SCIENCE OLYMPIAD

Official Guide

GRADE 8

International Olympiad Foundation

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GRADE VIII

CONTENTS

SECTION 1 : SCIENCE

1. Force and Pressure

Learning Objectives

* Force
* Forces are due to an Interaction
* Types of Forces
  - Units of force
  - Resultant Force
  - Effects of Force
* Pressure
* Pressure Exerted by Fluids
* Atmospheric Pressure
  - Variation of atmospheric pressure
  - Standard Atmospheric Pressure
  - Measuring Atmospheric Pressure

Force

Force can be defined as the push or pull on an object. It is the influence which can change the state of an object. Its S.I. unit is newton (N).

The direction in which the body is pushed or pulled gives the direction of the force.

Forces are Due to an Interaction

Interaction means mutual action. An interaction of one object with other object results in a force between the two objects.

Interaction between two bodies may or may not involve a direct physical contact.

Types of Forces

There are two types of forces

(1) Contact force

(2) Non-contact force

Contact Forces

Contact force is a force which acts only when the objects are in physical contact with each other.

For example: when you push a car, you are in actual physical contact with the car.

Some typical contact forces are:

(a) **Muscular force:** The force applied by the muscles of a human or animals is called muscular force Muscular force can be applied only when it is in contact with some other object.

Muscular force is used during walking, running, kicking and lifting certain objects. Animals exert muscular force in ploughing the field or carrying of loads from one place to another.

(b) Frictional force: It is the force exerted by a surface when an object moves across the surface. It can also be defined as the force, which opposes the motion of an object. There are two types of frictional forces:

(i) Kinetic friction (ii) Static friction

(i) Kinetic friction: The frictional force between any two moving surface is called the kinetic friction. There are different types of kinetic friction, such as sliding friction, rolling friction.

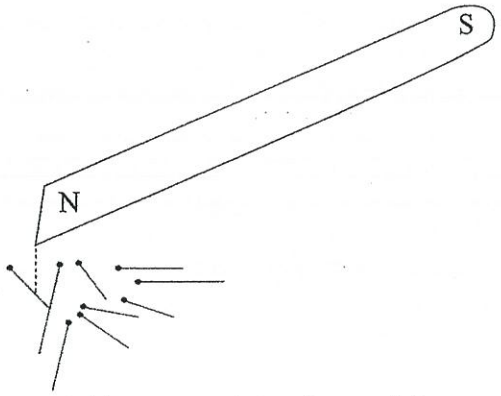
(ii) Static friction: It is the friction that acts between the surfaces of two motionless objects.

The force of friction acts along the two surfaces in contact. The force of friction is due to the roughness on the surface of the bodies in contact. A smooth surface exerts lesser force of friction than a rough surface.

Non–Contact Forces

Non-contact force is the force which can act even without any physical contact between the two objects.

For example: A magnet can pull iron particles from a distance.(Magnetic force)



Alpins are attracted by a magnet even from a distance

Fig:1.1

Some typical non-contact forces are:

(a) Magnetic force: The force exerted by a magnet is called magnetic force. The magnetic force acts from a distance.

(i) A magnet attracts another magnet when unlike poles are brought closer.

(ii) A magnet repels another magnet when the like - poles are brought closer

(iii) A magnet attracts nails and pins made from iron even from some distance.

(b) Electrostatic force:- An electrically charged object exerts force on an uncharged object. Such force is called the electrostatic force. For example, if we rub a plastic comb with our hair and bring the comb near the tiny piece of paper, the piece of paper will either stick to the comb, or will start moving due to the electrostatic force. Similarly, an ebonite rod when rubbed with the woollen cloth, it acquires the negative charge and attracts the tiny piece of paper.

(c) Gravitational force:- The force which exists between any two planets, or any two objects with mass in this universe, is called gravitational force. This force is always attractive in nature. All objects on the surface of the earth experience a force of gravity towards the centre of earth, which

is equivalent to the weight of the object. Numerically gravitational force is calculated by:

$$F = G\frac{M_1 \times M_2}{R^2}$$

where M_1 and M_2 are the masses of the objects.

G = Gravitational constant

Units of force: Force is measured in Newton and is denoted by N. Hence 1 Newton force is equivalent to the force required to accelerate one kilogram of mass, at the rate of one meter per second. Numerically it is given by, $F = m \times a$

where m = mass of the object

a = acceleration.

$1N = 1kg\ ms^{-2}$

Two other units of force which we encounter sometimes are

$1\ dyne = 1g\ cms^{-2} = 10^{-5}N$

Kilogram force: The force required to lift a body of mass 1 kg vertically is called one kilogram force. It is denoted by kgf.

Gram force: The force required to lift a body of mass 1 g vertically is called one gram force and denoted by gf

$1\ kgf = 1000gf$

$1\ kgf = 9.8N \approx 10N$

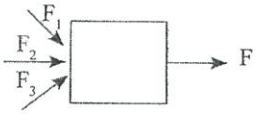
Resultant Force

The vector sum of all the individual forces acting at a point is called resultant force.

Resultant forces considered in following situations:

(i) If the two forces act in the same direction on an object, the net force acting on it is the sum of two forces.

(ii) If the two forces act in the opposite directions on an object, the net force acting on it is the difference between the two forces.



F is the resultant force of F_1, F_2 and F_3 forces

Fig: 1.2

Balanced Forces

"When the resultant of all the forces acting on a body is zero, the forces are said to be balanced forces."

The balanced forces:

- cannot set any stationary body in motion.
- cannot change the speed / velocity of a moving body.
- may change the shape and size of a soft object.

Unbalanced Forces

When the resultant of all the forces acting on a body is not zero, the forces are unbalanced forces. The unbalanced forces can:

- set a stationary object in motion.
- set a moving object at rest.
- change the direction of motion.

In the tug of war, when two teams pull equally hard, the rope does not move in any direction.

A force could be larger or smaller than the other. The strength of a force is usually expressed by the magnitude. We have to also specify the direction in which a force acts. If the direction or the magnitude of the applied force changes, its effect also changes.

Effects of Force

A force acting on a body:

(a) can change the state of motion
(b) can change the direction of a moving object
(c) can stop a moving object
(d) can change the speed of a moving object
(e) can change the size and shape of an object

Pressure

Pressure is defined as the force acting on a unit area.

$$\left[\text{Pressure} = \frac{Force(F)}{Area}\right] \rightarrow P = \frac{F}{A} \rightarrow p \propto \frac{1}{A}$$

(i) For a given force, smaller is the area of contact, higher is the pressure exerted by it.
(ii) For a given force, larger is the area of contact, lesser is the pressure exerted by it.
(iii) For a fixed area of contact, the pressure exerted increases with an increase in force.

The SI unit of pressure is newton per square metre (N/m^2). This unit is also called pascal (Pa).

So, $\boxed{1\ Pa = 1N/m^2}$

Commonly, the unit 1 atm is taken as the unit of pressure.

1 atm = 76 cm of mercury column
= 760 mm of mercury column

Pressure Exerted by Fluids

Gases and liquids are collectively called as fluids.

Liquids and gases exert pressure on all objects immersed in them and on the walls of the container in which they are stored.

Pressure exerted by liquids

A liquid contained in a vessel exerts pressure on its walls and bottom.

Properties of liquid pressure

1. Liquid pressure increases with depth:

   For example: Pressure acting on an object deep under the sea is much greater than at the sea level.

   The pressure experienced by deep-sea divers is so great that they have to wear specially designed suits, called diving suits, to protect themselves.

Dams are made stronger and thicker at the base than at the top to withstand the high pressure of water at the base.

2. Pressure exerted by a liquid is equal in all directions at a particular depth.
3. Pressure of a liquid does not depend upon the shape and size of the container.
4. Pascal's law: According to this rule, when pressure is applied on a liquid, it gets transmitted through out and equally in all directions.

Pressure exerted by gases (or air)

When too much air is blown into the ballon, the air pressure inside the balloon increases, this exerts a force on the inner walls of the balloon and causes it to burst. This shows that air (gases) exerts pressure.

Atmospheric Pressure

Atmospheric pressure is defined as the pressure exerted on an object by the weight of the air above it. The atmospheric pressure is minimum at the sea level.

Variation of atmospheric pressure

(i) The atmospheric pressure changes from place to place and from time to time due to changes in temperature and the quantity of water vapours in the air. The density of moist air is less than that of dry air. Also the density decreases with an increase in temperature, consequently the atmospheric pressure also decreases.

(ii) The atmospheric pressure at a place is due to the weight of the air above it. It is obvious that the pressure will decrease as you go higher up above the sea level. This leads to the rupture of blood vessels in the body, causing bleeding from the nose.

Roughly, the atmospheric pressure falls by one cm of mercury for every hundred metres increase in altitude or height.

Standard atmospheric pressure

Sea level is taken as standard for expressing the atmospheric pressure. The atmospheric pressure at sea level is considered as standard pressure. The value of standard atmospheric pressure is 76 cm or 0.76m of mercury (Hg).

The value of standard atmospheric pressure in N/m^2 is $100,000 = 10^5$ pascals.

Measuring atmospheric pressure

The atmospheric pressure is measured by an instrument called simple barometer or mercury barometer.

Another barometer is Aneroid barometer. It does not employ mercury (or any other barometric liquid). It is a direct reading barometer.

Some examples based on effect of area on pressure:

- The foundation of high rise buildings are kept wide. This is to prevent its sinking into the soil.
- Drawing pins, alpins have relatively much larger top and highly pointed and sharp ened lower end. This is why these can be easily pressed into softwood board.
- Camel can walk through desert (sandy soil) easily due to broader feet.
- The skiers use flat and long skies to slide on snow. This is because, due to larger area, pressure exerted on the snow will be lesser and the skier can easily slide without sinking into the snow.
- The rear wheels of tractor are made broader. The broad tyres reduce the pressure on the soil and the tractor could move easily through the field.

Did You Know

1. A person weighing 100kg on earth will weigh 38kg on the surface of moon.
2. The force of gravity 100km above the surface of earth will decrease by 3%
3. Friction between the moving parts of a machine can be reduced by lubrication.
4. A sharp knife is more effective in cutting than a blunt knife because the area of contact in sharp knife is lesser than that of a blunt knife.
5. The pressure at the centre of the earth is about 400 billion Pa.
6. The pressure of sunlight is about 3 millions Pa.

Key Points

1. Force is the push or pull on an object.
2. A force of one newton is defined as the force, which produces an acceleration of 1 m/s^2 on an object of mass 1 kg.
3. Muscular and frictional forces are contact forces.
4. Magnetic, electrostatic and gravitational forces are non–contact forces.
5. Pressure is defined as the force acting an a unit area of the surface.
6. The pressure exerted by the atmospheric air at any point on the earth is called atmospheric pressure at that point.
7. Atmospheric pressure decreases with the height.
8. Aneroid barometer is a direct reading instrument which is used for measuring atmospheric pressure.

