a mass number 4 and atomic number 2. Write the valency of this element?

36. Why do Helium, Neon and Argon have a zero valency?

37. The ratio of the radii of hydrogen atom and its nucleus is ~ 105. Assuming the atom and the nucleus to be spherical, (i) what will be the ratio of their sizes? (ii) If atom is represented by planet earth 'Re' = 6.4 ×106 m, estimate the size of the nucleus.

38. Enlist the conclusions drawn by Rutherford from his α -ray scattering experiment.

39. In what way is the Rutherford's atomic model different from that of Thomson's atomic model?

40. What were the drawbacks of Rutherford's model of an atom?

41. What are the postulates of Bohr's model of an atom?

42. Show diagramatically the electron distributions in a sodium atom and a sodium ion and also give their atomic number.

43. In the Gold foil experiment of Geiger and Marsden, that paved the way for Rutherford's model of an atom, ~ 1.00% of the α-particles were found to deflect at angles > 50. If one mole of α-particles were bombarded on the gold foil, compute the number of α-particles that would deflect at angles less than 50^0.

PHYSICS

REFERENCE STUDY MATERIAL

for

CLASS – IX

2017 – 18

CHAPTER WISE CONCEPTS, FORMULAS AND QUESTIONS INLCUDING HOTS QUESTIONS

CHAPTER – 8

MOTION

MOTION

Motion means movement. The motion of an object is perceived when its position changes continuously with respect to some stationary object.

DISTANCE

The **distance** travelled by an object is the length of actual path travelled by the object during the motion.

DISPLACEMENT

The **displacement** of an object is the shortest distance travelled between the initial and final position of the object.

- When final position coincides with the initial position, displacement is 0 but distance is not equal to 0.
- Both, the distance and displacement are measure in meter or cm or km.
- Distance is a scalar quantity having only. Displacement is a vector quantity having both magnitude and direction.
- The distance travelled by an object in motion can never be zero or negative. The displacement can be positive, zero or negative.

INTEXT QUESTIONS PAGE NO. 100

1. A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds?
Ans. The farmer takes 40 s to cover 4 × 10 = 40 m.
In 2 min and 20 s (140 s), he will cover a distance = $\frac{40}{40}\times 140 = 140m$
Therefore, the farmer completes $\frac{140}{40} = 3.5$ rounds (3 complete rounds and a half round) of the field in 2 min and 20 s.
That means, after 2 min 20 s, the farmer will be at the opposite end of the starting point.
Now, there can be two extreme cases.
Case I: Starting point is a corner point of the field.
In this case, the farmer will be at the diagonally opposite corner of the field after 2 min 20 s.
Therefore, the displacement will be equal to the diagonal of the field.
Hence, the displacement will be $\sqrt{10^2+10^2} = 14.1m$
Case II: Starting point is the middle point of any side of the field.
In this case the farmer will be at the middle point of the opposite side of the field after 2 min 20 s.
Therefore, the displacement will be equal to the side of the field, i.e., 10 m.
For any other starting point, the displacement will be between 14.1 m and 10 m.

2. Which of the following is true for displacement?
(a) It cannot be zero.
(b) Its magnitude is greater than the distance travelled by the object.
Ans. (a) Not true. Displacement can become zero when the initial and final position of the object is the same.

(b) Not true. Displacement is the shortest measurable distance between the initial and final positions of an object. It cannot be greater than the magnitude of the distance travelled by an object. However, sometimes, it may be equal to the distance travelled by the object.

UNIFORM MOTION

A body is said to have a uniform motion if it travels equal distances in equal intervals of time, no matter how small these intervals may be.

Eg. A vehicle running at a constant speed of 10m/sec ,will cover equal distances of 10metres every second, so its motion will be uniform.

NON-UNIFORM MOTION

A body is said to have a non- uniform motion if it travels unequal distances in equal intervals of time, no matter how small these intervals may be.

Eg. A freely ball from a certain height covers unequal distances in equal intervals of time, so its motion is non uniform.

Non uniform motion is also called accelerated motion.

SPEED

Speed of a body is defined as the distance travelled by the body in unit time.

$$Speed(v) = \frac{\text{distance travelled}(s)}{\text{time taken}(t)}$$

Speed is a scalar quantity.

Uniform Speed: When a body travels equal distances in equal intervals of time, the speed of the body is said to be uniform.

Non-uniform Speed: When a body travels unequal distances in equal intervals of time, the speed of the body is said to be non-uniform.

VELOCITY

Velocity of a body is the distance travelled by the body in unit time in a given direction.

$$Velocity = \frac{\text{distance travelled in a given direction}}{\text{time taken}} = \frac{\text{displacement}}{\text{time}}$$

Velocity is a vector quantity.

Uniform Velocity: When a body travels equal distances in equal intervals of time in a particular direction, the velocity of the body is said to be uniform.

Non-uniform Velocity: When a body travels unequal distances in equal intervals of time in a particular direction, the velocity of the body is said to be non-uniform.

Both speed and velocity are measured in m/s or cm/s or km/hr

AVERAGE VELOCITY

Average Velocity: When velocity of a body is changing at a uniform rate, average velocity is given by $v_{av} = \frac{\text{Initial velocity}(u) + \text{final velocity}(v)}{2}$

INTEXT QUESTIONS PAGE NO. 102

1. Distinguish between speed and velocity.

Ans.

Speed	Velocity
Speed is the distance travelled by an object in a given interval of time. It does not have any direction.	Velocity is the displacement of an object in a given interval of time. It has a unique direction.
The speed of an object can never be negative. At the most, it can become zero. This is because distance travelled can never be negative.	The velocity of an object can be negative, positive, or equal to zero. This is because displacement can take any of these three values.

2. Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?

Ans. $Average\ \ speed = \dfrac{\text{Total distance covered}}{\text{Total time taken}}$ and

$$Average\ \ velocity = \frac{\text{Displacement}}{\text{Total time taken}}$$

If the total distance covered by an object is the same as its displacement, then its average speed would be equal to its average velocity.

3. What does the odometer of an automobile measure?

Ans. The odometer of an automobile measures the distance covered by an automobile.

4. What does the path of an object look like when it is in uniform motion?

Ans. An object having uniform motion has a straight line path.

5. During an experiment, a signal from a spaceship reached the ground station in five minutes. What was the distance of the spaceship from the ground station? The signal travels at the speed of light, that is, 3×10^8 m s^{-1}.

Ans. Time taken by the signal to reach the ground station from the spaceship

= 5 min = 5 × 60 = 300 s

Speed of the signal = 3×10^8 m/s

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

$\therefore$ Distance travelled = Speed × Time taken = $3 \times 10^8 \times 300 = 9 \times 10^{10}$ m

Hence, the distance of the spaceship from the ground station is 9×10^{10} m.

ACCELERATION

Acceleration of a body is defined as the rate of change of velocity of the body with time. It is given by formula: $a = \dfrac{v-u}{t}$

It is measured in m/s^2 or cm/s^2 or km/hr^2. Acceleration is a vector quantity.

If the velocity of the body increases with time, the acceleration is positive, and the kind of motion is called accelerated motion. If the velocity of the body decreases with time, the acceleration is negative (retardation), and the motion is called decelerated motion.

Uniform Acceleration: When velocity of the body changes by equal amounts in equal intervals of time in a particular direction, the acceleration of the body is said to be uniform.

Non-uniform Acceleration: When velocity of the body changes by unequal amounts in equal intervals of time in a particular direction, the acceleration of the body is said to be non-uniform.

INTEXT QUESTIONS PAGE NO. 103

1. When will you say a body is in (i) uniform acceleration? (ii) non-uniform acceleration?
Ans. (i) A body is said to have uniform acceleration if it travels in a straight path in such a way that its velocity changes at a uniform rate, i.e., the velocity of a body increases or decreases by equal amounts in an equal interval of time.
(ii) A body is said to have non-uniform acceleration if it travels in a straight path in such a way that its velocity changes at a non-uniform rate, i.e., the velocity of a body increases or decreases in unequal amounts in an equal interval of time.

2. A bus decreases its speed from 80 km h^{-1} to 60 km h^{-1} in 5 s. Find the acceleration of the bus.

Ans. Initial speed of the bus, u = 80 km/h = $80 \times \frac{5}{18} = 22.22 m/s$

Final speed of the bus, v = 60 km/h = $60 \times \frac{5}{18} = 16.66 m/s$

Time take to decrease the speed, t = 5 s

$$Acceleration, a = \frac{v-u}{t} = \frac{16.66-22.22}{5} = -1.12 m/s^2$$

Here, the negative sign of acceleration indicates that the velocity of the car is decreasing.

3. A train starting from a railway station and moving with uniform acceleration attains a speed 40 km h^{-1} in 10 minutes. Find its acceleration.
Ans. Initial velocity of the train, u = 0 (since the train is initially at rest)

Final velocity of the train, v = 40 km/h = $40 \times \frac{5}{18} = 11.11 m/s$

$$Acceleration, a = \frac{v-u}{t} = \frac{11.11-0}{5} = 0.0185 m/s^2$$

Time taken, t = 10 min = 10 × 60 = 600 s
Hence, the acceleration of the train is 0.0185 m/s^2.

NUMERICALS

1. A particle is moving in a circle of diameter 5m. Calculate the distance covered and the displacement when it competes 3 revolutions.

2. A body thrown vertically upwards reaches a maximum height ‘h’. It then returns to ground. Calculate the distance travelled and the displacement.

3. A body travels a distance of 15m from A to B and then moves a distance of 20m at right angles to AB. Calculate the total distance travelled and the displacement.

4. An object is moving in a circle of radius ‘r’. Calculate the distance and displacement
(i) when it completes half the circle
(ii) when it completes one full circle.

5. An object travels 16m in 4s and then another 16m in 2s. What is the average speed of the object?

6. Vishnu swims in a 90m long pool. He covers 180m in one minute by swimming from one end to the other and back along the same straight path. Find the average speed and average velocity of Vishnu.

7. In along distance race, the athletics were expected to take four rounds of the track such that the line of finish was same as the line of start. Suppose the length of the track was 200m.

(a) What is the total distance to be covered by the athletics?

(b) What is the displacement of the athletics when they touch the finish line?

(c) Is the motion of the athletics uniform or non-uniform?

(d) Is the displacement of an athletic and the distance covered by him at the end of the race equal?

8. Starting from a stationary position, Bhuvan paddles his bicycle to attain a velocity of 6m/s in 30s. Then he applies brakes such that the velocity of bicycle comes down to 4m/s in the next 5s. Calculate the acceleration of the bicycle in both the cases.

9. Amit is moving in his car with a velocity of 45km/hr. How much distance will he cover
(a) in one minute and
(b) in one second.

10. The odometer of a car reads 2000 km at the start of a trip and 2400km at the end of the trip. If the trip took 8 hr, calculate the average speed of the car in km/hr and m/s.

11. An electric train is moving with a velocity of 120km/hr. How much distance will it move in 30s?

12. A body is moving with a velocity of 15m/s. If the motion is uniform, what will be the velocity after 10s?

13. A train travels some distance with a speed of 30km/hr and returns with a speed of 45km/hr. Calculate the average speed of the train.

14. A train 100m long moving on a straight level track passes a pole in 5s. Find
(a) the speed of the train

(b) the time it will take to cross a bridge 500m long.

15. A car travels along a straight line for first half time with speed 40km/hr and the second half time with speed 60km/hr. Find the average speed of the car.

16. A body starts rolling over a horizontal surface with an initial velocity of 0.5m/s. Due to friction, its velocity decreases at the rate of $0.05 m/s^2$. How much time will it take for the body to stop?

17. A car traveling at 36km/hr speeds upto 70km/hr in 5 seconds. What is its acceleration? If the same car stops in 20s, what is the retardation?

18. A scooter acquires a velocity of 36km/hr in 10seconds just after the start. It takes 20 seconds to stop. Calculate the acceleration in the two cases.

19. On a 120km track, a train travels the first 30 km at a uniform speed of 30 km/hr. How fast must the train travel the next 90 km so as to average 60 km/hr for the entire trip?

20. A train travels at 60 km/hr for 0.52 hr; at 30 km/hr for the next 0.24 hr and at 70 km/hr for the next 0.71 hr. What is the average speed of the train?

GRAPHICAL REPRESENTATION OF MOTION

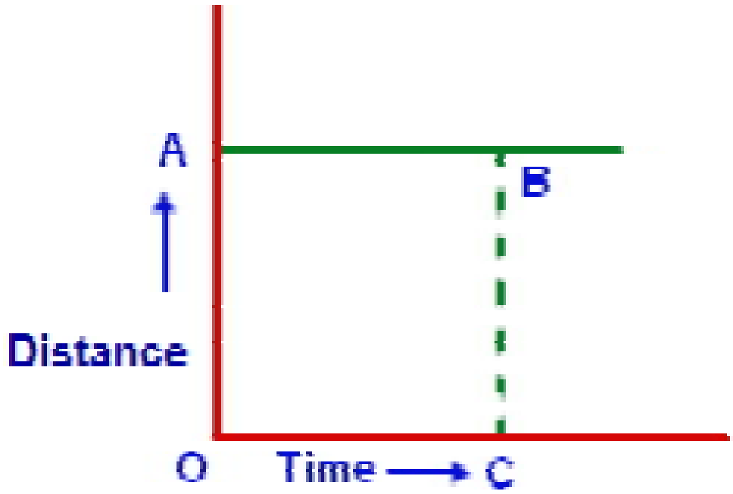
A graph represents the relation between two variable quantities in pictorial form. It is plotted between two variable quantities. The quantity that is varied our choice is called independent variable. The other quantity, which varies as a result of this change, is called dependent variable. For example, in distance-time graph, time is independent variable and distance is dependent variable. Similarly, in velocity-time graph, time is independent variable and velocity is dependent variable.

DISTANCE-TIME GRAPH

The distance-time graph represents the change in the position of a body with time. In this graph, we take time along the x-axis and the distance along the y-axis. The distance-time graph under different conditions are shown below.

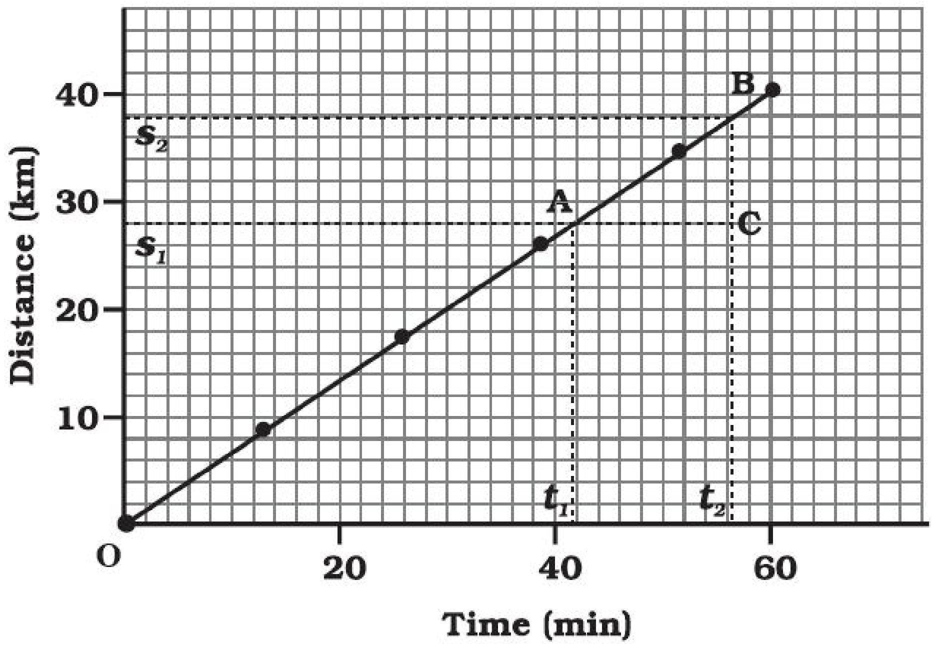
1. **When the body is at rest**

The position of the body does not change with time. Its distance from the origin continues to be same at all instants of time. Therefore, we obtain a straight line parallel to x-axis(time axis) (see the below figure)



2. **When the body is in uniform motion**

When an object travels equal distances in equal intervals of time, it moves with uniform speed. This shows that the distance travelled by the object is directly proportional to time taken. Thus, for uniform speed, a graph of distance travelled against time is a straight line, as shown in below figure. The portion OB of the graph shows that the distance is increasing at a uniform rate.



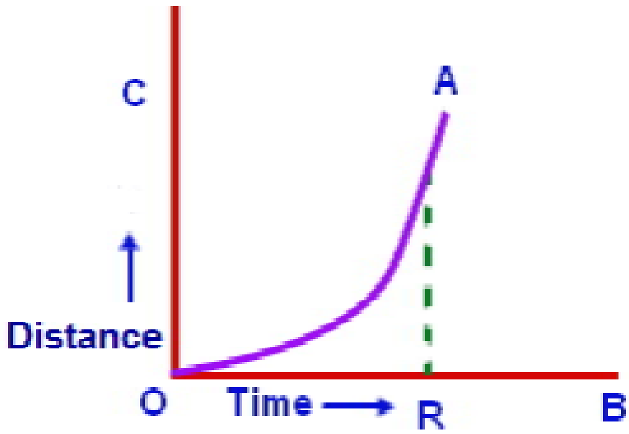
On the graph, AC denotes the time interval ($t_2 - t_1$) while BC corresponds to the distance ($s_2 - s_1$). We can see from the graph that as the object moves from the point A to B, it covers a distance ($s_2 - s_1$) in time ($t_2 - t_1$). The speed, v of the object, therefore can be represented as

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

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

3. **When the body is in non-uniform motion**

When a body moves with non-uniform speed it covers unequal distance in equal intervals of time. The distance-time graph for a body which is moving with non-uniform speed is not a straight line. It is a curve. The speed of the object will change with respect to time.



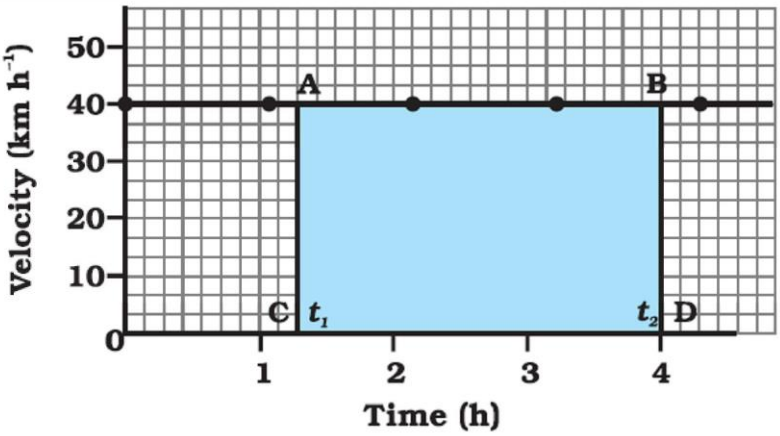
VELOCITY-TIME GRAPH

The geometrical relationship between the velocity of an object and the time taken by the object is called the velocity-time graph.

The velocity-time graph of an object can be drown by taking the time taken along the X-axis and the velocity along the Y-axis. The ratio of the velocity and the time taken will give the acceleration of the object. Therefore, the slope of the velocity-time graph gives the acceleration of the given object. That is, by using this graph one can find the acceleration of an object. The velocity-time graph under different conditions are shown below.

1. **When the body is moving with uniform velocity**

If the object moves at uniform velocity, the height of its velocity-time graph will not change with time. It will be a straight line parallel to the *x*-axis. We know that the product of velocity and time give displacement of an object moving with uniform velocity. The area enclosed by velocity-time graph and the time axis will be equal to the magnitude of the displacement.

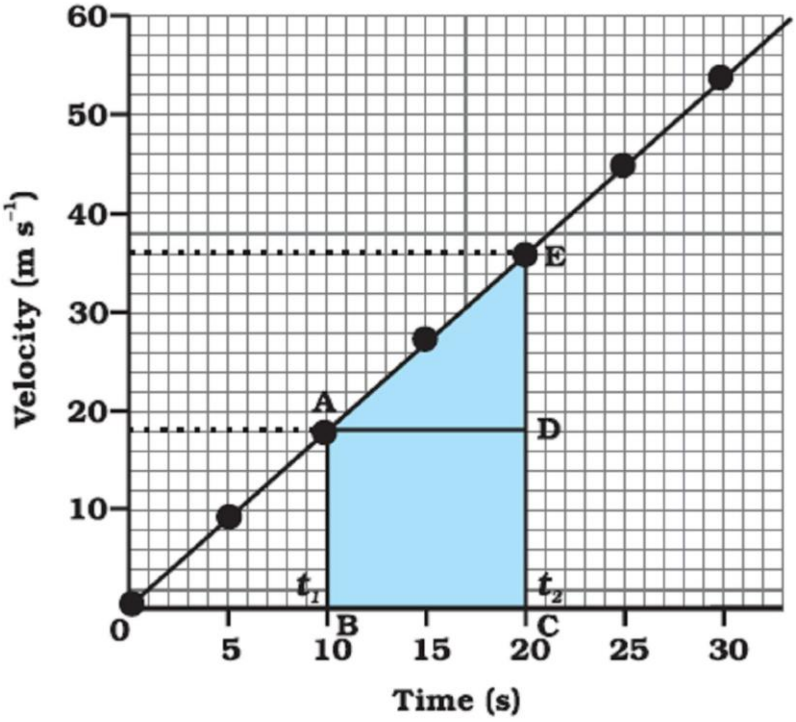


To know the distance moved by the car between time t_1 and t_2 using the above figure, draw perpendiculars from the points corresponding to the time t_1 and t_2 on the graph. The velocity of v km/h is represented by the height AC or BD and the time $(t_2 - t_1)$ is represented by the length AB. So, the distance s moved by the car in time $(t_2 - t_1)$ can be expressed as

$$s = AC \times CD = v(t_2 - t_1) = \text{Area of the rectangle ABDC (shaded portion)}$$

2. **When the body is moving with uniform acceleration**

In this case, the velocity-time graph for the motion of the car is shown in below figure. The nature of the graph shows that velocity changes by equal amounts in equal intervals of time. Thus, for all uniformly accelerated motion, the velocity-time graph is a straight line.



The area under the velocity-time graph gives the distance (magnitude of displacement) moved by the car in a given interval of time. If the car would have been moving with uniform velocity, the distance travelled by it would be represented by the area ABCD under the graph. Since the magnitude of the velocity of the car is changing due to acceleration, the distance *s* travelled by the car will be given by the area ABCDE under the velocity-time graph.

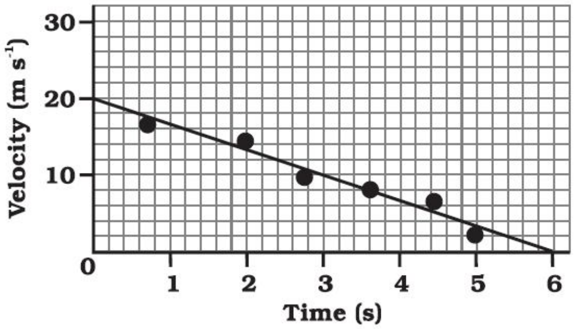
That is,

s = area ABCDE = area of the rectangle ABCD + area of the triangle ADE

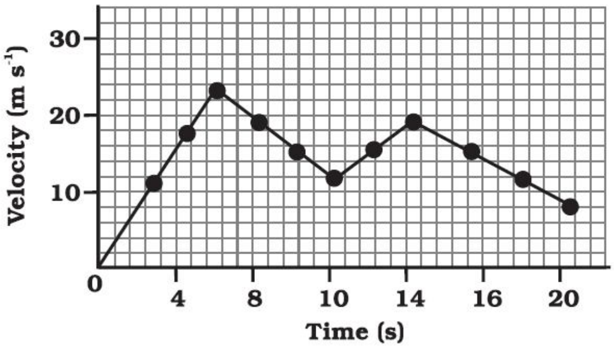
$$= AB \times BC + \frac{1}{2}(AD \times DE)$$

3. <u>When the body is moving with a variable acceleration</u>

In the case of non-uniformly accelerated motion, velocity-time graphs can have any shape. In below Fig. (a) shows a velocity-time graph that represents the motion of an object whose velocity is decreasing with time while Figure (b) shows the velocity-time graph representing the non-uniform variation of velocity of the object with time.



(a)

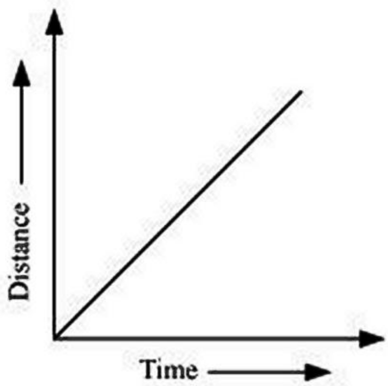


(b)

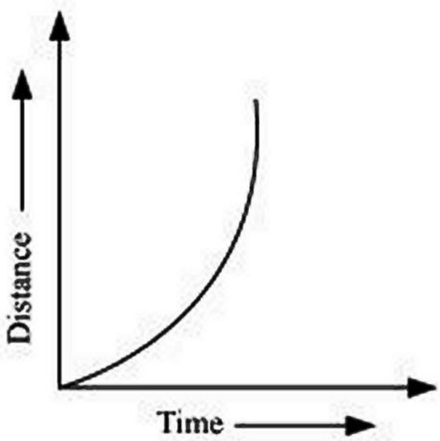
INTEXT QUESTIONS PAGE NO. 107

1. What is the nature of the distance–time graphs for uniform and non-uniform motion of an object?

Ans. The distance–time graph for uniform motion of an object is a straight line (as shown in the following figure).

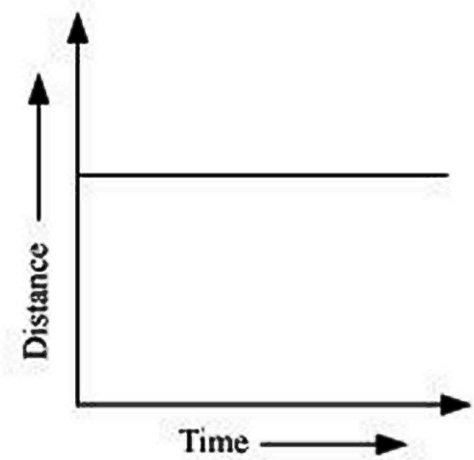


The distance–time graph for non-uniform motion of an object is a curved line (as shown in the given figure).



2. What can you say about the motion of an object whose distance–time graph is a straight line parallel to the time axis?

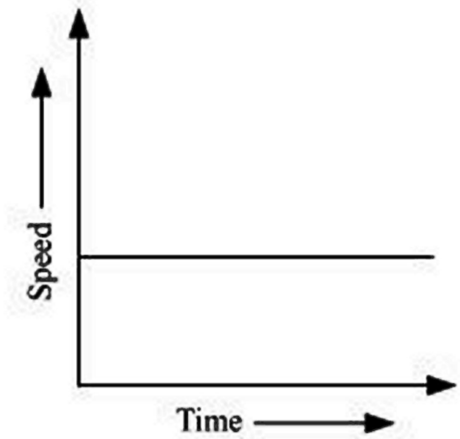
Ans. When an object is at rest, its distance–time graph is a straight line parallel to the time axis.



A straight line parallel to the *x*-axis in a distance–-time graph indicates that with a change in time, there is no change in the position of the object. Thus, the object is at rest.

3. What can you say about the motion of an object if its speed–time graph is a straight line parallel to the time axis?

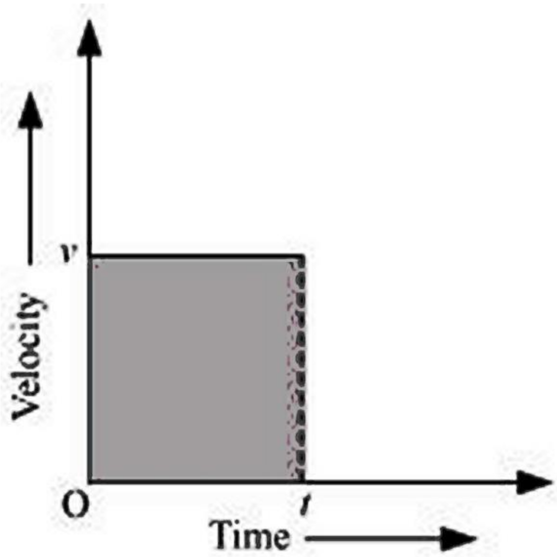
Ans. Object is moving uniformly.



A straight line parallel to the time axis in a speed–time graph indicates that with a change in time, there is no change in the speed of the object. This indicates the uniform motion of the object.

4. What is the quantity which is measured by the area occupied below the velocity–time graph?

Ans. Distance



The graph shows the velocity–time graph of a uniformly moving body.
Let the velocity of the body at time (t) be v.
Area of the shaded region = length × breath
Where, Length = t, Breath = v
Area = vt = velocity × time …(i)

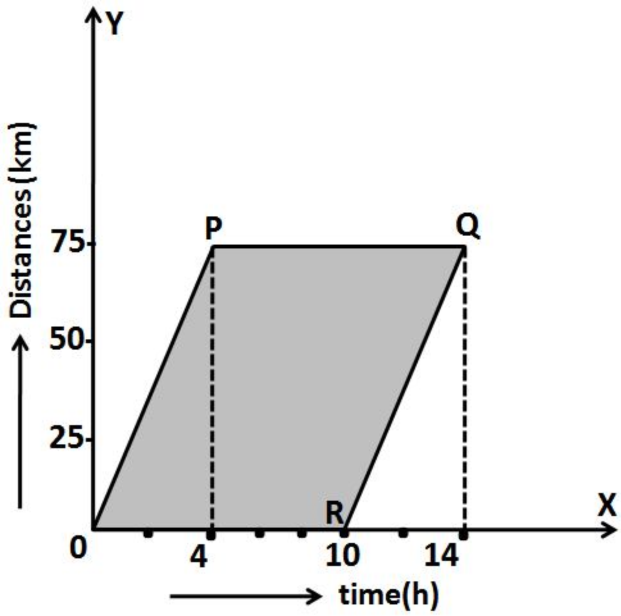
We know, $Velocity = \dfrac{\text{Distance}}{Time}$

∴ Distance = Velocity × Time…(ii)

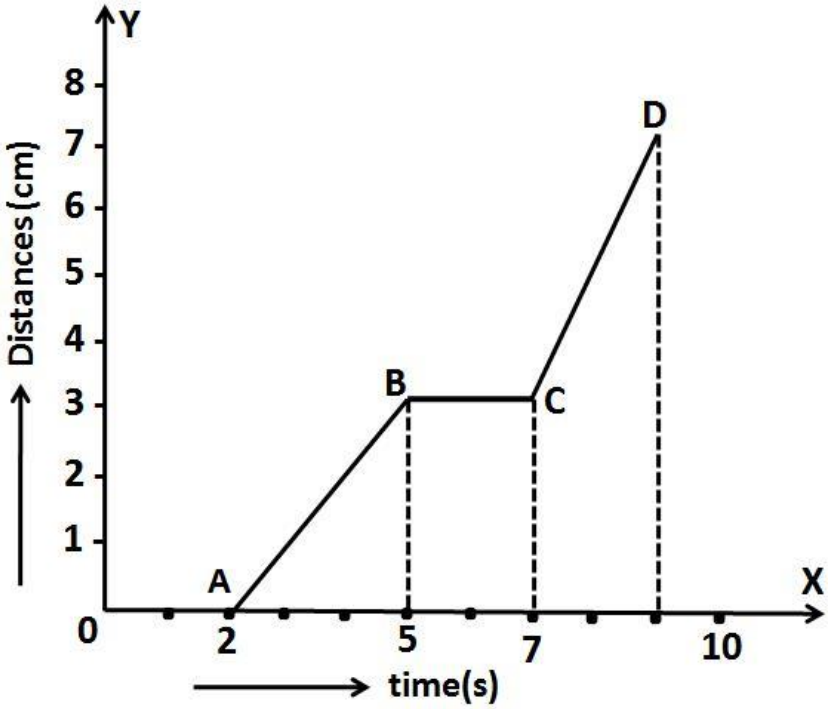
From equations (i) and (ii), Area = Distance
Hence, the area occupied below the velocity–time graph measures the distance covered by the body.

NUMERICALS

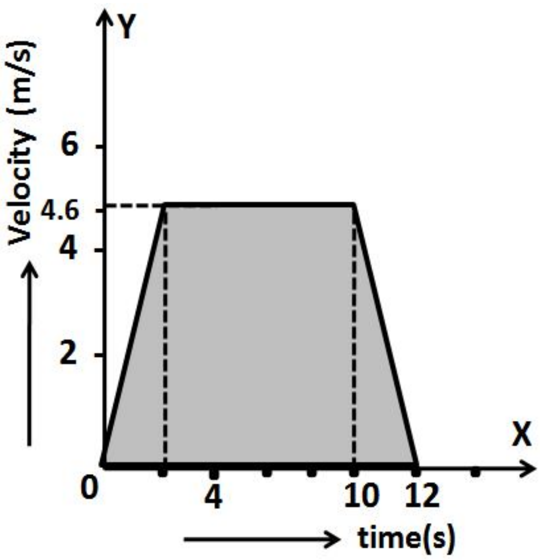
1. The right-sided figure is the distance-time graph of an object. Do you think it represents a real situation? If so, why? If not, why not?



2. The graph in below figure shows the positions of a body at different times. Calculate the speed of the body as it moves from (i) A to B (ii) B to C and (iii) C to D.



3. The velocity time graph of an ascending passenger lift is given below. What is the acceleration of the lift: (i) during the first two seconds (ii) between 2nd and 10th second (iii) during the last two seconds.



4. A body is moving uniformly with a velocity of 5m/s. Find graphically the distance travelled by it in 5 seconds.

5. Study the speed-time graph of a body shown in below figure and answer the following questions:

(a) What type of motion is represented by OA?