Multiple Choice Questions

1. Which of these is a contact force?
   (a) Magnetic force
   (b) Frictional force
   (c) Electrostatic force
   (d) Gravitational force
2. The force exerted by the earth on a body is called ———— of the body.
   (a) mass
   (b) weight
   (c) pressure
   (d) force
3. Atmospheric pressure is the pressure exerted by
   (a) solid
   (b) gases in air
   (c) liquid of rivers
   (d) atmosphere
4. Which of these cannot be changed by the force acting on an object?
   (a) mass
   (b) shape
   (c) state of rest
   (d) direction motion
5. Which of the following is TRUE for the pressure exerted by a liquid?
   (a) Pressure is independent of depth of the liquid.
   (b) Pressure is always in the downward direction only.
   (c) Pressure is exerted in all directions but downward pressure is greater than sideways pressure.
   (d) At the same depth, pressure is same in all directions.
6. As pressure is the force applied per unit area, so
   (a) school bags have narrow straps
   (b) pointed nails are easier to hammer in wood
   (c) all cutting tools have blunt cutting edge
   (d) tractors have thin and flat tyres
7. If the force is constant, then pressure is _____ proportional to area.
   (a) inversely
   (b) directly
   (c) not
   (d) none of these
8. If no force acts on a body, it will
   (a) break
   (b) get deformed
   (c) move with increasing speed
   (d) either remain at rest or move with the same speed
9. Let us take a beaker filled with water. We increase the pressure on air in the beaker at its button. The pressure is transmitted in
   (a) west direction
   (b) east direction
   (c) eqully in all directions
   (d) south direction
10. A force of 15N acts on an area of $1m^2$. The force is kept the same but the area is reduced to half. What will happen to the pressure?
    (a) Pressure get doubled
    (b) Pressure reduced to half
    (c) Pressure does not change
    (d) Pressure increases by 1.5 times

11. For a force to come into play, the two objects must
    (a) be placed apart
    (b) always move together in same direction
    (c) interact with each other
    (d) all of these
12. Force of friction
    (a) is a contact force
    (b) acts in the direction opposite to direction of motion
    (c) is small if surface are smooth
    (d) has all the above mentioned features
13. The study of causes of motion of an object is called
    (a) physics
    (b) dynamics
    (c) kinetics
    (d) mechanics
14. Which of these is NOT true about force?
    (a) It has magnitude.
    (b) It has direction.
    (c) It is scalar.
    (d) It changes the state of motion.
15. What effect does force produce when applied to an object?
    (a) It can change the speed or direction of motion of the object.
    (b) It can change the state of rest or motion of the object.
    (c) It can change the dimension or shape of the object.
    (d) All of these
16. Pressure is measured using
    (a) barometer
    (b) galvanometer
    (c) manometer
    (d) none of these
17. Two forces are acting simultaneously on the football and the football still remains static, i.e., at rest. The force is said to be _____ force.
    (a) constant
    (b) equilibrium
    (c) balanced
    (d) static
18. The value of atmospheric pressure on the surface of the earth at sea level is
    (a) 1.013×10^5 N/m^2
    (b) 1.50×10^5 N/m^2
    (c) 1.013×10^{-5} N/m^2
    (d) 1.50×10^{-5} N/m^2
19. If a set of forces applied on an object move or accelerate the body, then forces are called
    (a) balanced forces
    (b) effective forces
    (c) unbalanced forces
    (d) dynamic forces
20. Muscular force and friction force are
    (a) contact forces
    (b) gravitational forces
    (c) magnetic forces
    (d) distant forces
21. By applying a force of 1N, body of approximately how much mass can we hold in our hand?
    (a) 1000g
    (b) 100g
    (c) 10g
    (d) 0g

22. Electrostatic forces can be
    (a) attractive
    (b) repulsive
    (c) either (a) or (b)
    (d) neither (a) nor (b)

23. Pressure exerted by a block in standing position is ____ than the pressure exerted by the block in lying position.
    (a) less
    (b) more
    (c) equal
    (d) very less

24. The instrument used to measure the atmospheric pressure is
    (a) manometer
    (b) hygrometer
    (c) lactometer
    (d) barometer

25. When we press the bulb of a dropper with its nozzle kept in water, air in the dropper is seen to escape in the form of bubbles. Once we release the pressure on the bulb, water rises up in the dropper. The rise of water in the dropper is due to
    (a) pressure of water
    (b) atmospheric pressure
    (c) gravity
    (d) shape of rubber bulb

Answer Key

1. (b)	2. (b)	3. (d)	4. (a)	5. (d)	6. (b)	7. (a)	8. (d)	9. (c)	10 (a)
11. (c)	12. (d)	13. (b)	14. (c)	15. (d)	16. (c)	17. (c)	18. (a)	19. (c)	20. (a)
21. (d)	22. (c)	23. (a)	24. (d)	25. (b)					

2. Friction

Learning Objectives

* Force of Friction
* Causes of Friction
* Factors Affecting Friction
* Friction is a Self- Adjusting Force
* Types of Friction
* Friction : A Necessary Evil
* Disadvantage of Friction
* Ways to Increase Friction
* Ways to Reduce Friction
* Friction Due to Fluids

Force of Friction

The force acting along the two surfaces in contact which opposes the tendency of motion of one body over the other, is known as force of friction.

The force of friction doesn't depend on area of surface in contact.

Causes of Friction

Friction is due to the following factors:

Due to the Interlocking of Surfaces

When a body (wooden block) is pulled over another, the 'hills' and 'valleys' of the surface in contact interlock with each other and oppose the relative motion between the two bodies. This give rise to frictional force.

Due to Adhesive Force

Two rough surfaces when placed together, their surfaces are in contact with each other. The atoms or molecules present at such points of contact attract each other due to electrostatic attraction. These attractions are called as the force of adhesion.

The force of adhesion between the two surfaces give rise to friction.

The Force of Friction Depends on the Following Factors

(i) **Nature of the surface in contact:** If the surface is rough, there is large interlocking between the surface in contact, hence frictional force is larger. For smoother surface, less interlocking takes place, so there is less friction.

(ii) The weight of the object: As we know frictional force (f_e) = μ N (where μ = cofficient of friction and N = normal reaction) since for hacker height normal reaction will be larger so, prochain force will be lighter.

Types of Friction

There are three kinds of friction.

(i) Static friction (ii) Sliding friction (iii) Rolling friction.

Static friction

When the applied force is gradually increased, the force of friction also increases at the same rate and the body remains stationary. This force of friction is called static friction (f_s). Since the force of friction adjusts itself to the applied force, so it is also called self adjusting force.

If the applied force is increased further, a stage reaches when the body just begins to move. At this stage force of static friction is maximum $(f_s)_{max}$ This is the limiting value of the static friction, or limiting friction.

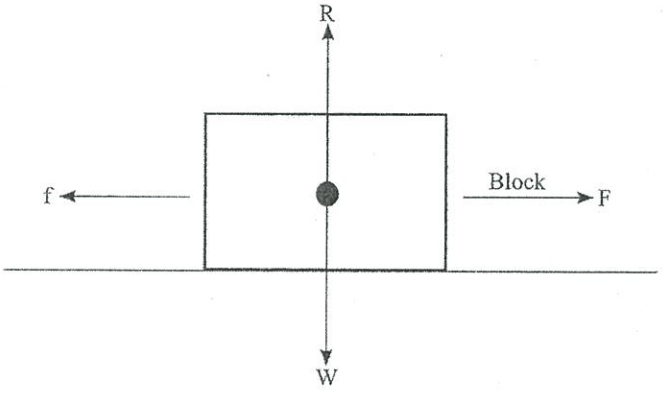


Fig: 2.1 ***Showing that the force of Friction is a self-adjusting force***

Sliding (or kinetic) friction

The frictional force between any two moving surfaces in contact is called kinetic friction. Example: If a boy is sliding on a slider in the garden, the force exerted by the slider on the boy is sliding friction.

The force required to keep a body in motion is less than the force required to start the motion. Therefore, the sliding (or kinetic) friction is less than the static friction.

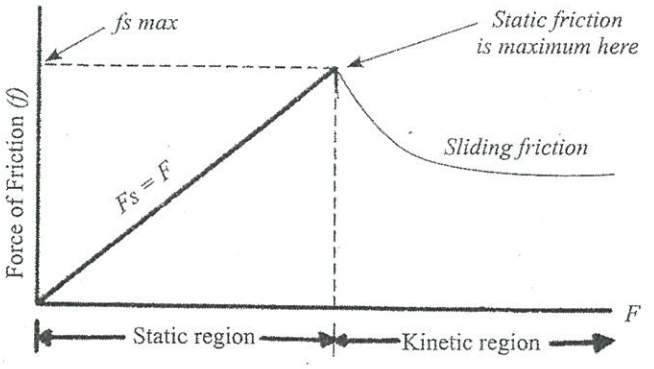


Fig: 2.2 ***Static and Sliding Friction***

Rolling friction

The force of friction existing between the two surfaces in contact when one of them is rolling over the other is called rolling friction. For example: If a wheel is rolling down the slope, the friction between wheel and slope is called the rolling friction.

Rolling friction is much smaller than the sliding friction. That is why all vehicles are mounted on wheels and ball-bearings for rotatory motion. In a ball bearing, the axle rotates on the balls without sliding.

Friction: A Necessary Evil

Friction is useful in many aspects:

(i) Friction between paper and pencil enables us to draw and write on paper.

(ii) Friction between feet and the ground allows movements like walking, running etc.

(iii) Friction between the surface of the road and tyres of vehicles allows the vehicles to move.

(iv) Without friction, nails and screws could not be used to hold things together and knots could not be tied.

(v) Friction between the hands and the object helps us to hold the object easily by providing a grip.

(vi) The surface of the head of a match stick and the sides of the match box are deliberately made rough to increase the friction. Due to increased friction, larger frictional energy heat up the side of the match box because of which the match box lights up easily.

Disadvantages of Friction

(i) Friction causes wear and tear of moving machine parts.

(ii) Friction between various parts of machines lead to a loss of energy. Therefore, friction reduces the efficiency of machines.

Ways to increase friction

(i) Tyres of vehicles have treads and soles of our shoes have grooves to increase friction.

(ii) Roads are made rough to prevent slipping. Even handles of cricket and tennis bats are made of rough materials to get better grip.

(iii) Spikes on the shoes of mountaineers help to get a good grip on ice surface.

Ways to reduce friction

The friction between two surfaces can be reduced by the following methods:

(i) **Polishing :** Polishing makes the surface smooth and hence reduces the friction to a greater extent.

(ii) **Lubrication:** Applying oil or grease between two surfaces reduces the friction.

(iii) **Ball bearings:** Smooth balls are placed between two metal rings such that the ring rotates which provide very little friction.