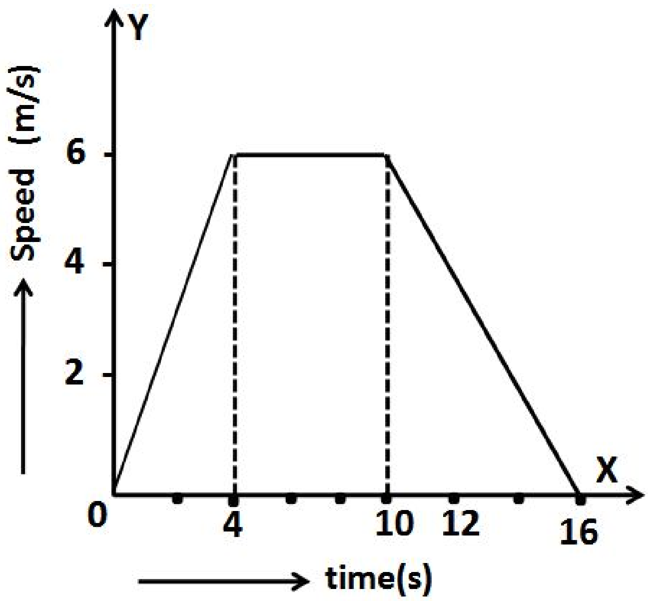
(b) What type of motion is represented by AB?

(c) What type of motion is represented by BC?

(d) Calculate the acceleration of the body.

(e) Calculate the retardation of the body.

(f) Calculate the distance travelled by the body from A to B.



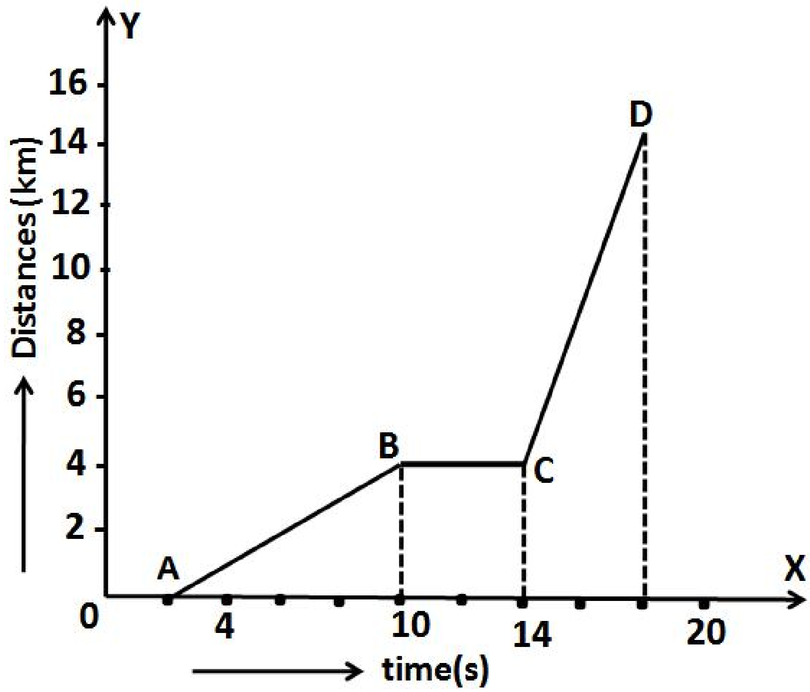
6. In the above question, calculate (i) distance travelled from O to A (ii) distance travelled from B to C. (iii) total distance travelled by the body in 16 sec.

7. A car is moving on a straight road with uniform acceleration. The following table gives the speed of the car at various instants of time:

Time(t)	0	10	20	30	40	50
Speed(m/s)	5	10	15	20	25	30

Draw the speed time graph choosing a convenient scale. Determine from it (i) the acceleration of the car (ii) the distance travelled by the car in 50 sec.

8. The graph in below figure shows the positions of a body at different times. Calculate the speed of the body as it moves from (i) A to B (ii) B to C and (iii) C to D.



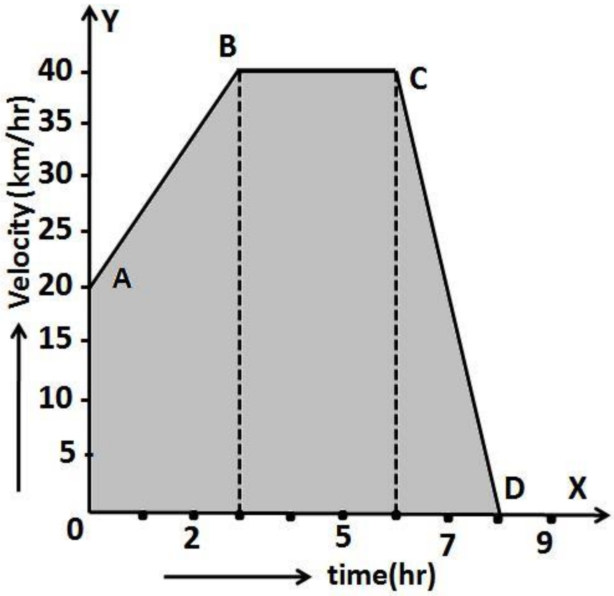
9. A car is moving on a straight road with uniform acceleration. The speed of the car varies with time as follows:

Time(t)	0	2	4	6	8	10

Speed(m/s)	4	8	12	16	20	24

Draw the speed time graph choosing a convenient scale. Determine from it (i) the acceleration of the car (ii) the distance travelled by the car in 10 sec.

10. The graph given below is the velocity-time graph for a moving body. Find (i) velocity of the body at point C (ii) acceleration acting on the body between A and B (iii) acceleration acting on the body between B and C.



EQUATIONS OF MOTION BY GRAPHICAL METHOD

When an object moves along a straight line with uniform acceleration, it is possible to relate its velocity, acceleration during motion and the distance covered by it in a certain time interval by a set of equations known as the equations of motion. There are three such equations. These are:

$$v = u + at \text{ --------------- } (1)$$

$$s = ut + \frac{1}{2}at^2 \text{ ------------- } (2)$$

$$2a\,s = v^2 - u^2 \text{ ----------- } (3)$$

where u is the initial velocity of the object which moves with uniform acceleration a for time t, v is the final velocity, and s is the distance travelled by the object in time t. Eq. (1) describes the velocity-time relation and Eq. (2) represents the position-time relation. Eq. (3), which represents the relation between the position and the velocity, can be obtained from Eqs. (1) and (2) by eliminating t. These three equations can be derived by graphical method.

EQUATION FOR VELOCITY-TIME RELATION

In the graph, AC gives the initial velocity (u). BE gives the final velocity (v). CE represents the time taken t. DF gives the change in velocity.

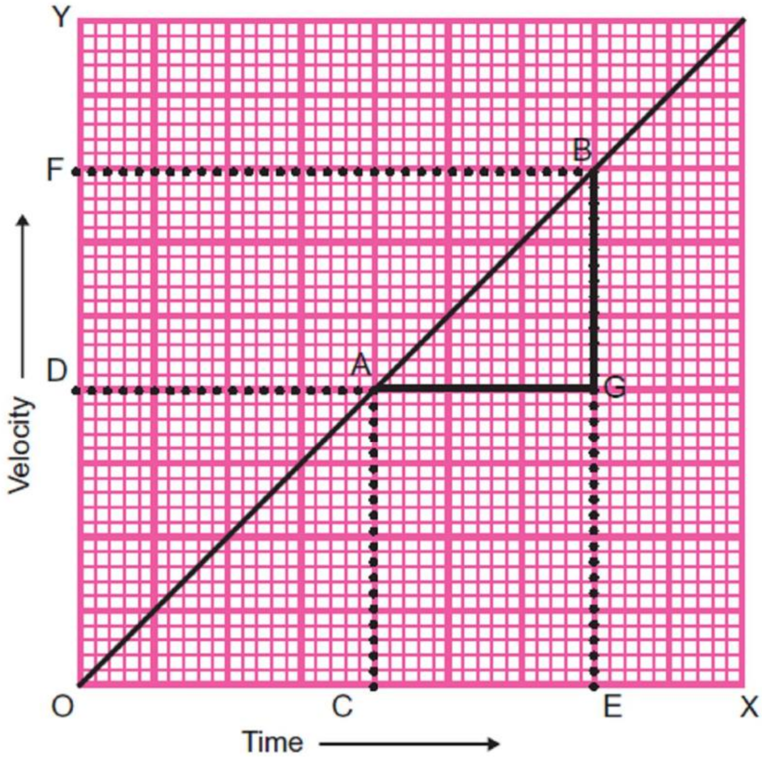
$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time}}$$

$$\Rightarrow a = \frac{DF}{CE} = \frac{OF - OD}{OE - OC}$$

But OE – OC = t

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

$\Rightarrow v - u = at$ …… (i)
$\Rightarrow v = u + at$ ……(I)



EQUATION FOR POSITION-VELOCITY RELATION

Let 's' be the displacement of the body in a time t.
In the graph, Displacement = Area CABE
s = Area of the rectangle CAGE + Area of the triangle ABG.

$s = AC \times CE + \frac{1}{2}(AG \times GB)$

Here AC = u
CE = t
AG = t
GB = v – u = at [from(i)]

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

$s = ut + \frac{1}{2}at^2$ …………… (II)

EQUATION FOR POSITION-TIME RELATION

In the graph, Displacement = Area of the trapezium CABE

$s = \frac{1}{2}(AC+EB) \times CE$

Here AC = u, EB = v, CE = t

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

From (i), we have $t = \frac{v-u}{a}$

Substituting the value of t,

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

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

$$\Rightarrow v^2 - u^2 = 2as$$

$v^2 = u^2 + 2as$ …………….(III)

(I), (II) and (III) are the equations of motion.

Acceleration due to gravity

The velocity of the body gradually decreases and becomes zero at a maximum height.The body is decelarated or retarded. When the body is allowed to fall down, the velocity gradually increases. Now the body is accelerated.

The decelaration or acceleration due to the gravitational force of earth is known as accelaration due to gravity, denoted as ‘g’. The average value of ‘g’ is 9.8 m/s2. The velocity of the body thrown vertically upwards will decrease by 9.8m for every second and the velocity of a body falling down increases by 9.8m for every second.

The equations of motion for this body can be obtained from the equations of motion.

$$v = u + at$$

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

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

For the body thrown upwards, equations can be obtained by substituting
$a = -g$ and $s = h$ we get,

$$v = u - gt$$

$$h = ut - \frac{1}{2}gt^2$$

$$v^2 = u^2 - 2gh$$

When a body allowed to fall freely, $u = 0$. $a = g$ and $s = h$.
Now, the equations will be

$$v = gt$$

$$h = \frac{1}{2}gt^2$$

$$v^2 = 2gh$$

INTEXT QUESTIONS PAGE NO. 109

1. A bus starting from rest moves with a uniform acceleration of 0.1 m s^{-2} for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.

Ans.

(a) Initial speed of the bus, $u = 0$ (since the bus is initially at rest)

Acceleration, $a = 0.1$ m/s^2

Time taken, $t = 2$ minutes = 120 s

Let v be the final speed acquired by the bus.

$$\therefore a = \frac{v-u}{t} \Rightarrow 0.1 = \frac{v-0}{}$$

$$\therefore v = 12 \text{ m/s}$$

(b) According to the third equation of motion:
$v^2 - u^2 = 2as$
Where, s is the distance covered by the bus
$(12)^2 - (0)^2 = 2(0.1)\ s$
$s = 720$ m
Speed acquired by the bus is 12 m/s.
Distance travelled by the bus is 720 m.

2. A train is travelling at a speed of 90 km h^{-1}. Brakes are applied so as to produce a uniform acceleration of −0.5 m s^{-2}. Find how far the train will go before it is brought to rest.
Ans. Initial speed of the train, u = 90 km/h = 25 m/s
Final speed of the train, v = 0 (finally the train comes to rest)
Acceleration = −0.5 m s^{-2}
According to third equation of motion:
$v^2 = u^2 + 2\ as$
$(0)^2 = (25)^2 + 2\ (-0.5)\ s$
Where, s is the distance covered by the train
$$s = \frac{25^2}{2 \times 0.5} = 625m$$
The train will cover a distance of 625 m before it comes to rest.

3. A trolley, while going down an inclined plane, has an acceleration of 2 cm s^{-2}. What will be its velocity 3 s after the start?
Ans. Initial velocity of the trolley, u = 0 (since the trolley was initially at rest)
Acceleration, a = 2 cm s^{-2} = 0.02 m/s^2
Time, t = 3 s
According to the first equation of motion:
$v = u + at$
Where, v is the velocity of the trolley after 3 s from start
$v = 0 + 0.02 \times 3 = 0.06$ m/s
Hence, the velocity of the trolley after 3 s from start is 0.06 m/s.

4. A racing car has a uniform acceleration of 4 m s^{-2}. What distance will it cover in 10 s after start?
Ans. Initial velocity of the racing car, u = 0 (since the racing car is initially at rest)
Acceleration, a = 4 m/s^2
Time taken, t = 10 s
According to the second equation of motion: $s = ut + \frac{1}{2}at^2$
Where, s is the distance covered by the racing car
$$s = 0 + \frac{1}{2} \times 4 \times 10^2 = \frac{400}{2} = 200m$$
Hence, the distance covered by the racing car after 10 s from start is 200 m.

5. A stone is thrown in a vertically upward direction with a velocity of 5 m s^{-1}. If the acceleration of the stone during its motion is 10 m s^{-2} in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?
Ans. Initially, velocity of the stone,u = 5 m/s
Final velocity, v = 0 (since the stone comes to rest when it reaches its maximum height)
Acceleration of the stone, a = acceleration due to gravity, g = 10 m/s^2
(in downward direction)
There will be a change in the sign of acceleration because the stone is being thrown upwards.

Acceleration, $a = -10$ m/s^2
Let s be the maximum height attained by the stone in time t.
According to the first equation of motion:
$v = u + at$
$0 = 5 + (-10)\ t$
$\therefore t = \frac{-5}{-10} = 0.5s$
According to the third equation of motion:
$v^2 = u^2 + 2\ as$
$(0)^2 = (5)^2 + 2(-10)$ s
$s = \frac{5^2}{20} = 1.25m$
Hence, the stone attains a height of 1.25 m in 0.5 s.

UNIFORM CIRCULAR MOTION

An athlete runs along the circumference of a circular path. This type of motion is known as circular motion. The movement of an object in a circular path is called circular motion.

When an object moves in a circular path with a constant velocity, its motion is called uniform circular motion. In uniform circular motion, the magnitude of the velocity is constant at all points and the direction of the velocity changes continuously.

We know that the circumference of a circle of radius r is given by $2\pi r$. If the athlete takes t seconds to go once around the circular path of radius r, the velocity v is given by

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

NUMERICALS

1. A car increases its speed from 20 km/h to 50 km/h in 10 seconds. What is its acceleration?

2. A ship is moving at a speed of 56km/h. One second later, it is moving at 58km/h. What is its acceleration?

3. A scooter acquires a velocity of 36km/h in 10 seconds just after the start. Calculate the acceleration of the scoter.

4. A racing car has uniform acceleration of 4m/s^2. What distance will it cover in 10 seconds after start?

5. A car acquires a velocity of 72km/h in 10 seconds starting from rest. Find (a) the acceleration (b) the average velocity (c) the distance travelled in this time.

6. A body is accelerating at a constant rate of 10m/s^2. If the body starts from rest, how much distance will it cover in 2 seconds?

7. An object undergoes an acceleration of 8m/s^2 starting from rest. Find the distance

travelled in 1 second.

8. A moving train is brought to rest within 20 seconds by applying brakes. Find the initial velocity, if the retardation due to brakes is $2 m/s^2$.

9. A car accelerates uniformly from 18km/h to 36 km/h in 5 seconds. Calculate (i) acceleration and (ii) the distance covered by the car in that time.

10. A body starts to slide over a horizontal surface with an initial velocity of 0.5 m/s. Due to friction, its velocity decreases at the rate of $0.05 m/s^2$. How much time will it take for the body to stop?

11. A train starting from the rest moves with a uniform acceleration of $0.2 m/s^2$ for 5 minutes. Calculate the speed acquired and the distance travelled in this time.

12. A bus was moving with a speed of 54 km/h. On applying brakes, it stopped in 8 seconds. Calculate the acceleration and the distance travelled before stopping.

13. A motor cycle moving with a speed of 5 m/s is subjected to an acceleration of 0.2 m/s^2. Calculate the speed of the motor cycle after 10 seconds and the distance travelled in this time.

14. The brakes applied to a car produce an acceleration of $6 m/s^2$ in the opposite direction to the motion. If the car takes 2 seconds to stop after the application of brakes, calculate the distance it travels during this time.

15. A train starting from rest attains a velocity of 72 km/h in 5 minutes. Assuming that the acceleration is uniform, find (i) the acceleration and (ii) the distance travelled by the train for attaining this velocity.

16. Calculate the speed of the tip of second's hand of a watch of length 1.5 cm.

17. A cyclist goes once round a circular track of diameter 105m in 5 minutes. Calculate his speed.

18. A cyclist moving on a circular track of radius 50m complete revolution in 4 minutes. What is his (i) average speed (ii) average velocity in one full revolution?

19. The length of minutes hand of a clock in 5 cm. Calculate its speed.

20. A car starts from rest and moves along the x-axis with constant acceleration 5m/s2 for 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?

21. An object is dropped from rest at a height of 150m and simultaneously another object is dropped from rest at a height 100m. What is the difference in their heights after 2 seconds if both the objects drop with same acceleration? How does the difference in heights vary with time?

22. Obtain a relation for the distance travelled by an object moving with a uniform acceleration in the interval between 4^{th} and 5^{th} seconds.

23. Two stones are thrown vertically upwards simultaneously with their initial velocities u_1 and u_2 respectively. Prove that the heights reached by them would be in the ratio of $u_1^2:u_2^2$ (Assume upward acceleration is – g and downward acceleration to be +g).

24. An object starting from rest travels 20m in first 2 seconds and 160m in next 4 seconds. What will be the velocity after 7 seconds from the start?

25. An electron moving with a velocity of 5 x 10^4 m/s enters into a uniform electric field and acquires a uniform acceleration of 10^4m/s^2 in the direction of its initial motion. (i) Calculate the time in which the electron would acquire a velocity double of its initial velocity. (ii) How much distance the electron would cover in this time?

EXERCISE QUESTIONS PAGE NO. 112

1. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?
Ans. Diameter of a circular track, d = 200 m

Radius of the track, $r = \dfrac{d}{2} = 100m$

Circumference = $2\pi r$ = 2π (100) = 200π m
In 40 s, the given athlete covers a distance of 200π m.

In 1 s, the given athlete covers a distance = $\dfrac{200\pi}{40}\ m$

The athlete runs for 2 minutes 20 s = 140 s

$\therefore$ Total distance covered in $140s = \dfrac{200\times22}{40\times7}\times140 = 2200m$

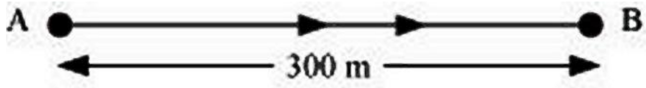
The athlete covers one round of the circular track in 40 s. This means that after every 40 s, the athlete comes back to his original position. Hence, in 140 s he had completed 3 rounds of the circular track and is taking the fourth round.
He takes 3 rounds in 40 × 3 = 120 s. Thus, after 120 s his displacement is zero.
Then, the net displacement of the athlete is in 20 s only. In this interval of time, he moves at the opposite end of the initial position. Since displacement is equal to the shortest distance between the initial and final position of the athlete, displacement of the athlete will be equal to the diameter of the circular track.

$\therefore$ Displacement of the athlete = 200

m

Distance covered by the athlete in 2 min 20 s is 2200 m and his displacement is 200 m.

2. Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 50 seconds and then turns around and jogs 100 m back to point C in another 1 minute. What are Joseph's average speeds and velocities in jogging (a) from A to B and (b) from A to C?
Ans. (a) From end A to end B



Distance covered by Joseph while jogging from A to B = 300 m
Time taken to cover that distance = 2 min 50 seconds = 170 s

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

Total distance covered = 300 m
Total time taken = 170 s
Displacement = shortest distance between A and B = 300 m
Time interval = 170 s

$$Average \ \ speed = \frac{300}{170} = 1.765 m/s$$

$$Average\ \ velocity = \frac{\text{Displacement}}{\text{Total time taken}}$$

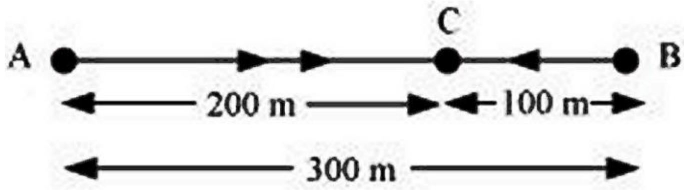
Displacement = shortest distance between A and B = 300 m

Time interval = 170 s

$$Average\ \ velocity = \frac{300}{170} = 1.765 m/s$$

The average speed and average velocity of Joseph from A to B are the same and equal to 1.765 m/s.

(b) From end A to end C



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

Total distance covered = Distance from A to B + Distance from B to C

= 300 + 100 = 400 m

Total time taken = Time taken to travel from A to B + Time taken to travel from B to C = 170 + 60 = 230 s

$$Average\ \ speed = \frac{400}{230} = 1.739 m/s$$

$$Average\ \ velocity = \frac{\text{Displacement}}{\text{Total time taken}}$$

Displacement from A to C = AC = AB − BC = 300 − 100 = 200 m

Time interval = time taken to travel from A to B + time taken to travel from B to C

= 170 + 60 = 230 s

$$Average\ \ velocity = \frac{200}{230} = 0.87 m/s$$

The average speed of Joseph from A to C is 1.739 m/s and his average velocity is 0.87 m/s.

3. Abdul, while driving to school, computes the average speed for his trip to be 20 km/h. On his return trip along the same route, there is less traffic and the average speed is 40 km/h. What is the average speed for Abdul's trip?

Ans. Case I: While driving to school

Average speed of Abdul's trip = 20 km/h

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

Total distance = Distance travelled to reach school = *d*

Let total time taken = t_1

$$\therefore 20 = \frac{d}{t_1} \Rightarrow t_1 = \frac{d}{20} \text{..........}(i)$$

Case II: While returning from school

Total distance = Distance travelled while returning from school = *d*

Now,total time taken = t_2

$$\therefore 40 = \frac{d}{t_2} \Rightarrow t_1 = \frac{d}{40} \text{..........}(ii)$$

$$\text{Average Speed for Abdul's trip} = \frac{\text{Total distance covered in the trip}}{\text{Total time taken}}$$

Where,
Total distance covered in the trip = $d + d = 2d$
Total time taken, t = Time taken to go to school + Time taken to return to school
$= t_1 + t_2$

$$\therefore \text{Average speed} = \frac{2d}{t_1+t_2}$$

From equations (i) and (ii),

$$\text{Average speed} = \frac{2d}{\frac{d}{20}+\frac{d}{40}} = \frac{2}{\frac{2+1}{40}} = \frac{80}{3} = 26.67 m/s$$

Hence, the average speed for Abdul's trip is 26.67 m/s.

4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of 3.0 m/s^2 for 8.0 s. How far does the boat travel during this time?
Ans. Initial velocity, $u = 0$ (since the motor boat is initially at rest)
Acceleration of the motorboat, $a = 3 \text{ m/s}^2$
Time taken, $t = 8$ s
According to the second equation of motion:

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

Distance covered by the motorboat, s

$$s = 0 + \frac{1}{2} \times 3 \times 8^2 = 96m$$

Hence, the boat travels a distance of 96 m.

5. A driver of a car travelling at 52 km/h applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 km/h in another car applies his brakes slowly and stops in 10 s. On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?
Ans. <u>Case A</u>:
Initial speed of the car, u_1 = 52 km/h = 14.4 m/s
Time taken to stop the car, t_1 = 5 s
Final speed of the car becomes zero after 5 s of application of brakes.
<u>Case B:</u>
Initial speed of the car, u_2 = 3 km/h = 0.833 m/s 0.83 m/s
Time taken to stop the car, t_2 = 10 s
Final speed of the car becomes zero after 10 s of application of brakes.
Plot of the two cars on a speed–time graph is shown in the following figure:

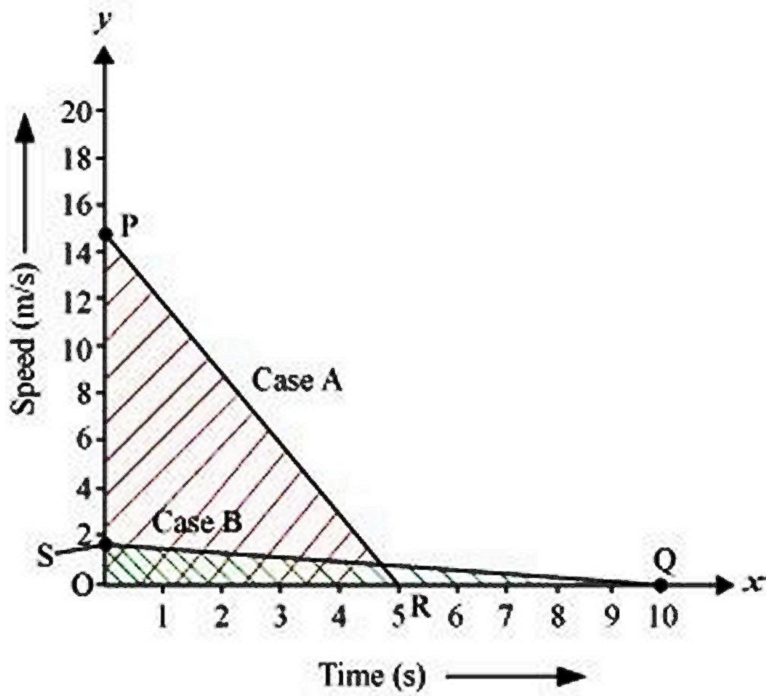
Distance covered by each car is equal to the area under the speed–time graph.
Distance covered in case A,

$$S_1 = \frac{1}{2} \times OP \times OR = \frac{1}{2} \times 14.4 \times 5 = 36m$$

Distance covered in case B,

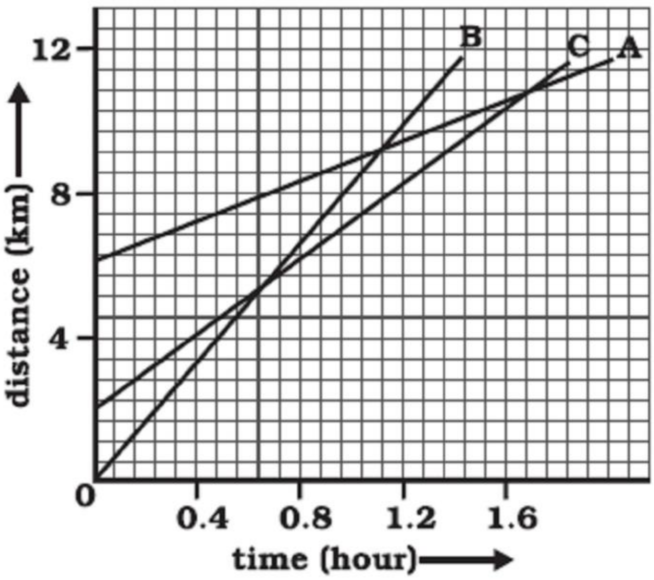
$$S_2 = \frac{1}{2} \times OS \times OQ = \frac{1}{2} \times 0.83 \times 10 = 4.15m$$

Area of ΔOPR > Area of ΔOSQ



Thus, the distance covered in case A is greater than the distance covered in case B.
Hence, the car travelling with a speed of 52 km/h travels farther after brakes were applied.

6. Fig 8.11 shows the distance-time graph of three objects A,B and C. Study the graph and answer the following questions:



(a) Which of the three is travelling the fastest?
(b) Are all three ever at the same point on the road?
(c) How far has C travelled when B passes A?
(d) How far has B travelled by the time it passes C?

Ans. $Speed = \frac{\text{Distance}}{\text{Time}}$

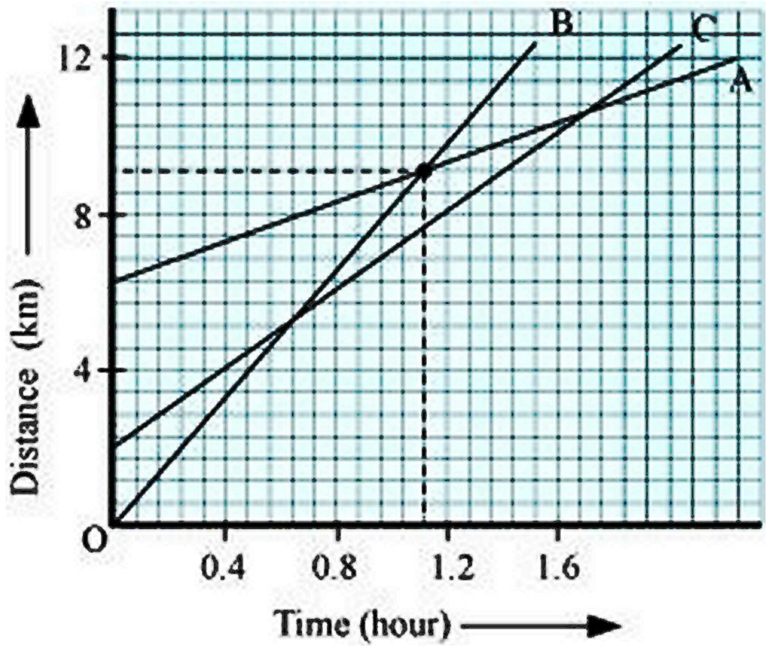
Slope of the graph= $\frac{\text{y-axis}}{\text{x-axis}} = \frac{\text{Distance}}{\text{Time}}$

$\therefore$ Speed = slope of the graph

Since slope of object B is greater than objects A and C, it is travelling the fastest.

(b) All three objects A, B and C never meet at a single point. Thus, they were never at the same point on road.

(c) On the distance axis:



7 small boxes = 4 km

$\therefore$ 1 small box $= \frac{4}{7} km$

Initially, object C is 4 blocks away from the origin.

$\therefore$ Initial distance of object C from origin $= \frac{16}{7} km$

Distance of object C from origin when B passes A = 8 km

Distance covered by C $= 8 - \frac{16}{7} = \frac{56-16}{7} = \frac{40}{7} = 5.714 km$

Hence, C has travelled a distance of 5.714 km when B passes A.

(d)

Distance covered by B at the time it passes C for 9 boxes $= \frac{4}{7} \times 9 = \frac{36}{7} = 5.143 km$

Hence, B has travelled a distance of 5.143 km when B passes A.

7. A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of 10 m/s^2, with what velocity will it strike the ground? After what time will it strike the ground?

Ans. Distance covered by the ball, s = 20 m

Acceleration, a = 10 m/s^2

Initially, velocity, u = 0 (since the ball was initially at rest)

Final velocity of the ball with which it strikes the ground, v

According to the third equation of motion:

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

$v^2 = 0 + 2\,(10)\,(20)$

v = 20 m/s

According to the first equation of motion:

$v = u + at$

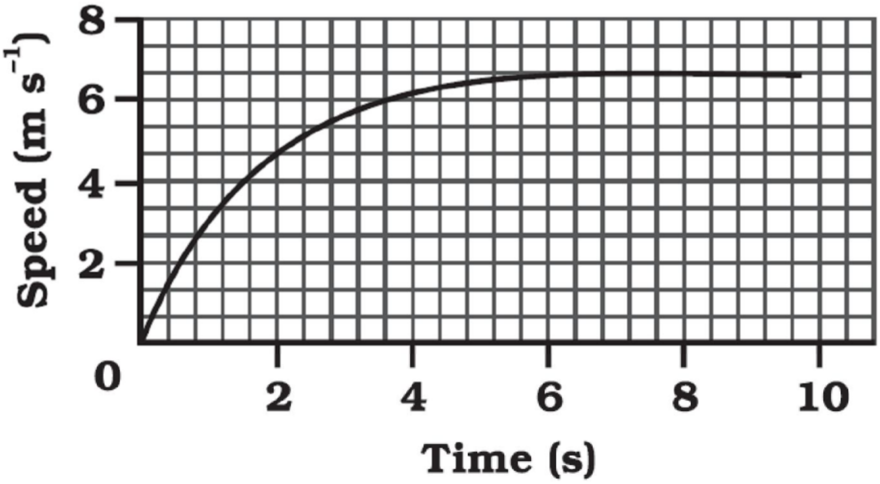
Where,

Time, t taken by the ball to strike the ground is,

$$20 = 0 + 10\,(t)$$

$t = 2$ s
Hence, the ball strikes the ground after 2 s with a velocity of 20 m/s.

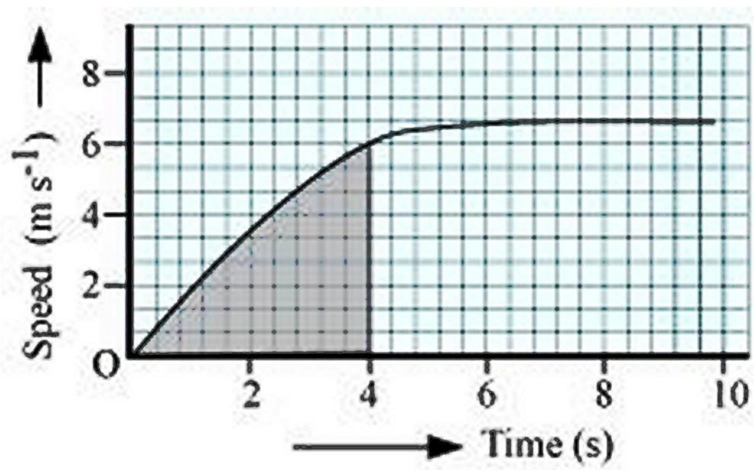
8. The speed-time graph for a car is shown is Fig. 8.12.



(a) Find how far does the car travel in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period.
(b) Which part of the graph represents uniform motion of the car?

(a)

The shaded area which is equal to $\frac{1}{2} \times 4 \times 6 = 12m$ represents the distance travelled by the car in the first 4 s.



(b) The part of the graph in red colour between time 6 s to 10 s represents uniform motion of the car.

9. State which of the following situations are possible and give an example for each of these: (a) an object with a constant acceleration but with zero velocity (b) an object moving in a certain direction with an acceleration in the perpendicular direction.
Ans. (a) Possible
When a ball is thrown up at maximum height, it has zero velocity, although it will have constant acceleration due to gravity, which is equal to 9.8 m/s^2.
(b) Possible
When a car is moving in a circular track, its acceleration is perpendicular to its direction.

10. An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to revolve around the earth?

Ans. Radius of the circular orbit, r = 42250 km

Time taken to revolve around the earth, t = 24 h

Speed of a circular moving object,

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

$$\Rightarrow v = \frac{2 \times 3.14 \times 42250}{24}$$

$$\Rightarrow v = 1.105 \times 10^4 km/h = 3.069 km/s$$

Hence, the speed of the artificial satellite is 3.069 km/s.

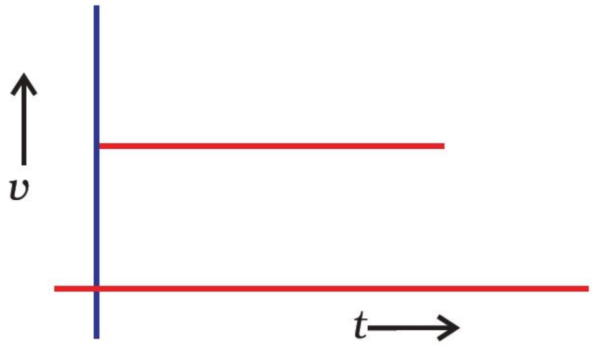
ASSIGNMENT QUESTIONS
MOTION

Multiple Choice Questions

1. If the displacement of an object is proportional to square of time, then the object moves with
(a) uniform velocity
(b) uniform acceleration
(c) increasing acceleration
(d) decreasing acceleration

2. The distance time graph of a body coincides with its time axis. The body must be
(a) in uniform motion
(b) at rest
(c) in uniformly accelerated motion
(d) in zig-zag motion

3. From the given $v - t$ graph (see below Fig.), it can be inferred that the object is
(a) in uniform motion
(b) at rest
(c) in non-uniform motion
(d) moving with uniform acceleration



4. The velocity time graph of a body is parallel to the time axis. The body is
(a) at rest
(b) having uniform acceleration
(c) having zero acceleration
(d) having non-uniform acceleration

5. A particle is moving in a circular path of radius r. The displacement after half a circle would be:
(a) Zero
(b) πr
(c) $2r$
(d) $2\pi r$

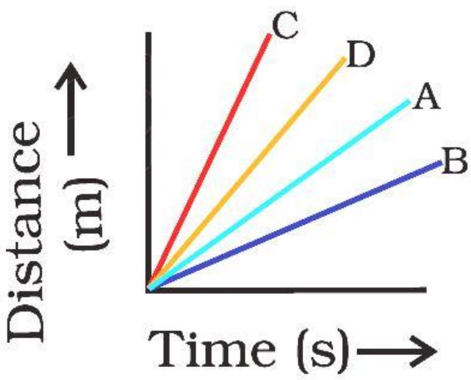
6. A body is thrown vertically upward with velocity u, the greatest height h to which it will rise is,
(a) u/g (b) $u^2/2g$ (c) u^2/g (d) $u/2g$

7. The numerical ratio of displacement to distance for a moving object is
(a) always less than 1
(b) always equal to 1
(c) always more than 1
(d) equal or less than 1

8. Suppose a boy is enjoying a ride on a *merry-go-round* which is moving with a constant speed of 10 m/s. It implies that the boy is
(a) at rest
(b) moving with no acceleration
(c) in accelerated motion
(d) moving with uniform velocity

9. Area under a $v - t$ graph represents a physical quantity which has the unit
(a) m^2
(b) m
(c) m^3
(d) m/s

10. Four cars A, B, C and D are moving on a levelled road. Their distance versus time graphs are shown in below Fig.. Choose the correct statement
(a) Car A is faster than car D.
(b) Car B is the slowest.
(c) Car D is faster than car C.
(d) Car C is the slowest.



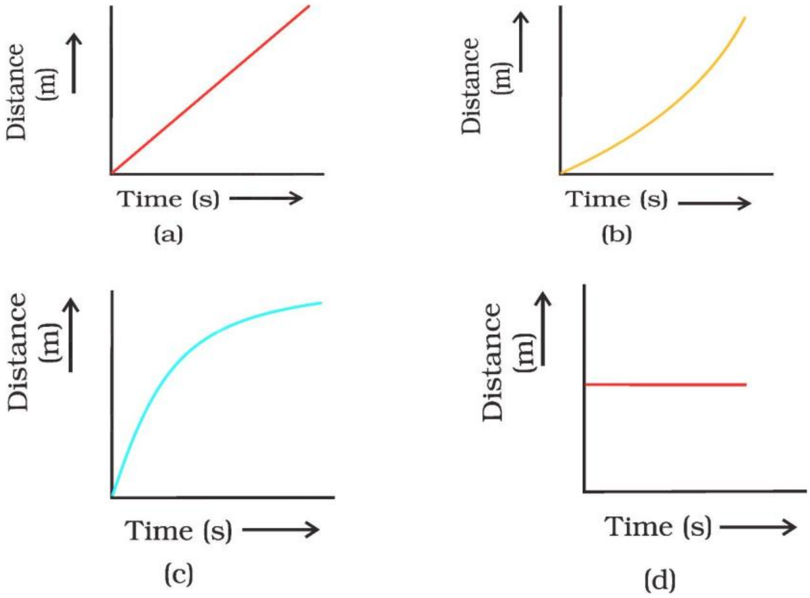
11. Slope of a velocity – time graph gives

(a) the distance
(b) the displacement
(c) the acceleration
(d) the speed

12. In which of the following cases of motions, the distance moved and the magnitude of displacement are equal?

(a) If the car is moving on straight road
(b) If the car is moving in circular path
(c) The pendulum is moving to and fro
(d) The earth is revolving around the Sun

13. Which of the following figures (see below Figure) represents uniform motion of a moving object correctly?



SHORT ANSWER QUESTIONS

14. The displacement of a moving object in a given interval of time is zero. Would the distance travelled by the object also be zero? Justify you answer.

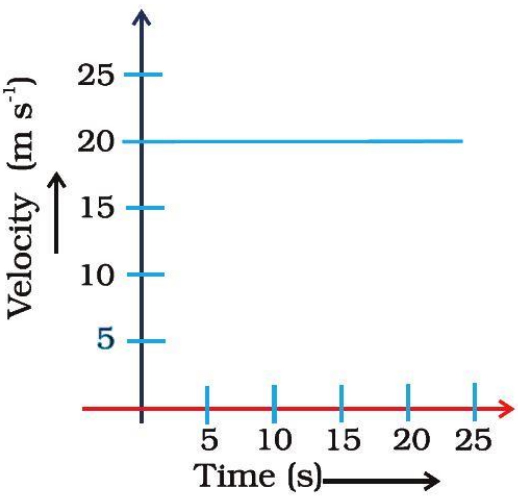
15. How will the equations of motion for an object moving with a uniform velocity change?

16. A car starts from rest and moves along *the x*-axis with constant acceleration 5 m/s^2 for 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?

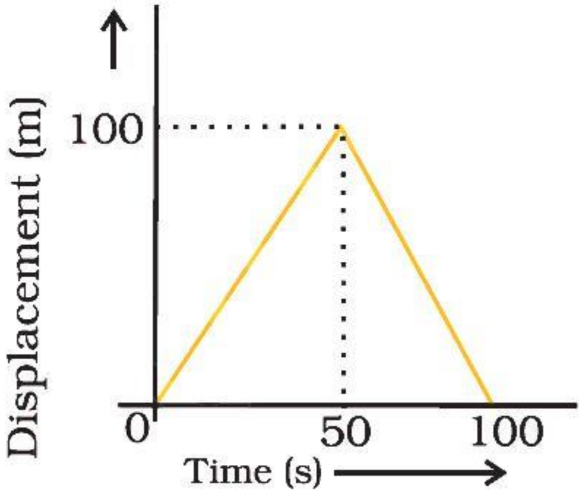
17. A motorcyclist drives from A to B with a uniform speed of 30 km/h and returns back with a speed of 20 km/h. Find its average speed.

18. Draw a velocity versus time graph of a stone thrown vertically upwards and then coming downwards after attaining the maximum height.

19. The velocity-time graph (see below Figure) shows the motion of a cyclist. Find (i) its acceleration (ii) its velocity and (iii) the distance covered by the cyclist in 15 seconds.



20. A girl walks along a straight path to drop a letter in the letterbox and comes back to her initial position. Her displacement–time graph is shown in below figure. Plot a velocity–time graph for the same.



LONG ANSWER QUESTIONS

21. An object starting from rest travels 20 m in first 2 s and 160 m in next 4 s. What will be the velocity after 7 s from the start.

22. An electron moving with a velocity of 5 × 104 m/s enters into a uniform electric field and acquires a uniform acceleration of 104 m/s^2 in the direction of its initial motion.
(i) Calculate the time in which the electron would acquire a velocity double of its initial velocity.
(ii) How much distance the electron would cover in this time?

23. Obtain a relation for the distance travelled by an object moving with a uniform acceleration in the interval between 4th and 5th seconds.

24. Two stones are thrown vertically upwards simultaneously with their initial velocities u_1 and u_2 respectively. Prove that the heights reached by them would be in the ratio of $u_1^2 : u_2^2$ (Assume upward acceleration is $-g$ and downward acceleration to be $+g$).

25. An object is dropped from rest at a height of 150 m and simultaneously another object is dropped from rest at a height 100 m. What is the difference in their heights after 2 s if both the objects drop with same accelerations? How does the difference in heights vary with time?

CHAPTER – 9

FORCE AND LAWS OF MOTION

FORCE

A force is anything that can cause a change to objects. Forces can:

- change the shape of an object
- move or stop an object
- change the direction of a moving object.

A force can be classified as either a contact force or a non-contact force.

A contact force must touch or be in contact with an object to cause a change. Examples of contact forces are:

- the force that is used to push or pull things, like on a door to open or close it
- the force that a sculptor uses to turn clay into a pot
- the force of the wind to turn a windmill

A non-contact force does not have to touch an object to cause a change. Examples of non-contact forces are:

- the force due to gravity, like the Earth pulling the Moon towards itself
- the force due to electricity, like a proton and an electron attracting each other
- the force due to magnetism, like a magnet pulling a paper clip towards itself

The unit of force is the newton (symbol N). This unit is named after Sir Isaac Newton who first defined force. Force is a vector quantity and has a magnitude and a direction.

EFFECT OF FORCE:

1. Force can make a stationary body in motion. For example a football can be set to move by kicking it, i.e. by applying a force.
2. Force can stop a moving body – For example by applying brakes, a running cycle or a running vehicle can be stopped.
3. 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.
4. 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.
5. 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 can also divided into two types:

1. Balanced Forces
2. Unbalanced Forces

BALANCED FORCES

If the resultant of applied forces is equal to zero, it is called balanced forces.

Example : - In the tug of war if both the teams 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.

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 balanced 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:

NEWTON'S LAWS OF MOTION:

- Newton's First Law of Motion - 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.
- Newton's Second Law of Motion - The rate of change of momentum is directly proportional to the force applied in the direction of force.
- Newton's Third Law of Motion - There is an equal and opposite reaction for evrey action

NEWTON'S FIRST LAW OF MOTION:

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 untill a exernal force is applied to change its state. Similarly an object will remain in motion untill 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 is start 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 tendency to remain in rest. Because of this 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 the contact with bus come in rest while the rest parts of his body have tendency to remain in motion. Because of this person falls forward if he is not alert.

MASS AND INERTIA:

The property of an object because of which it resists to get disturbed 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 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 pul a heavy box over the ground than lighter one.

INTEXT QUESTIONS PAGE NO. 118

1. Which of the following has more inertia: (a) a rubber ball and a stone of the same size? (b) a bicycle and a train? (c) a five-rupees coin and a one-rupee coin?
Ans. Inertia is the measure of the mass of the body. The greater is the mass of the body; the greater is its inertia and vice-versa.
(a) Mass of a stone is more than the mass of a rubber ball for the same size. Hence, inertia of the stone is greater than that of a rubber ball.
(b) Mass of a train is more than the mass of a bicycle. Hence, inertia of the train is greater than that of the bicycle.
(c) Mass of a five rupee coin is more than that of a one-rupee coin. Hence, inertia of the five rupee coin is greater than that of the one-rupee coin.

2. In the following example, try to identify the number of times the velocity of the ball changes:
"A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team". Also identify the agent supplying the force in each case.
Ans. The velocity of the ball changes four times. As a football player kicks the football, its speed changes from zero to a certain value. As a result, the velocity of the ball gets changed. In this case, the player applied a force to change the velocity of the ball. Another player kicks the ball towards the goal post. As a result, the direction of the ball gets changed. Therefore, its velocity also changes. In this case, the player applied a force to change the velocity of the ball. The goalkeeper collects the ball. In other words, the ball comes to rest. Thus, its speed reduces to zero from a certain value. The velocity of the ball has changed. In this case, the goalkeeper applied an opposite force to stop/change the velocity of the ball. The goalkeeper kicks the ball towards his team players. Hence, the speed of the ball increases from zero to a certain value. Hence, its velocity changes once again. In this case, the goalkeeper applied a force to change the velocity of the ball.

3. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.
Ans. Some leaves of a tree get detached when we shake its branches vigorously. This is because when the branches of a tree are shaken, it moves to and fro, but its leaves tend to remain at rest. This is because the inertia of the leaves tend to resist the to and fro motion. Due to this reason, the leaves fall down from the tree when shaken vigorously.

4. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?
Ans. Due to the inertia of the passenger. Every body tries to maintain its state of motion or

state of rest. If a body is at rest, then it tries to remain at rest. If a body is moving, then it tries to remain in motion. In a moving bus, a passenger moves with the bus. As the driver applies brakes, the bus comes to rest. But, the passenger tries to maintain his state of motion. As a result, a forward force is exerted on him. Similarly, the passenger tends to fall backwards when the bus accelerates from rest. This is because when the bus accelerates, the inertia of the passenger tends to oppose the forward motion of the bus. Hence, the passenger tends to fall backwards when the bus accelerates forward.

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 x Velocity.

Or, p = m x v

Where, p = momentum, m = mass of the object and v = velocity of the object.

NEWTON'S SECOND LAW OF MOTION

Newton's second Law of Motion states that The rate of change of momentum is directly proportional to the force applied in the direction of force.
For example; when acceleration is applied on a moving vehicle, the momentum of the vehicle increases and the increase is in the direction of motion because the force is being applied in the direction of motion. On the other hand, when brake is applied on the moving vehicle, the momentum of the vehicle decreases and the decrease is in the opposite direction of motion because the force is being applied in the opposite direction of motion.
Mathematical formulation of Newton's Second Law of Motion:
Let mass of an moving object = m.
Let the velocity of the object changes from 'u' to 'v' in the interval of time 't'.
This means,
Initial velocity of the object = u.
Final velocity of the object = v.
We know that momentum (p) = Mass x velocity
Therefore,
Momentum (p) of the object at its initial velocity u = m x u = mu
Momentum (p) of the object at its final velocity v = m x v = mv
The change in momentum = mv – mu

$$\text{Rate of change of momentum} = \frac{mv - mu}{t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

According to the Newton's Second Law of motion force is directly proportional to the rate of change of momentum.

This means, Force ∝ Rate of change of moentum

After substituting the value of rate of change of momentum from equation (i) we get.

$$Force \propto \frac{mv - mu}{t}$$

$$\Rightarrow F \propto \frac{m(v-u)}{t}$$

$$\Rightarrow F \propto ma \left(\because a = \frac{v-u}{t} \right)$$

$$\Rightarrow F = k.ma \quad \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(ii)}$$

where, k is proportionality constant.
Since, 1 unit force is defined as the mass of 1kg object produces the acceleration of $1 m/s^2$
Therefore, 1 unit of Force = k x 1 kg x $1 m/s^2$

Thus $k = 1$.

By substituting the value of 'k = 1' in equation (ii) we get

F = m.a ……………… (iii)

⇒ Force = mass × acceleration

Thus Newton's Second Law of Motion gives the relation between force, mass and acceleration of an object.

According to the relation obtained above, Newton's Second Law can be modified as follows:

The product of mass and acceleration is the force acting on the object.

The SI unit of Force: Newton (N)

Since Force = Mass x Acceleration

The unit of mass = kg and The unit of acceleration = m/s^2

If force, mass and acceleration is taken as 1 unit.

Therefore,

1 Newton (N) = 1kg x $1 m/s^2$

Thus, Newton (N) = kg m/s^2

Equation (iii) can be also written as

$a = \frac{F}{m}$ ………………… (iv)

This equation is the form of Newton's Second Law of Motion.

According to this equation, Newton's Second Law of Motion can also be stated as follow:

The acceleration produced by a moving body is directly proportional to the force applied over it and inversely proportional to the mass of the object.

From the above relation it is clear that

Acceleration increases with increase in force and vice versa.

Acceleration decreases with increase in mass and vice versa.

That's why a small vehicle requires less force to attain more acceleration while a heavy vehicle requires more force to get the same acceleration.

NEWTON'S SECOND LAW OF MOTION IN EVERYDAY LIFE:

a. A fielder pulls his hand backward; while catching a cricket ball coming with a great speed, to reduce the momentum of the ball with a little delay. According to Newton's Second Law of Motion; rate of change of momentum is directly proportional to the force applied in the direction.

b. While catching a cricket ball the momentum of ball is reduced to zero when it is stopped after coming in the hands of fielder. If the ball is stopped suddenly, its momentum will be reduced to zero instantly. The rate of change in momentum is very quick and as a result, the player's hand may get injured. Therefore, by pulling the hand backward a fielder gives more time to the change of momentum to become zero. This prevents the hands of fielder from getting hurt.

NUMERICAL

1. What is acceleration produced by a force of 12 Newton exerted on an object of mass 3 kg?

2. What force would be needed to produce an acceleration of $4 m/s^2$ on a ball of mass 6 kg?

3. A force of 5 N gives a mass m_1, an acceleration of 8 m/s^2, and a mass m_2, an acceleration of 24 m/s^2. What acceleration would give if both the masses are tied together?

4. Calculate the force required to impart a car a velocity of 30m/s in 10 seconds. The mass of the car is 1500 kg.

5. A motorcycle is moving with a velocity of 90km/h and it takes 5 seconds to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcycle if its mass along with the rider is 200kg.

6. What is the momentum of a man of mass 75kg when he walks with a velocity of 2m/s?

7. What would be the force required to produce an acceleration of $2 m/s^2$ in a body of mass 12 kg? What would be the acceleration it the force were doubled?

8. A man pushes a box of mass 50 kg with a force of 80N.What will be the acceleration of the box? What would be the acceleration if the mass were doubled?

9. A certain force exerted for 1.2 second raises the speed of an object from 1.8m/s to 4.2 m/s. Later, the same force is applied for 2 second. How much does the speed change in 2 second?

10. A constant force acts on an object of mass 5 kg for duration of 2 second. It increases the object's velocity from 3cm/s to 7m/s. Find the magnitude of the applied force. Now if the force were applied for a duration of 5 seconds, what would be the final velocity of the object?

11. A motorcar is moving with a velocity of 108km/h and it takes 4 seconds to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcar it its mass along with the passengers is 1000 kg.

12. A force of 5 N gives a mass m_1, an acceleration of $10 m/s^2$, and a mass m_2, an acceleration of $20 m/s^2$. What acceleration would it give if both the masses were tied together?

13. For how long should a force of 100 N act on a body of mass 20 kg so that it acquires a velocity of 100 m/s?

14. A 150 g ball traveling at 30m/s strikes the palm of a players hand and is stopped in 0.06 sec. Calculate the force exerted by the ball on the hand.

15. A body of mass 1 kg is kept at rest. A constant force of 6.0 N starts acting on it . Find the time taken by the body to move through a distance of 12m.

16. A force of 4 N acts on a body of mass 2 kg for 4 s. Assuming that the body to be initially at rest, find (i) its velocity when the force stops acting (ii) the distance covered in 10 s after the force starts acting.

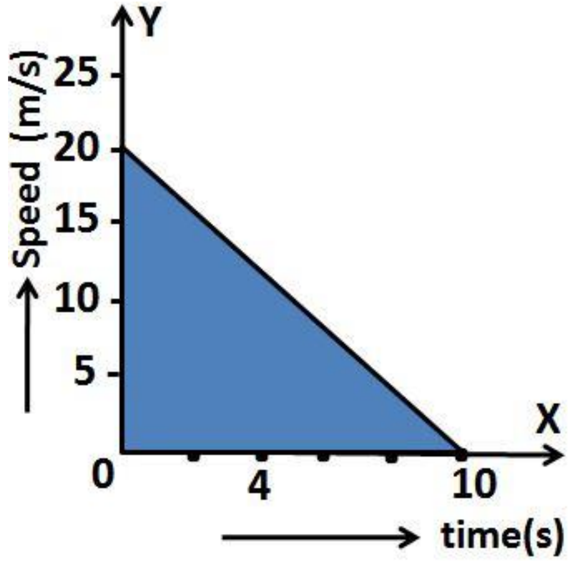
17. A feather of mass 10 g is dropped from a height. It is found to fall down with a constant velocity. What is the net force acting on it?

18. A hockey ball of mass 200g traveling from west to east at 10m/s is struck by a hockey stick. As a result, then ball gets turned back and now has a speed of 5m/s. If the ball and hockey stick were in contact for 0.2 s, calculate (i) initial and final momentum of the ball (ii) rate of change of momentum of the ball (iii) the force exerted by hockey stick on the ball.

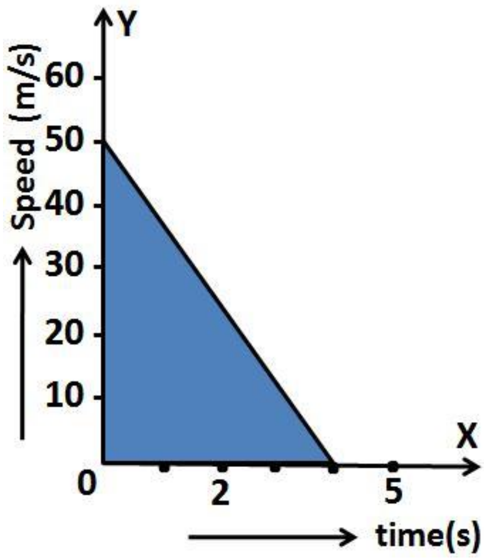
19. A stone of mass 500 g is thrown with a velocity of 20m/s across the frozen surface of a lake. It comes to rest after traveling a distance of 0.1 km. Calculate force of friction between the stone and frozen surface of lake.

20. A body starts from rest and rolls down a hill with a constant acceleration. If its travels 400 m in 20 seconds, calculate the force acting on the body if its mass is 10kg.

21. The velocity time graph of a ball of mass 20g moving along a straight line on a long table is given in below figure. How much force does the table exert on the ball to bring it to rest?



22. The speed time graph of a ball of mass 30g moving along a straight line is shown in below figure. Calculate the opposing force that brings the ball to rest.



What will be the percentage change in momentum of a body when both its mass and velocity are doubled?

23. A force of 2 N gives a mass m1 an acceleration of 5m/s2 and a mass m2, an accelerated of 7m/s2. What acceleration would be produced if both the masses are tied together?

24. A body of mass 2 kg moving with a velocity of 10m/s is brought to rest in 5 sec. Calculate the stopping force applied.

NEWTON'S THIRD LAW OF MOTION

Newton's Third Law of Motion states that there is always reaction for every action in opposite direction and of equal magnitude.

Explanation: Whenever a force is applied over a body, that body also applies same force of equal magnitude and in opposite direction.

Example –

(a) Walking of a person - A person is able to walk because of the Newton's Third Law of Motion. During walking, a person pushes the ground in backward direction and in the reaction the ground also pushes the person with equal magnitude of force but in opposite direction. This enables him to move in forward direction against the push.

(b) Recoil of gun - When bullet is fired from a gun, the bullet also pushes the gun in opposite direction, with equal magnitude of force. This results in gunman feeling a backward push from the butt of gun.

(c) Propulsion of a boat in forward direction – Sailor pushes water with oar in backward direction; resulting water pushing the oar in forward direction. Consequently, the boat is pushed in forward direction. Force applied by oar and water are of equal magnitude but in opposite directions.

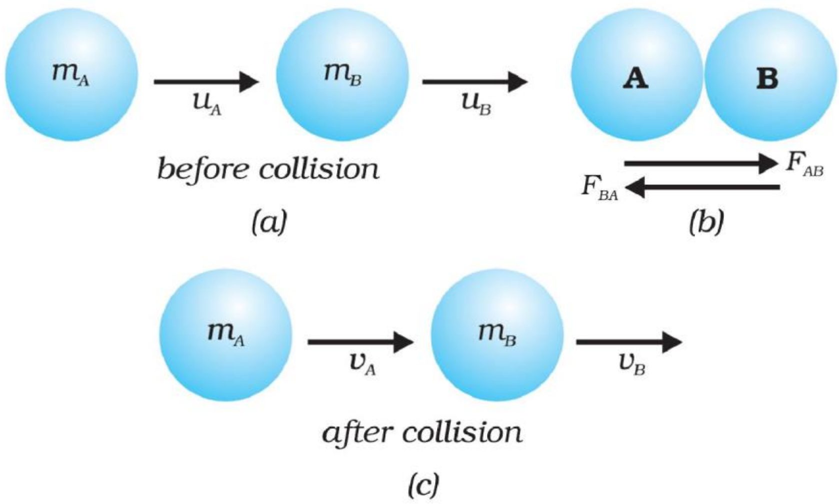
CONSERVATION OF MOMENTUM –

Law of Conservation of Momentum – The sum of momenta of two objects remains same even after collision.

In other words, the sum of momenta of two objects before collision and sum of momenta of two objects after collision are equal.

Mathematical Formulation of Conservation of Momentum:

Suppose that, two objects A and B are moving along a straight line in same direction and the velocity of A is greater than the velocity of B.



Let the initial velocity of A=u_A

Let the initial velocity of B= u_B

Let the mass of A= m_A

Let the mass of B=m_B

Let both the objects collide after some time and collision lasts for ' t' second.

Let the velocity of A after collision= v_A

Let the velocity of B after collision= v_B

We know that, Momentum = Mass x Velocity
Therefore,
Momentum of A (F_A) before collision = m_A x u_A
Momentum of B (F_B) before collision = m_B x u_B
Momentum of A after collision = m_A x v_A
Momentum of B after collision = m_B x v_B

Now, we know that Rate of change of momentum = mass x rate of change in velocity

$\Rightarrow$ Rate of change of momentum =mass$\times \dfrac{\text{Change in velocity}}{time}$

Therefore, rate of change of momentum of A during collision, $F_{AB} = m_A\left(\dfrac{v_A - u_A}{t}\right)$

Similarly, the rate of change of momentum of B during collision, $F_{BA} = m_B\left(\dfrac{v_B - u_B}{t}\right)$

Since, according to the Newton's Third Law of Motion, action of the object A (force exerted by A) will be equal to reaction of the object B (force exerted by B). But the force exerted in the course of action and reaction is in opposite direction.
Therefore,

$$F_{AB} = -F_{BA}$$

$$or, m_A\left(\frac{v_A - u_A}{t}\right) = -m_B\left(\frac{v_B - u_B}{t}\right)$$

$$\Rightarrow m_A(v_A - u_A) = -m_B(v_B - u_B)$$

$$\Rightarrow m_A v_A - m_A u_A = -m_B v_B + m_B u_B$$

$$\Rightarrow m_A v_A + m_B v_B = m_A u_A + m_B u_B \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Above equation says that total momentum of object A and B before collision is equal to the total momentum of object A and B after collision. We observe that the total momentum of the two balls remains unchanged or conserved provided no other external force acts. As a result of this ideal collision experiment, we say that the sum of momenta of the two objects before collision is equal to the sum of momenta after the collision provided there is no external unbalanced force acting on them. This is known as the law of conservation of momentum. This statement can alternatively be given as the total momentum of the two objects is unchanged or conserved by the collision.

CONSERVATION OF MOMENTUM – PRACTICAL APPLICATION

- Bullet and Gun – When bullet is fired from a gun, gun recoils in the opposite direction of bullet. The momentum of bullet is equal to momentum of gun. Since, the bullet is has very small mass compared to the gun, hence velocity of bullet is very high compared to the recoil of gun. In the case of firing of bullet, law of conservation of momentum is applied as usual.
- When a cricket ball is hit by bat, the Law of Conservation of Momentum is applied.

NUMERICAL

1. The velocity of a body of mass 10kg increases from 4m/s to 8m/s when a force acts on it for 2s. (a) What is the momentum before and after the force acts? (b) What is the gain in momentum per second? (c) What is the value of the force?

2. A boy pushes a wall with a force of 20N. What is the magnitude and direction of the force experienced by the body?

3. A 20 g bullet is shot from a 5 kg gun with a velocity of 500m/s. What is the speed of the recoil of the gun?

4. A 10 g bullet is shot from a 5 kg gun with a velocity of 400m/s. What is the speed of the recoil of the gun?

5. When two bodies A and B interact with each other, A exerts a force of 10N on B, towards east. What is the force exerted by B on A?

6. A man weighting 60kg runs along the rails with a velocity of 18km/h and jumps into a car of mass 1 quintal standing on the rails. Calculate the velocity with which car will start traveling along the rails.

7. The car A of mass 1500kg, traveling at 25m/s collides with another car B of amss 1000kg traveling at 15m/s in the same direction. After collision, the velocity of car A becomes 20m/s. Calculate the velocity of car B after collision.

8. A bullet of mass 10g is fired from a gun of mass 6 kg with a velocity of 300m.s. Calculate the recoil velocity of the gun.

9. A bullet of mass 50g is fired from a gun of mass 6 kg with a velocity of 400m.s. Calculate the recoil velocity of the gun.

10. A bullet of mass 10g is moving with a velocity of 400m/s gets embedded in a freely suspended wooden block of mass 900g. What is the velocity acquired by the block?

11. A gun of mass 3 kg fires a bullet of mass 30g. The bullet takes 0.003s to move through the barrel of the gun and acquires a velocity of 100m/s. Calculate (i) the velocity with which the gun recoils (ii) the force exerted on gunman due to recoil of the gun.

12. A heavy car of mass 200kg traveling at 10m/s has a head on collision with a sports car B of mass 500kg. If both cars stop dead on colliding, what was the velocity of car B?

13. A machine gun fires 25h bullet at the rate of 600 bullets per minute with a speed of 200m/s. Calculate the force required to keep the gun in position.

14. A bullet of mass 20g is moving with a velocity of 300m/s gets embedded in a freely suspended wooden block of mass 880g. What is the velocity acquired by the block?

15. A girl of mass 50kg jumps out of a rowing boat of mass 300kg on to the bank with a horizontally velocity of 3m/s. With what velocity does the boat begin to move backwards?

16. A truck of mass 2500kg moving at 15m/s collides with a car of mass 1000kg moving with at 5m/s in the opposite direction. What is their common velocity?

17. A bullet of mass 20 g is fired horizontally with a velocity of 150m/s from a pistol of mass 2kg. What is the recoil velocity of the pistol?

18. A body of mass 60kg running at 3m/s jumps on to a trolley of mass 140kg moving with a velocity of 1.5m/s in the same direction. What is their common velocity?

19. A girl of mass 40kg jumps with a horizontal velocity of 5m/s onto a stationary cart with frictionless wheels. The mass of the cart is 3kg. What is her velocity as the cart starts moving? Assume that there is no external unbalanced force working in the horizontal direction?

20. Two hockey players of opposite teams, while trying to hit a hockey ball on the ground collide and immediately become entangled. One has a mass of 60kg, and was moving with a velocity 5m/s, while the other has a mass 55kg and was moving faster with a velocity of 6m/s towards the first player. In which direction and with what velocity will they move after they become entangled? Assume that the frictional force acting between the feet of the two players and ground is negligible.

INTEXT QUESTIONS PAGE NO. 126

1. If action is always equal to the reaction, explain how a horse can pull a cart.
Ans. A horse pushes the ground in the backward direction. According to Newton's third law of motion, a reaction force is exerted by the Earth on the horse in the forward direction. As a result, the cart moves forward.

2. Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high velocity.
Ans. Due to the backward reaction of the water being ejected. When a fireman holds a hose, which is ejecting large amounts of water at a high velocity, then a reaction force is exerted on him by the ejecting water in the backward direction. This is because of Newton's third law of motion. As a result of the backward force, the stability of the fireman decreases. Hence, it is difficult for him to remain stable while holding the hose.

3. From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 m s^{-1}. Calculate the initial recoil velocity of the rifle.
Ans. Mass of the rifle, m_1 = 4kg
Mass of the bullet, m_2 = 50g = 0.05 kg
Recoil velocity of the rifle = v_1
Bullet is fired with an initial velocity, v_2 = 35m/s
Initially, the rifle is at rest.
Thus, its initial velocity, $v = 0$
Total initial momentum of the rifle and bullet system $=(m_1 + m_2)v = 0$
Total momentum of the rifle and bullet system after firing
$= m_1v_1 + m_2v_2 = 4(v_1) + 0.05 \times 35 \qquad = 4v_1 + 1.75$
According to the law of conservation of momentum:
Total momentum after the firing = Total momentum before the firing

$$4v + 1.75 = 0 \Rightarrow v = -\frac{1.75}{} = -0.4375 m/s$$

1 1 4

The negative sign indicates that the rifle recoils backwards with a velocity of 0.4375 m/s.

4. Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 m s^{-1} and 1 m s^{-1}, respectively. They collide and after the collision, the first object moves at a velocity of 1.67 m s^{-1}. Determine the velocity of the second object.

Ans.