(iv) **By sprinkling fine powder:** Small quantity of fine powder on a wooden surface or floor etc *reduces* friction. That is why a small quantity of talcum powder is applied on carrom - board. Graphite powder is used in machines to reduce friction.

(v) **By streamlining the body of an object:** Streamline body experience less friction from air or water. Bodies of aeroplanes, rockets, ships, etc., are streamlined. Birds and fish also have streamlined bodies.

Friction Due to Fluids

The frictional force exerted by fluids (liquids and gases) is known as drag force.

When a solid moves in a liquid or a gas, the surface of the solid experiences friction. However, the force of friction between a solid and a liquid surface is less than the two solids. The force of friction between a solid surface and a gas is lesser than the surface of solid and liquid.

The meteors enter the earth's atmosphere at very high speeds. At such speeds the friction due to air is also very large. Due to this, temperature of meteors entering the earth atmosphere rises to a very high level. As a result meteors burn out soon after entering.

To protect spaceships from burning during entry to the earth's atmosphere, they are provided with a heat shield.

Dependence of frictional force on object in liquid

(i) Nature of the fluid
(ii) Shape of the object and
(iii) Speed of object with respect to the fluid.

Did You Know

1. Patterns or grooves on the soles of shoes are made to increase friction. This helps person to walk on the floor without slipping.
2. A boat is more difficult to pull on the beach than on the sea due to more friction between the boat and the beach surface.

Key Points

1. Friction is a property that opposes tendency of motion of an object over another.
2. Adhesion is an attraction between the two surfaces.
3. There are three types of friction - static, sliding and rolling frictions.
4. Static friction > Sliding friction > Rolling friction.
5. The symmetrical shape of a body / object which offers least resistance due to friction is called streamlined shape.
6. The frictional force exerted by fluids is called drag force.

Multiple Choice Questions

1. Which of the following represents frictional force?
   (a) $f_r = \mu N$
   (b) $f_r = 6 \pi nr$
   (c) $f_r = \mu Nr$
   (d) $f_r = \mu$

2. Which of these is true about friction?
   (a) It can stop a moving object.
   (b) It can change the direction of a moving object.
   (c) It can make a moving object faster.
   (d) It can change the shape of an object.

3. Two bodies in contact but not moving with respect to each other can exert
   (a) stable friction
   (b) static friction
   (c) limitinsg friction
   (d) sliding friction

4. Oiling or greasing of moving parts in a machine
   (a) reduces the friction
   (b) changes the friction
   (c) increases the friction
   (d) stops the friction

5. Disadvantage of friction is that
   (a) we can write on paper
   (b) we are able to walk
   (c) we can stop a moving vehicle
   (d) the parts of machine wear and tear

6. A ball moving on a horizontal surface stops because of the
   (a) force of gravity
   (b) force of friction
   (c) atmospheric pressure
   (d) blockage

7. When one object moves over the surface of other object,
   (a) surface of only lower object exerts frictional force on the upper object
   (b) surface of both the objects exert force in the direction opposite to each other
   (c) either (a) or (b) can be possible
   (d) none of these

8. Ball bearings are useful because rolling friction is
   (a) less than sliding friction
   (b) more than sliding friction
   (c) equal to sliding friction
   (d) easier to manage friction

9. The smoother the surface is, _____ will be the friction.
   (a) greater
   (b) lesser
   (c) slippery
   (d) smooth

10. Fluid friction can be reduced by
    (a) streamlining
    (b) ball bearing
    (c) lubrication
    (d) oiling

11. Friction always oppose
    (a) movement
    (b) slip
    (c) speed
    (d) force of gravity

12. Which of the following is correct regarding friction?
    (a) wastes energy
    (b) wears out the rubbing surface
    (c) generates heat
    (d) all of these

13. Friction is minimized by
    (a) polishing and lubrication
    (b) streamlining
    (c) use of wheels and ball bearings
    (d) all of these

14. Frictional force that fluids exert on an object is called
    (a) brag
    (b) blag
    (c) drag
    (d) krag

15. The bodies of aeroplanes, missiles, rockets, cars are streamlined to reduce friction with air. This is called
    (a) air resistance
    (b) air friction
    (c) drag
    (d) gravitational resistance

16. The force of friction between two bodies in contact is
    (a) parallel to body position
    (b) parallel to contact surface
    (c) perpendicular to contact surface
    (d) inclined at 45° to contact surface

17. Friction due to water and air can be reduced by suitably designing the shape of the objects. This is called
    (a) ball - setting
    (b) frictional adjustment
    (c) streamlining
    (d) figure correction

18. Method of increasing friction is by
    (a) using lubricant
    (b) providing grooves on sole of shoes
    (c) polishing the surfaces
    (d) using ball bearing

19. Sprinkling of powder on the caromboard ____ friction.
    (a) decreases
    (b) increases
    (c) does not affect
    (d) none of these

20. The force of friction that exists between the surfaces in contact when one body slides over the surface of other body is called ____ friction.
    (a) rolling
    (b) static
    (c) sliding
    (d) moving

21. Which of these frictions is the least in magnitude?
    (a) static friction
    (b) sliding friction
    (c) rolling friction
    (d) all are equal

22. Which of these frictions is largest in magnitude in comparison to other frictions?
    (a) rolling
    (b) sliding
    (c) static
    (d) all are equal

23. Which of these statements is NOT correct?
    (a) A ball moving on a horizontal surface stops due to force of friction.
    (b) Force of friction helps us to walk on ground.
    (c) Wheels are spherical in shape as rolling friction is less than sliding friction.
    (d) Tyres have grooves to reduce the friction.

24. What type of friction does not allow two surfaces to slide upon one another?
    (a) fluid friction
    (b) static friction
    (c) sliding friction
    (d) drag

25. When two bodies are in contact, friction opposes the relative motion between
    (a) the upper surface
    (b) the lower surface
    (c) both the surfaces in contact
    (d) none of these

Answer Key

1. (a)	2. (c)	3. (b)	4. (a)	5. (d)	6. (b)	7. (b)	8. (a)	9 (b)	10. (a)
11. (a)	12. (d)	13. (d)	14. (c)	15. (a)	16. (b)	17. (c)	18. (b)	19. (a)	20. (c)
21. (c)	22. (c)	23. (d)	24. (b)	25. (c)					

3. Light

International Olympiad Foundation

Learning Objectives

* Reflecting of Light
* Laws of Reflection
* Regular and Irregular or Diffused Reflection
* Real and Virtual Images
* Formation of Images by a Plane Mirror
* Ray Diagram for the Formation of Image by a Plane Mirror
* Reflected Light can be Reflected Again
* Multiple Images
* Kaleidoscope
* Periscope
* Sunlight - White or Coloured (Dispersion of Light)
* The Human Eye - What is Inside our Eye
* Working of the Human Eye
* Persistence of Vision
* Defects of the Eye - Myopia
  - Hypermetropia
* Care of the Eye
* Visually Challenged Persons can Read and Write
* The Braille System.

Light is an electromagnetic wave and form of energy which enables us to see things around us. The objects which emit light are known as source of light or luminous objects, like sun. Those objects which can't produce light of its own are called non–luminous object e.g. *Moon, earth* etc.

Reflection of Light

When the light ray is incident on the surface of an object, it is reflected, transmitted, or absorbed. When it falls on the polished surface, it reverts back in the same medium. This phenomenon is known as reflection of light. In other words "Bouncing back of the light after striking a polished surface is called reflection of light."

Silver metal is the best reflector of light, as it reflects all of the light falling on it.

Incident ray of ligth: The ray of light which falls on an object is called incident ray of light.

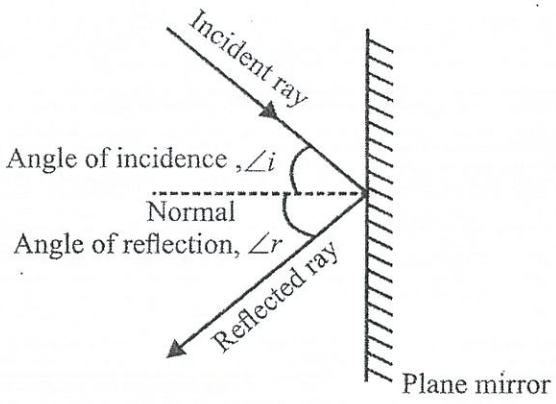


Fig: 3.1 ***Reflection of light through a plane mirror***

Reflected Ray: The ray of light which bounces back in its own medium from the surface of an object is called reflected ray.

Angle of Incidence: The angle between the incident ray and the normal at the point of incidenc is called the angle of incidence. It is denoted by ∠i.

Angle of Reflection: The angle between the reflected ray and the normal at the point of incidence is called the angle of reflection. It is denoted by ∠r.

Laws of Reflection

There are two laws of reflection:

(i) Angle of reflection (∠r) is equal to the angle of incidence (∠i).

(ii) Incident ray, reflected ray and normal at the point of incidence all lie in the same plane.

Regular and Irregular or Diffused Reflection

Depending upon the nature of the reflecting surface, there are two types of reflections.

Regular Reflection

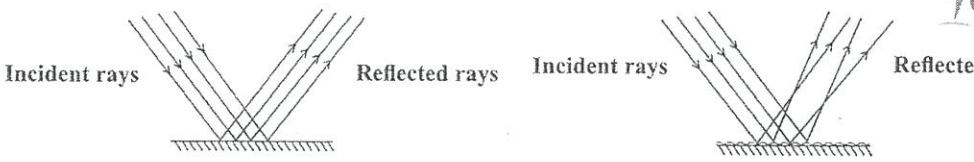
When a parallel beam of light falls on a smooth and highly polished surface, then the reflected beam is also parallel and directed in a fixed direction. Such reflection of light is called regular reflection.

The glare of regular reflected light beam is dazzling. Search lights and automobile head light are the examples of regular reflection of light.

Diffused Reflection

When a parallel beam of light falls on a rough surface, and the reflected light is not parallel but spreads over a wide area. Such reflection of light is called irregular or diffused reflection.

Light reflected from the wooden table, newspaper etc. are the examples of diffused reflection of light.



Regular or specular reflection — a

Irregular or diffused reflection — b

Fig: 3.2

Real and Virtual Image

The image that can be obtained on the screen is called real image. A real image is formed when reflected light ray coming from an object actually meets at a point. Real image can be formed with the help of concave mirror and convex lens if the object is placed at its focus or beyond the focus.

The image that cannot be obtained on the screen is called virtual image. When the reflected rays of light coming from an object appears to meet at a point, a virtual image is formed. The images formed by a plane mirror are always virtual.

A concave mirror and convex lens form a virtual image when the object is placed at a distance, less than its focal length.

A convex mirror and concave lens forms a virtual image of the object placed before it.

Formation of Images by a Plane Mirror

In case of a plane mirror, the distance of object and image formed are equal but are on the opposite side of the mirror. When an object is placed in front of a plane mirror, the right side of the object appears to be left and the left side appears to be right. This phenomenon is called lateral inversion.

The word AMBULANCE on the hospital van is always written in the form of its mirror image. This is done because, we will be able to see the hospital van coming behind us in rear view mirror of a car. and thus can give pass to the van.

Uses of plane mirror:

(a) It is used as a viewing mirror in our house.
(b) It is used in the shop of the barber, jeweler etc.
(c) For making kaleidoscope and periscope.

Ray Diagram for the Formation of Image by a Plane Mirror

To construct a ray diagram for the formation of an image follow the following rules:

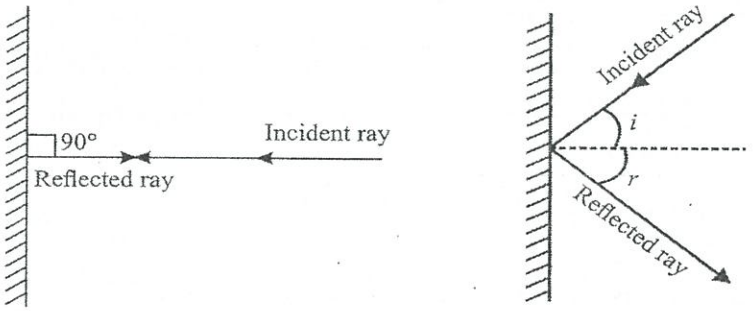


Fig: 3.3 *Reflection of rays from a plane mirror*

- A ray of light falling on a plane mirror at 90° (per-pendicular) gets reflected back from the mirror by the same path.
- A ray of light falling on a plane mirror at any angle gets reflected from the mirror such that the angle of incidence is equal to the angle of reflection.

Image of a point Object in a Plane Mirror

Suppose a point object O is placed in front of a plane mirror MM′. Consider two rays of light OA and OB falling on the mirror at points A and B respectively. These rays after suffering reflection get reflected along AC and BD, respectively. The reflected ray appear to come point I. The point I is the image of the point object O.

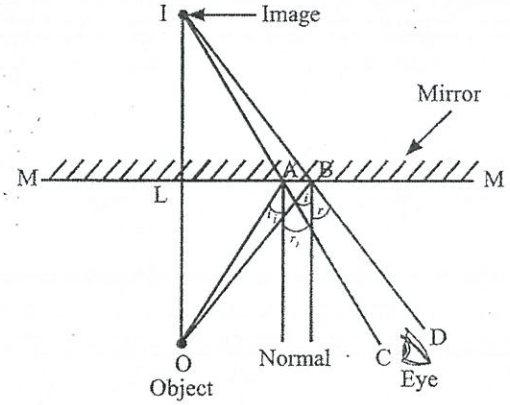


Fig: 3.4 ***Image of a point object in a plane mirror***

Image of an Extended Object in a Plane Mirror

Consider a candle OO′ placed in front of a mirror MM′.

- Rays OA, OB, start from the top of the candle get reflected after striking the mirror.
- The reflected rays AE and BF appear to come from the point I. The point I is the image of the top of the candle.
- Rays O′C and O′D start form the lowest point of the candle get reflected after striking the mirror.
- The reflected rays, CG and DH appear to come from point I′. The point I′ is the image of the foot of the candle.
- Thus the II' is the image of the object OO′ (the candle).

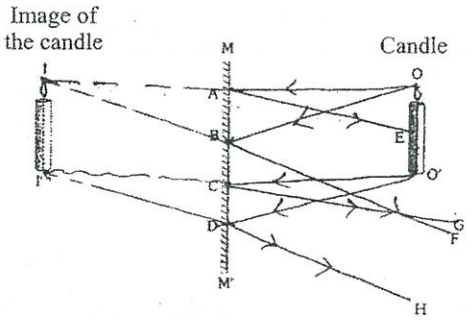


Fig: 3.5 ***Image of an Extended Object in a Plane Mirror***

Note: (i) **The image in a plane mirror is:** virtual, of the same size as the object, laterally inverted, formed as far behind the mirror as the object is in front.

(ii) **Reflected Light can be Reflected Again:** When two mirrors are placed inclined at an angle to each other, many images of the object placed before them are seen. This is because the image formed in one mirror acts as the object for the other.

Multiple images

The number of images seen depends upon the angle at which the two mirrors are placed and can be determined by the formula:

$$n = \frac{360}{\theta} - 1$$

Where n = number of images formed.

θ = angle between the two mirrors.

1. **When the two mirrors are placed at right angles to each other :** When the object is placed in front of two plane mirrors placed at right angles to each other, three images are formed:

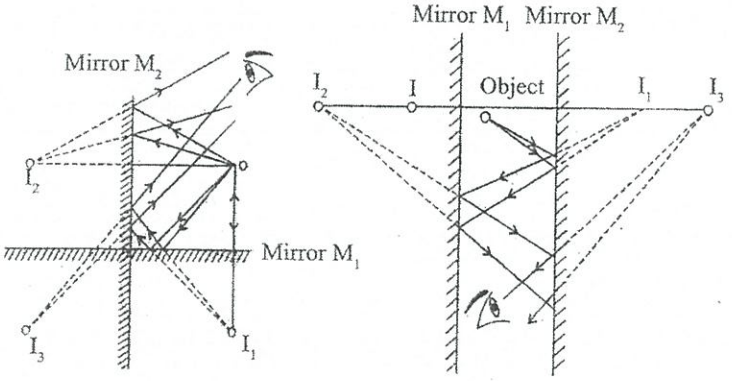
   (i) The image I_1 of the object O is due to mirror 1.

   (ii) The image I_2 of the object O is due to mirror 2.

   (iii) The third image I_3 may be considered to the image of I_2 in the image of the mirror 2 or the image of I_2 in the image of the mirror 1.

   The image I_3 is an overlap of two images. Thus the image I_3 is brighter than both I_1 and I_2.

2. **When the two plane mirrors are placed parallel to each other:** Consider and object (O) placed in between the two plane mirrors held parallel to each other. The image of the object in mirror M_2 is formed at I_1 as for behind the mirror as the object in front of it. The image I_1 acts as object for mirror M_1 and its image is formed at I_2. The image I_2 when acts as the object for mirror M_2 and the corresponding image is formed at I_3.



(a) Formation of multiple images by two mirrors at right angles to each other

(b) Formation of images when two plane mirrors are placed parallel to each other

Fig: 3.6

The process of image formation continues like this and infinite number of images are formed in the mirrors. But In actual practice, however, only the first few images are sharp and can be seen clearly.

Kaleidoscope

Kaleidoscope is based on the principle of multiple reflection of light from a set of three mirrors inclined at each other at an angle of 60°.

Periscope

Periscope is a device which is used for seeing objects which are not in direct line of sight, such as to see ships on the surface of water from a submarine.

Periscope is based on the principle of reflection of light.

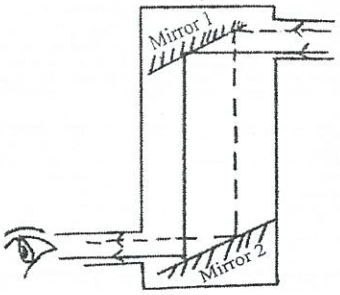


Fig: 3.7 *A Periscope*

Sunlight-White or Coloured (Dispersion of Light)

White light consists of seven colours. When it is passed through a prism, it splits into its constituent colours known as VIBGYOR. The process of spilitting up of white light into its constituent colours is called **dispersion** of light, and the band of seven colours formed is called **spectrum**. The seven colours of the spectrum are violet, indigo, blue, green, yellow, orange, and red. Red colour is at the top of the spectrum as it bend least while the violet colour is at the bottom of the spectrum as it bent most. Dispersion of white light when passes through the prism is due to the difference in the angle of refraction of light of different colour. The sequence of the colours in the spectrum are in the decreasing order of their wavelength from top to bottom.

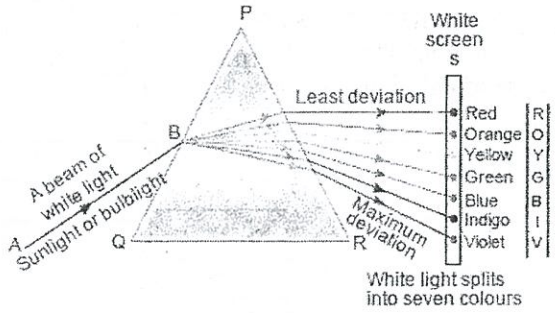


Fig: 3.8 *Dispersion of light*

As a result the red light bends the least and the violet light bends the most.

Rainbow

One of the various effects of the dispersion is the formation of rainbow in the sky.

After rain, a large number of small droplets of water remain suspended in the air. Each drop acts like a small prism. When sunlight falls on these drops, the white light splits into seven colours. The dispersed light from a large number of drops forms a continuous band of seven colours: red on the outer side and violet on the inner side. This coloured band is called rainbow. Rainbow is produced due to the combined phenomena of dispersion, total internal reflection and refraction.

Human Eye

Eye is a natural optical instrument. It enables us to see things around us. Some of the important parts of eye and its function are as follows .

(i) **Pupil**: The tiny hole in centre of the eye through which light enters is known as pupil.

(ii) **Iris:** It is coloured part of the eye. It controls the amount of light entering the eye by increasing or decreasing the size of the pupil.

(iii) **Sclera**: It is the white part of the eye. It is filled with a clear watery fluid.

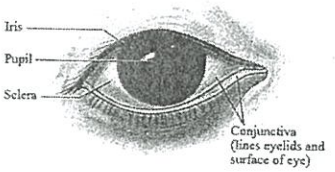


Fig: 3.9 ***External parts of human eye***

(iv) **Cornea:** It is a thin, transparent tissue that covers the front of the eye. Light enters the eye through the cornea. Most of the reflection of light takes place in cornea.

(v) **Retina:** It is the inner most layer of the eye ball on which eye lens focuses the image.

Retina consist of two kinds of light sensitive cells:

(a) **Cone cells:** They are sensitive to bright light. Cones sense colours.

(b) **Rod cells:** They are sensitive to dim light. Due to cone shaped cells, we can differentiate between different colours.

(vi) **Eye lens:** It is jelly transparent tissue found between the pupil and the retina. Ciliary muscles hold the lens at a place and helps in changing the focal length of the lens.

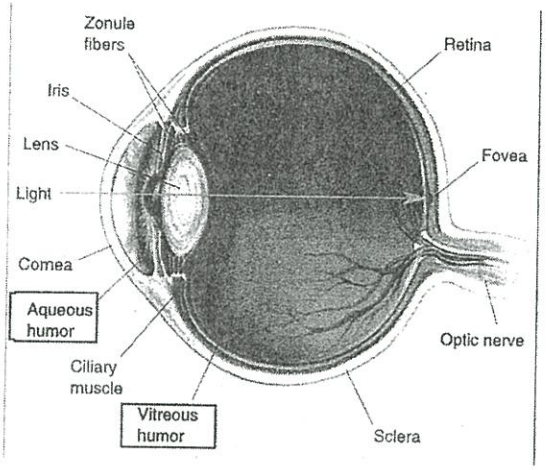


Fig: 3.10 ***The main internal parts of human eye***

(vii) **Optical nerve:** It carries nerve impulses from retina to the brain and gives the sense of vision.