Mass of one of the objects, m_1 = 100 g = 0.1 kg

Mass of the other object, m_2 = 200 g = 0.2 kg

Velocity of m_1 before collision, v_1 = 2 m/s

Velocity of m_2 before collision, v_2 = 1 m/s

Velocity of m_1 after collision, v_3 = 1.67 m/s

Velocity of m_2 after collision = v_4

According to the law of conservation of momentum:

Total momentum before collision = Total momentum after collision

$\therefore m_1v_1 + m_2v_2 = m_3v_3 + m_4v_4$

$\Rightarrow (0.1) \times 2 + (0.2) \times 1 = (0.1) \times 1.67 + (0.2) \times v_4$

$\Rightarrow 0.4 = 0.167 + 0.2v_4$

$\therefore v_4 = 1.165$ m/s

Hence, the velocity of the second object becomes 1.165 m/s after the collision.

EXERCISE QUESTIONS PAGE NO. 128

1. An object experiences a net zero external unbalanced force. Is it possible for the object to be travelling with a non-zero velocity? If yes, state the conditions that must be placed on the magnitude and direction of the velocity. If no, provide a reason.

Ans. Yes. Even when an object experiences a net zero external unbalanced force, it is possible that the object is travelling with a non-zero velocity. This is possible only when the object has been moving with a constant velocity in a particular direction. Then, there is no net unbalanced force applied on the body. The object will keep moving with a non-zero velocity. To change the state of motion, a net non-zero external unbalanced force must be applied on the object.

2. When a carpet is beaten with a stick, dust comes out of it. Explain.

Ans. Inertia of an object tends to resist any change in its state of rest or state of motion. When a carpet is beaten with a stick, then the carpet comes to motion. But, the dust particles try to resist their state of rest. According to Newton’s first law of motion, the dust particles stay in a state of rest, while the carpet moves. Hence, the dust particles come out of the carpet.

3. Why is it advised to tie any luggage kept on the roof of a bus with a rope?

Ans. When the bus accelerates and moves forward, it acquires a state of motion. However, the luggage kept on the roof, owing to its inertia, tends to remain in its state of rest. Hence, with the forward movement of the bus, the luggage tends to remain at its original position and ultimately falls from the roof of the bus. To avoid this, it is advised to tie any luggage kept on the roof of a bus with a rope.

4. A batsman hits a cricket ball which then rolls on a level ground. After covering a short distance, the ball comes to rest. The ball slows to a stop because

(a) the batsman did not hit the ball hard enough.

(b) velocity is proportional to the force exerted on the ball.

(c) there is a force on the ball opposing the motion.

(d) there is no unbalanced force on the ball, so the ball would want to come to rest.

Ans. (c) A batsman hits a cricket ball, which then rolls on a level ground. After covering a short distance, the ball comes to rest because there is frictional force on the ball opposing its motion. Frictional force always acts in the direction opposite to the direction of motion. Hence, this force is responsible for stopping the cricket ball.

5. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20 s. Find its acceleration. Find the force acting on it if its mass is 7 metric tonnes (*Hint*: 1 metric tonne = 1000 kg.)

Ans. Initial velocity, $u = 0$ (since the truck is initially at rest)
Distance travelled, $s = 400$ m
Time taken, $t = 20$ s

According to the second equation of motion: $s = ut + \frac{1}{2}at^2$

Where, Acceleration = a

$400 = 0 + \frac{1}{2}a(20)^2 \quad \Rightarrow 400 = \frac{1}{2}a(400)$

$\Rightarrow$ a = 2m/s^2
1 metric tonne = 1000 kg (Given)

$\therefore$ 7 metric tonnes = 7000 kg
Mass of truck, $m = 7000$ kg
From Newton's second law of motion:
Force, F = Mass × Acceleration
$F = ma = 7000 \times 2 = 14000$ N
Hence, the acceleration of the truck is 2 m/s^2 and the force acting on the truck is 14000 N.

6. A stone of 1 kg is thrown with a velocity of 20 m/s across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?

Ans. Initial velocity of the stone, $u = 20$ m/s
Final velocity of the stone, $v = 0$ (finally the stone comes to rest)
Distance covered by the stone, $s = 50$ m
According to the third equation of motion:
$v^2 = u^2 + 2as$
Where,
Acceleration, a
$(0)^2 = (20)^2 + 2 \times a \times 50$
$a = -4$ m/s^2
The negative sign indicates that acceleration is acting against the motion of the stone.
Mass of the stone, $m = 1$ kg
From Newton's second law of motion:
Force, F = Mass × Acceleration
$F = ma$
$F = 1 \times (-4) = -4$ N
Hence, the force of friction between the stone and the ice is −4 N.

7. A 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate:
(a) the net accelerating force;
(b) the acceleration of the train; and
(c) the force of wagon 1 on wagon 2.

Ans.
(a)Force exerted by the engine, $F = 40000$ N
Frictional force offered by the track, $F_f = 5000$ N
Net accelerating force, $F_a = F - F_f = 40000 - 5000 = 35000$ N
Hence, the net accelerating force is 35000 N.
(b)Acceleration of the train = a
The engine exerts a force of 40000 N on all the five wagons.
Net accelerating force on the wagons, $F_a = 35000$ N
Mass of the wagons, m = Mass of a wagon × Number of wagons
Mass of a wagon = 2000 kg
Number of wagons = 5
$\therefore\ m = 2000 \times 5 = 10000$ kg
Mass of the engine, $m' = 8000$ kg
Total mass, $M = m + m' = 18000$ kg
From Newton's second law of motion:
$F_a = Ma$
$$\Rightarrow a = \frac{F_a}{M} = \frac{35000}{18000} = 1.944 m/s^2$$
Hence, the acceleration of the wagons and the train is 1.944 m/s^2.
(c)Mass of all the wagons except wagon 1 is 4 × 2000 = 8000 kg
Acceleration of the wagons = 3.5 m/s^2
Thus, force exerted on all the wagons except wagon 1
= 8000 × 3.5 = 28000 N
Therefore, the force exerted by wagon 1 on the remaining four wagons is 28000 N.
Hence, the force exerted by wagon 1 on wagon 2 is 28000 N.

8. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of 1.7 m/s^2?
Ans. Mass of the automobile vehicle, m = 1500 kg
Final velocity, v = 0 (finally the automobile stops)
Acceleration of the automobile, $a = -1.7\ ms^{-2}$
From Newton's second law of motion:
Force = Mass × Acceleration = 1500 × (−1.7) = −2550 N
Hence, the force between the automobile and the road is −2550 N, in the direction opposite to the motion of the automobile.

9. What is the momentum of an object of mass m, moving with a velocity v?
(a) $(mv)^2$ (b) mv^2 (c) ½ mv^2 (d) mv
Ans. (d) mv
Mass of the object = m
Velocity = v
Momentum = Mass × Velocity
Momentum = mv

10. Using a horizontal force of 200 N, we intend to move a wooden cabinet across a floor at a constant velocity. What is the friction force that will be exerted on the cabinet?
Ans. A force of 200 N is applied in the forward direction. Thus, from Newton's third law of motion, an equal amount of force will act in the opposite direction. This opposite force is the fictional force exerted on the cabinet. Hence, a frictional force of 200 N is exerted on the cabinet.

11. Two objects, each of mass 1.5 kg, are moving in the same straight line but in opposite directions. The velocity of each object is 2.5 m s-1 before the collision during which they stick together. What will be the velocity of the combined object after collision?

Ans. Mass of one of the objects, $m_1 = 1.5$ kg

Mass of the other object, $m_2 = 1.5$ kg

Velocity of m_1 before collision, $v_1 = 2.5$ m/s

Velocity of m_2, moving in opposite direction before collision, $v_2 = -2.5$ m/s

(Negative sign arises because mass m_2 is moving in an opposite direction)

After collision, the two objects stick together.

Total mass of the combined object = $m_1 + m_2$

Velocity of the combined object = v

According to the law of conservation of momentum:

Total momentum before collision = Total momentum after collision

$m_1v_1 + m_2\, v_1 = (m_1 + m_2)\, v$

$1.5(2.5) + 1.5\,(-2.5) = (1.5 + 1.5)\, v$

$3.75 - 3.75 = 3\, v$

$v = 0$

Hence, the velocity of the combined object after collision is 0 m/s.

12. According to the third law of motion when we push on an object, the object pushes back on us with an equal and opposite force. If the object is a massive truck parked along the roadside, it will probably not move. A student justifies this by answering that the two opposite and equal forces cancel each other. Comment on this logic and explain why the truck does not move.

Ans. The truck has a large mass. Therefore, the static friction between the truck and the road is also very high. To move the car, one has to apply a force more than the static friction. Therefore, when someone pushes the truck and the truck does not move, then it can be said that the applied force in one direction is cancelled out by the frictioal force of equal amount acting in the opposite direction. Therefore, the student is right in justifying that the two opposite and equal cancel each other.

13. A hockey ball of mass 200 g travelling at 10 m/s is struck by a hockey stick so as to return it along its original path with a velocity at 5 m/s. Calculate the change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick.

Ans. Mass of the hockey ball, $m = 200$ g = 0.2 kg

Hockey ball travels with velocity, $v_1 = 10$ m/s

Initial momentum = mv_1

Hockey ball travels in the opposite direction with velocity, $v_2 = -5$ m/s

Final momentum = mv_2

Change in momentum = $mv_1 - mv_2 = 0.2\,[10 - (-5)] = 0.2\,(15) = 3$ kg m s^{-1}

Hence, the change in momentum of the hockey ball is 3 kg m s^{-1}.

14. A bullet of mass 10 g travelling horizontally with a velocity of 150 m/s strikes a stationary wooden block and comes to rest in 0.03 s. Calculate the distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet.

Ans. Now, it is given that the bullet is travelling with a velocity of 150 m/s.

Thus, when the bullet enters the block, its velocity = Initial velocity, $u = 150$ m/s

Final velocity, $v = 0$ (since the bullet finally comes to rest)

Time taken to come to rest, $t = 0.03$ s

According to the first equation of motion, $v = u + at$

Acceleration of the bullet, a

$0 = 150 + (a \times 0.03\ \text{s})$

$$a = \frac{-150}{0.03} = -5000 m/s^2$$

(Negative sign indicates that the velocity of the bullet is decreasing.)

According to the third equation of motion:

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

$0 = (150)^2 + 2\,(-5000)\,s$

$$s = \frac{-(150)^2}{-2(5000)} = \frac{22500}{10000} = 2.25m$$

Hence, the distance of penetration of the bullet into the block is 2.25 m.

From Newton's second law of motion:

Force, F = Mass × Acceleration

Mass of the bullet, m = 10 g = 0.01 kg

Acceleration of the bullet, $a = 5000\ m/s^2$

$F = ma = 0.01 \times 5000 = 50$ N

Hence, the magnitude of force exerted by the wooden block on the bullet is 50 N.

15. An object of mass 1 kg travelling in a straight line with a velocity of 10 m/s collides with, and sticks to, a stationary wooden block of mass 5 kg. Then they both move off together in the same straight line. Calculate the total momentum just before the impact and just after the impact. Also, calculate the velocity of the combined object.

Ans.

Mass of the object, m_1 = 1 kg

Velocity of the object before collision, v_1 = 10 m/s

Mass of the stationary wooden block, m_2 = 5 kg

Velocity of the wooden block before collision, v_2 = 0 m/s

$\therefore$ Total momentum before collision = $m_1 v_1 + m_2 v_2$

= 1 (10) + 5 (0) = 10 kg m s^{-1}

It is given that after collision, the object and the wooden block stick together.

Total mass of the combined system = $m_1 + m_2$

Velocity of the combined object = v

According to the law of conservation of momentum:

Total momentum before collision = Total momentum after collision

$m_1 v_1 + m_2 v_2 = (m_1 + m_2)\, v$

$1\,(10) + 5\,(0) = (1 + 5)\, v$

$$v = \frac{10}{6} = \frac{5}{3} m/s$$

The total momentum after collision is also 10 kg m/s.

Total momentum just before the impact = 10 kg m s^{-1}

Total momentum just after the impact = $(m_1 + m_2)\, v = 6 \times \frac{5}{3} = 10 kgm/s$

Hence, velocity of the combined object after collision = $\frac{5}{3} m/s$.

16. An object of mass 100 kg is accelerated uniformly from a velocity of 5 m/s to 8 m/s in 6 s. Calculate the initial and final momentum of the object. Also, find the magnitude of the force exerted on the object.

Ans.

Initial velocity of the object, u = 5 m/s

Final velocity of the object, v = 8 m/s

Mass of the object, m = 100 kg

Time take by the object to accelerate, t = 6 s

Initial momentum = mu = 100 × 5 = 500 kg m s^{-1}
Final momentum = mv = 100 × 8 = 800 kg m s^{-1}

Force exerted on the object, $F = \dfrac{mv - mu}{t}$

$$\Rightarrow F = \frac{m(v-u)}{t} = \frac{800-500}{6} = \frac{300}{6} = 50N$$

Initial momentum of the object is 500 kg m s^{-1}.
Final momentum of the object is 800 kg m s^{-1}.
Force exerted on the object is 50 N.

17. Akhtar, Kiran and Rahul were riding in a motorcar that was moving with a high velocity on an expressway when an insect hit the windshield and got stuck on the windscreen. Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motorcar (because the change in the velocity of the insect was much more than that of the motorcar). Akhtar said that since the motorcar was moving with a larger velocity, it exerted a larger force on the insect. And as a result the insect died. Rahul while putting an entirely new explanation said that both the motorcar and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

Ans.

According to the law of conservation of momentum:

Momentum of the car and insect system before collision = Momentum of the car and insect system after collision

Hence, the change in momentum of the car and insect system is zero.

The insect gets stuck on the windscreen. This means that the direction of the insect is reversed. As a result, the velocity of the insect changes to a great amount. On the other hand, the car continues moving with a constant velocity. Hence, Kiran's suggestion that the insect suffers a greater change in momentum as compared to the car is correct. The momentum of the insect after collision becomes very high because the car is moving at a high speed. Therefore, the momentum gained by the insect is equal to the momentum lost by the car.

Akhtar made a correct conclusion because the mass of the car is very large as compared to the mass of the insect.

Rahul gave a correct explanation as both the car and the insect experienced equal forces caused by the Newton's action-reaction law. But, he made an incorrect statement as the system suffers a change in momentum because the momentum before the collision is equal to the momentum after the collision.

18. How much momentum will a dumb-bell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take its downward acceleration to be 10 m/s^2.

Ans. Mass of the dumbbell, m = 10 kg
Distance covered by the dumbbell, s = 80 cm = 0.8 m
Acceleration in the downward direction, a = 10 m/s^2
Initial velocity of the dumbbell, u = 0
Final velocity of the dumbbell (when it was about to hit the floor) = v
According to the third equation of motion:
$v^2 = u^2 + 2as$
$v^2 = 0 + 2\,(10)\,0.8$
v = 4 m/s
Hence, the momentum with which the dumbbell hits the floor is = mv = 10 × 4 = 40 kg m s^{-1}

ADDITIONAL EXERCISE QUESTIONS PAGE NO. 128

1. The following is the distance-time table of an object in motion:

Time in seconds	Distance in metres
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343

(a) What conclusion can you draw about the acceleration? Is it constant, increasing, decreasing, or zero?
(b)What do you infer about the forces acting on the object?

Ans.

(a) There is an unequal change of distance in an equal interval of time. Thus, the given object is having a non − uniform motion. Since the velocity of the object increases with time, the acceleration is increasing.

(b)According to Newton's second law of motion, the force acting on an object is directly proportional to the acceleration produced in the object. In the given case, the increasing acceleration of the given object indicates that the force acting on the object is also increasing.

2. Two persons manage to push a motorcar of mass 1200 kg at a uniform velocity along a level road. The same motorcar can be pushed by three persons to produce an acceleration of 0.2 m s-2. With what force does each person push the motorcar? (Assume that all persons push the motorcar with the same muscular effort.)

Ans.

Mass of the motor car = 1200 kg

Only two persons manage to push the car. Hence, the acceleration acquired by the car is given by the third person alone.

Acceleration produced by the car, when it is pushed by the third person,

$a = 0.2\ m/s^2$

Let the force applied by the third person be F.

From Newton's second law of motion:

Force = Mass × Acceleration

$F = 1200 \times 0.2 = 240$ N

Thus, the third person applies a force of magnitude 240 N.

Hence, each person applies a force of 240 N to push the motor car.

3. A hammer of mass 500 g, moving at 50 m s-1, strikes a nail. The nail stops the hammer in a very short time of 0.01 s. What is the force of the nail on the hammer?

Ans.

Mass of the hammer, m = 500 g = 0.5 kg

Initial velocity of the hammer, u = 50 m/s

Time taken by the nail to the stop the hammer, $t = 0.01$ s
Velocity of the hammer, $v = 0$ (since the hammer finally comes to rest)
From Newton's second law of motion:

$$Force, F = \frac{m(v-u)}{t} = \frac{0.5(0-50)}{0.01} = -2500N$$

The hammer strikes the nail with a force of −2500 N. Hence, from Newton's third law of motion, the force of the nail on the hammer is equal and opposite, i.e., +2500 N.

4. A motorcar of mass 1200 kg is moving along a straight line with a uniform velocity of 90 km/h. Its velocity is slowed down to 18 km/h in 4 s by an unbalanced external force. Calculate the acceleration and change in momentum. Also calculate the magnitude of the force required.

Ans.

Mass of the motor car, $m = 1200$ kg
Initial velocity of the motor car, u = 90 km/h = 25 m/s
Final velocity of the motor car, $v = 18$ km/h = 5 m/s
Time taken, $t = 4$ s
According to the first equation of motion:
$v = u + at$
$5 = 25 + a(4)$
$a = -5\ \text{m/s}^2$
Negative sign indicates that its a retarding motion i.e. velocity is decreasing.
Change in momentum = $mv - mu = m(v-u)$
$= 1200\ (5 - 25) = -24000\ \text{kg m s}^{-1}$
Force = Mass × Acceleration
$= 1200 \times -5 = -6000$ N
Acceleration of the motor car = $-5\ \text{m/s}^2$
Change in momentum of the motor car = $-24000\ \text{kg m s}^{-1}$
Hence, the force required to decrease the velocity is 6000 N. (Negative sign indicates retardation, decrease in momentum and retarding force)

5. A large truck and a car, both moving with a velocity of magnitude v, have a head-on collision and both of them come to a halt after that. If the collision lasts for 1 s:
(a) Which vehicle experiences the greater force of impact?
(b) Which vehicle experiences the greater change in momentum?
(c) Which vehicle experiences the greater acceleration?
(d) Why is the car likely to suffer more damage than the truck?

Ans.

Let the mass of the truck be M and that of the car be m.
Thus, $M > m$
Initial velocity of both vehicles, v
Final velocity of both vehicles, $v' = 0$ (since the vehicles come to rest after collision)
Time of impact, $t = 1$ s
(a) From Newton's second law of motion, the net force experienced by each vehicle is given by the relation:

$$F_{car} = \frac{m(v'-v)}{t} = -mv$$

$$F_{truck} = \frac{M(v'-v)}{t} = -Mv$$

Since the mass of the truck is greater than that of the car, it will experience a greater force of impact.

(b) Initial momentum of the car = mv
Final momentum of the car = 0
Change in momentum = mv
Initial momentum of the truck = Mv
Final momentum of the truck = 0
Change in momentum = Mv
Since the mass of the truck is greater than that of the car, it will experience a greater change in momentum.

(c) From the first equation of motion, acceleration produced in a system is independent of the mass of the system. The initial velocity, the final velocity, and the time of impact remain the same in both cases. Hence, both the car and the truck experience the same amount of acceleration.

(d)According to Newton's third law of motion, for every action there is an equal and opposite reaction that acts on different bodies. Since the truck experiences a greater force of impact (action), this larger impact force is also experienced by the car (reaction). Thus, the car is likely to suffer more damage than the truck.

ASSIGNMENT QUESTIONS
FORCE AND LAWS OF MOTION

Multiple Choice Questions

1. Which of the following statement is ***not*** correct for an object moving along a straight path in an accelerated motion?
(a) Its speed keeps changing
(b) Its velocity always changes
(c) It always goes away from the earth
(d) A force is always acting on it

2. The forces of action and reaction are
(a) always equal only
(b) always equal and opposite
(c) always equal but in same direction
(d) always unequal and opposite.

3. According to the third law of motion, action and reaction
(a) always act on the same body
(b) always act on different bodies in opposite directions
(c) have same magnitude and directions
(d) act on either body at normal to each other

4. The action and reaction forces at
(a) on different bodies always
(b) on some body always
(c) on same body, sometimes
(d) on different bodies, sometimes

5. A goalkeeper in a game of football pulls his hands backwards after holding the ball shot at the goal. This enables the goal keeper to
(a) exert larger force on the ball
(b) reduce the force exerted by the ball on hands
(c) increase the rate of change of momentum
(d) decrease the rate of change of momentum

6. The inertia of an object tends to cause the object
(a) to increase its speed
(b) to decrease its speed
(c) to resist any change in its state of motion
(d) to decelerate due to friction

7. Principle of conservation of linear momentum is deduced from
(a) Newton’s first law
(b) Newton’s second law
(c) Newton’s third law
(d) none of the above

8. The function of mud guards is based on
(a) inertia of rest
(b) inertia of direction

(c) inertia of motion
(d) none of the above

9. The force of action and reaction
(a) always cancel each other
(b) never cancel
(c) cancel sometimes
(d) cannot say

10. A passenger in a moving train tosses a coin which falls behind him. It means that motion of the train is
(a) accelerated
(b) uniform
(c) retarded
(d) along circular tracks

11. An object of mass 2 kg is sliding with a constant velocity of 4 m s–1 on a frictionless horizontal table. The force required to keep the object moving with the same velocity is
(a) 32 N
(b) 0 N
(c) 2 N
(d) 8 N

12. Rocket works on the principle of conservation of
(a) mass
(b) energy
(c) momentum
(d) velocity

13. A water tanker filled up to $\frac{2}{3}$ of its height is moving with a uniform speed. On sudden application of the brake, the water in the tank would
(a) move backward
(b) move forward
(c) be unaffected
(d) rise upwards

14. Inertia of a body in linear motion is measured by its
(a) mass
(b) momentum
(c) velocity
(d) none of the above

15. What mass of a body can attain an acceleration of $5 m/s^2$ under a force of 250 N?
(a) 5 kg
(b) 250 kg
(c) 50 kg
(d) 10 kg

SHORT ANSWER QUESTIONS

16. There are three solids made up of aluminium, steel and wood, of the same shape and same volume. Which of them would have highest inertia?

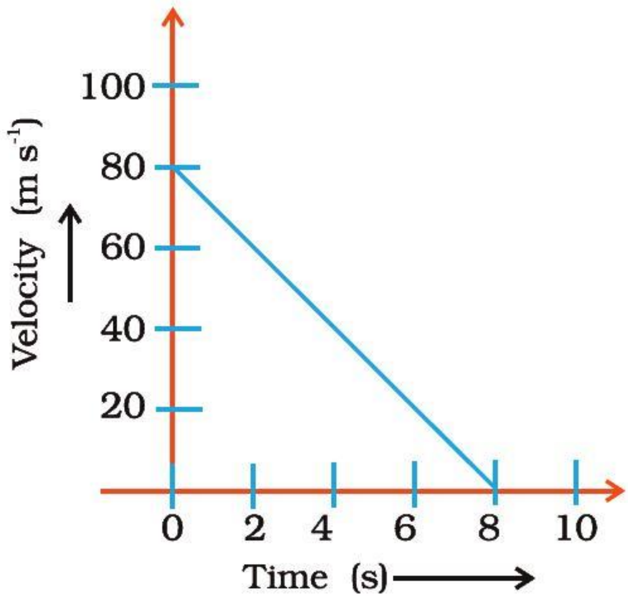
17. Two balls of the same size but of different materials, rubber and iron are kept on the smooth floor of a moving train. The brakes are applied suddenly to stop the train. Will the balls start rolling? If so, in which direction? Will they move with the same speed? Give reasons for your answer.

18. Two identical bullets are fired one by a light rifle and another by a heavy rifle with the same force. Which rifle will hurt the shoulder more and why?

19. A horse continues to apply a force in order to move a cart with a constant speed. Explain why?

20. Suppose a ball of mass *m* is thrown vertically upward with an initial speed *v*, its speed decreases continuously till it becomes zero. Thereafter, the ball begins to fall downward and attains the speed *v* again before striking the ground. It implies that the magnitude of initial and final momentums of the ball are same. Yet, it is not an example of conservation of momentum. Explain why ?

21. Velocity versus time graph of a ball of mass 50 g rolling on a concrete floor is shown in below Figure. Calculate the acceleration and frictional force of the floor on the ball.



22. A truck of mass *M* is moved under a force *F*. If the truck is then loaded with an object equal to the mass of the truck and the driving force is halved, then how does the acceleration change?

23. Why does a gun recoil on firing? Obtain an expression for recoil velocity of gun.

24. A rocket can move in air free space, but a jet plane cannot. Why?

25. Two friends on roller-skates are standing 5 m apart facing each other. One of them throws a ball of 2 kg towards the other, who catches it, How will this activity affect the position of the two? Explain your answer.

26. Water sprinkler used for grass lawns begins to rotate as soon as the water is supplied. Explain the principle on which it works.

LONG ANSWER QUESTIONS

27. Using second law of motion, derive the relation between force and acceleration. A bullet of 10 g strikes a sand-bag at a speed of 103 m/s and gets embedded after travelling 5 cm. Calculate

(i) the resistive force exerted by the sand on the bullet

(ii) the time taken by the bullet to come to rest.

28. Derive the unit of force using the second law of motion. A force of 5 N produces an acceleration of 8 m/s^2 on a mass m_1 and an acceleration of 24 m/s^2 on a mass m_2 . What acceleration would the same force provide if both the masses are tied together?

29. State and explain Newton's third law of motion. How will you prove it experimentally?

30. What is momentum? Write its SI unit. Interpret force in terms of momentum. Represent the following graphically

(a) momentum versus velocity when mass is fixed.

(b) momentum versus mass when velocity is constant.

CHAPTER – 10

GRAVITATION

NEWTON'S UNIVERSAL LAW OF GRAVITATION

Every object in the Universe attracts every other object with a force which is
(i) directly proportional to the product of their masses, and
(ii) inversely proportional to the square of the distance between their centres. The direction of the force is along the line joining the centres of two objects.

$F \propto m_1 m_2$ and $F \propto \frac{1}{r^2}$ $\quad \Rightarrow F \propto \frac{m_1 m_2}{r^2}$

$F = \frac{G.m_1 m_2}{r^2}$ where G is a constant proportionality and is called universal gravitational constant.

UNITS AND VALUE OF GRAVITATIONAL CONSTANT

$$F = \frac{G.m_1 m_2}{r^2}$$

$$\Rightarrow G.m_1 m_2 = F.r^2 \Rightarrow G = \frac{F.r^2}{m_1 m_2}$$

Unit of G is Nm^2/kg^2.
If $m_1 = m_2 = 1$ kg, r = 1 then we have G = F
Hence, Universal gravitational constant G is numerically equal to the gravitational force of attraction between two bodies, each of unit mass kept at unit distance from each other.
Value of G = 6.67×10^{-11} Nm^2/kg^2.

KEPLER'S LAWS OF PLANETARY MOTION

KEPLER'S FIRST LAW

Every planet revolves around the Sun in an elliptical orbit, with the sun situated at any one of the foci of the ellipse.

KEPLER'S SECOND LAW

In the elliptical orbit of the planet, the line joining the centre of the planet to the centre of the Sun sweeps equal intervals of time.

KEPLER'S THIRD LAW

The square of time period of revolution of a planet around the Sun is directly proportional to the cube of the semi-major axis of the elliptical orbit.

$$r^3 \propto T^2 \Rightarrow \frac{r^3}{T^2} = constant$$

where r = radius of orbit = mean distance of planet from the Sun (inm), T = the time period of revolution of planet around the Sun (in second)

IMPORTANCE OF THE UNIVERSAL LAW OF GRAVITATION

The universal law of gravitation successfully explained several phenomena which were believed to be unconnected:
(i) the force that binds us to the earth;
(ii) the motion of the moon around the earth;

(iii) the motion of planets around the Sun; and

(iv) the tides due to the moon and the Sun.

INTEXT QUESTIONS PAGE NO. 134

1. State the universal law of gravitation
Ans. The universal law of gravitation states that every object in the universe attracts every other object with a force called the gravitational force. The force acting between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. For two objects of masses m_1 and m_2 and the distance between them r, the force (F) of attraction acting between them is given by the universal law of gravitation as:

$$F = \frac{Gm_1m_2}{r^2}$$

Where, G is the universal gravitation constant given by: $G = 6.67 \times 10^{-11} Nm^2/kg^2$

2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.
Ans. Let M_E be the mass of the Earth and m be the mass of an object on its surface. If R is the radius of the Earth, then according to the universal law of gravitation, the gravitational force (F) acting between the Earth and the object is given by the relation:

$$F = \frac{Gm_1m_2}{r^2}$$

FREE FALL

When an object falls from any height under the influence of gravitational force only, it is known as free fall. In the case of free fall no change of direction takes place but the magnitude of velocity changes because of acceleration.
This acceleration acts because of the force of gravitation and is denoted by ‘g’. This is called acceleration due to gravity.

EXPRESSION FOR ACCELERATION DUE TO GRAVITATION ‘G’.
Let mass of the object put under free fall = m.
And acceleration due to gravity = g.
Therefore, according to Newton’s Second Law of Motion which states that Force is the product of mass and acceleration,
F = m x g -----------------(i)
Now, according to Universal Law of gravitation,

$$F = G.\frac{M.m}{d^2} \ldots\ldots\ldots\ldots\ldots\ (ii)$$

Thus, from above two expressions, we get
Where, g is acceleration due to gravity,
G is the Universal Gravitational Constant.
M is the mass of earth.
And d is the distance between object and centre of earth.

WHEN OBJECT IS NEAR THE SURFACE OF EARTH
When an object is near the surface of earth, the distance between object and centre of the earth will be equal to the radius of earth because the distance of object is negligible in comparison of the radius of earth.
Let the radius of earth is equal to R.

Therefore, after substituting ‘R’ at the place of ‘d’ we get,

$$g = \frac{GM}{R^2} \text{ ....}(iv)$$

Since, earth is not a perfect sphere rather it has oblique shape. Therefore, radius at the equator is greater than at the poles.

Since, value of 'g' is reciprocal of the square of radius of earth, thus, the value of 'g' will be greater at the poles and less at the equator.

And the value of 'g' will decrease with increase of distance of object from earth.

Calculation of value of 'g'

We know that

The accepted value of G is 6.673 x 10^{-11}Nm^2/kg^2.

The mass of earth, M = 6 x 10^{24} kg

The radius of earth, R = 6.4 x 10^6 m

Therefore, by using expression, $g = \frac{GM}{R^2}$, the value of 'g' can be calculated.

Therefore, after substituting the value of G, M and R in the expression for 'g' we get.

$$g = \frac{6.673 \times 10^{-11} \times 6 \times 10^{24}}{(6.4 \times 10^6)^2}$$

$$\Rightarrow g = 9.8 m/s^2$$

Motion of an object under the influence of gravitational force of earth

The expression for 'g' is written as

$$g = \frac{GM}{R^2}$$

Since, the value of 'g' does not depend upon the mass or distance of an object, therefore, all objects fall over the earth with the same rate.

The equations for motion are as follows:

v = u + at ……….. (i)

s = ut + $\frac{1}{2}$ at^2 ………. (ii)

v^2 = u^2 + 2as ……… (iii)

Therefore, the equations of motion are also applied to calculate the velocity, distance, etc by replacing 'a' by 'g'. After substituting 'g' at the place of 'a' we get above equations as follows:

v = u + gt ……….. (iv)

s = ut + $\frac{1}{2}$ gt^2 ………. (v)

v^2 = u^2 + 2gs ……… (vi)

In the calculation; initial velocity (u), final velocity (v), time taken (t), or distance covered (s), the value of 'g' is taken as positive in the case of object moving towards earth and taken as negative in the case of object is thrown in opposite direction of earth.

MASS

Mass is the measurement of inertia and inertia is the property of any object which opposes the change in state of the object. It is inertia because of which an object in rest has tendency to remain in rest and an object in motion has tendency to remain in motion.

Inertia depends upon the mass of an object. Object having greater mass has greater inertia and vice versa. Mass of an object remains constant everywhere, i.e. mass will remain same whether that object is at the moon, at the earth or anywhere in the universe.

WEIGHT:

Earth attracts every object towards it. We know that force is the product of mass and acceleration due to gravity.

This means, F = m x g -----------------------(i)

The force by which earth attracts an object towards it is called the weight of the object, which is the product of mass (m) of the object and acceleration due to gravity (g).

Weight is denoted by ‘W’.

Therefore, by substituting in the expression ‘F = mg’ we get,

W = m x g ------------------------------(ii)

Since weight is the force which is acting vertically downwards, therefore, weight has both magnitude and direction and hence it is a vector quantity.

Since the value of ‘g’ is always constant at a given place,

Therefore, expression ‘W = m x g’ can be written as follows:

W α m --------------------(iii)

This means weight of any object is directly proportional to its mass, i.e. weight will increase with the increase of mass and decrease with decrease in mass.

This is the cause that weight of any object is the measure of its mass.

The unit of weight

Since, weight of an object is equal to the force by which an object is attracted towards earth, therefore, unit of weight is same as the unit of force.

Therefore, Unit of weight is ‘newton (N)’.

WEIGHT OF AN OBJECT ON THE SURFACE OF MOON

Let M_E be the mass of the Earth and m be an object on the surface of the Earth. Let R_E be the radius of the Earth. According to the universal law of gravitation, weight W_E of the object on the surface of the Earth is given by,

$$W_E = \frac{GM_E m}{R_E^2}$$

Let M_M and R_M be the mass and radius of the moon. Then, according to the universal law of gravitation, weight W_M of the object on the surface of the moon is given by:

$$W_M = \frac{GM_M m}{R_M^2} \qquad \Rightarrow \frac{W_M}{W_E} = \frac{\frac{GM_M m}{R_M^2}}{\frac{GM_E m}{R_E^2}} = \frac{M_M R_E^2}{M_E R_M^2}$$

$$where, M_E = 5.98\times10^{24} kg, M_M = 7.36\times10^{22} kg$$

$$R_E = 6.4\times10^6 m, R_M = 1.74\times10^6 m$$

$$\frac{W_M}{W_E} = \frac{7.36\times10^{22}\times(6.4\times10^6)^2}{5.98\times10^{24}\times(1.74\times10^6)^2} = 0.165 \approx \frac{1}{6}$$

Therefore, the weight of an object on the moon $\frac{1}{6}^{th}$ its weight on the earth

NUMERICAL

1. The gravitational force between two objects is F. How will this force change when (i) distance between them is reduced to half (ii) the mass of each object is quadrupled?