(viii) **Blind spot:** Blind spot is a region on the retina that does not have any rods and cones. So the images falling on this part of the retina cannot be seen.

Persistence of Vision

The image formed on the retina persists for 1/16th of a second after we have stopped looking at the object. The ability for the eye to retain the image of the object for 1/16th of a second after we have stopped looking at the object is called persistence of vision.

The phenomenon of the persistence of vision is employed in the motion-picture projection (cinematography).

Defects of Vision

The abnormalities in the normal vision of the eye are called defects of vision.

Most common defects of vision are:

(i) Myopia (ii) Hypermetropia

Myopia (Short Sightedness)

Short-sighted people can see nearby object clearly but can't see distant object. This is because the image is focused in front of the retina. This defect can be corrected by using a concave lens of a suitable focal length.

Hyper metropia (long sightedness)

Long-sighted people can see distant objects clearly but cannot see nearby object. This is because the rays of light focus the image behind the retina. Hypermetropia can be corrected by using a convex lens of a suitable focal length.

Cataract

Sometimes the eye lens becomes cloudy or opaque and causes blurred or dimmed vision leading to an eye disease called cataract. Cataract can be corrected by surgery in which the eye lens is replaced by an artificial lens.

Care of the Eye

There are some suggestions for the caring of eyes:

(i) We should wash our eyes with cold water thrice a day.
(ii) We should not read in too dim light.
(iii) Do not look at the sun or a powerful light directly.
(iv) Always read at the normal distance.
(v) In case of any injury or other problem, we should consult an eye specialist.

Food items such as spinach, milk, butter, pumpkin, tomato, carrot, cabbage and mango are rich in vitamin A.

Deficiency of vitamin A leads to night blindness. A person suffering from night blindness can see during the day but cannot see at night or in dim light.

Visually Challenged Persons can Read and Write

Some persons including children can be visually handicapped. They have very limited vision to see. Some persons cannot see at all since birth. Some persons may loose their eyesight because of a disease. Such persons tries to identify things by touching and listening to voices more carefully. They develop their other senses more sharply. However, additional resources can enable them to develop their capabilities further.

The Braille System

Visually disabled people can recognize (after a little training) the letters by using the sense of touch. Louis Braille (1820) developed this method, so that visually impaired people can read. This method is called Braille system.

Braille system has 63 dot patterns or characters. Each character represents a letter, a combination of letters, a common word or a grammatical sign. Dots are arranged in cells (called Braille cell) of two vertical rows of three dots each.

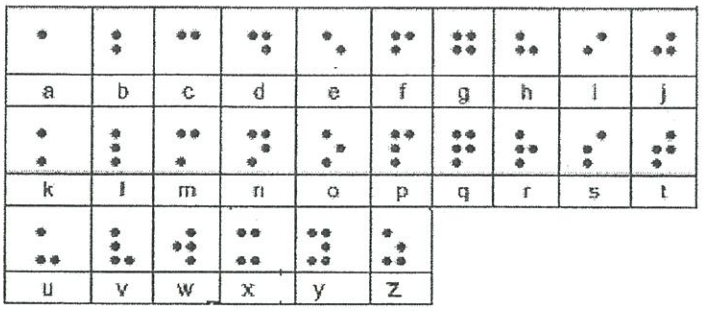
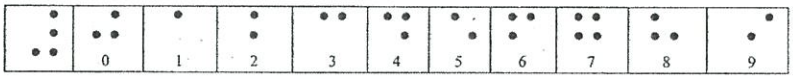


Fig: 3.10 ***Alphabets A-Z in Braille***



Numbers 0-9 in Braille

Patterns of dots to represent some English alphabets and some common words are shown. These patterns when embossed on Braille sheets, help visually challenged persons to recognize words by touching. To make them easier to touch, the dots are raised slightly.

Visually challenged people learn the Braille system by beginning with letters, then special characters and letter combinations. This method depend upon recognition by touching. Each character has to be memorized. Braille texts can be produced by hand or by machine.

Did You Know

1. The light takes about 8 minute and 17 second to reach the earth from the sun.
2. The range of vision for a normal healthy eye is from 25 cm to infinity.
3. In one second nearly 100 lightning bolts strike the earth.
4. Sir Issac Newton was the first to obtain the spectrum of sunlight by passing the sunlight through a prism.
5. Light is made up of electromagnetic radiations and always travels in straight lines.

Key Points

1. Light always travels in a straight line due to its transverse nature.
2. The image formed in case of mirror and lens is either real or virtual, depending on the position of the object.
3. There are two laws of light i.e. reflection and refraction.
4. The speed of light in vacuum is 3×10^8 m/sec.
5. The refractive index is the ratio of speed of light in one medium to the speed of light in another medium.
6. Periscope is a device which is used for seeing objects which are not in direct line of sight.
7. Dispersion of light is splitting of white light into its constituent seven colours.
8. Rainbow is the natural phenomenon based on the dispersion of light.
9. Lights of different colours travel with different speeds.
10. The red light travels fastest and violet light is slowest of all the seven colours.

Multiple Choice Questions

1. If you stand in front of a plane mirror and scratch your right cheek, your image
   (a) scratches its right cheek
   (b) scratches its left cheek
   (c) scratches both cheeks
   (d) does not scratch at all
2. Image formed by plane mirror is always
   (a) inverted and real
   (b) real and erect
   (c) virtual and of some size
   (d) virtual and enlarged
3. Man observes that the distance between the mirror and his image is 4m. If he moves 1m towards the mirror, the distance between him and his image will be
   (a) 6m
   (b) 7m
   (c) 8m
   (d) 9m
4. Diffused reflection occurs if a ray of light is reflected by a
   (a) concave mirror
   (b) convex mirror
   (c) plane mirror
   (d) rough surface
5. The image which can only be seen by the eye but cannot be taken on screen is called
   (a) inverted image
   (b) lateral image
   (c) virtual image
   (d) illusionary image
6. Visually challenged persons can read and write using
   (a) periscope
   (b) Braille system
   (c) kaleidoscope
   (d) special spectacles
7. Two plane mirrors are kept at the following angles one by one. In which case is the number of images formed the maximum?
   (a) 30°
   (b) 45°
   (c) 60°
   (d) 75°
8. Two plane mirrors kept at 60° from each other will form how many images of an object kept between them?
   (a) 3
   (b) 5
   (c) 7
   (d) 11
9. If medium A is optically denser than medium B, then the speed of light is
   (a) the same in both mediums.
   (b) higher in medium A than in medium B.
   (c) higher in medium B than in medium A.
   (d) higher in medium A or B depending on thickness of the two mediums.
10. The splitting of white light into its constituent colours is called
    (a) refraction
    (b) dispersion
    (c) deviation
    (d) displacement
11. If a person is suffering from hypermetropia, which object he/she most likely to see blurred?
    (a) object 25cm away
    (b) object 10m away
    (c) object 100m away
    (d) object at infinity

12. At what position of the object does a convex lens act as a magnifying glass?
    (a) between F and 2F
    (b) Beyond F
    (c) Between F and O
    (d) Beyond 2F
13. A normal eye cannot clearly see objects closer than ___ cm.
    (a) 10
    (b) 15
    (c) 20
    (d) 25
14. How many dots does the Braille system use?
    (a) 9
    (b) 7
    (c) 6
    (d) 5
15. Which one of these controls the amount of light entering the eye?
    (a) pupil
    (b) iris
    (c) cornea
    (d) ciliary muscles
16. When white light passes through a glass prism, it is
    (a) deviated and dispersed
    (b) deviated but not dispursed
    (c) laterally displaced and not dispersed
    (d) reflected only
17. Myopia is corrected by using spectacles with
    (a) glass slabs
    (b) concavo-convex lenses
    (c) convex-lenses
    (d) concave lenses
18. Because of which reflection do we see objects from every direction?
    (a) irregular reflection
    (b) diffused reflection
    (c) both (a) and (b)
    (d) neither (a) nor (b)
19. The second law of reflection states that
    (a) $\angle i = \angle r$
    (b) incident, normal and reflected ray, all lie in the same plane
    (c) the point at which the incident ray strikes the surface is called the point of incidence
    (d) $\angle i + \angle r = 180°$
20. The number of images formed by mirror at angle θ to each other is given by
    (a) $n = \frac{360°}{\theta} + 1$
    (b) $n = \left(\frac{360°}{\theta} - 90°\right) \times 2$
    (c) $n = \frac{360°}{\theta} - 1$
    (d) $n = 360° \times \theta - 1$
21. In which of these objects is plane mirror used?
    (a) as looking glass
    (b) In solar cookers
    (c) in kaleidoscope
    (d) all of these
22. The body which absorbs some light incident on it and reflects the remaining light is
    (a) opaque
    (b) transparent
    (c) shining
    (d) rough

23. A light year is the distance that light travels in one year and is equal to
    (a) 3.25×10^{12} km
    (b) 6.5×10^{12} km
    (c) 9.5×10^{12} km
    (d) 1.65×10^{12} km
24. Time taken for light to reach from the earth to the sun is
    (a) 4.12 minutes
    (b) 8.3 minutes
    (c) 9.5 minutes
    (d) 24 hours
25. The brain of a human being interprets the image as
    (a) erect and of correct size
    (b) inverted and of correct size
    (c) erect but of smaller size
    (d) none of these

Answer Key

1. (b)	2. (c)	3. (a)	4. (d)	5. (c)	6. (b)	7. (a)	8. (b)	9. (c)	10. (b)
11. (a)	12. (c)	13. (d)	14. (c)	15. (b)	16. (a)	17. (d)	18. (c)	19. (b)	20. (c)
21. (d)	22. (a)	23. (c)	24. (b)	25. (a)					

4. Sound

Learning Objectives

* Production of Sound
* Sound Produced by Humans
* Sounds need a medium for Propagation
* Human Ears
* Vibrations or Oscillations
* Speed of Sound
* Characterstics of Sound (Loudness, Pitch, Quality of Tone)
* Audible and Inuadible Sounds
* Noise and Music
* Noise Pollution

Sound is a form of energy which gives the sensation of hearing.
It is a vibration which propagates as audible mechanical wave through medium such as air and water.

Production of Sound

Sound is produced when an object vibrates, for example sound produced by speaker of radio, television bell, stereo system mixer, grinder etc. Whenever we hear a sound, then some material must be vibrating to produce it. A vibrating object which produces sound, has a certain amount of energy which travels in the form of sound waves. The energy required to make an object vibrate and produces sound is provided by some outside source like our hand, wind etc.

Sound Produced by Humans

In humans, sound is produced by the voice box or the larynx. The voice box is at the upper end of the wind pipe. Two vocal cords are stretched across the voice box in such a way that it leaves a narrow silt between them. Air passes through this slit. When air from the lungs is forced out through the slit, the vocal cords vibrate to produce sound.

The vocal cords in men are about 20mm long. In women, they are about 5mm shorter. Children have very short vocal cords. This is the reason that the voices of men, women and children are different.

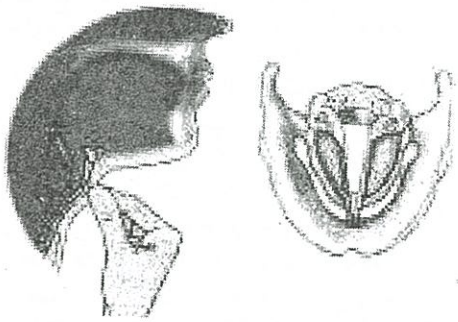


Fig: 4.1 *Voice box in Humans*

Medium for Propagation of Sound

The matter through which sound travel is known as medium. It can be solid, liquid or gas. The sound needs medium to travel. It cannot travel in vacuum, as vacuum do not have any molecules to vibrate. Thus, for propagation of sound material medium is required. If we go to the outer space, we cannot talk

because there is no air. That is why the astronauts use wireless communication, i.e., radio waves to talk with each other in the outer space.

The speed of the sound is different in different mediums, because the density of different medium is different. It is faster in solid and slowest in gas. The speed of sound is 340m/s in air, 1500 m/s in water and 5000m/s in solid. But if we compare the speed of light with that of sound, we find that light travels faster than sound. Thus, during rain, we see the light first and hear the sound of thunder little later.

Human Ears

Ears are the sense organs which help us to feel the sensation of sound.

Construction of Human Ear

The ear consists of three compartments: outer ear, middle ear and inner ear.

The part of the ear which we see outside the head is called outer ear. The outer ear consists of a broad part called pinna and about 2 to 3 centimtres long passage called ear canal. At the end of ear canal, is a thin membrane called eardrum.

The middle ear contains three small and delicate bones called hammer, anvil and stirrup.

The inner ear has a coiled tube called cochlea. The liquid present in cochlea contains nerve cells which are sensitive to sound.

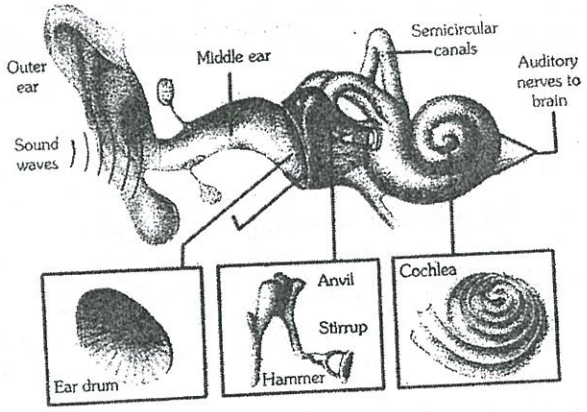


Fig: 4.2 ***Structure of the Human Ear***

Working of Human Ear

The sound waves coming from a sound producing source are collected by the pinna of outer ear. These sound waves passes through the ear canal and falls on the ear-drum. When the sound waves fall on ear drum, the eardrum starts vibrating back and forth rapidly.

The vibrating ear-drum causes a small bone hammer to vibrate. From hammer, vibrations are passed on to the second bone anvil and finally to third bone' stirrup. The vibrating stirrup strikes on the membrane of the oval window and passes its vibrations to the liquid and the cochlea begins to vibrate. The vibrating liquid of cochlea sets up electrical impulses in the nerve cells present in it. These electrical impulses are carried by auditory nerve to the brain. The brain interprets these electrical impulses as sound and we get the sensation of hearing.

Vibrations or Oscillations

Rapid to and fro movements of a body about its mean position are called vibration. The to and fro motion of a body on the same path with its mean position in the middle of its vibrating path is called oscillatory motion.

Some examples of oscillatory motion are:

(a) Motion of a swing

(b) Motion of the heart muscles in a healthy person

(c) Motion of the pendulum of a wall clock

(d) Vibrating string of a musical instrument

When a body undergoes an oscillatory motion, it passes through a particular position at regular intervals of time. Therefore, oscillatory motion is periodic.

Oscillation

The movement of a body from one extreme position to the other and back is called an oscillation.

For example:

The movement of bob from A to B, B to C and then C to A is one complete oscillation.

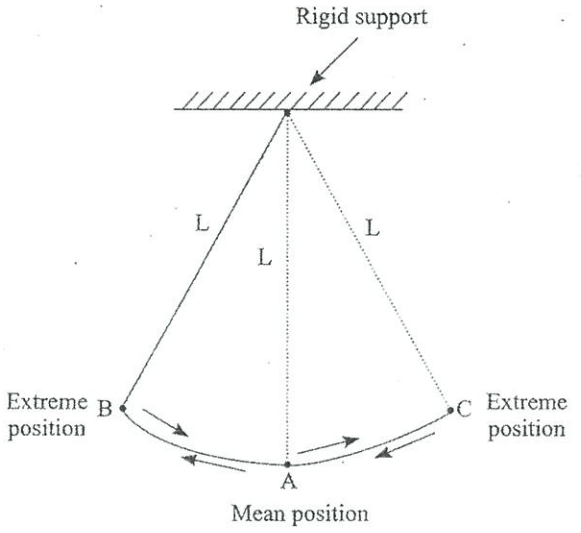


Fig: 4.3 ***Oscillations of the bob of a Simple Pendulum***

Amplitude of Oscillation

When a particle vibrates, it gets displaced from its original position. Amplitude is defined as the maximum displacement of a particle from its mean position. It is denoted by A and S.I unit of amplitude is meter (m). For a body oscillating in the air, the amplitude of oscillation gradually decreases due to air-resistance. It is called dumped oscillation

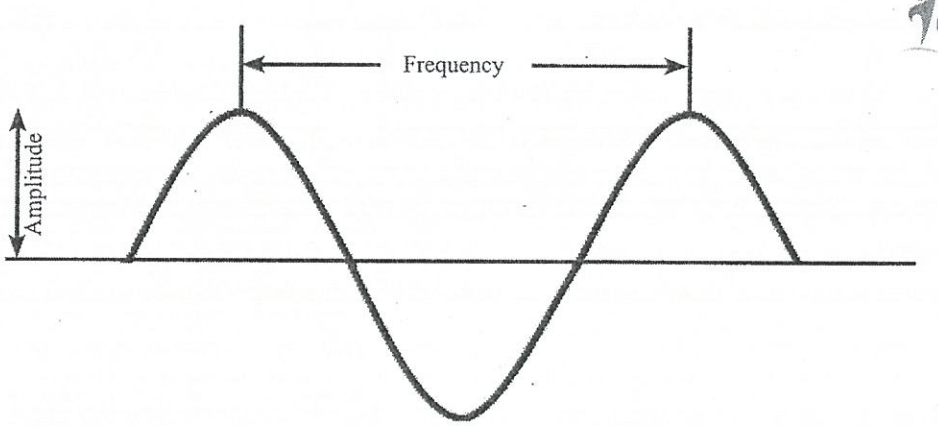


Fig: 4.4 ***Amplitude and Frequency***

Time period

Time period is defined as the time taken to complete one oscillation. It is denoted by (T) and S.I. unit of time period is second (s).

Frequency

Frequency is defined as the number of oscillations per second. The S.I. unit of frequency is hertz (Hz). If one object oscillates 100 times per second, it is said to have a frequency of 100 Hz. Frequency determines the pitch of a sound. It is denoted by (υ).

Frequency (υ) is related to the time period (T) by the relationship.

$$\nu = \frac{1}{T}$$

[1 Hz = one cycle per second]

Wavelength

The distance between any two consecutive crests or troughs is called wavelength. It is denoted by (λ) and S.I. unit of it is metre (m).

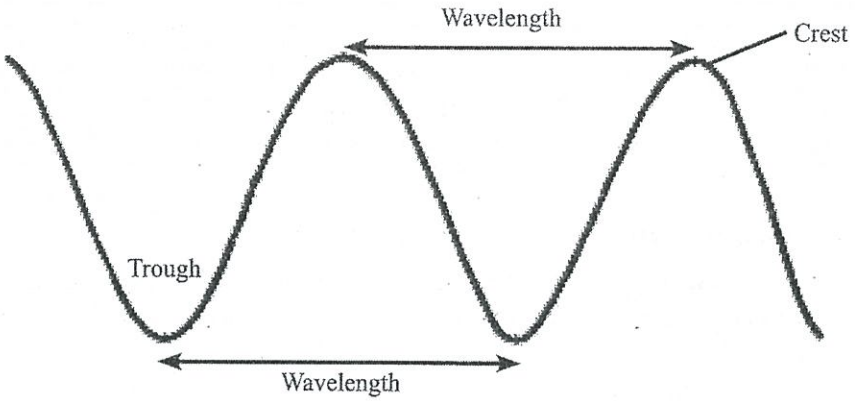


Fig: 4.5

If v is the velocity of the wave and λ is the wavelength of the wave, the frequency of the wave is given by

$$\text{Frequency}(v) = \frac{Velocity(V)}{Wavelength(\lambda)}$$

i.e, $v = v\,\lambda$

Example : What is the frequency of the sound wave travelling with a velocity of 680m/sec and a wavelength of 2m?

Answer: Given $v = 680$m/sec

$\lambda = 2$m

As we know that

$$v = \frac{V}{\lambda}$$

$$\Rightarrow v = \frac{680}{2} = 340 \text{ Hz}$$

Speed of Sound

Sound travels at different speeds in different media. The speed of sound in air, water and in steel is 330 m/s, 1500 m/s and 6000m/s respectively.

As per definition,

$$\text{Speed of sound} = \frac{\text{Distance travelled by the sound}}{\text{Time taken}}$$

As sound can travel faster in solids with respect to air, so you can easily hear the sound of an approaching train by putting your ear on the track, well before you could hear its sound in the air.

Example : A gun is fired in the air at a distance of 660m from a person. He hears the sound of the gun after 2 sec. What is the speed of sound?

Answer: Distance travelled by sound = 660m

Time taken = 2s

Speed of sound in air = ?

As we know that

$$\text{speed of sound} = \frac{Distance\ travelled\ by\ the\ sound}{Time\ taken\ by\ the\ sound}$$

$$= \frac{660m}{2s} = 330\text{m/s}$$

Thus, speed of sound is 330m/s.

Characteristics of Sound

A sound normally has three characteristics, which help us to recognize the sound. These three characteristics are: (i) Loudness (ii) Pitch (iii) Quality or tone.