2. A sphere of mass 40kg is attracted by a second sphere of mass 15kg when their centres are 20 cm apart, with a force of 0.1 milligram weight. Calculate the value of gravitational constant.

3. A body of mass 1 kg is placed at a distance of 2m from another body of mass 10kg. At what distance from the body of 1 kg, another body of mass 5 kg be placed so that the net force of gravitation acting on the body of mass 1 kg is zero?

4. A geostationary satellite is orbiting the earth at a height 5 R above the surface of earth, where R is the radius of earth. Find the time period of another satellite at a height of 2 R from the surface of earth.

5. The distance of planet Jupiter from the sun 5.2 times that of Earth. Find the period of revolution of Jupiter around sun.

6. If the distance of Earth from the Sun were half the present value, how many days will make one year?

7. Two satellites of a planet have periods 32 days and 256 days. If the radius of orbit of former is R, find the orbital radius of the latter.

8. The mass of Earth is 6 x 10^{24} kg and that of moon is 7.4 x 10^{22} kg. If the distance between the Earth and the Moon is 3.84 x 10^{5} km, calculate the force exerted by Earth on the Moon. Given G = 6.7 x 10^{-11} Nm^2/kg^2.

9. If the distance between two masses is increased by a factor of 4, by what factor would the mass of one of them have to be altered to maintain the same gravitational force?

10. Two bodies A and B having masses 2kg and 4kg respectively are separated by 2m. Where should a body of mass 1kg be placed so that the gravitational force on this body due to bodies A and B is zero?

11. The mass of Sun is 2 x 10^{30} kg and mass of Earth is 6 x 10^{24} kg. If the distance between the centres of Sun and Earth is 1.5 x 10^{8} km, calculate the force of gravitation between them.

12. Two electrons each of mass 9.1 x 10^{-31} kg are at a distance of $10\overset{0}{A}$. Calculate the gravitational force of attraction between them. Given $1\overset{0}{A} = 10^{-10}m$

13. The gravitational force between force two objects is 100 N. How should the distance between these objects be changed so that force between them becomes 50 N?

14. Calculate the force of gravitation between two objects of masses 80kg and 1200 kg kept at a distance of 10 m from each other. Given G = 6.67 x 10^{-11} Nm^2/kg^2.

15. Calculate the force of attraction between the Earth and the Sun, given that the mass of Earth is 6 x 10^{24} kg and that of sun is 2 x 10^{30} kg. The average distance between thte two is 1.5 x 10^{11}m.

16. A sphere of mass 25kg attracts another sphere of mass 24kg with a force of 0.1milligram weight. If distance between the centres of two spheres is 20cm, what is the value of G?

17. If distance between two masses is quadrupled, what will be the new force of attraction between them? Given the initial gravitational pull is 9.8N.

18. An electron of mass 9.1 x 10–31kg is at a distance of $10\overset{0}{\text{A}}$ from a proton of mass 1.67 x 10^{-27}kg. Calculate the gravitational force of attraction between them. Given $1\overset{0}{\text{A}} = 10^{-10}m$

19. Two bodies A and B having masses 20kg and 40kg are separted by 10m. At what distance from body A should another body C of mass 15kg be placed so that net gravitational force on C is zero?

20. Calculate the gravitational force on a body of mass 1kg lying on the surface of earth. Given mass of earth is 6 x 10^{24} kg and radius of earth is 6400km.

INTEXT QUESTIONS PAGE NO. 136

1. What do you mean by free fall?
Ans. Gravity of the Earth attracts every object towards its centre. When an object is released from a height, it falls towards the surface of the Earth under the influence of gravitational force. The motion of the object is said to have free fall.

2. What do you mean by acceleration due to gravity?
Ans. When an object falls towards the ground from a height, then its velocity changes during the fall. This changing velocity produces acceleration in the object. This acceleration is known as acceleration due to gravity (g). Its value is given by 9.8 m/s^2.

INTEXT QUESTIONS PAGE NO. 138

1. What are the differences between the mass of an object and its weight?
Ans.

Mass	**Weight**
Mass is the quantity of matter contained in the body.	Weight is the force of gravity acting on the body.
It is the measure of inertia of the body.	It is the measure of gravity.
Mass is a constant quantity.	Weight is not a constant quantity. It is different at different places.
It only has magnitude.	It has magnitude as well as direction.
Its SI unit is kilogram (kg).	Its SI unit is the same as the SI unit of force, i.e., Newton (N).

2. Why is the weight of an object on the moon $\frac{1}{6}^{th}$ its weight on the earth?

Ans. Let M_E be the mass of the Earth and m be an object on the surface of the Earth. Let R_E be the radius of the Earth. According to the universal law of gravitation, weight W_E of the object on the surface of the Earth is given by,

$$W_E = \frac{GM_E m}{{R_E}^2}$$

Let M_M and R_M be the mass and radius of the moon. Then, according to the universal law of gravitation, weight W_M of the object on the surface of the moon is given by:

$$W_M = \frac{GM_M m}{{R_M}^2}$$

$$\frac{W_M}{W_E} = \frac{\frac{GM_M m}{{R_M}^2}}{\frac{GM_E m}{{R_E}^2}} = \frac{M_M {R_E}^2}{M_E {R_M}^2}$$

$$where, M_E = 5.98 \times 10^{24} kg, M_M = 7.36 \times 10^{22} kg$$

$$R_E = 6.4 \times 10^6 m, R_M = 1.74 \times 10^6 m$$

$$\frac{W_M}{W_E} = \frac{7.36 \times 10^{22} \times (6.4 \times 10^6)^2}{5.98 \times 10^{24} \times (1.74 \times 10^6)^2} = 0.165 \approx \frac{1}{6}$$

Therefore, the weight of an object on the moon $\frac{1}{6}^{th}$ its weight on the earth

NUMERICAL

1. Calculate the force of gravity acting on your friend of mass 60kg. Given mass of earth = 6×10^{24} kg and radius of Earth = 6.4×10^6m.

2. Mass of an object is 10kg. What is its weight on Earth?

3. What is the mass of an object whose weight is 49N?

4. An object weighs 10N when measured on the surface of the earth. What would be its weight when measured on the surface of the Moon?

5. An object is thrown vertically upwards and rises to a height of 10m. Calculate (i) the velocity with which the object was thrown upwards and (ii) the time taken by the object to reach the highest point.

6. A force of 2 kg wt. acts on a body of mass 4.9kg. Calculate its acceleration.

7. A force of 20N acts upon a body weight is 9.8N. What is the mass of the body and how much is its acceleration?

8. A body has a weight of 10 kg on the surface of earth. What will be its mass and weight when taken to the centre of earth?

9. How much would a 70 kg man weigh on moon? What will be his mass on earth and moon? Given g on moon = 1.7 m/s^2.

10. The Earth's gravitational force causes an acceleration of 5 m/s^2 in a 1 kg mass somewhere in space. How much will the acceleration of a 3 kg mass be at the same place?

11. A particle is thrown up vertically with a velocity of 50m/s. What will be its velocity at the highest point of the journey? How high would the particle rise? What time would it take to reach the highest point? Take g = 10 m/s^2.

12. If a planet existed whose mass was twice that of Earth and whose radius 3 times greater, how much will a 1kg mass weigh on the planet?

13. A boy on cliff 49m high drops a stone. One second later, he throws a second stone after the first. They both hit the ground at the same time. With what speed did he throw the second stone?

14. A stone drops from the edge of a roof. It passes a window 2m high in 0.1s. How far is the roof above the top of the window?

15. A stone is dropped from the edge of a roof. (a) How long does it take to fall 4.9m ? (b) How fast does it move at the end of that fall? (c) How fast does it move at the end of 7.9m? (d) What is its acceleration after 1s and after 2s?

EXERCISE QUESTIONS PAGE NO. 143

1. How does the force of gravitation between two objects change when the distance between them is reduced to half?
Ans. According to the universal law of gravitation, gravitational force (*F*) acting between two objects is inversely proportional to the square of the distance (*r*) between them, i.e.,
$$F \propto \frac{1}{r^2}$$
If distance *r* becomes *r*/2, then the gravitational force will be proportional to $\dfrac{1}{\left(\dfrac{r}{2}\right)^2} = \dfrac{4}{r^2}$
Hence, if the distance is reduced to half, then the gravitational force becomes four times larger than the previous value.

2. Gravitational force acts on all objects in proportion to their masses. Why then, a heavy object does not fall faster than a light object?
Ans. All objects fall on ground with constant acceleration, called acceleration due to gravity (in the absence of air resistances). It is constant and does not depend upon the mass of an object. Hence, heavy objects do not fall faster than light objects.

3. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (Mass of the earth is 6×10^{24} kg and radius of the earth is 6.4×10^6 m).
Ans. According to the universal law of gravitation, gravitational force exerted on an object

of mass m is given by:

$$F = \frac{GMm}{r^2}$$

Where,

Mass of Earth, $M = 6 \times 10^{24}$ kg

Mass of object, $m = 1$ kg

Universal gravitational constant, G = 6.7×10^{-11} Nm^2 kg^{-2}

Since the object is on the surface of the Earth, r = radius of the Earth (R)

$r = R = 6.4 \times 10^6$ m

Gravitational force, $F = \frac{GMm}{R^2} = \frac{6.7\times10^{-11}\times6\times10^{24}\times1}{(6.4\times10^6)^2} = 9.8N$

4. The earth and the moon are attracted to each other by gravitational force. Does the earth attract the moon with a force that is greater or smaller or the same as the force with which the moon attracts the earth? Why?

Ans. According to the universal law of gravitation, two objects attract each other with equal force, but in opposite directions. The Earth attracts the moon with an equal force with which the moon attracts the earth.

5. If the moon attracts the earth, why does the earth not move towards the moon?

Ans. The Earth and the moon experience equal gravitational forces from each other. However, the mass of the Earth is much larger than the mass of the moon. Hence, it accelerates at a rate lesser than the acceleration rate of the moon towards the Earth. For this reason, the Earth does not move towards the moon.

6. What happens to the force between two objects, if

(i) the mass of one object is doubled?

(ii) the distance between the objects is doubled and tripled?

(iii) the masses of both objects are doubled?

Ans. According to the universal law of gravitation, the force of gravitation between two objects is given by: $F = \frac{Gm_1m_2}{r^2}$

(i) F is directly proportional to the masses of the objects. If the mass of one object is doubled, then the gravitational force will also get doubled.

(ii) F is inversely proportional to the square of the distances between the objects. If the distance is doubled, then the gravitational force becomes one-fourth of its original value. Similarly, if the distance is tripled, then the gravitational force becomes one-ninth of its original value.

(iii) F is directly proportional to the product of masses of the objects. If the masses of both the objects are doubled, then the gravitational force becomes four times the original value.

7. What is the importance of universal law of gravitation?

Ans. The universal law of gravitation proves that every object in the universe attracts every other object.

8. What is the acceleration of free fall?

Ans. When objects fall towards the Earth under the effect of gravitational force alone, then they are said to be in free fall. Acceleration of free fall is 9.8 m s^{-2}, which is constant for all objects (irrespective of their masses).

9. What do we call the gravitational force between the Earth and an object?

Ans. Gravitational force between the earth and an object is known as the weight of the object.

10. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets him at the equator. Will the friend agree with the weight of gold bought? If not, why? [*Hint*: The value of *g* is greater at the poles than at the equator].

Ans. Weight of a body on the Earth is given by:

$W = mg$

Where,

m = Mass of the body

g = Acceleration due to gravity

The value of g is greater at poles than at the equator. Therefore, gold at the equator weighs less than at the poles. Hence, Amit's friend will not agree with the weight of the gold bought.

11. Why will a sheet of paper fall slower than one that is crumpled into a ball?

Ans. When a sheet of paper is crumbled into a ball, then its density increases. Hence, resistance to its motion through the air decreases and it falls faster than the sheet of paper.

Gravitational force on the surface of the moon is only $\frac{1}{6}$ as strong as gravitational force on the Earth. What is the weight in newtons of a 10 kg object on the moon and on the Earth?

Ans. Weight of an object on the moon = $\frac{1}{6} \times$ Weight of an object on the Earth

Also,

Weight = Mass × Acceleration

Acceleration due to gravity, g = 9.8 m/s^2

Therefore, weight of a 10 kg object on the Earth = 10 × 9.8 = 98 N

And, weight of the same object on the moon = $\frac{1}{6} \times 98 = 16.3N$

12. A ball is thrown vertically upwards with a velocity of 49 m/s. Calculate

(i) the maximum height to which it rises.

(ii)the total time it takes to return to the surface of the earth.

Ans. According to the equation of motion under gravity:

$v^2 - u^2 = 2\ gs$

Where,

u = Initial velocity of the ball

v = Final velocity of the ball

s = Height achieved by the ball

g = Acceleration due to gravity

At maximum height, final velocity of the ball is zero, i.e., $v = 0$

$u = 49$ m/s

During upward motion, g = − 9.8 m s^{-2}

Let h be the maximum height attained by the ball.

Hence, $0 - 49^2 = 2 \times (-9.8) \times h$

$$\Rightarrow h = \frac{49 \times 49}{2 \times 9.8} = 122.5m$$

Let t be the time taken by the ball to reach the height 122.5 m, then according to the equation of motion:

$v = u + gt$

We get,

$$0 = 49 + t \times (-9.8) \Rightarrow 9.8t = 49 \Rightarrow t = \frac{49}{} = 5s$$

9.8

But,
Time of ascent = Time of descent
Therefore, total time taken by the ball to return = 5 + 5 = 10 s

13. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground.
Ans. According to the equation of motion under gravity:
$v^2 - u^2 = 2\,gs$
Where,
u = Initial velocity of the stone = 0
v = Final velocity of the stone
s = Height of the stone = 19.6 m
g = Acceleration due to gravity = 9.8 m s^{-2}
$\therefore\ v^2 - 0^2 = 2 \times 9.8 \times 19.6$
$v^2 = 2 \times 9.8 \times 19.6 = (19.6)^2$
$v = 19.6$ m s^{-1}
Hence, the velocity of the stone just before touching the ground is 19.6 m s^{-1}.

14. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking g = 10 m/s^2, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?
Ans. According to the equation of motion under gravity:
$v^2 - u^2 = 2\,gs$
Where,
u = Initial velocity of the stone = 40 m/s
v = Final velocity of the stone = 0
s = Height of the stone
g = Acceleration due to gravity = −10 m s^{-2}
Let h be the maximum height attained by the stone.
Therefore,

$$0-(40)^2 = 2\times h\times(-10) \Rightarrow h = \frac{40\times40}{20} = 80m$$

Therefore, total distance covered by the stone during its upward and downward journey = 80 + 80 = 160 m
Net displacement of the stone during its upward and downward journey
= 80 + (−80) = 0

15. Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth = 6 × 10^{24} kg and of the Sun = 2 × 10^{30} kg. The average distance between the two is 1.5 × 10^{11} m.
Ans. According to the universal law of gravitation, the force of attraction between the Earth and the Sun is given by: $F = \frac{GM_{Sun}M_{Earth}}{R^2}$
Where,
M_{Sun} = Mass of the Sun = 2 × 10^{30} kg
M_{Earth} = Mass of the Earth = 6 × 10^{24} kg
R = Average distance between the Earth and the Sun = 1.5 × 10^{11} m
G = Universal gravitational constant = 6.7 × 10^{-11} Nm^2 kg^{-2}

$$F = \frac{6.7\times10^{-11}\times2\times10^{30}\times6\times10^{24}}{} = 3.57\times10^{22}N$$

$(1.5\times10^{11})^2$

16. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.

Ans. Let the two stones meet after a time t.

(i) For the stone dropped from the tower:

Initial velocity, $u = 0$

Let the displacement of the stone in time t from the top of the tower be s.

Acceleration due to gravity, g = 9.8 m s^{-2}

From the equation of motion,

$$s = ut + \frac{1}{2}gt^2 = 0 \times t + \frac{1}{2} \times 9.8 \times t$$

$$\Rightarrow s = 7.9t^2 ------(1)$$

(ii) For the stone thrown upwards:

Initial velocity, u = 25 m s^{-1}

Let the displacement of the stone from the ground in time t be s'.

Acceleration due to gravity, g = −9.8 m s^{-2}

Equation of motion,

$$s' = ut + \frac{1}{2}gt^2 = 25t - \frac{1}{2} \times 9.8 \times t^2$$

$$\Rightarrow s' = 25t - 4.9t^2 ------(2)$$

The combined displacement of both the stones at the meeting point is equal to the height of the tower 100 m.

$$\therefore s + s' = 100$$

$$\Rightarrow \frac{1}{2}gt^2 + 25t - \frac{1}{2}gt^2 = 100$$

$$\Rightarrow t = \frac{100}{25} = 4s$$

In 4 s, the falling stone has covered a distance given by equation (1) as

$$s = \frac{1}{2} \times 10 \times 4^2 = 80m$$

Therefore, the stones will meet after 4 s at a height (100 − 80) = 20 m from the ground

17. A ball thrown up vertically returns to the thrower after 6 s. Find

(a) the velocity with which it was thrown up,

(b) the maximum height it reaches, and

(c) its position after 4 s.

Ans. (a) Time of ascent is equal to the time of descent. The ball takes a total of 6 s for its upward and downward journey.

Hence, it has taken 3 s to attain the maximum height.

Final velocity of the ball at the maximum height, $v = 0$

Acceleration due to gravity, g = −9.8 m s^{-2}

Equation of motion, $v = u + gt$ will give,

$0 = u + (-9.8 \times 3)$

$u = 9.8 \times 3 = 29.4$ ms^{-1}

Hence, the ball was thrown upwards with a velocity of 29.4 m s^{-1}.

(b) Let the maximum height attained by the ball be h.

Initial velocity during the upward journey, u = 29.4 m s^{-1}

Final velocity, $v = 0$

Acceleration due to gravity, g = −9.8 m s^{-2}

From the equation of motion, $s = ut + \frac{1}{2}at^2$

$\Rightarrow h = 29.4 \times 3 + \frac{1}{2} \times (-9.8) \times 3^2 = 44.1 m$

(c) Ball attains the maximum height after 3 s. After attaining this height, it will start falling downwards.
In this case,
Initial velocity, $u = 0$
Position of the ball after 4 s of the throw is given by the distance travelled by it during its downward journey in 4 s − 3 s = 1 s.

Equation of motion, $s = ut + \frac{1}{2}gt^2$ will give

$\Rightarrow s = 0 \times t + \frac{1}{2} \times (9.8) \times 1^2 = 4.9 m$

Total height = 44.1 m
This means that the ball is 39.2 m (44.1 m − 4.9 m) above the ground after 4 seconds.

ASSIGNMENT QUESTIONS
GRAVITATION

MULTIPLE CHOICE QUESTIONS

1. Two objects of different masses falling freely near the surface of moon would
(a) have same velocities at any instant
(b) have different accelerations
(c) experience forces of same magnitude
(d) undergo a change in their inertia

2. The value of acceleration due to gravity
(a) is same on equator and poles
(b) is least on poles
(c) is least on equator
(d) increases from pole to equator

3. The gravitational force between two objects is *F*. If masses of both objects are halved without changing distance between them, then the gravitational force would become
(a) $F/4$ (b) $F/2$ (c) F (d) $2F$

4. A boy is whirling a stone tied with a string in an horizontal circular path. If the string breaks, the stone
(a) will continue to move in the circular path
(b) will move along a straight line towards the centre of the circular path
(c) will move along a straight line tangential to the circular path
(d) will move along a straight line perpendicular to the circular path away from the boy

5. An object is put one by one in three liquids having different densities. The object floats with $\frac{1}{9}, \frac{2}{11}$ *and* $\frac{3}{7}$ parts of their volumes outside the liquid surface in liquids of densities d_1, d_2 and d_3 respectively. Which of the following statement is correct?
(a) $d_1 > d_2 > d_3$
(b) $d_1 > d_2 < d_3$
(c) $d_1 < d_2 > d_3$
(d) $d_1 < d_2 < d_3$

6. In the relation $F = G\,M\,m/d^2$, the quantity G
(a) depends on the value of g at the place of observation
(b) is used only when the earth is one of the two masses
(c) is greatest at the surface of the earth
(d) is universal constant of nature

7. Law of gravitation gives the gravitational force between
(a) the earth and a point mass only
(b) the earth and Sun only
(c) any two bodies having some mass
(d) two charged bodies only

8. The value of quantity G in the law of gravitation
(a) depends on mass of earth only
(b) depends on radius of earth only
(c) depends on both mass and radius of earth

(d) is independent of mass and radius of the earth

9. Two particles are placed at some distance. If the mass of each of the two particles is doubled, keeping the distance between them unchanged, the value of gravitational force between them will be

(a) $\frac{1}{4}$ (b) 4 times (c) $\frac{1}{2}$ times (d) unchanged

10. The earth attracts a body of mass 2 kg on its surface with a force of
(a) 9.8 N
(b) 19.6 N
(c) 6.67×10^{-11} N
(d) $2 \times 6.67 \times 10^{-11}$ N

11. A stone dropped from a building takes 4 s to reach the ground. The height of the building is
(a) 19.6 m
(b) 80.4 m
(c) 78.4 m
(d) 156.8 m

12. If g_e is acceleration due to gravity on earth and g_m is acceleration due to gravity on moon, then
(a) $g_e = g_m$
(b) $g_e < g_m$
(c) $g_e = \frac{1}{6} g_m$
(d) $g_m = \frac{1}{6} g_e$

13. The mass of a body on the surface of earth is 12 kg. If acceleration due to gravity on moon is $\frac{1}{6}$ of acceleration due to gravity on earth, then its mass on moon will be
(a) 2 kgf
(b) 72 kg
(c) 12 kg
(d) zero

14. The atmosphere is held to the earth by
(a) gravity
(b) wind
(c) clouds
(d) earth's magnetic field

15. The force of attraction between two unit point masses separated by a unit distance is called
(a) gravitational potential
(b) acceleration due to gravity
(c) gravitational field
(d) universal gravitational constant

16. The weight of an object at the centre of the earth of radius *R* is
(a) zero
(b) infinite
(c) *R* times the weight at the surface of the earth

(d) $1/R^2$ times the weight at surface of the earth

SHORT ANSWER QUESTIONS

17. What is the source of centripetal force that a planet requires to revolve around the Sun? On what factors does that force depend?

18. On the earth, a stone is thrown from a height in a direction parallel to the earth's surface while another stone is simultaneously dropped from the same height. Which stone would reach the ground first and why?

19. Suppose gravity of earth suddenly becomes zero, then in which direction will the moon begin to move if no other celestial body affects it?

20. Identical packets are dropped from two aeroplanes, one above the equator and the other above the north pole, both at height h. Assuming all conditions are identical, will those packets take same time to reach the surface of earth. Justify your answer.

21. The weight of any person on the moon is about 1/6 times that on the earth. He can lift a mass of 15 kg on the earth. What will be the maximum mass, which can be lifted by the same force applied by the person on the moon?

22. Calculate the average density of the earth in terms of g, G and R.

23. The earth is acted upon by gravitation of Sun, even though it does not fall into the Sun. Why?

24. Calculate the density of Earth from Newton's law of gravitation.

25. A body weighs more at poles than at the equator of earth. Why?

26. Two particles of equal mass(m) move in a circle of radius (r) under the action of their mutual gravitational attraction. Find the speed of each particle.

LONG ANSWER QUESTIONS

27. How does the weight of an object vary with respect to mass and radius of the earth. In a hypothetical case, if the diameter of the earth becomes half of its present value and its mass becomes four times of its present value, then how would the weight of any object on the surface of the earth be affected?

28. How does the force of attraction between the two bodies depend upon their masses and distance between them? A student thought that two bricks tied together would fall faster than a single one under the action of gravity. Do you agree with his hypothesis or not? Comment.

29. Two objects of masses m_1 and m_2 having the same size are dropped simultaneously from heights h_1 and h_2 respectively. Find out the ratio of time they would take in reaching the ground. Will this ratio remain the same if (i) one of the objects is hollow and the other one is solid and (ii) both of them are hollow, size remaining the same in each case. Give reason.

30. Distinguish between mass and weight. Show that mass of a body numerically equal to weight of the body except at the centre of earth.

CHAPTER - 10
GRAVITATION (CONTINUED)

THRUST AND PRESSURE

Force acting normally on a surface is called the thrust i.e. the force that acts on an object perpendicular to its surface is the thrust, measured in newton in the SI system.

When you stand on loose sand, the force, that is, the weight of your body is acting on an area equal to area of your feet. When you lie down, the same force acts on an area equal to the contact area of your whole body, which is larger than the area of your feet. Thus, the effects of forces of the same magnitude on different areas are different. In the above cases, thrust is the same. But effects are different. Therefore the effect of thrust depends on the area on which it acts. The effect of thrust on sand is larger while standing than while lying.

The thrust acting on unit area of the surface is called the pressure.
If a thrust F acts on an area A, then

$$\text{Pr}essure(P) = \frac{Thrust(F)}{Area(A)}$$

$$\boxed{P = \frac{F}{A}}$$

Thus, the same force acting on a smaller area exerts a larger pressure, and a smaller pressure on a larger area. This is the reason why a nail has a pointed tip, knives have sharp edges and buildings have wide foundations.

The SI unit of pressure is called pascal(Pa).

$$1 \text{ Pa} = 1 \text{ N/m}^2$$

One pascal is defined as the pressure exerted on a surface of area of 1 m^2 by a thrust of 1 N acting normally on it.

Other units of pressure are bar and millibar(m bar)

where 1 bar = 10^5 N/m^2 and 1 millibar = 10^2 N/m^2
or 1 bar = 10^5 Pa and 1 m bar = 10^2 Pa

1 atmospheric pressure (1 atm) = 101.3 k Pa = 1.013 bar = 1013 m bar

NUMERICALS

1. A cube of edge length 10 cm is placed inside a liquid. The pressure at the centre of the face is 15 Pa. Find the force exerted by the liquid on this face.

2. A force of 16 N is distributed uniformly on one surface of a cube of edge 8 cm. Find the pressure on this surface.

3. A force of 100 N is applied on an object of area 2 m^2. Calculate the pressure.

4. The force on a phonogram needle is 1.2 N. The point has a circular cross-section of radius 0.1mm. What pressure does it exert on the record in (i) Pa (ii) atm ?

5. A force of 15 N is uniformly distributed over an area of 150 m^2. Find the pressure in pascals.

6. How much force should be applied on an area of 1 cm^2 to get a pressure of 15 Pa?

7. A block weighing 1.0 kg is in the shape of a cube of length 10 cm. It is kept on a horizontal table. Find the pressure on the portion of the table where the block is kept.

8. The pressure due to atmosphere is 1.013 x 10^5 Pa. Find the force exerted by the atmosphere on the top surface of a table 2.0 m long and 1.0 m wide.

9. Find the thrust acting on the human body due to atmospheric pressure. Take the surface area of a man of middle size to be 1.5 m^2 and atmospheric pressure (1 atm) = 1.013 x 10^5 Pa.

10. A boy weighing 60 kg f is wearing shoes with heel area of cross section 20 cm^2 while a girl weighing 45 kg f is wearing shoes with heel of area of cross section 1.5 cm^2. Compare the pressure exerted on ground by their heels when they stand on the heel of one floor.

11. A nail is driven into a wooden board by using a hammer. The impact of the hammer on the head of nail produces a thrust of 25 N. If the area of the head is 0.5 mm^2 and of the tip 0.1 mm^2, find the pressure on the head and the tip of the nail.

12. A car weighs 1200 kg. This weight is evently distributed on 4 wheels. If the pressure in each tyre is 15 kg wf/cm^2, what is the area of each tyre in contact.

13. Calculate the greatest and the least pressure exerted by a metal block of size 20 cm x 8 cm c 5 cm and having a mass of 5 kg.

14. A hydraulic automobile lift is designed to lift cars with a maximum mass of 3000 kg. The area of the piston carrying the load is 425 cm^2. What maximum pressure would the smaller piston have to bear?

15. A block of wood is kept on a table top. The mass of the wooden block is 5 kg and its dimension are 40 cm x 20 cm x 10 cm. Find the pressure exerted by the wooden block on the table top if it is made to lie on the table with its sides of dimensions
(a) 20 cm x 10 cm (b) 40 cm x 20 cm. Given g = 9.8 m/s^2.

PRESSURE IN FLUIDS

Those substances, which can flow easily, are called fluids. All liquids and gases are fluids. A solid exerts pressure on a surface due to its weight. Similarly, fluids have weight, and they also exert pressure on the base and walls of the container in which they are enclosed. Pressure exerted in any confined mass of fluid is transmitted undiminished in all directions. In other words, a fluid (liquid or gas) exerts pressure in all directions – even upwards.

BUOYANCY

When a body floats or immerses in a liquid, the pressure on the bottom surface is more than that the pressure on the top surface. Due to the difference in pressure, an upward force acts on the body. This upward force is called upthrust or buoyant force. The buoyant force is equal to the weight of the liquid displaced.

The buoyant force (upthrust) acts through the centre of gravity of the displaced liquid which is known as **centre of buoyancy**. Due to the upthrust exerted on the body by the liquid, the weight of the body appears to be less when the body is immersed in the liquid.

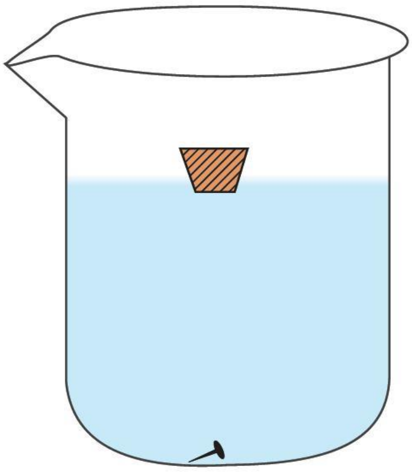
For example, when we immerse a mug into a bucket of water, the mug filled with water appears to be lighter as long as it is under water. But when it is lifted up out of the water we feel that the mug is heavier. This shows that the weight of the body under water is less than its weight when it is above the surface of water.

WHY OBJECTS FLOAT OR SINK WHEN PLACED ON THE SURFACE OF WATER?

If the density of the material of the body is less than that of density of water, it floats and in case if the density of the material of the body is more than that of density of water, it sinks.

The cork floats while the nail sinks. This is because of the difference in their densities. The density of cork is lesser than the density of water. This means that the upthrust of water on the cork is greater than the weight of the cork. So it floats.

The density of the iron nail is more than the density of the water. This means that the upthrust of water on the iron is lesser than the weight of the nail. So it sinks.



Therefore objects of density less than that of a liquid float on the liquid. The objects of density greater than that of a liquid sink in the liquid.

INTEXT QUESTIONS PAGE NO. 141

1. Why is it difficult to hold a school bag having a strap made of a thin and strong string?
Ans.: It is difficult to hold a school bag having a thin strap because the pressure on the shoulders is quite large. This is because the pressure is inversely proportional to the surface area on which the force acts. The smaller is the surface area; the larger will be the pressure on the surface. In the case of a thin strap, the contact surface area is very small. Hence, the

pressure exerted on the shoulder is very large.

2. What do you mean by buoyancy?
Ans.: The upward force exerted by a liquid on an object immersed in it is known as buoyancy. When you try to immerse an object in water, then you can feel an upward force exerted on the object, which increases as you push the object deeper into water..

3. Why does an object float or sink when placed on the surface of water?
Ans.: If the density of an object is more than the density of the liquid, then it sinks in the liquid. This is because the buoyant force acting on the object is less than the force of gravity. On the other hand, if the density of the object is less than the density of the liquid, then it floats on the surface of the liquid. This is because the buoyant force acting on the object is greater than the force of gravity.

ARCHIMEDES' PRINCIPLE

When a body is immersed in fluid (liquid or gas) it experiences an apparent loss of weight which is equal to the weight of the fluid displaced. The apparent loss in weight of the body is equal to the upthrust on the body.

Points to be remembered:

- When a body is immersed either partially or fully in a liquid, it experiences and upthrust or buoyant force (F_B). This upthrust (F_B) is equal to the weight (W_l) of the liquid displaced by the body i.e. $F_B = W_l = V.d_l.g$

  where 'd_l' is the density of liquid in which the body is immersed and V is the volume of the liquid displaced.
- Buoyant Force (F_B) depends upon : (a) Volume of the liquid displaced and (b) density of the liquid.
- Apparent weight of a body in a liquid = true weight of the body (W) – weight (W_l)
- Loss in weight when a body is immersed in a liquid = $F_B = W_l$.
- Archimedes' principle has many applications. It is used in designing ships and submarines. Lactometers, which are used to determine the purity of a sample of milk and hydrometers used for determining density of liquids, are based on this principle.

A ship made up of iron floats in water. This is because the ship is hollow and contains air. The large space inside the ship enables it to displace a volume of water much greater than the actual volume of iron that was used in the construction. So the weight of water is placed is greater than the weight of the ship.

A body which floats in a liquid is in equilibrium under the action of the two forces. (a) It's weight acting vertically downwards and (b)the resultant thrust on it due to the liquid acting upwards. These two forces must be equal and opposite. The resultant upthrust may be equal to or greater than the weight of the liquid by the body, and that it acts through the centre of gravity of the displaced liquid.

LAWS OF FLOATATION

1. The weight of the floating body is equal to the weight of the liquid displaced by it.
2. The centre of gravity of the floating body and the centre of gravity of the liquid displaced (centre of buoyancy) are in the same vertical line.

INTEXT QUESTIONS PAGE NO. 142

1. You find your mass to be 42 kg on a weighing machine. Is your mass more or less than 42 kg?
Ans.: When you weigh your body, an upward force acts on it. This upward force is the buoyant force. As a result, the body gets pushed slightly upwards, causing the weighing machine to show a reading less than the actual value.