Loudness

When the amplitude of a vibrating body is high, the sound produced is loud. For example: when we strike a drum using less force, the vibration is less and thus the amplitude is also less, so a soft sound

is produced. When we use a greater force to strike the drum, the vibration is more and so the amplitude is high, therefore a loud sound is produced. The loudness of a sound also depends on the quantity of air that is made to vibrate. *Loudness* is measured in decibels (dB). If the loudness of the sound is more than 80dB, it is called noisy sound and it creates sound pollution.

The loudness of the jet aeroplane is 130dB.

Pitch

Pitch refers to the shrillness of the sound produced. When the frequency of a vibrating body is high, the pitch is said to be high. For example, the pitch of the whistle of a train is higher than the sound produced by the beating of a drum (low pitch). The whistle has a higher pitch because it has a higher frequency. A man's voice is flat having a low pitch, where as a woman's voice is shrill having a high pitch.

Quality

Quality is that characteristic of sound, which helps us to differentiate between the sounds of different instruments. Quality of a sound is also called its tone.

The sound produced by sitar, tabla, flute, etc., are different from each other, even if their pitch and frequency are same. This difference in the quality of different sounds is because of the shape of the waves, which is different for different instruments.

Audible and Inaudible Sounds

The range of frequency from 20Hz to 20,000Hz is known as the frequency range of hearing in humans. The sound which we are able to hear is called audible sound.

The sound of frequencies lower than 20 hertz are known as infrasonic sounds (or infra sound). Infrasonic sounds cannot be heard by human beings. Earthquakes and some animals like whales, elephants and rhinoceros produce infrasonic sound. It is observed that some animals get disturbed and start running here and there just before the earthquake occurs. This is because, before the main shock waves, the earthquake produces low frequency infrasonic sounds which can be detected by these animals.

The sounds of frequencies higher than 20,000 hertz are known as ultrasonic sounds (or ultrasound). Ultrasonic sounds cannot be heard by human beings. Though human beings cannot hear ultrasonic sounds, but dogs can hear ultrasonic sounds. This is the reason why dogs are used for detective work by the police. Bats, monkeys, deer, cats, dolphins and leopards can also hear ultrasonic sounds.

Noise and Music

The sound which produces pleasant effect on our ears and mind is called musical sound. The sound produced by musical instruments, such as piano, violin, flute, etc., is musical sound. The sound level in musical sound usually lies between 10dB and 30dB.

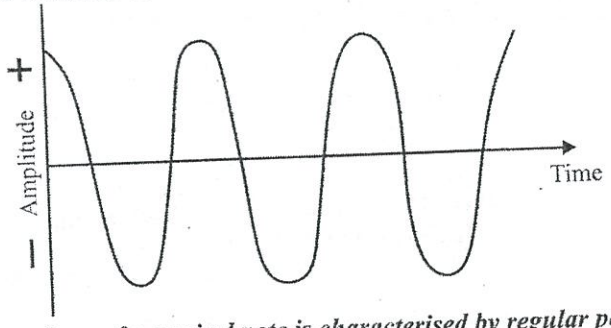


Fig: 4.6 ***The waveform of a musical note is characterised by regular periodic vibrations***

The sound that produces discordant and not pleasing to our ears and mind is called noise. The sound produced by a machine in factory, old car, scooter, aeroplane, etc., are noise. The sound level in noise usually lies above 80dB.

Musical sound is produced by a series of regular waves which follow one another at regular intervals without any sudden change in amplitude.

Noise produced by a series of waves at irregular intervals of time and there are sudden changes in amplitude. Noise is usually of low frequency.

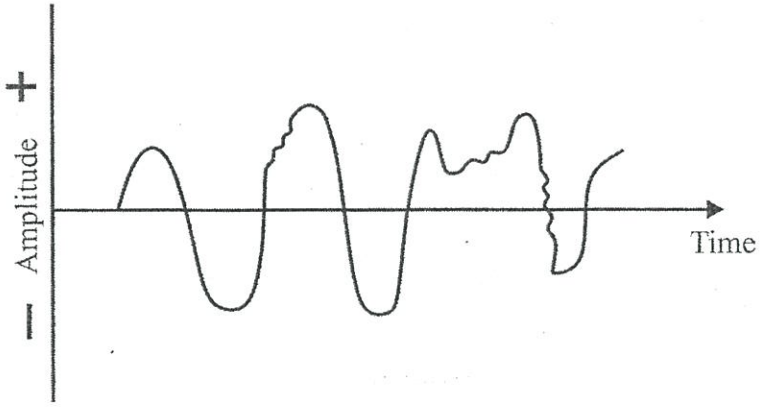


Fig: 4.7 ***The waveform of a musical note is characterised by regular, nonperiodic vibrations***

Musical sound Differ from Noise

The wave form of musical sound is present in regular manner, while in noise it is irregular. The frequency of musical sound is high and of noise is low. The nature of vibration of musical sound is regular and periodic, while in noise it is irregular and non periodic.

The effect of musical sound in ear and mind of a person is pleasant and comfortable and the effect of noise is displeasing and discordant.

Noise Pollution

Noise pollution is the disturbance caused by the presence of undesirable, extremely loud and harmful sound in the environment.

Source of noise pollution

Any object that produces undesirable noise is a source of noise pollution. Some examples are, blaring noise of horns of automobiles, loudspeakers, bursting of crackers, running of machines and television and radio played at a loud volume.

Harmful effects of noise pollution

Some of the harmful effects of noise pollution are:

(i) Disturbed sleep
(ii) Stress which can lead to high blood pressure
(iii) Irritation and loss of concentration
(iv) Temporary or permanent loss of hearing which is caused due to continuous exposure to loud noise over a period of time

Measures to limit noise pollution

Some ways to keep noise pollution under control are:

(i) Avoid playing radio or television too loud.
(ii) Avoid use of loud speakers.
(iii) Plant more trees to reduce the impact of noise.
(iv) Avoid using the horn on a vehicle unnecessarily.
(v) Use silencers in motor vehicle, aeroplanes, machinery in factories, etc.
(vi) Set up industries in remote areas far away from residential areas.

Did You Know

1. The speed of sound in steel is 15 times faster than the speed of sound in air.
2. The amount of energy in the tail of electric eels is equivalent to the energy needed to light 12 electric bulbs. The shock of it can kill a person.
3. The blue whale produces loudest sound in the world. It can produce a sound of 188dB, which can be picked up from 850km distance.
4. The total sound energy of 200 pianos is equivalent to the energy needed to light one bulb.

Key Points

1. The sound is produced due to the disturbance created in the medium by any source.
2. Sound wave is longitudinal in nature and travels in successive compression and rarefactions.
3. Sound cannot travel in vacuum.
4. Larynx is the voice box at the upper end of the wind pipe.
5. The audible range for a normal human ear is 20Hz to 20,000Hz.
6. Speed of sound in a solid > speed of sound in a liquid > speed of sound in a gas.
7. A sound is characterized by its loudness, pitch and quality (or tone).
8. The sound which produces pleasant effect on our ears is called musical sound.
9. Loud and harsh sound is called noise. Noise is produced by irregular vibrations.
10. Noise pollution can damage ear membrane and causes loss of hearing.

Multiple Choice Questions

1. The speed of sound in air is
   (a) 331 m/s
   (b) 665 m/s
   (c) 1550 m/s
   (d) 173 m/s
2. Sound is produced by a
   (a) moving object
   (b) stationary object
   (c) vibrating object
   (d) rotating object
3. Shrillness of the sound is determined by the ____ of vibration.
   (a) amplitude
   (b) frequency
   (c) Noise
   (d) oscillation
4. The length of vocal cords of a man is about
   (a) 5mm
   (b) 10mm
   (c) 15mm
   (d) 20mm
5. Human being can hear two sounds separately and distinctly if they are separated by a time interval
   of _____ second(s).
   (a) 0.1
   (b) 0.01
   (c) 1
   (d) 10
6. The quality of two sounds with the same fundamental frequency differs because of the number and relative loudness of the _____
   (a) sound
   (b) harmonics
   (c) pitch
   (d) none of these
7. An object vibrates with a frequency of 15 Hz. Which of the following is true?
   (a) It produces sound which we can hear if we strain our ears.
   (b) It produces sound which we can hear.
   (c) It produces sound which we cannot hear.
   (d) It does not produce a sound.
8. Maximum displacement of an oscillating body is called
   (a) time period
   (b) pitch
   (c) amplitude
   (d) harmonics
9. Sound travels faster in solids than in gases because
   (a) sound is a form of energy
   (b) sound bounces back when reflected to a solid
   (c) sound cannot travel in gases smoothly
   (d) molecules of solids are closely packed as compared to gases
10. The audible range of sound frequencies for human beings is
    (a) 0Hz – 20Hz
    (b) 20Hz – 2000Hz
    (c) 50Hz – 5000Hz
    (d) 20Hz – 20,000Hz

11. The to - and - fro motion of a body about its mean position is called
    (a) oscillation (b) vibration
    (c) fluctuation (d) rotation
12. Shrillness of the sound, also called as pitch, is determined by which characteristic of sound?
    (a) amplitude (b) frequency
    (c) harmonics (d) time period
13. Which surface absorbs sound better?
    (a) hard (b) smooth
    (c) slippery (d) soft
14. Prolonged exposure to noise louder than ____ can lead to permanent hearing damage.
    (a) 70dB (b) 17dB
    (c) 7dB (d) 700dB
15. Sounds whose frequencies are greater than 20,000 Hz are called
    (a) infrasonic sounds (b) supersonic sound
    (c) ultrasonic sound (d) none of these
16. In which of the following materials is the speed of sound maximum?
    (a) air (b) salty water
    (c) iron (d) snow
17. Pitch of sound depends on
    (a) amplitude of oscillation (b) frequency of oscillation
    (c) both (a) and (b) (d) none of these
18. Time taken by an object to complete one oscillation is called
    (a) frequency (b) time frame
    (c) time period (d) sonic
19. Which of the following frequencies a man can hear?
    (a) 7Hz (b) 18Hz
    (c) 220Hz (d) 50,000Hz
20. In our ears, the vibrations in the air are picked up by which ear?
    (a) outer ear (b) inner ear
    (c) middle ear (d) none of these
21. Sound of frequency 320Hz is of lower pitch than the sound of frequency
    (a) 20Hz (b) 256Hz
    (c) 190Hz (d) 370Hz
22. The quality of sound produced by a tuning fork is different from that produced by a musical instrument because of the difference in
    (a) frequency (b) harmonics
    (c) amplitude (d) none of these

23. Voice of which of these is likely to have a minimum frequency?
    (a) man (b) baby boy
    (c) little girl (d) woman
24. In stringed instruments, frequency of sound produced depends on
    (a) tightness of string (b) length of string
    (c) thickness of string (d) all of the above
25. The astronauts on the moon can see each other but cannot hear each other because
    (a) there is no atmosphere
    (b) the moon is very far from the earth
    (c) there is very low temperature
    (d) the gravitational force does not exist there
26. The thunder of cloud is heard _____ compared to flash of lightning.
    (a) sooner (b) earlier
    (c) later (d) at same time

Answer Key

1. (a)	2. (c)	3. (b)	4. (d)	5. (a)	6. (b)	7. (c)	8. (c)	9. (d)	10. (d)
11. (a)	12. (b)	13. (d)	14. (a)	15. (b)	16. (c)	17. (b)	18. (c)	19. (c)	20. (b)
21. (d)	22. (b)	23. (a)	24. (b)	25. (a)	26. (c)				

5. Chemical Effects of Electric Current

Learning Objectives

* Some Common Terms used to Describe Chemical Effects of Electricity
* Detectors to be used for Detecting the Flow of Current
* Behaviour of Solids Towards the Flow of Current
* Chemical Effects of Electric Current (Electrolysis, Electroplating)
* Application of Electrolysis
* Objectives of Electroplating
* Applications of Electroplating

Chemical effects of electric current is a phenomenon by which, if current is passed through an electrolytic solution, it breaks the solution into its constituent ions and it moves to their respective electrodes.