2. You have a bag of cotton and an iron bar, each indicating a mass of 100 kg when measured on a weighing machine. In reality, one is heavier than other. Can you say which one is heavier and why?
Ans.: The iron bar is heavier than the bag of cotton. This is because the surface area of the cotton bag is larger than the iron bar. Hence, more buoyant force acts on the bag than that on an iron bar. This makes the cotton bag lighter than its actual value. For this reason, the iron bar and the bag of cotton show the same mass on the weighing machine, but actually the mass of the iron bar is more that that of the cotton bag.

DENSITY

Density of a substance is defined as its mass per unit volume.

$$\boxed{Density(d) = \frac{mass(m)}{volume(V)} \quad or \quad d = \frac{m}{v}}$$

The SI unit of density is kg/m^3.

RELATIVE DENSITY

Relative density of a substance is defined as the ratio of its density to that of water at 4^0C.

$$\boxed{\text{Relative density} = \frac{\text{Density of substance}}{\text{Density of water at } 4^0\text{C}}}$$

Relative density can also be defined as the ratio between the mass of the substance and the mass of an equal volume of water at 4^0C.

Density of water at 4^0C = 1 g/cm^3 = 1000 kg/m^3.

Since the relative density is a ratio of similar quantities, it has no unit

NUMERICALS

1. Calculate the mass of a body whose volume is 2 m^3 and density 0.52 g/cm3.

2. A wooden block of dimensions 10 cm x 20 cm x 50 cm weighs 6.5kg. Calculate the density of the block.

3. A dining hall has dimensions 50m x 15m x 3.5m. Calculate the mass of air in the hall. Given density of air = 1.30 kg/m^3.

4. A thread of mercury of 10.2 g is in a tube of uniform cross-section $0.1 cm^2$. Calculate the length of the thread. The density of mercury is 13.6 g/cm^3.

5. The mass of a empty bucket of capacity 10 litres is 1 kg. Find its mass when completely filled with a liquid of relative density 0.8.

6. A piece of copper of mass 106g is dipped in a measuring cylinder containing water at 22 ml mark. The water rises to 34 ml mark. Find (a) volume of the copper piece (b) the density of copper.

7. A bottle weighs 30g when empty, 53.4 g when filled with a liquid and 48 g when filled with water. Calculate the density of the liquid. Given, density of water at 4^0C = 1000 kg/m^3.

8. An iron cylinder of radius 1.4 cm and length 8 cm is found to weigh 369.6 g. Calculate the density of iron.

9. Calculate the mass of air enclosed in a room of length, breadth and height equal to 5m, 3m and 4m respectively. Density of air = 1.3 kg/m^3.

10. The mass of a solid rectangle block of iron is 23.6 g and its dimensions are 2.1cm x 1.2cm x 1.1cm. Calculate the density of iron.

11. The mass of an empty 40 litre petrol tank of a vehicle is 8.0 kg. What will be its mass when filled completely with a fuel of density 700 kg/m^3.

12. A weather forecasting plastic balloon of volume $15m^3$ contains hydrogen of density 0.09 kg/m^3. The mass of the empty balloon is 7.15kg. Calculate (a) the mass of hydrogen in the balloon (b) the mass of the balloon filled with hydrogen.

13. The mass of a density bottle is 25g when empty, 50g when filled completely with water and 365g when filled completely with mercury. Find the density of mercury.

14. A bottle can hold 100 g of water at 4^0C What mass of sea water (density = 1030 kg/m^3) can hold it hold?

15. Relative density of silver is 10.8. The density of water is 1000 kg/m^3. What is the density of silver in SI?

16. A piece of rock salt weighs 108.2 g in air and 48.2 g in saturated brine of relative density 1.2. What is the relative density of the rock salt?

17. A silver ornament is suspected to be hollow. Its weight is 250g and it displaces 50 cc of water. If the relative density of silver be 10, find the volume of the cavity.

18. If 100 cc iron of relative density 7.8 floats on mercury of relative density 13.6, what volume of iron is immersed?

19. A coil of wire of cross-section 0.75 mm^2 weighs 125g in air and 115 g in water. Find the length of the coil. (Density of water = 1000 kg/m^3?

20. A cubical block of water is dipped completely in water. Each edge of the block is 1cm in length. Find the buoyant force acting on the block.

21. A body of mass 2.0 kg and density 8000 kg/m^3 is completely dipped in a liquid of density 800 kg/m^3. Find the force of buoyancy on it.

22. A piece of iron of density 7.8 x 10^3 kg/m^3 and volume 100 cm^3 is totally immersed in water. Calculate (a) the weight of iron piece in air (b) the upthrust and (c) apparent weight in water.

23. A solid body of mass 150g and volume 250 cm^3 is put in water. Will the body float or sink?

24. A body of 50 cm^3 is completely immersed in water. Find the force of buoyancy on it.

25. A metallic sphere of radius 2.0 cm is completely dipped in water. Find the force of buoyancy on it.

26. A body of 2.0 kg floats in a liquid. What is the buoyant force on the body?

27. A solid of density 5000 kg/m^3 weighs 0.5 kg f in air. It is completely immersed in water of density 1000 kg/m^3. (a) Calculate the apparent weight of the solid in water. (b) What will be its apparent weight if water is replaced by a liquid of density 8000 kg/m^3.

28. The mass of block made of certain material is 13.5 kg and its volume is 15 x 10^{-3} m^3. Will the block float or sink in water? Give a reason for your answer.

29. A solid body of mass 4.0 x 10^3 kg and volume $2m^3$ is put in water. Will the body float or sink?

30. A cube 8.5 cm on each side has a mass of 0.65 kg. Will the cube float or sink in water? Give reason for your answer.

<u>EXERCISE QUESTIONS PAGE NO. 145</u>

19. In what direction does the buoyant force on an object immersed in a liquid act?
An object immersed in a liquid experiences buoyant force in the upward direction.

20. Why does a block of plastic released under water come up to the surface of water?
Two forces act on an object immersed in water. One is the gravitational force, which pulls the object downwards, and the other is the buoyant force, which pushes the object upwards. If the upward buoyant force is greater than the downward gravitational force, then the object comes up to the surface of the water as soon as it is released within water. Due to this reason, a block of plastic released under water comes up to the surface of the water.

21. The volume of 50 g of a substance is 20 cm3. If the density of water is 1 gcm^{-3}, will the substance float or sink?

If the density of an object is more than the density of a liquid, then it sinks in the liquid. On the other hand, if the density of an object is less than the density of a liquid, then it floats on the surface of the liquid.

$$\text{Here, density of the substance} = \frac{\text{Mass of the substance}}{\text{Volume of the substance}} = \frac{50}{20} = 2.5 g/cm^3$$

The density of the substance is more than the density of water (1 g cm−3). Hence, the substance will sink in water.

22. The volume of a 500 g sealed packet is 350 cm^3. Will the packet float or sink in water if the density of water is 1 g cm^{-3}? What will be the mass of the water displaced by this packet?

$$\text{Density of the 500 g sealed packet} = \frac{\text{Mass of the packet}}{\text{Volume of the packet}} = \frac{500}{350} = 1.428 g/cm^3$$

The density of the substance is more than the density of water (1 g/cm^3). Hence, it will sink in water.

The mass of water displaced by the packet is equal to the volume of the packet, i.e., 350g.

CHAPTER - 11
WORK AND ENERGY

WORK
Work (W) is said to be done, when a force (F) acts on the body and point of application of the force is displaced (s) in the direction of force.

Work done = force x displacement W = F x s

i). If the body is displaced in the same direction of force, work is done by a force
ii). If the displacement is against a force, the work is done against the force.
iii). If the displacement is perpendicular to the direction of the force, work done is zero.

Unit of work

Unit of work is joule (J).

One joule of work is said to be done when a force of 1 newton acting on a body displacing it by a distance of 1 m.

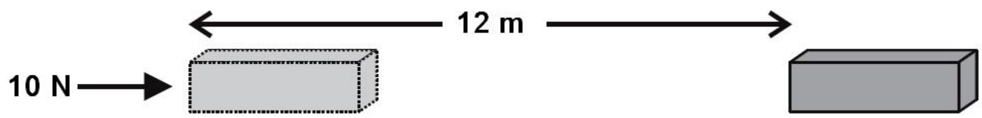
Larger units of work are

i) kilojoule (1000 joule)

ii) megajoule (10 lakh joule)

NUMERICALS

1. A force of 10 N acts on an object. The object is displaced through 12 m, in the direction of the force. If the force acts all through the displacement, find the work done by the force.



2. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.

3. A boy pushes a book by applying a force of 40 N. Find the work done by this force on the book is displaced through 25 cm along the path.

4. A ball of mass 1 kg thrown upwards, reaches a maximum height of 4 m. Calculate the work done by the force of gravity during the vertical displacement. (g = $10m/s^2$)

5. Find the amount of work done by a labourers who carrier ‘n’ bricks of ‘m’ kg each to the roof of a house ‘h’ metre high by climbing a ladder.

6. An engine pulls a train 1 km over a level track. Calculate the work done by the train given that the frictional resistance is 5×10^5 N.

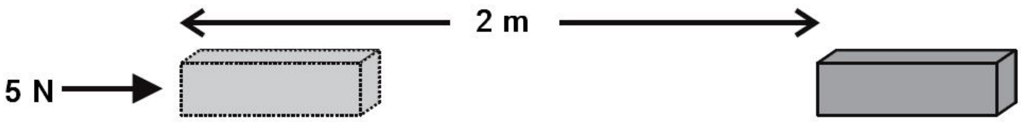
7. A man weighing 70 kg carries a weight of 10 kg on the top of a tower 100 m high. Calculate the work done by the man ($g = 10m/s^2$).

8. A boy of mass 55 kg runs up a flight of 40 stairs, each measuring 0.15m. Calculate the work done by the boy.

9. Calculate the work done in lifting 200 kg of water through a vertical height of 6 metres ($g = 10m/s^2$).

10. A crane pulls up a car of mass 500 kg to a vertical height of 4 m. Calculate the work done by the crane.

11. A force of 5 N acts on an object. The object id displaced through 8 m, in the direction of the force. If the force acts all through the displacement, find the work done by the force.



12. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.

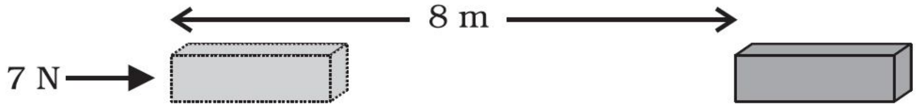
13. Calculate the work done by a student in lifting 0.5 kg book from the ground and keeping it on a shelf 1.5m high.

14. A collie carries a load of 50 kg on his head and walks on a level road upto 100 m. What is the work done by him?

15. A car weighing 1000 kg and traveling at 30m/s stops at a distance of 50m decelerating uniformly. What is the force exerted on it by the brakes? What is the work done by the brakes?

INTEXT QUESTIONS PAGE NO. 148

1. A force of 10 N acts on an object. The displacement is, say 8 m, in the direction of the force. Let us take it that the force acts on the object through the displacement. What is the work done in this case?



Ans: When a force F acts on an object to displace it through a distance S in its direction, then the work done W on the body by the force is given by:

Work done = Force × Displacement
$W = F \times S$
where, F = 7 N , S = 8 m
Therefore, work done, $W = 7 \times 8 = 56$ Nm $= 56$ J

INTEXT QUESTIONS PAGE NO. 149

1. **When do we say that work is done?**
   Ans: Work is done whenever the given conditions are satisfied:
   (i) A force acts on the body.
   (ii) There is a displacement of the body caused by the applied force along the direction of the applied force.

2. **Write an expression for the work done when a force is acting on an object in the direction of its displacement.**
   Ans: When a force F displaces a body through a distance S in the direction of the applied force, then the work done W on the body is given by the expression:
   Work done = Force × Displacement
   $W = F \times s$

3. **Define 1 J of work.**
   Ans: 1 J is the amount of work done by a force of 1 N on an object that displaces it through a distance of 1 m in the direction of the applied force.

4. **A pair of bullocks exerts a force of 140 N on a plough. The field being ploughed is 15 m long. How much work is done in ploughing the length of the field?**
   Ans: Work done by the bullocks is given by the expression:
   Work done = Force × Displacement
   $W = F \times d$
   Where,
   Applied force, F = 140 N
   Displacement, d = 15 m
   $W = 140 \times 15 = 2100$ J
   Hence, 2100 J of work is done in ploughing the length of the field.

ENERGY

The energy of the body is defined as its capacity to do work.

Unit of energy

Energy is measured in terms of work. Unit of energy is also joule. One joule of energy is required to do one joule of work.

DIFFERENT FORMS OF ENERGY

We live in a world where we have energy in many different forms. Some important forms of energy are mechanical energy, chemical energy, light energy, heat energy, electrical energy, nuclear energy and sound energy.

MECHANICAL ENERGY

The energy used to displace a body or to change the position of the body or to deform the body is known as mechanical energy.

Mechanical energy is of two types
i) Kinetic energy ii) Potential energy

KINETIC ENERGY

Energy possessed by an object due to its motion is called kinetic energy.
Kinetic energy of an object increases with its speed. Kinetic energy of an object moving with a velocity is equal to the work done on it to make it acquire that velocity.

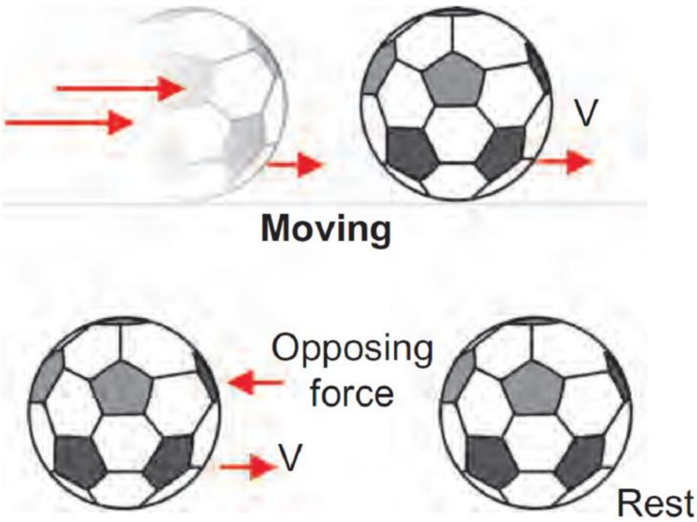
Example-1 Kinetic energy of a hammer is used to drive a nail into the wall.
Example-2 Bullet fi red from a gun can penetrate into a target due to its kinetic energy.

EXPRESSION FOR KINETIC ENERGY

Let a body (ball) of mass m is moving with an initial velocity v. If it is brought to rest by applying a retarding (opposing) force F, then it comes to rest by a displacement S. Let, E_k = work done against the force used to stop it.

$$E_k = F . S \text{ -----> } (1)$$

But retarding force F = ma-----> (2)



Let initial velocity u = v, fi nal velocity v = 0
From III equation of motion, $v^2 = u^2 + 2as$ applying,

$$0 = v^2 - 2as \text{ (a is retardation)}$$

$$2as = v^2$$

$$\text{displacement, } s = \frac{v^2}{2a} \text{ ---------------->(3)}$$

substituting (2) and (3) in (1), we get

$$E_k = ma.\frac{v^2}{2a}$$

$$\Rightarrow E_k = \frac{1}{2}mv^2$$

Kinetic Energy of a moving object is defined as half the product of the mass of the object square of the speed of the object.

Work done (W) = Change in kinetic energy(E_k)
$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ (when v > u)
Or $W = \frac{1}{2}mu^2 - \frac{1}{2}mv^2$ (when u > v)

INTEXT QUESTIONS PAGE NO. 152

1. What is the kinetic energy of an object?
Ans:

Kinetic energy is the energy possessed by a body by the virtue of its motion. Every moving object possesses kinetic energy. A body uses kinetic energy to do work. Kinetic energy of hammer is used in driving a nail into a log of wood, kinetic energy of air is used to run wind mills, etc.

2. **Write an expression for the kinetic energy of an object.**
Ans:
If a body of mass m is moving with a velocity v, then its kinetic energy E_k is given by the expression, $E_k = \frac{1}{2}mv^2$. Its SI unit is Joule (J).

3. **The kinetic energy of an object of mass, m moving with a velocity of 5 ms^{-1} is 25 J. What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?**
Ans: Expression for kinetic energy is $E_k = \frac{1}{2}mv^2$
m = Mass of the object
v = Velocity of the object = 5 m/s
Given that kinetic energy, E_k = 25 J
(i) If the velocity of an object is doubled, then v = 5 × 2 = 10 m/s.
Therefore, its kinetic energy becomes 4 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 4 = 100 J.
(ii) If velocity is increased three times, then its kinetic energy becomes 9 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 9 = 225 J.

NUMERICALS

21. How far should a man of mass 60 kg run so that his kinetic energy is 750 J?

22. Find the mass of the body which has 5 J of kinetic energy while moving at a speed of 2 m/s.

23. A player kicks a ball of mass 250 g at the centre of a field. The ball leaves his foot with a speed of 10m/s. Find the work done by the player on the ball.

24. A body of mass 5 kg, initially at rest, is subjected to a force of 20 N. What is the kinetic energy acquired by the body at the end of 10 s?

25. A bullet of mass 20g moving with a velocity of 500m/s, strikes a tree and goes out from the other side with a velocity of 400m/s. Calculate the work done by the bullet in joule in passing through the tree.

26. An object of mass 15 kg is moving with a uniform velocity of 4m/s. What is the kinetic energy possessed by the object?

27. What is the work done to increase the velocity of a car from 30 km/hr to 60 km/he if the mass of the car is 1500kg?

28. A bullet of mass 0.03kg moving with a velocity of 400m/s, penetrates 12 cm into fixed a constant resistive force of 1000 N to the motion of the bullet, find (a) the initial kinetic energy of the bullet (b) the distance through which the bullet has penetrated.

29. Two bodies of equal masses move with uniform velocities v and 3v respectively. Find the ratio of their kinetic energies.

30. The mass of a ball A is double the mass of another ball B. The ball A moves at half the speed of the ball B. Calculate the ratio of the kinetic energy of A to the kinetic energy of B.

31. A truck weighing 5000 kgf and a cart weighing 500 kgf are moving with the same speed. Compare their kinetic energies.

32. A bullet of mass 20g is found to pass two points 30m apart in 4s? Assuming the speed to be constant find its kinetic energy.

POTENTIAL ENERGY

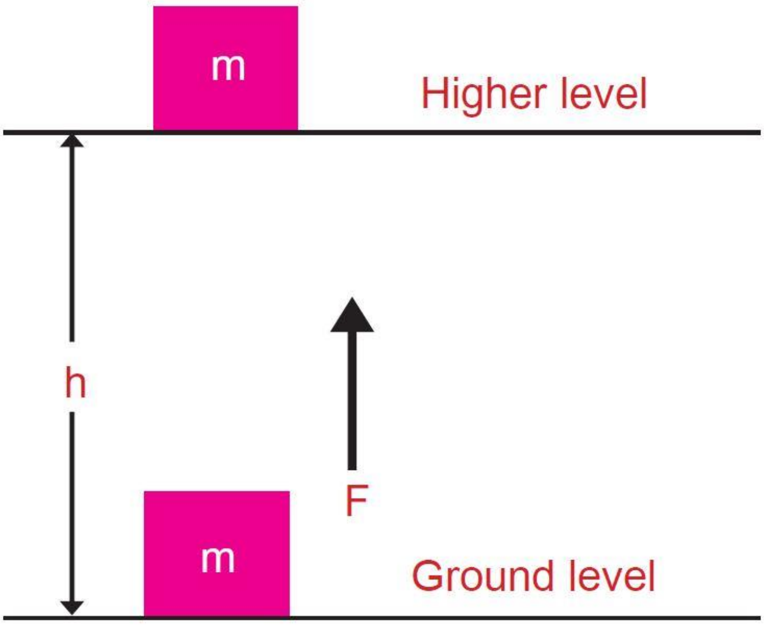
The energy possessed by a body by virtue of its position or due to state of strain, is called *potential energy*. The work done to lift a body above the ground level gives the potential energy of the body. Eg. weight lifting.

Example: Water stored in reservoir has large amount of potential energy due to which it can drive a water turbine when allowed to fall down. This is the principle of production of hydro-electric energy.

EXPRESSION FOR POTENTIAL ENERGY OF A BODY ABOVE THE GROUND LEVEL

Work is done in raising an object from the ground to certain height against the gravity is stored in the body as a potential energy.

Consider an object of mass m. It is raised through a height h from the ground. Force is needed to do this.



The downward force acting on the body due to gravity = mg.

The work has to be done to lift the body through a height h against the force of gravity as shown in above figure.

The object gains energy to do the work done (w) on it.

work done = force x displacement

w = F x h

w = mgh [Since F=ma and a=g, therefore F=mg]

Work done is equal to potential energy of an object.

$$Ep = mgh.$$

NOTE: The potential energy of an object at a height depends on the ground level or the zero level you choose. An object in a given position can have a certain potential energy with respect to one level and a different value of potential energy with respect to another level.

NUMERICALS

1. A body of mass 4 kg is taken from a height of 5m to a height 10m. Find the increase in potential energy.

2. An object of mass 1 kg is raised through a height 'h'. Its potential energy increases by 1 J, find the height 'h'.

3. A 5 kg ball is thrown upwards with a speed of 10m/s. (a) Find the potential energy when it reaches the highest point. (b) Calculate the maximum height attained by it.

4. A 5 kg ball is dropped from a height of 10m. (a) Find the initial potential energy of the ball (b) Find the kinetic energy just before it reaches the ground and (c) Calculate the velocity before it reaches the ground.

5. A body is thrown up with a kinetic energy of 10J. If it attains a maximum height of 5m, find the mass of the body.

6. A rocket of mass 3×10^6 kg takes off from a launching pad and acquires a vertical velocity of 1 km/s and an altitude of 25 km. Calculate its (a) potential energy (b) kinetic energy.

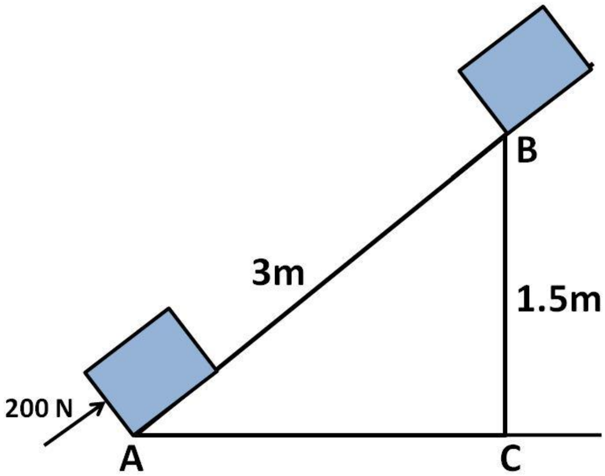
7. Find the energy possessed by an object of mass 10 kg when it is at a height of 6m above the ground. Given, $g = 9.8 \text{ m/s}^2$.

8. An object of mass 12 kg is at a certain height above the ground. If the potential energy of the object is 480 J, find the height at which the object is with respect to the ground. Given, $g = 10 \text{ m/s}^2$.

9. Calculate the increase in potential energy as a block of 2 kg is lifted through 2m.

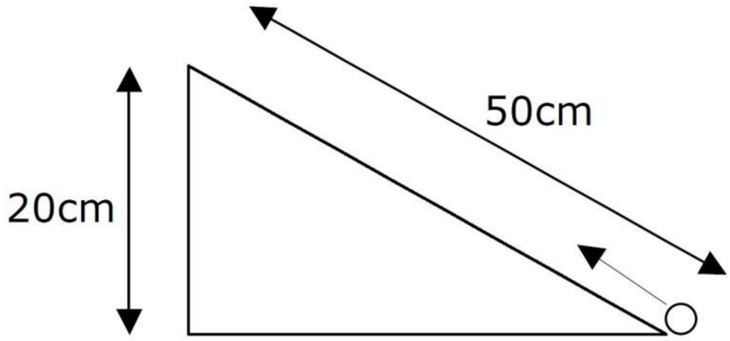
10. A ball of mass 1 kg is dropped from a height of 5m. (a) Find the kinetic energy of the ball just before it reaches the ground (b) What is the speed at this instant?

11. A block of mass 30 kg is pulled up by a rope as shown in below figure with a constant speed by applying of 200 N parallel to the slope. A and B are the initial and final positions of the block. Calculate (a) work done by the force in moving the block from A to B. (b) the potential energy gained by the block (c) account for the difference in work done by the force and the increase in potential energy of the block.



12. A body of mass 5 kg falls from height of 5m. How much energy does it possess at any instant?

13. A 800g ball is pulled up a slope as shown in the diagram. Calculate the potential energy it gains.



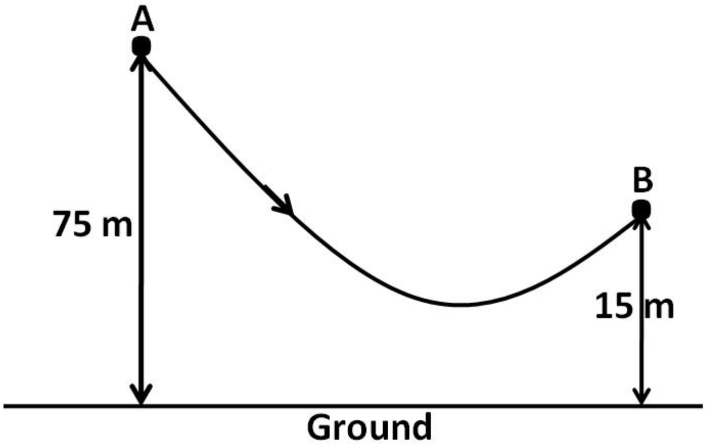
14. A spring is compressed by a toy cart of mass 150g. On releasing the cart, it moves with a speed of 0.2m/s. Calculate the elastic potential energy of the spring.

15. An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.

16. A box has a mass of 5.8kg. The box is lifted from the garage floor and placed on a shelf. If the box gains 145 J of Potential Energy (Ep), how high is the shelf?

17. A man climbs on to a wall that is 3.6m high and gains 2268J of potential energy. What is the mass of the man?

18. Below figure shows a ski- jump. A skier of mass 60 kg stands at A at the top of the ski-jump. He moves from A to B and takes off his jump at B. (a) Calculate the change in the gravitational potential energy of the skier between A and B (b) If 75% of the energy in part (a) becomes the kinetic energy at B, calculate the speed at which the skier arrives at B.



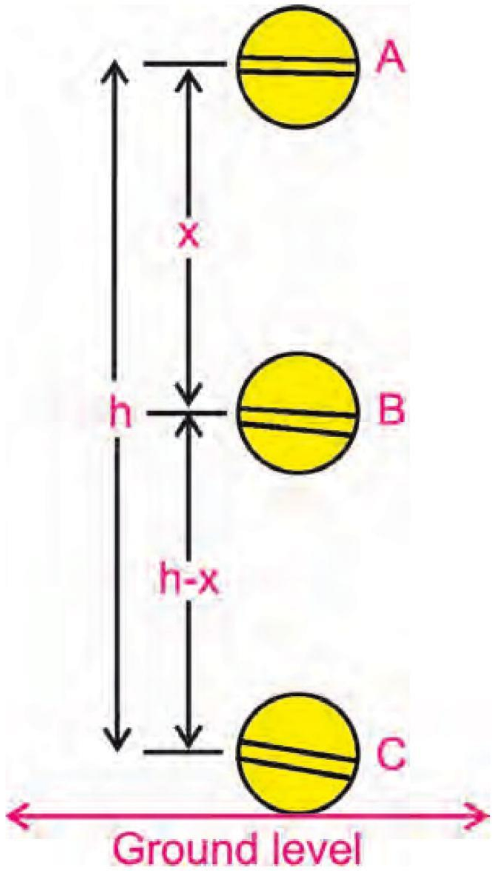
19. Consider the case of freely falling body given in the figure:
At A,
Kinetic energy=0 and
Potential energy=mgh
At B,
Kinetic energy=mgx
At C,
Kinetic energy=mgh and Potential energy=0

a) Find the potential energy of the body at B.

b) Find the total energy at A,B and C.

c) Is there any variation in total energy?

What do you infer from the result?



20. A bag of wheat weighs 200 kg. To what height should it be raised so that its potential energy may be 9800 joules? (9.8 m/s^2)

POWER

Power is defined as the rate of doing work or the rate of transfer of energy. If an agent does a work *W* in time *t*, then power is given by:

$$Power = \frac{Work}{Time} = \frac{Energy}{Time}$$

$$\Rightarrow P = \frac{W}{t}$$

The unit of power is watt having the symbol W. 1 watt is the power of an agent, which does work at the rate of 1 joule per second.
Power is 1 W when the rate of consumption of energy is 1 J/s.
1 watt = 1 joule/second or 1 W = 1 J/s.

Larger Units of Power

1 kilowatt = 1000 watts

1 kW = 1000 W

1 kW = 1000 J/s.

Commercial unit of energy is kilo watt hour.
A unit which is exclusively used in engineering is called a horse power (hp)

1 hp = 746 W

Commercial unit of energy: kilowatt hour (kWh)

$$1 \text{ kWh} = 1 \text{ kW} \times 1 \text{ h} = 1000 \text{ W} \times 3600 \text{ s} = 3600000 \text{ J}$$
$$= 3.6 \times 10^6 \text{ J} = 3.6 \text{ MJ(Mega Joule)}$$

One kilowatt hour is the amount of energy consumed by an agent in one hour working at a constant rate of one kilowatt. It is also called unit of electrical energy

INTEXT QUESTIONS PAGE NO. 156

1. **What is power?**
   Ans:
   Power is the rate of doing work or the rate of transfer of energy. If W is the amount of work done in time t, then power is given by the expression,
   $$Power = \frac{Work}{Time} = \frac{Energy}{Time} \qquad \Rightarrow P = \frac{W}{t}$$
   It is expressed in watt (W).

2. **Define 1 watt of power.**
   Ans:
   1 watt is the power of an agent, which does work at the rate of 1 joule per second.
   Power is 1 W when the rate of consumption of energy is 1 J/s.
   1 watt = 1 joule/second or 1 W = 1 J/s.

3. **A lamp consumes 1000 J of electrical energy in 10 s. What is its power?**
   Ans: Here, electrical energy consumption, W = 1000 J, time, t = 10 s.
   $$Power = \frac{W}{T} = \frac{1000}{10} = 100W$$

4. **Define average power.**
   Ans: A body can do different amount of work in different time intervals. Hence, it is better to define average power. Average power is obtained by dividing the total amount of work done in the total time taken to do this work.
   $$\text{Average power} = \frac{\text{total energy consumed}}{\text{total time taken}}$$

NUMERICALS

1. Two girls each of weight 400N, climb up a rope through a height of 8m. We name one of the girls A and the other B. Girl A takes 20s while B takes 50s to accomplish this task. What is the power expended by each girl?
2. A boy of mass 50kg runs up a staircase of 45 steps in 9s. If the height of each step is 15cm, find his power. Take g = 10 m/s^2.
3. An electric bulb of 60W is used for 6 hr per day. Calculate the ‘units’ of energy consumed in one day by the bulb.
4. A 60 kg person climbs stairs of total height 20 m in 2 min. Calculate the power delivered.

5. The work done by the heart is 1 J per beat. Calculate the power of the heart if it beats 72 times/min.
6. A man exerts a force of 200 N in pulling a cart at a constant speed of 16m/s. Calculate the power spent by the man.
7. Calculate the power of an engine required to lift 10^5 kg of coal per hour from a mine 360m deep.
8. A man does 200 J of work in 10 s and a boy does 100 J of work in 4s. (a) Who is delivering more power? (b) Find the ratio of the power delivered by the man to that delivered by the boy.
9. A boy of mass 40 kg runs up a flight of 50 steps, each of 10cm high in 5s. Find the power developed by the boy.
10. A car of mass 2000 kg is lifted up a distance of 30m by a crane in 1 min. A second crane does the same job in 2 min. What is the power applied by each crane? Do the carne consume the same or different amounts of fuel? Neglect power dissipation against friction.
11. What should be the power of an engine required to lift 90 metric tones of coal per hour from a mine whose depth is 200m?
12. How much time does it take to perform 500 J of work at a rate of 10 W?
13. Calculate the units of energy consumed by 100 W electric bulb in 5 hours.
14. A lift is designed to carry a load of 4000 kg through 10 floors of a building, averaging 6 m per floor, in 10s. Calculate the power of the lift.

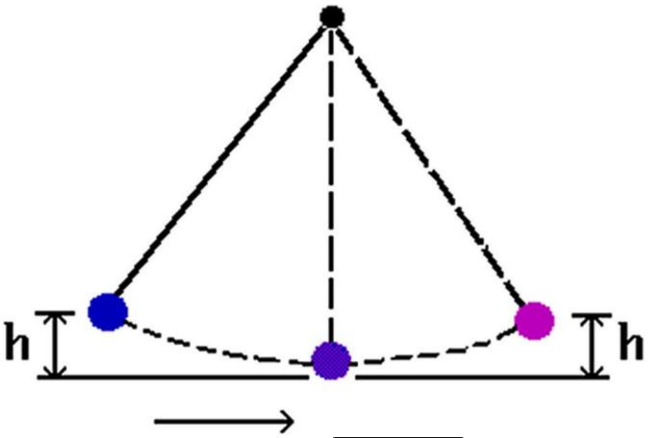
ENERGY TRANSFERMATION

- **Water from dam:** Potential energy into Kinetic energy
- **Microphone :** Sound energy into Electrical energy
- **TV Camera :** Light energy into Electrical energy
- **Solar Cell :** Light energy into Electrical energy
- **Iron Box :** Electrical energy into Heat energy
- **Loud speaker :** Electrical energy into Sound energy
- **Fan :** Electrical energy into Mechanical energy
- **Light :** Electrical energy into Light energy

LAW OF CONSERVATION OF ENERGY

Energy in a system may take on various forms (e.g. kinetic, potential, heat, light). The law of conservation of energy states that energy may neither be created nor destroyed. Therefore the sum of all the energies in the system is a constant.

The most commonly used example is the pendulum:



The formula to calculate the potential energy is: $\boxed{PE = mgh}$
The mass of the ball = 10kg
The height, h = 0.2m
The acceleration due to gravity, g = 9.8 m/s^2
Substitute the values into the formula and you get:
PE = 19.6J (J = Joules, unit of energy)

- The position of the blue ball is where the Potential Energy (PE) = 19.6J while the Kinetic Energy (KE) = 0.
  As the blue ball is approching the purple ball position the PE is decreasing while the KE is increasing. At exactly halfway between the blue and purple ball position the PE = KE.
- The position of the purple ball is where the Kinetic Energy is at its maximum while the Potential Energy (PE) = 0.
  At this point, theoretically, all the PE has transformed into KE> Therefore now the KE = 19.6J while the PE = 0.
- The position of the pink ball is where the Potential Energy (PE) is once again at its maximum and the Kinetic Energy (KE) = 0.

We can now say and understand that:

$$\boxed{PE + KE = 0}$$

$$\boxed{PE = -KE}$$

The sum of PE and KE is the total mechanical energy:

$$\boxed{\text{Total Mechanical Energy} = PE + KE}$$

COMMERCIAL UNIT OF ENERGY

The unit joule is too small and hence is inconvenient to express large quantities of energy. We use a bigger unit of energy called kilowatt hour (kW h).
The commercial unit of electric energy is kilowatt hour (kW h), commonly known as 'unit'.
1 kWh is the amount of energy consumed by an electrical gadget in one hour at the rate of 1000 J/s or 1kW.

$$\boxed{\begin{gathered}1\text{ kW h} = 1\text{ kW} \times 1\text{ h}\\ = 1000\text{ W} \times 3600\text{ s}\\ = 3600000\text{ J}\\ 1\text{ kW h} = 3.6 \times 10^6\text{ J.}\end{gathered}}$$

The energy used in households, industries and commercial establishments are usually expressed in kilowatt hour. For example, electrical energy used during a month is expressed in terms of ‘units’. Here, 1 ‘unit’ means 1 kilowatt hour.

EXERCISE QUESTIONS PAGE NO. 158 AND 159

1. **Look at the activities listed below. Reason out whether or not work is done in the light of your understanding of the term ‘work’.**
   a). Suma is swimming in a pond.
   b). A donkey is carrying a load on its back.
   c). A wind-mill is lifting water from a well.
   d). A green plant is carrying out photosynthesis.
   e). An engine is pulling a train.
   f). Food grains are getting dried in the sun.
   g). A sailboat is moving due to wind energy.

Ans:

Work is done whenever the given two conditions are satisfied:
(i) A force acts on the body.
(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.
(a) While swimming, Suma applies a force to push the water backwards. Therefore, Suma swims in the forward direction caused by the forward reaction of water. Here, the force causes a displacement. Hence, work is done by Seema while swimming.
(b) While carrying a load, the donkey has to apply a force in the upward direction. But, displacement of the load is in the forward direction. Since, displacement is perpendicular to force, the work done is zero.
(c) A wind mill works against the gravitational force to lift water. Hence, work is done by the wind mill in lifting water from the well.
(d) In this case, there is no displacement of the leaves of the plant. Therefore, the work done is zero.
(e) An engine applies force to pull the train. This allows the train to move in the direction of force. Therefore, there is a displacement in the train in the same direction. Hence, work is done by the engine on the train.
(f) Food grains do not move in the presence of solar energy. Hence, the work done is zero during the process of food grains getting dried in the Sun.
(g)Wind energy applies a force on the sailboat to push it in the forward direction. Therefore, there is a displacement in the boat in the direction of force. Hence, work is done by wind on the boat.

2. **An object thrown at a certain angle to the ground moves in a curved path and falls back to the ground. The initial and the final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object?**

   Ans: Work done by the force of gravity on an object depends only on vertical displacement. Vertical displacement is given by the difference in the initial and final positions/heights of the object, which is zero.

   Work done by gravity is given by the expression,
   $W = mgh$, where, h = Vertical displacement = 0
   $W = mg \times 0 = 0$ J
   Therefore, the work done by gravity on the given object is zero joule.

3. **A battery lights a bulb. Describe the energy changes involved in the process.**
Ans: When a bulb is connected to a battery, then the chemical energy of the battery is transferred into electrical energy. When the bulb receives this electrical energy, then it converts it into light and heat energy. Hence, the transformation of energy in the given situation can be shown as:
Chemistry Energy $\rightarrow$ Electrical Energy $\rightarrow$ Light Energy + Heat Energy

4. **Certain force acting on a 20 kg mass changes its velocity from 5 m s^{-1} to 2 m s^{-1}. Calculate the work done by the force.**
Ans: Kinetic energy is given by the expression, $(E_k)_v = \frac{1}{2}mv^2$
where, E_k = Kinetic energy of the object moving with a velocity, v
m= Mass of the object
(i) Kinetic energy when the object was moving with a velocity 5 m s−1
$$(E_k)_5 = \frac{1}{2}\times 20\times 5^2 = 250J$$
Kinetic energy when the object was moving with a velocity 2 m s−1
$$(E_k)_2 = \frac{1}{2}\times 20\times 2^2 = 40J$$
Work done by force is equal to the change in kinetic energy.
Therefore, work done by force = $(E_k)_2 - (E_k)_5$ = 40 − 250 = −210 J
The negative sign indicates that the force is acting in the direction opposite to the motion of the object.

5. **A mass of 10 kg is at a point A on a table. It is moved to a point B. If the line joining A and B is horizontal, what is the work done on the object by the gravitational force? Explain your answer.**
Ans: Work done by gravity depends only on the vertical displacement of the body. It does not depend upon the path of the body. Therefore, work done by gravity is given by the expression,
W = mgh
where, Vertical displacement, h = 0
Therefore, W = mg × 0 = 0
Hence, the work done by gravity on the body is zero.

6. **The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?**
Ans: No. The process does not violate the law of conservation of energy. This is because when the body falls from a height, then its potential energy changes into kinetic energy progressively. A decrease in the potential energy is equal to an increase in the kinetic energy of the body. During the process, total mechanical energy of the body remains conserved. Therefore, the law of conservation of energy is not violated.

7. **What are the various energy transformations that occur when you are riding a bicycle?**
Ans: While riding a bicycle, the muscular energy of the rider gets transferred into heat energy and kinetic energy of the bicycle. Heat energy heats the rider's body. Kinetic energy provides a velocity to the bicycle. The transformation can be shown as:
Mechanical Energy $\rightarrow$ Kinetic Energy + Heat Energy
During the transformation, the total energy remains conserved.

8. Does the transfer of energy take place when you push a huge rock with all your might and fail to move it? Where is the energy you spend going?

Ans: When we push a huge rock, there is no transfer of muscular energy to the stationary rock. Also, there is no loss of energy because muscular energy is transferred into heat energy, which causes our body to become hot.

9. A certain household has consumed 250 units of energy during a month. How much energy is this in joules?

Ans: 1 unit of energy is equal to 1 kilowatt hour (kWh).

1 unit = 1 kWh

1 kWh = 3.6×10^6 J

Therefore, 250 units of energy = $250 \times 3.6 \times 10^6 = 9 \times 10^8$ J

10. An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.

Ans: Gravitational potential energy is given by the expression,

W = mgh

Where,

h = Vertical displacement = 5 m

m = Mass of the object = 40 kg

g = Acceleration due to gravity = 9.8 m s−2

Therefore, W = 40 × 5 × 9.8 = 1960 J.

At half-way down, the potential energy of the object will be $\frac{1960}{2}$ = 980 J.

At this point, the object has an equal amount of potential and kinetic energy. This is due to the law of conservation of energy. Hence, half-way down, the kinetic energy of the object will be 980 J.

11. What is the work done by the force of gravity on a satellite moving round the earth? Justify your answer.

Ans: Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

If the direction of force is perpendicular to displacement, then the work done is zero.

When a satellite moves around the Earth, then the direction of force of gravity on the satellite is perpendicular to its displacement. Hence, the work done on the satellite by the Earth is zero.

12. Can there be displacement of an object in the absence of any force acting on it? Think. Discuss this question with your friends and teacher.

Ans: Yes. For a uniformly moving object

Suppose an object is moving with constant velocity. The net force acting on it is zero. But, there is a displacement along the motion of the object. Hence, there can be a displacement without a force.

13. A person holds a bundle of hay over his head for 30 minutes and gets tired. Has he done some work or not? Justify your answer.

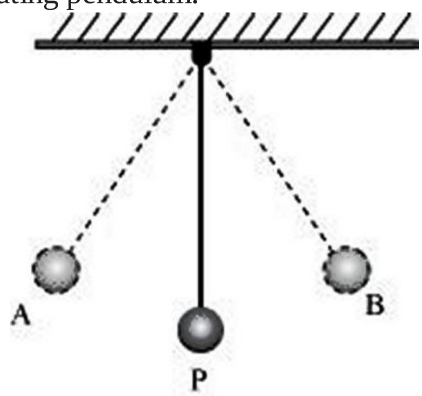
Ans: Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.
When a person holds a bundle of hay over his head, then there is no displacement in the bundle of hay. Although, force of gravity is acting on the bundle, the person is not applying any force on it. Hence, in the absence of force, work done by the person on the bundle is zero.

14. An electric heater is rated 1500 W. How much energy does it use in 10 hours?
Ans: Energy consumed by an electric heater can be obtained with the help of the expression, $P = \frac{W}{T}$
where, Power rating of the heater, P = 1500 W = 1.5 kW
Time for which the heater has operated, T = 10 h
Work done = Energy consumed by the heater
Therefore, energy consumed = Power × Time = 1.5 × 10 = 15 kWh
Hence, the energy consumed by the heater in 10 h is 15 kWh.

15. Illustrate the law of conservation of energy by discussing the energy changes which occur when we draw a pendulum bob to one side and allow it to oscillate. Why does the bob eventually come to rest? What happens to its energy eventually? Is it a violation of the law of conservation of energy?
Ans: The law of conservation of energy states that energy can be neither created nor destroyed. It can only be converted from one form to another.
Consider the case of an oscillating pendulum.



When a pendulum moves from its mean position P to either of its extreme positions A or B, it rises through a height h above the mean level P. At this point, the kinetic energy of the bob changes completely into potential energy. The kinetic energy becomes zero, and the bob possesses only potential energy. As it moves towards point P, its potential energy decreases progressively. Accordingly, the kinetic energy increases. As the bob reaches point P, its potential energy becomes zero and the bob possesses only kinetic energy. This process is repeated as long as the pendulum oscillates.

The bob does not oscillate forever. It comes to rest because air resistance resists its motion. The pendulum loses its kinetic energy to overcome this friction and stops after some time.

The law of conservation of energy is not violated because the energy lost by the pendulum to overcome friction is gained by its surroundings. Hence, the total energy of the pendulum and the surrounding system remain conserved.

16. An object of mass, *m* is moving with a constant velocity, *v*. How much work should be done on the object in order to bring the object to rest?

Ans: Kinetic energy of an object of mass, m moving with a velocity, v is given by the expression, $E_k = \frac{1}{2}mv^2$

To bring the object to rest, $\frac{1}{2}mv^2$ amount of work is required to be done on the object.

17. Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h?

Ans: Kinetic energy, $E_k = \frac{1}{2}mv^2$

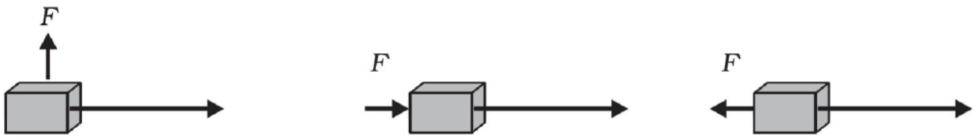
Where, Mass of car, m = 1500 kg

Velocity of car, v = 60 km/h $= 60 \times \frac{5}{18}\ ms^{-1}$

$\therefore E_k = \frac{1}{2} \times 1500 \times \left(60 \times \frac{5}{18}\right)^2 = 20.8 \times 10^4\ J$

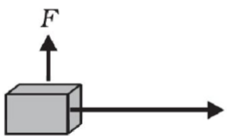
Hence, 20.8 × 104 J of work is required to stop the car.

18. In each of the following a force, *F* is acting on an object of mass, *m*. The direction of displacement is from west to east shown by the longer arrow. Observe the diagrams carefully and state whether the work done by the force is negative, positive or zero.



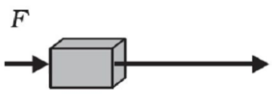
Ans: Work is done whenever the given two conditions are satisfied:
(i) A force acts on the body.
(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

Case I



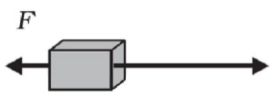
In this case, the direction of force acting on the block is perpendicular to the displacement. Therefore, work done by force on the block will be zero.

Case II



In this case, the direction of force acting on the block is in the direction of displacement. Therefore, work done by force on the block will be positive.

Case III



In this case, the direction of force acting on the block is opposite to the direction of displacement. Therefore, work done by force on the block will be negative.

19. Soni says that the acceleration in an object could be zero even when several forces are

acting on it. Do you agree with her? Why?

Ans: Acceleration in an object could be zero even when several forces are acting on it. This happens when all the forces cancel out each other i.e., the net force acting on the object is zero. For a uniformly moving object, the net force acting on the object is zero. Hence, the acceleration of the object is zero. Hence, Soni is right.

20. Find the energy in kW h consumed in 10 hours by four devices of power 500 W each.

Ans: Energy consumed by an electric device can be obtained with the help of the expression for power, $P = \frac{W}{T}$

where, Power rating of the device, P = 500 W = 0.50 kW
Time for which the device runs, T = 10 h
Work done = Energy consumed by the device
Therefore, energy consumed = Power × Time = 0.50 × 10 = 5 kWh
Hence, the energy consumed by four equal rating devices in 10 h will be 4 × 5 kWh = 20 kWh = 20 Units

21. A freely falling object eventually stops on reaching the ground. What happenes to its kinetic energy?

Ans: When an object falls freely towards the ground, its potential energy decreases and kinetic energy increases. As the object touches the ground, all its potential energy gets converted into kinetic energy. As the object hits the hard ground, all its kinetic energy gets converted into heat energy and sound energy. It can also deform the ground depending upon the nature of the ground and the amount of kinetic energy possessed by the object.

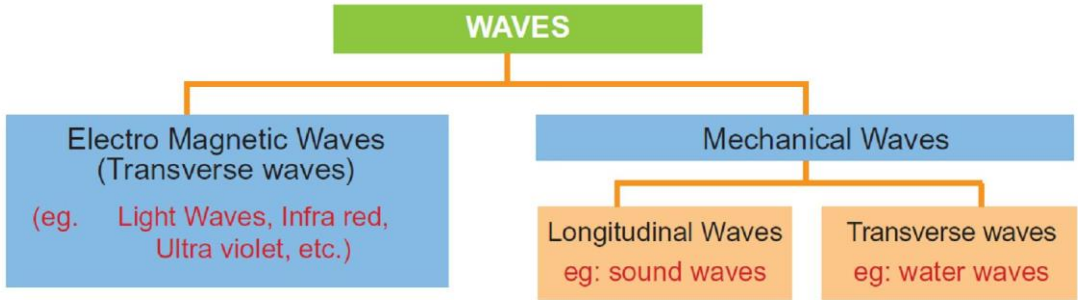
CHAPTER - 12
SOUND

Sound is a mechanical wave and needs a material medium like air, water, steel etc. for its propagation.
A **medium** is the substance or material through which a pulse or a wave moves.

INTEXT QUESTIONS PAGE NO. 162

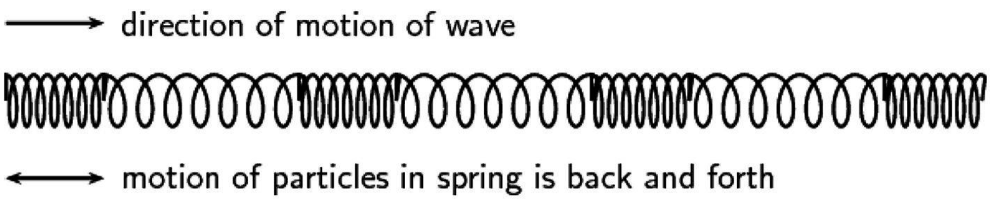
1. How does the sound produced by a vibrating object in a medium reach your ear?
Ans: When an object vibrates, it forces the neighbouring particles of the medium to vibrate. These vibrating particles then force the particles adjacent to them to vibrate. In this way, vibrations produced by an object are transferred from one particle to another till it reaches the ear.

LONGITUDINAL AND TRANSVERSE WAVE

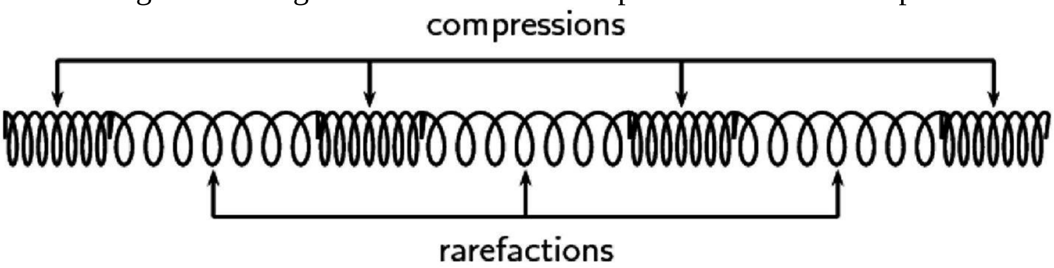


A **longitudinal wave** is a wave where the particles in the medium move **parallel** to the direction of propagation of the wave.
"If the particles of a medium vibrate in a direction, parallel to or along the direction of propagation of wave, it is called longitudinal wave"

Sound waves are pressure waves caused by objects which are vibrating. Sound waves **need a medium through which to travel.**

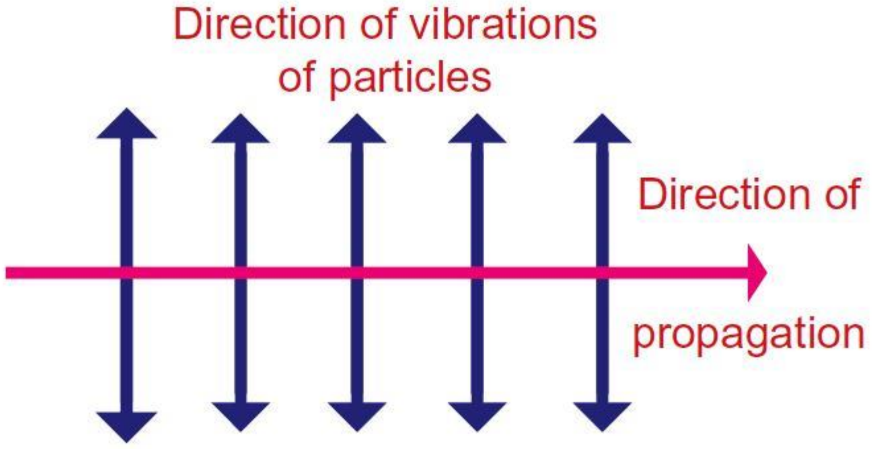


A compression is a region in a longitudinal wave where the particles are closest together. A rarefaction is a region in a longitudinal wave where the particles are furthest apart.

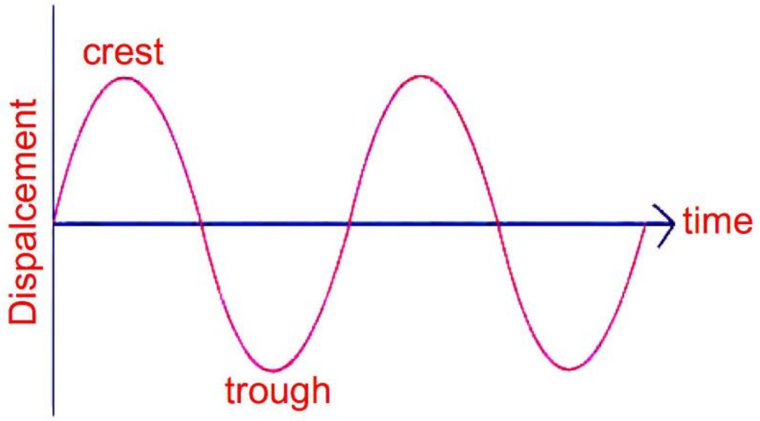


TRANSVERSE WAVE

“If the particles of the medium vibrate in a direction, perpendicular to the direction of propagation, the wave is called transverse wave.”
Example: water waves, vibrations of stretched string.



Transverse waves propagate in a medium in the form of crests and troughs as shown in fig:



Crest : The maximum displacement along the upward direction.
Trough: The maximum displacement along the downward direction.

INTEXT QUESTIONS PAGE NO. 163

1. Explain how sound is produced by your school bell.
   Ans: When the school bell vibrates, it forces the adjacent particles in air to vibrate. This disturbance gives rise to a wave and when the bell moves forward, it pushes the air in front of it. This creates a region of high pressures known as compression. When the bell moves backwards, it creates a region of low pressure know as rarefaction. As the bell continues to move forward and backward, it produces a series of compressions and rarefactions. This makes the sound of a bell propagate through air.

2. Why are sound waves called mechanical waves?
   Ans: Sound waves force the medium particles to vibrate. Hence, these waves are known as mechanical waves. Sound waves propagate through a medium because of the interaction of the particles present in that medium.

3. Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Ans: Sound needs a medium to propagate. Since the moon is devoid of any atmosphere, you cannot hear any sound on the moon.

CHARACTERISTICS OF SOUND

Sound can be distinguished from each other by the following three characteristics:

1. Loudness or Intensity
2. Pitch or Frequency
3. Quality or Timbre

1. Loudness

The sensation produced in the ear, which enables us to distinguish between a loud, and a faint sound is called loudness.
The amplitude of the wave determines the loudness or softness of a sound basically.

Intensity

The intensity of sound is defined as the amount of energy passing per unit time per unit area in a direction perpendicular to the area.

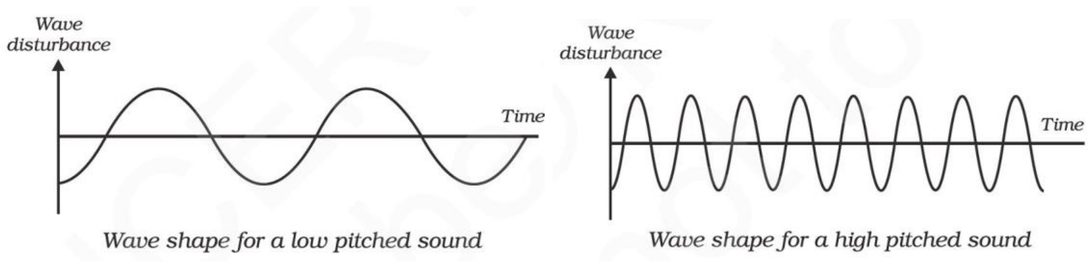
$$Intensity = \frac{energy}{area \times time} = \frac{power}{area}\left(\because power = \frac{energy}{area}\right)$$

The unit of intensity is watt/metre^2(W/m^2) .
Difference between loudness and intensity

Loudness	Intensity
1. It is not an entirely physical quantity	**1.** It is a physical quantity which can be accurately measured.
2. It depends upon (i) sensitivity of the ear and (ii) intensity of the sound	**2.** It does not depends upon sensitivity of the ear.

Pitch or Frequency

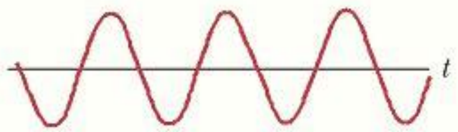
Pitch is that characteristics of sound which helps in differentiating between a shrill sound from a grave (flat or dull) sound.
High and low pitched sounds are called treble and bass respectively.



Quality or Timbre

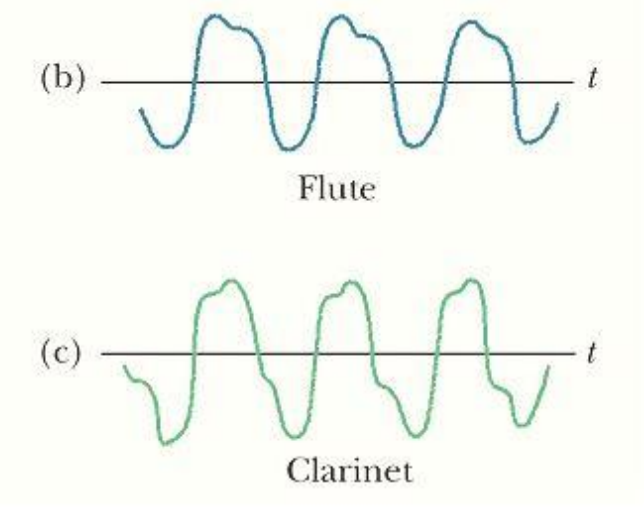
The characteristic of a sound which distinguishes it from another of the same pitch and loudness is called quantity or timbre.

A sound of single frequency is called a tone.

(a) 

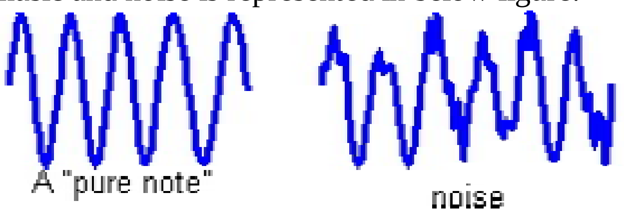
Tuning fork

A sound which is produced due to a mixture of several frequencies is called a note.



Music and Noise

The difference between music and noise is represented in below figure:



First figure is regular and has a definite amplitude. It represents a musical sound.

A musical sound can be defined as a pleasant continuous and uniform sound produced by regular and periodic vibrations. Example: The pleasant sound produced by a guitar, piano, tuning fork etc.

The second curve represents a noise. The curve is irregular and has no definite amplitude.

Musical sound is pleasant to hear and is of rich quality. Noise on the other hand is unpleasant to hear.

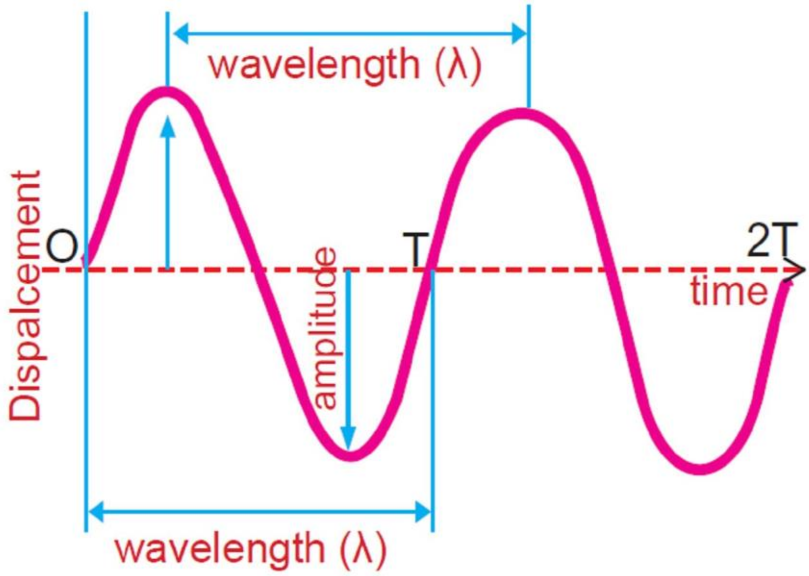
Noise can be defined as an irregular succession of disturbances, which are discordant and unpleasant to the ear.

TERMS RELATED TO SOUND WAVES

The ***amplitude*** A is the maximum excursion of a particle of the medium from the particles undisturbed position.

The ***wavelength*** is the horizontal length of one cycle of the wave.

The ***period*** is the time required for one complete cycle.



The ***frequency*** is related to the period and has units of Hz, or s^{-1}. The number of such oscillations per unit time is the frequency of the sound wave. $\nu = \frac{1}{T}$

The speed of sound is defined as the distance which a point on a wave, such as a compression or a rarefaction, travels per unit time.

We know, speed, $v = \frac{\text{distance}}{\text{time}} = \frac{\lambda}{\text{T}}$

Here λ is the wavelength of the sound wave. It is the distance travelled by the sound wave in one time period (T) of the wave. Thus, $v = \lambda\nu \quad \left(\because \nu = \frac{1}{T}\right)$

That is, speed = wavelength × frequency.
The speed of sound remains almost the same for all frequencies in a given medium

INTEXT QUESTIONS PAGE NO. 166

1. Which wave property determines (a) loudness, (b) pitch?
Ans: (a) Amplitude (b) Frequency
(a) The loudness of a sound depends on its amplitude. If the amplitude of a sound is large, then the sound produced will also be loud.
(b) The pitch of a sound depends on its frequency. A sound will be considered a high pitched sound, if its frequency is high.

2. Guess which sound has a higher pitch: guitar or car horn?
Ans: The frequency of the vibration of a sound produced by a guitar is greater than that produced by a car horn. Since the pitch of a sound is proportional to its frequency, the guitar has a higher pitch than a car horn.

INTEXT QUESTIONS PAGE NO. 166

1. What are wavelength, frequency, time period and amplitude of a sound wave?
Ans: Wavelength: The distance between two consecutive compressions or two consecutive rarefactions is known as the wavelength. Its SI unit is metre (m).
Frequency: The number of complete oscillations per second is known as the frequency of a sound wave. It is measured in hertz (Hz).

Amplitude: The maximum height reached by the crest or trough of a sound wave is called its amplitude.

2. How are the wavelength and frequency of a sound wave related to its speed?
Ans: Speed, wavelength, and frequency of a sound wave are related by the following equation:
Speed (v) = Wavelength (λ) × Frequency (ν)
$v = \lambda \times \nu$

3. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.
Ans: Frequency of the sound wave, ν = 220 Hz
Speed of the sound wave, v = 440 m s^{-1}
For a sound wave,
Speed = Wavelength × Frequency
$v = \lambda \times \nu$
$$\therefore \lambda = \frac{v}{\nu} = \frac{440}{220} = 2m$$
Hence, the wavelength of the sound wave is 2 m.

4. A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?
Ans: The time interval between two successive compressions is equal to the time period of the wave. This time period is reciprocal of the frequency of the wave and is given by the relation:
$$T = \frac{1}{frequency} = \frac{1}{500} = 0.002s$$

INTEXT QUESTIONS PAGE NO. 166

1. Distinguish between loudness and intensity of sound.
Ans: Intensity of a sound wave is defined as the amount of sound energy passing through a unit area per second. Loudness is a measure of the response of the ear to the sound. The loudness of a sound is defined by its amplitude. The amplitude of a sound decides its intensity, which in turn is perceived by the ear as loudness.

SONIC BOOM

When the speed of any object exceeds the speed of sound it is said to be travelling at supersonic speed. Bullets, jet aircrafts etc. often travel at supersonic speeds. When a sound, producing source moves with a speed higher than that of sound, it produces shock waves in air. These shock waves carry a large amount of energy. The air pressure variation associated with this type of shock waves produces a very sharp and loud sound called the “sonic boom”. The shock waves produced by a supersonic aircraft have enough energy to shatter glass and even damage buildings.

INTEXT QUESTIONS PAGE NO. 167

1. In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?
Ans: The speed of sound depends on the nature of the medium. Sound travels the fastest in

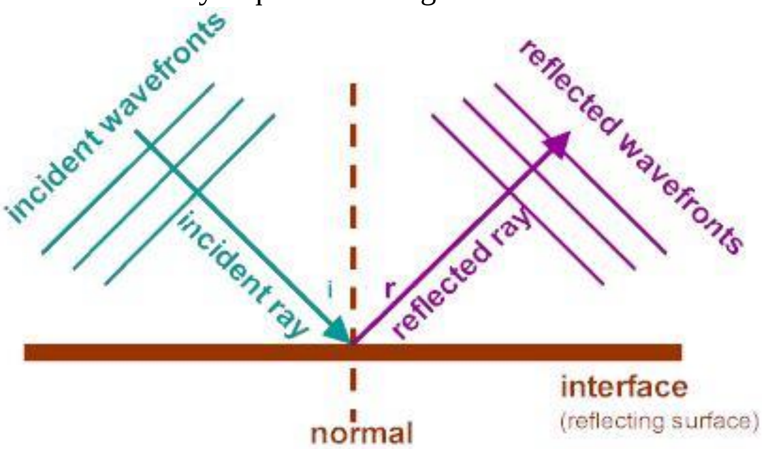
solids. Its speed decreases in liquids and it is the slowest in gases.

Therefore, for a given temperature, sound travels fastest in iron.

REFLECTION OF SOUND

The reflection of sound follows the law "angle of incidence equals angle of reflection", sometimes called the law of reflection. The law state that:

1. The incident wave, the reflected wave and the normal(at the pont of incidence), all lie in the same plane.
2. The angle of reflection is always equal to the angle of incidence. i. e. $\angle i = \angle r$



ECHO

An echo is the phenomenon of repetition of sound of a source by reflection from an obstacle. The sensation of sound persists in our brain for about 0.1 s. This property is called persistence of hearing. Therefore, to hear a distinct echo the time interval between the original sound and the reflected one must be at least 0.1s.

Let d = minimum distance of the obstacles from the source

v = speed of sound in air

t = total time taken by the sound to reach the listener after reflection.

Then by distance = speed x time formula we have, 2d = v x t

Substituting v = 344m/s (speed of the sound in air at 20^0C) and t = 0.1s, we get

$$2d = 344 \times 0.1 = 34.4 \text{ m}$$

$$\mathbf{d = 17.2\ m}$$

Hence for hearing a distinct echo, the minimum distance of the obstacle from the source of sound should be 17.2m.

$$\boxed{d = \frac{vt}{2}}$$

where d is the distance between the source of sound and the obstacle, t is the time taken by sound in going to the obstacle and coming back and v is the speed of sound.

d is measured in metre, v in m/s and t in second.

INTEXT QUESTIONS PAGE NO. 168

1. An echo returned in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 m s^{-1}?

   Ans: Speed of sound, v = 342 m s^{-1}

   Echo returns in time, t = 3 s

   Distance travelled by sound = v × t = 342 × 3 = 1026 m

   In the given time interval, sound has to travel a distance that is twice the distance of the reflecting surface and the source.

Hence, the distance of the reflecting surface from the source $= \frac{1026}{2} = 513m$

MULTIPLE ECHOES

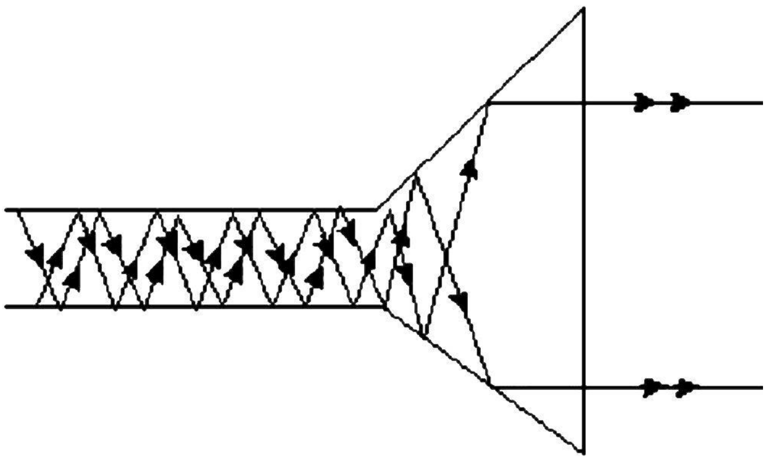
When sound is repeatedly reflected from a number of obstacles at suitable distances, many echoes are heard one after the other. This constitutes multiple echoes.

Uses of Multiple Reflection of sound

The phenomenon of multiple reflection of sound are given below:

1. *Megaphones or Speaking tubes.*

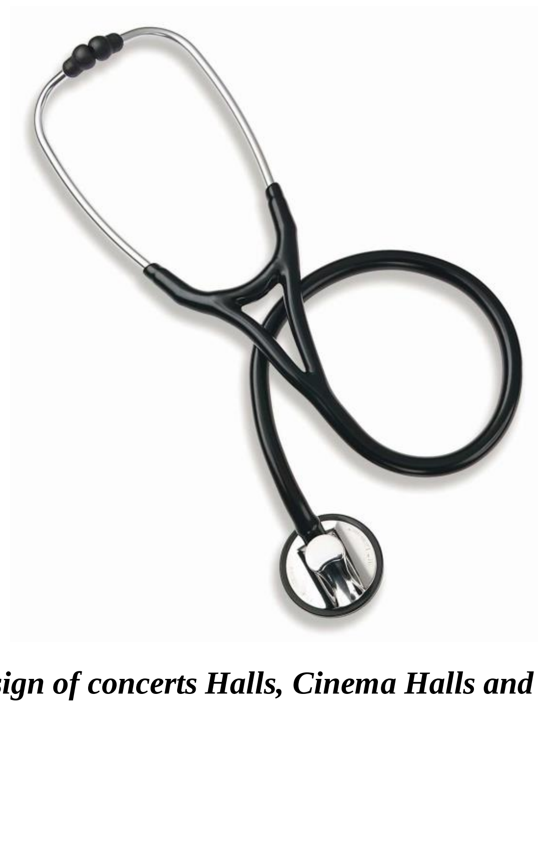
Megaphones or loudhailers, horns, musical instruments are all designed to send sound in a particular direction without spreading it in all directions. In these instruments, a tube followed by a conical opening reflects sounds successively to guide most of the sound waves from the source in the forward direction.

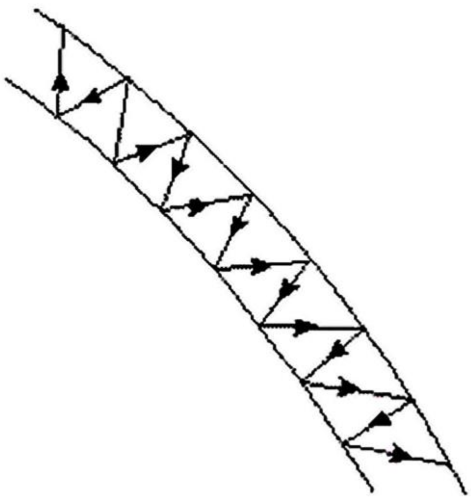


Multiple reflection of sound in a megaphone

2. *Stethoscope*

Stethoscope is a medical instrument used for listening to sounds produced within the body, chiefly in the heart or lungs. In stethoscopes the sound of the patient's heartbeat reaches the doctor's ears by multiple reflection of sound, as shown in below figure.

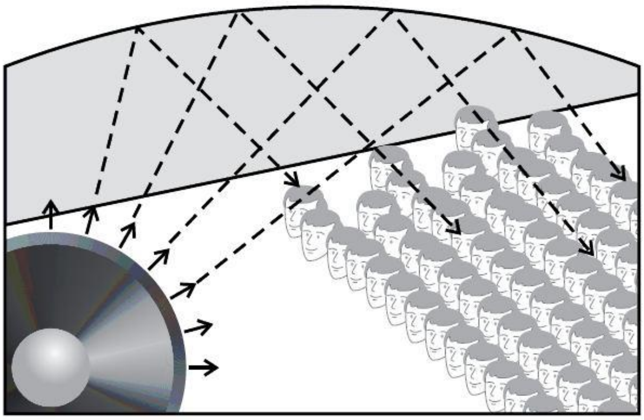


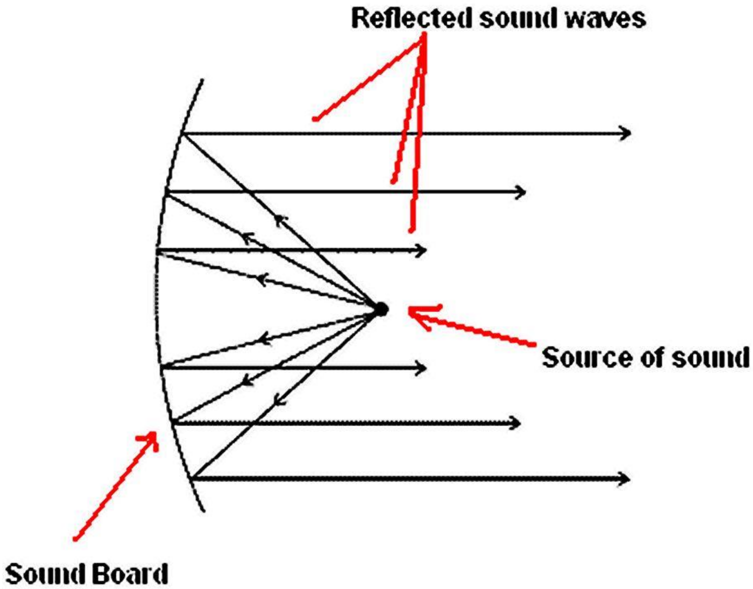


Muliple reflection of sound in the tube of stethoscope

3. *Design of concerts Halls, Cinema Halls and Conference Halls*

The ceilings of these halls are curved. This enables the sound to reach all corners of the hall after reflection from the ceiling as shown in below left figure.





A sound board, which is a curved sound reflecting surface, is placed behind the stage. The source is located at the focus of this reflecting surface. Sound waves coming from the source become parallel after reflection from the sound board and spread evenly throughout the width of the hall as shown in above right sided figure.

REVERBERATION

A sound created in a big hall will persist by repeated reflection from the walls until it is reduced to a value where it is no longer audible. The repeated reflection that results in this persistence of sound is called reverberation.

INTEXT QUESTIONS PAGE NO. 169

1. Why are the ceilings of concert halls curved?
   Ans: Ceilings of concert halls are curved so that sound after reflection (from the walls) spreads uniformly in all directions.

RANGE OF FREQUENCIES

There are three categories of longitudinal mechanical waves which cover different range of frequencies:

1. **Sound waves or Audible waves**
   These waves have frequencies which lie between 20 Hz to 20 kHz.

2. Infrasonic waves or Infrasound

Those longitudinal mechanical waves whose frequencies are below 20 Hz are called infrasonic waves.

3. Ultrasonic waves or Ultrasound

Those longitudinal mechanical waves whose frequencies are lie above 20 kHz are called ultrasonic waves.

APPLICATIONS OF ULTRASOUND

INDUSTRIAL USES OF ULTRASOUND

1. Cleaning instruments and electronics components

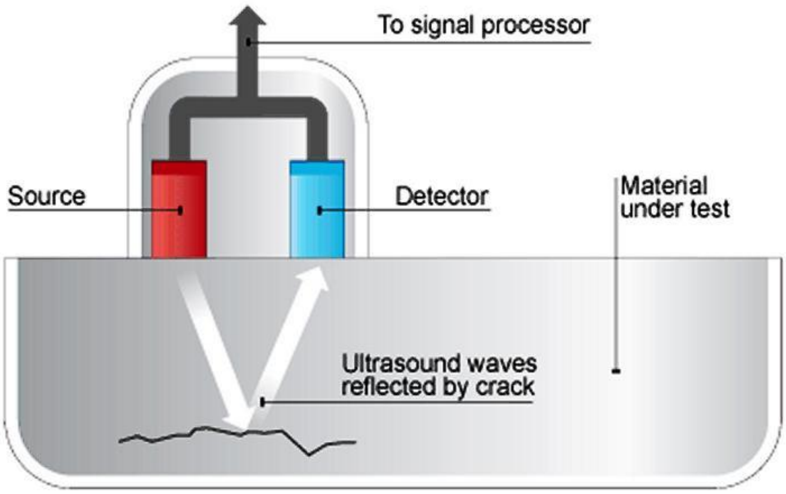
Ultrasound is generally used to clean parts located in hard-to-reach places, for example, spiral tube, odd shaped parts, electronic components etc. Objects to be cleaned are placed in a cleaning solution and ultrasonic waves are sent into the solution. Due to the high frequency, the particles of dust, grease and dirt get detached and drop out. The objects thus get thoroughly cleaned.

2. Plastic welding

Application of small pressure and ultrasonic vibration to two similar surface produce sufficient thermal energy to bond the surfaces together

3. Detecting flaws and cracks in metal blocks.

Ultrasounds can be used to detect cracks and flaws in metal blocks. Metallic components are generally used in construction of big structures like buildings, bridges, machines and also scientific equipment. The cracks or holes inside the metal blocks, which are invisible from outside reduces the strength of the structure. Ultrasonic waves are allowed to pass through the metal block and detectors are used to detect the transmitted waves. If there is even a small defect, the ultrasound gets reflected back indicating the presence of the flaw or defect, as shown in figure.



Medical uses of Ultrasound

1. Echocardiography

Ultrasonic waves are made to reflect from various parts of the heart and form the image of the heart. This technique is called 'echocardiography'.

2. Ultrasonography

Ultrasound scanner is an instrument which uses ultrasonic waves for getting images of internal organs of the human body. A doctor may image the patient's organs such as the liver, gall bladder, uterus, kidney, etc. It helps the doctor to detect abnormalities, such as stones in the gall bladder and kidney or tumours in different organs. In this technique the ultrasonic waves travel through the tissues of the body and get reflected from a region where there is a change of tissue density. These waves are then converted into electrical signals that are used to generate images of the organ. These images are then displayed on a monitor or printed on a film. This technique is called ‘ultrasonography’. Ultrasonography is also used for examination of the foetus during pregnancy to detect congenial defects and growth abnormalities.

3. Surgical uses.

Ultrasound is used for bloodless brain surgery as well as painless extraction of teeth etc. Ultrasound may be employed to break small ‘stones’ formed in the kidneys into fine grains. These grains later get flushed out with urine.

4. Therapeutic uses.

Ultrasound is used for treatment of neuralgic and rheumatic pains.

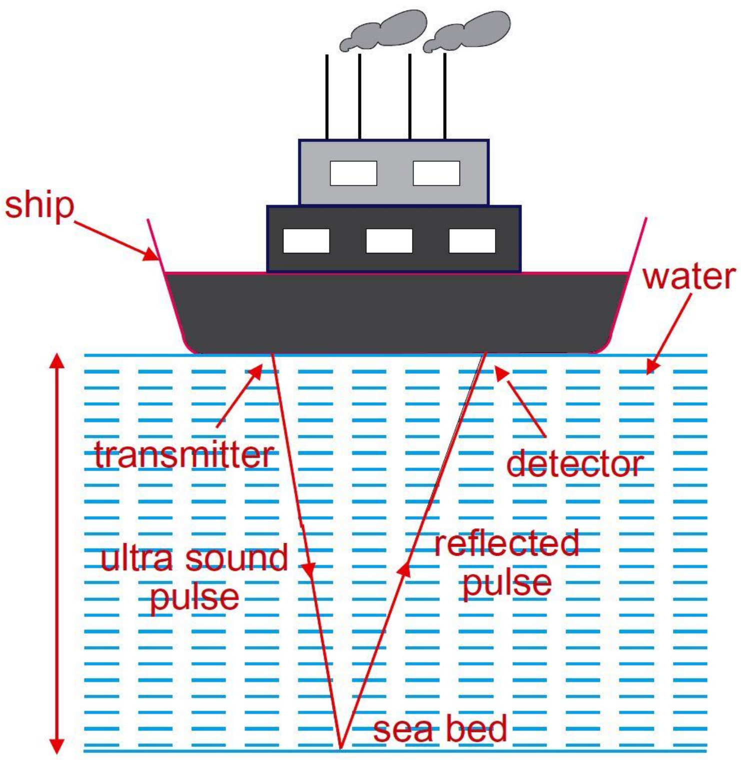
Communication (SONAR)

It is an acronym which means **SO**und **N**avigation **A**nd **R**anging.

A sonar is a device which measure the distance, direction and speed of objects lying under water using ultrasonic waves.

How does the sonar work?

The transmitter produces and transmits ultrasonic waves. These waves travel through water and after striking the object on the seabed, get reflected back and are sensed by the detector. The detector converts the ultrasonic waves into electrical signals which are appropriately interpreted. The distance of the object that reflected the sound wave can be calculated by knowing the speed of sound in water and the time interval between transmission and reception of the ultrasound.



Let the time interval between transmission and reception of ultrasound signal be t and the speed of sound through seawater be v. The total distance, $2d$ travelled by the ultrasound is then, $2d = v \times t$. The above method is called echo-ranging.

The sonar technique is used to determine the depth of the sea and to locate underwater hills, valleys, submarine, icebergs, sunken ship etc.

INTEXT QUESTIONS PAGE NO. 170

1. What is the audible range of the average human ear?
Ans: The audible range of an average human ear lies between 20 Hz to 20,000 Hz. Humans cannot hear sounds having frequency less than 20 Hz and greater than 20,000 Hz.

2. What is the range of frequencies associated with
(a) Infrasound?
(b) Ultrasound?
Ans: (a) Infrasound has frequencies less than 20 Hz.
(b) Ultrasound has frequencies more than 20,000 Hz.

INTEXT QUESTIONS PAGE NO. 172

1. A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is 1531 m/s, how far away is the cliff?
Ans: Time taken by the sonar pulse to return, t = 1.02 s
Speed of sound in salt water, v = 1531 m s^{-1}
Distance of the cliff from the submarine = Speed of sound × Time taken
Distance of the cliff from the submarine $= 1.02 \times 1531 = 1561.62 m$
Distance travelled by the sonar pulse during its transmission and reception in water = 2 × Actual distance = 2d

$$\text{Actual distance, } d = \frac{\text{Distance of the cliff from the submarine}}{2}$$

$$= \frac{1561.62}{2} = 780.31 m$$

NUMERICALS

1. A boy hears an echo of his own voice from a distant hill after 1 s. the speed of sound is 340m/s. What is the distance of the hill from the boy?

2. A boy is standing in front of wall at a distance of 85m produces 2 claps per second. He notices that the sound of his clapping coincides with the echo. The echo is heard only once when clapping is stopped. Calculate the speed of sound.

3. A man stationed between two parallel cliffs fires a gun. He hears the first echo after 1.5 s and the next after 2.5 s. What is the distance between the cliffs and when does he hear the third echo? Take the speed of sound in air is 340 m/s.

4. A man fires a shot and hears an echo from a cliff after 2s. He walks 85m towards the cliff and the echo of a second shot is now heard after 1.4s What is the velocity of sound and how far was the man from the cliff when he first heard the echo?

5. A boy hears an echo of his own voice from a distant hill after 2.5 s. the speed of sound is 340m/s. Calculate the distance of the hill from the boy.

6. A person clapped his hands near a cliff and heard the echo after 5 s. What is the distance of the cliff from the person if the speed of the sound, v is taken as 346 m/s?

7. A child hears an echo from a cliff after the sound of powerful cracker is produced. How far away is the cliff from the child? (Take speed of the sound in air as 340 m/s).

8. An observer standing between two cliffs fires a gun. He hears one echo after 1.5 s and another after 3.5 s. If the speed of sound is 340 m/s, find (a) the distance of the observer from the first cliff and (b) distance between the cliffs.

9. A boy stands 60m in front of a tall wall and claps. The boy continues to clap every time an echo is heard. Another boy finds that the time between the first (1st) and the fifty first (51st) clap is 18s. Calculate the speed of the sound.

10. A person standing between two vertical cliffs and 680m away from the nearest cliff, shouted. He heard the first echo after 4s and the second echo 3s later. Calculate (a) the speed of sound in air and the distance between the two cliffs.

11. A man standing at 51m from a wall fires a gun. Calculate the time after which an echo is heard. The speed of sound is 340 m/s.

12. A man fires a gun towards a hill and hears its echo after 5s. He then moves 340m towards the hill and fires his gun again. This time he hears the echo after 3s. Calculate the speed of the sound.

13. An engine is approaching a hill at constant speed. When it is at a distance of 0.9km, it blows a whistle, whose echo is heard by the driver after 5s. If the speed of sound is 340m/s, calculate the speed of the engine.

14. It takes 2.4a to record the echo of a sonar. If the speed of sound in water is 1450 m/s, find the depth of the ocean floor.

15. A ship which is stationary, is at a distance of 2900 m from the seabed. The ship sends an ultrasound signal to the seabed and its echo is heard 4s. Find the speed of sound in water.

16. A ship sends out ultrasound that returns from the seabed and is detected after 3.42s. If the speed of the ultrasound through sea water is 1531 m/s, what is the distance of the seabed from the ship?

17. A sonar device on a submarine sends out a signal and receives an echo 5s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3625m.

18. A sonar emits pulses on the surface of water which are detected after reflection from its bottom at a depth of 1531m. If the time interval between the emission and detection of the pulse is 2s, find the speed of sound in water.

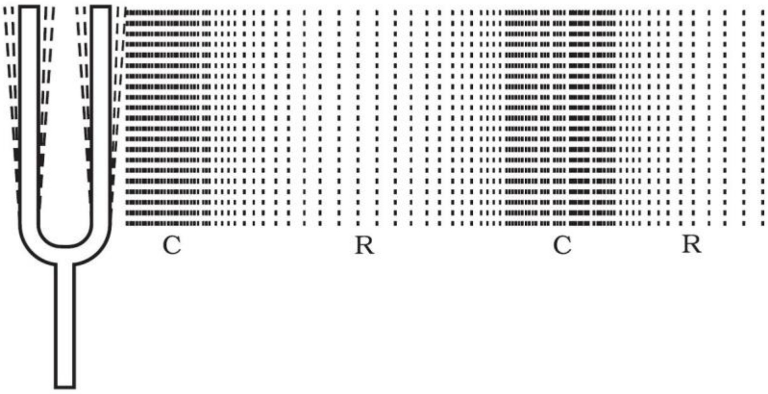
19. A sonar device on a submarine sends out a signal and receives an echo 10 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 7650m.

20. A man standing at 68m from a wall fires a gun. Calculate the time after which an echo is heard. The speed of sound is 340 m/s.

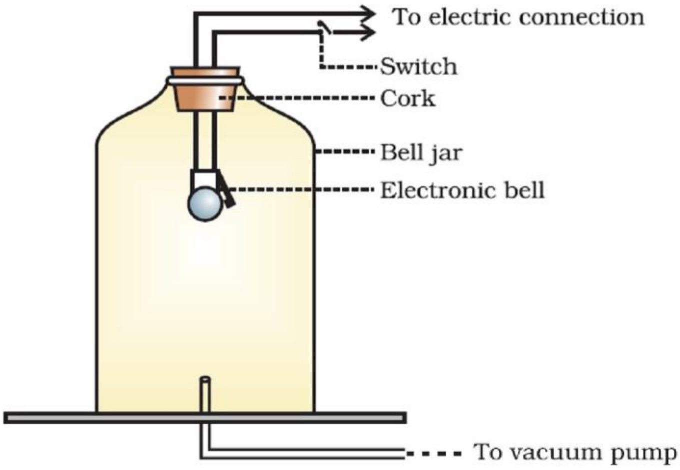
EXERCISE QUESTIONS PAGE NO. 174 AND 175

1. **What is sound and how is it produced?**
   Ans: Sound is produced by vibration. When a body vibrates, it forces the neighbouring particles of the medium to vibrate. This creates a disturbance in the medium, which travels in the form of waves. This disturbance, when reaches the ear, produces sound.

2. **Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.**
   Ans: When a vibrating body moves forward, it creates a region of high pressure in its vicinity. This region of high pressure is known as compressions. When it moves backward, it creates a region of low pressure in its vicinity. This region is known as a rarefaction. As the body continues to move forward and backwards, it produces a series of compressions and rarefactions (as shown in the following figure).



3. **Cite an experiment to show that sound needs a material medium for its propagation.**
   Ans: Take an electric bell and hang this bell inside an empty bell-jar fitted with a vacuum pump (as shown in the following figure).



Initially, one can hear the sound of the ringing bell. Now, pump out some air from the bell-jar using the vacuum pump. It will be observed that the sound of the ringing bell decreases. If one keeps on pumping the air out of the bell-jar, then at one point, the glass-jar will be devoid of any air. At this moment, no sound can be heard from the ringing bell although one can see that the prong of the bell is still vibrating. When there is no air present inside, we can say that a vacuum is produced. Sound cannot travel through vacuum. This shows that sound needs a material medium for its propagation.

4. Why is sound wave called a longitudinal wave?

Ans: The vibration of the medium that travels along or parallel to the direction of the wave is called a longitudinal wave. In a sound wave, the particles of the medium vibrate in the direction parallel to the direction of the propagation of disturbance. Hence, a sound wave is called a longitudinal wave.

5. **Which characteristic of the sound helps you to identify your friend by his voice while sitting with others in a dark room?**
   Ans: Quality of sound is that characteristic which helps us identify a particular person. Sound produced by two persons may have the same pitch and loudness, but the quality of the two sounds will be different.

6. **Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?**
   Ans: The speed of sound (344 m/s) is less than the speed of light (3 x 10^8 m/s). Sound of thunder takes more time to reach the Earth as compared to light. Hence, a flash is seen before we hear a thunder.

7. **A person has a hearing range from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as 344 m s^{-1}.**
   Ans: For a sound wave,
   Speed = Wavelength × Frequency
   $v = \lambda \times \nu$
   Given that the speed of sound in air = 344 m/s
   (i) For, ν_1 = 20 Hz
   $$\lambda_1 = \frac{v}{\nu_1} = \frac{344}{20} = 1.72m$$
   (ii) For, ν_2 = 20,000 Hz
   $$\lambda_2 = \frac{v}{\nu_2} = \frac{344}{20,000} = 0.0172m$$
   Hence, for humans, the wavelength range for hearing is 0.0172 m to 17.2 m.

8. **Two children are at opposite ends of an aluminium rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in air and in aluminium to reach the second child.**
   Ans: Let the length of the aluminium rod be d.
   Speed of sound wave in aluminium at 25°C, $v_{Al} = 6420ms^{-1}$
   Therefore, time taken by the sound wave to reach the other end,
   $$t_{Al} = \frac{d}{v_{Al}} = \frac{d}{6420}$$
   Speed of sound wave in air at 25°C, $v_{Air} = 346ms^{-1}$
   Therefore, time taken by sound wave to reach the other end,
   $$t_{Air} = \frac{d}{v_{Air}} = \frac{d}{346}$$
   The ratio of time taken by the sound wave in air and aluminium:
   $$\frac{t_{Air}}{t_{Al}} = \frac{\frac{d}{346}}{\frac{d}{6420}} = \frac{6420}{6420} = 18.55:1$$

9. **The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?**
Ans: Frequency is defined as the number of oscillations per second. It is given by the relation:

$$\text{Frequency} = \frac{\text{Number of oscillations}}{\text{Total time}}$$

Number of oscillations = Frequency × Total time
Given, Frequency of sound = 100 Hz
Total time = 1 min = 60 s
Number of oscillations/Vibrations = 100 × 60 = 6000
Hence, the source vibrates 6000 times in a minute, producing a frequency of 100 Hz.

10. **Does sound follow the same laws of reflection as light does? Explain.**
Ans: Sound follows the same laws of reflection as light does. The incident sound wave and the reflected sound wave make the same angle with the normal to the surface at the point of incidence. Also, the incident sound wave, the reflected sound wave, and the normal to the point of incidence all lie in the same plane.

11. **When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remains the same. Do you hear echo sound on a hotter day?**
Ans: An echo is heard when the time interval between the original sound and the reflected sound is at least 0.1 s. The speed of sound in a medium increases with an increase in temperature. Hence, on a hotter day, the time interval between the original sound and the reflected sound will decrease. Therefore, an echo can be heard only if the time interval between the original sound and the reflected sound is greater than 0.1 s.

12. **Give two practical applications of reflection of sound waves.**
Ans: (i) Reflection of sound is used to measure the distance and speed of underwater objects. This method is known as SONAR.
(ii) Working of a stethoscope is also based on reflection of sound. In a stethoscope, the sound of the patient's heartbeat reaches the doctor's ear by multiple reflection of sound.

13. **A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower. When is the splash heard at the top? Given, g = 10 m s^{-2} and speed of sound = 340 m s^{-1}.**
Ans: Height of the tower, s = 500 m
Velocity of sound, v = 340 m s^{-1}
Acceleration due to gravity, g = 10 m s^{-2}
Initial velocity of the stone, u = 0 (since the stone is initially at rest)

Time taken by the stone to fall to the base of the tower, t_1
According to the second equation of motion:

$$s = ut_1 + \frac{1}{2}gt_1^2$$

$$\Rightarrow 500 = 0 \times t_1 + \frac{1}{2} \times 10 \times t_1^2$$

$$\Rightarrow t_1^2 = 100 \Rightarrow t_1 = 10s$$

Now, time taken by the sound to reach the top from the base of the tower, $t_2 = \frac{}{340} = 1.47s$

Therefore, the splash is heard at the top after time, t

Where, $t = t_1 + t_2 = 10 + 1.47 = 11.47s$

14. A sound wave travels at a speed of 339 m s–1. If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?

Ans: Speed of sound, v = 339 m s−1

Wavelength of sound, λ = 1.5 cm = 0.015 m

Speed of sound = Wavelength × Frequency

$v = \lambda \times \nu$

$\therefore \nu = \frac{v}{\lambda} = \frac{339}{0.015} = 22600Hz$

The frequency range of audible sound for humans lies between 20 Hz to 20,000 Hz. Since the frequency of the given sound is more than 20,000 Hz, it is not audible.

15. What is reverberation? How can it be reduced?

Ans: Persistence of sound (after the source stops producing sound) due to repeated reflection is known as reverberation. As the source produces sound, it starts travelling in all directions. Once it reaches the wall of a room, it is partly reflected back from the wall. This reflected sound reaches the other wall and again gets reflected partly. Due to this, sound can be heard even after the source has ceased to produce sound.

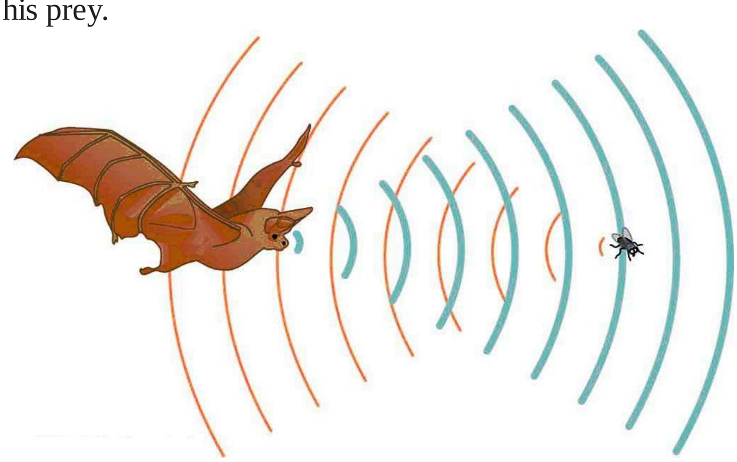
To reduce reverberations, sound must be absorbed as it reaches the walls and the ceiling of a room. Sound absorbing materials like fibreboard, rough plastic, heavy curtains, and cushioned seats can be used to reduce reverberation.

16. What is loudness of sound? What factors does it depend on?

Ans: A loud sound has high energy. Loudness depends on the amplitude of vibrations. In fact, loudness is proportional to the square of the amplitude of vibrations.

17. Explain how bats use ultrasound to catch a prey.

Ans: Bats produce high-pitched ultrasonic squeaks. These high-pitched squeaks are reflected by objects such as preys and returned to the bat’s ear. This allows a bat to know the distance of his prey.

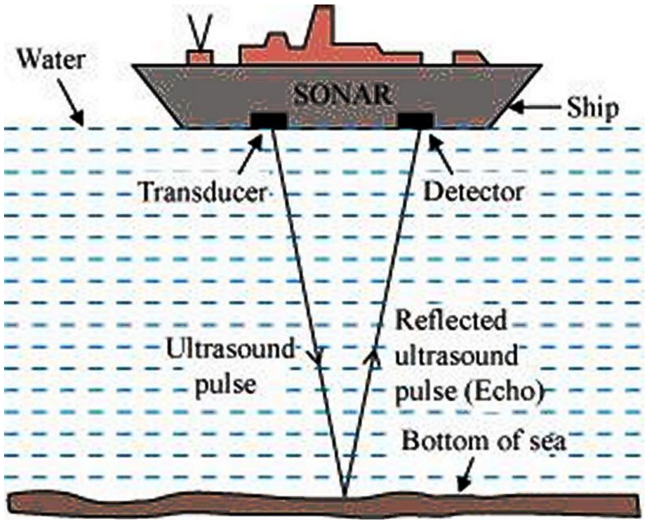


18. How is ultrasound used for cleaning?

Ans: Objects to be cleansed are put in a cleaning solution and ultrasonic sound waves are passed through that solution. The high frequency of these ultrasound waves detaches the dirt from the objects.

19. Explain the working and application of a sonar.

Ans: SONAR is an acronym for Sound Navigation And Ranging. It is an acoustic device used to measure the depth, direction, and speed of under-water objects such as submarines and ship wrecks with the help of ultrasounds. It is also used to measure the depth of seas and oceans.



A beam of ultrasonic sound is produced and transmitted by the transducer (it is a device that produces ultrasonic sound) of the SONAR, which travels through sea water. The echo produced by the reflection of this ultrasonic sound is detected and recorded by the detector, which is converted into electrical signals. The distance (d) of the under-water object is calculated from the time (t) taken by the echo to return with speed (v) is given by $2d = v \times t$. This method of measuring distance is also known as 'echo-ranging'.

20. A sonar device on a submarine sends out a signal and receives an echo 5 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3625 m.

Ans: Time taken to hear the echo, t = 5 s

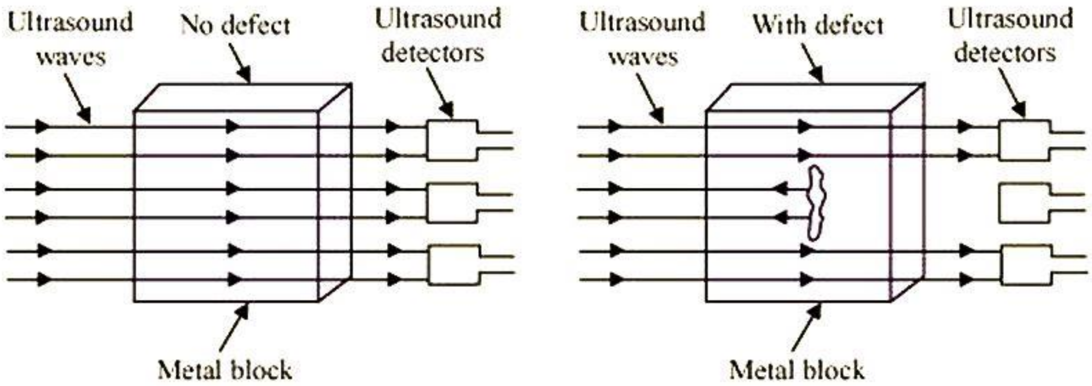
Distance of the object from the submarine, d = 3625 m

Total distance travelled by the sonar waves during the transmission and reception in water = 2d

Velocity of sound in water, $v = \frac{2d}{t} = \frac{2 \times 3625}{5} = 1450 ms^{-1}$

21. Explain how defects in a metal block can be detected using ultrasound.

Ans: Defects in metal blocks do not allow ultrasound to pass through them and they are reflected back. This fact is used to detect defects in metal blocks. Ultrasound is passed through one end of a metal block and detectors are placed on the other end. The defective part of the metal block does not allow ultrasound to pass through it. As a result, it will not be detected by the detector. Hence, defects in metal blocks can be detected using ultrasound.



22. Explain how the human ear works.

Ans: Different sounds produced in our surroundings are collected by pinna that sends these sounds to the ear drum via the ear canal. The ear drum starts vibrating back and forth rapidly when the sound waves fall on it. The vibrating eardrum sets the small bone hammer into vibration. The vibrations are passed from the hammer to the second bone anvil, and finally to the third bone stirrup. The vibrating stirrup strikes on the membrane of the oval window and passes its vibration to the liquid in the cochlea. This produces electrical impulses in nerve cells. The auditory nerve carries these electrical impulses to the brain. These electrical impulses are interpreted by the brain as sound and we get a sensation of hearing.