Some Common Terms used to Describe Chemical Effects of Electricity

Electrolyte: A substance which dissociates into its ions in solution and acquires the capacity to conduct electricity is called electrolyte.

Electrolytic Solution: A solution of an electrolyte is called electrolytic solution. Examples of electrolytes are sodium chloride (common salt), sulphuric acid, sodium hydroxide (caustic soda), etc.

Non-electrolyte: A substance which does not conduct electricity in solution or in the molten state due to unavailability of free ions is called non-electrolyte.

For example: Benzene, ethyl alcohol, sugar, urea and carbon tetrachloride.

Conductor: Materials which allow charge or electricity to flow through them are called conductors.

For example: Copper, silver, iron, brass, graphite, aluminum, etc.

The best conductor of electricity is silver (Ag), but is not used commonly as it is very expansive in compassion with copper and aluminum.

Insulator: Materials which do not allow electricity to flow through them are called insulators. Glass, quartz, plastics, dry wood, sulphur and dry piece of cloth are some examples of insulator.

Cathode and Anode: In an electrolytic cell, the electrode at which electricity enters the solution is called anode and the electrode at which current leaves the solution is called cathode. Anode is positively charged electrode and cathode is negatively charged electrode in an electrolytic cell.

Cation and Anion: An electrolyte when melted or dissolved in water produces ions. The positively charged ion is called a cation and the negatively charged ion is called an anion.

These ions are free to move throughout the solution and conduct electricity.

Electrolysis: The process of splitting of an electrolyte with the help of electricity into its constituent ions is called electrolysis. During electrolysis, cations on gaining electrons get reduced at cathode and anions on loosing electrons get oxidised at anode.

For example: Electrolysis of molten sodium chloride gives sodium metal at cathode and chlorine gas at anode.

Electrodes: A metallic wire or rod or plate through which electric current either enters or leaves an electrolytic solution is called an electrode.

Voltmeter: An instrument which is used for measuring the voltage across the two terminals of an electric circuit is called voltmeter. It is connected in parallel. Voltage is measured in volts (v).

Ammeter: An instrument which is used for measuring the current flowing through the circuit is called ammeter. It is connected in series. Current is measured in ampere (A).

Voltameter: A glass or plastic container containing two electrodes and an electrolytic solution is called voltameter. It is also known as electrolytic cell.

Cell: Cell is the source of electricity produced by chemical reaction. A combination of cells are called battery. A cell or a battery gives direct current (dc).

Detectors Used for Detecting the Flow of Current

When a good conductor is placed in any electrical circuit, a strong current flows through it. For such cases, a battery bulb can be used as a detector.

(i) If the bulb glows, the material placed in the circuit is a good conductor.

(ii) If the bulb glows dimly, the material placed in the circuit is a poor conductor.

(iii) If the bulb goes off the material placed in circuit is an insulator.

When the current flowing through the circuit is too weak, then the bulb may not glow at all. In such cases, a more sensitive detector such as an LED or a magnetic compass can be used.

Fig: 5.1 ***Battery bulb***

LED (Light Emitting Diode)

An LED is an electronic device. It has two leads. The longer lead is the positive (+) and the smaller one is negative (–) terminal. LEDs are available in different colours. It starts emitting light even when a very weak current flows through it.

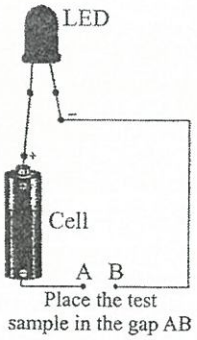
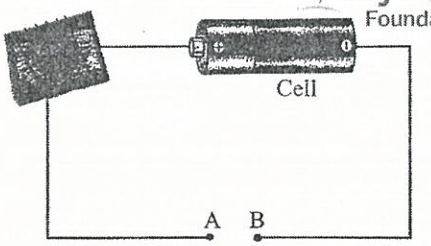


Fig: 5.2 ***LED as a current detector***

Detector Based on Magnetic Compass

This detector is based on the magnetic effect of current. When current passess through a circuit, magnetic field develops around the current carrying wires. So, when a magnetic compass is placed near it, needle get deflected. The detector based on magnetic compass can detect even weak current.



Place the test sample in the gap AB

Fig: 5.2 ***Current detector based on the magnetic effect of current***

Behaviour of Solids Towards the Flow of Current

All metals and alloys are good conductors. Electricity flows through them easily.

Metals and alloys get warm on passing electricity due to the resistive offered. However there is no change in the chemical composition or structure of the metal or alloy.

An insulator doesn't allow current to flow/ pass through rubber, dry wood, plastics.

Behaviour of Liquids Towards the Flow of Current

Pure water i.e., distilled water is a poor conductor of electricity due to absence of ions, whereas water from taps, ponds and wells (which contains, impurities such as salts) is a good conductor of electricity.

Some liquids are good conductor of electricity while some are poor conductors. The liquids can be tested for conduction of electricity. The free end of a tester is dipped in liquid to be tested and then observe the bulb. If it glows, it confirms that the liquid is good conductor otherwise liquid is a poor conductor.

Chemical Effects of Electric Current

The chemical effects of current involve transformation of electrical energy into chemical energy.

The two processes which show the chemical effect of current are:

(1) Electrolysis (2) Electroplating

Electrolysis

The process of decomposition of an electrolyte on passing electricity through it is called electrolysis.

For example: When electricity is passed through acidified water, it decomposes into hydrogen and oxygen gases.

$$\text{Water} \xrightarrow[(acidulated)]{electricity} \text{Hydrogen} + \text{Oxyge.}$$

$$H_2O \xrightarrow[acidulated]{electricity} H_2 + \frac{1}{2}O_2$$

(at cathode) (at anode)

Applications of Electrolysis

The most common applications of electrolysis are:

Electro refining

Electro refining is a process in which metals such as gold, silver and copper are purified or refined. Impure metal is used as anode and refined metal is deposited at cathode.

Extraction of metals

Metals such as aluminium and sodium are extracted using chemical effects of electric current. It gives highest purity of metal, extracted.

Manufacture of industrial chemicals

Many chemicals which are used in industry in large quantities are prepared by electrolytic method.

Some of these are:- (i) Hydrogen gas (H_2) is prepared by the electrolysis of acidified water, or 20% NaOH solution. Oxygen is obtained as by-product.

(ii) Sodium hydroxide (caustic soda) NaOH and chlorine gas (Cl_2) are prepared by the electrolysis of brine (20% common salt solution).

Electroplating

The process of depositing a thin layer of any superior metal over an object of a cheaper metal, commonly for decorative purpose, or to prevent it from corrosion with the help of electric current, is called electroplating.

For example: Deposition of silver on brass or copper objects.

Objectives of electroplating

Electroplating is done for the following purposes:

(i) For decoration purposes: Silver or gold plating of brass - ware such as flower vase.

(ii) For preventing corrosion: Iron objects can be protected by electroplating it with nickel or brass objects, such as bathroom fittings, etc., are electroplated with chromium.

Applications of Electroplating

Some of the applications of electroplating are

(i) Jewellery makers electroplate less expensive metals with silver and gold to make attractive appearance of it.

(ii) Chromium plating is done on many objects such as car parts, bath taps, bicycle handle bars, wheel rims, metal railing, etc., to give it a shiny appearance.

(iii) Iron cans are electroplated with tin to store food. Electroplated iron cans with tin prevents the food to come into direct contact with iron.

(iv) Iron corrodes and rusts rapidly in presence of oxygen and moisture. To prevent corrosion and rusting of iron, it is electroplated with zinc. This is called galvanization.

Did You Know

1. The bodies of switches, plugs, sockets and handles of electrical appliances are made up of insulators such as Bakelite.
2. Alternating current (AC) cannot be used for carrying out electrolysis because in AC, the polarity keeps on changing at a very fast rate - say 50 cycle per second in our country.
3. Pure water is a non-conductor of electricity due to absence of free ions. Before electrolysis, it is made conducting by adding a small quantity of an alkali (e.g. sodium hydroxide) or an acid. (e.g. sulphuric acid)

Key Points

1. Electricity is an extremely versatile form of energy.
2. Protons are positively charged particles where as electrons are negatively charged particles.
3. The materials which do not allow charge or electricity to pass through them are called insulators.
4. Coulomb's law quantifies the strength of the attraction or repulsion between two charged particles.
5. The materials which allow electricity to pass through them are called conductors.
6. Extraction of metals by passing electricity through their molten salts or aqueous solutions of their salts is called electrometallurgy.

Multiple Choice Questions

1. A body can be charged by
   (a) touching it to a charged body
   (b) rubbing it against another body
   (c) bringing a charged body near it
   (d) all of the above methods
2. Adding solute salt to water
   (a) increases its electrical conductivity
   (b) does not change its conductivity
   (c) decreases its electrical conductivity
   (d) none of the above
3. Which of these is not true?
   (a) vinegar is a good conductor of electricity
   (b) carbon rod acts as an electrode
   (c) LED is a conductor
   (d) distilled water is an insulator
4. The gold-leaf electroscope is used to
   (a) detect charge only
   (b) detect, measure and find the nature of charge
   (c) detect and measure charge only
   (d) none of these
5. During electroplating, the metal on which electroplating is to be done should be
   (a) anode
   (b) cathode
   (c) electrolyte
   (d) solution
6. Chromium plating is done on objects like
   (a) handles of almirah
   (b) bicycle parts
   (c) kitchen gas burner
   (d) all of these
7. The process of deposition of a layer of any desired metal on another metallic object by means of electricity is called
   (a) electrolysis
   (b) electrodialysis
   (c) electroplating
   (d) none of these
8. Which of these metals will you electroplate on iron to protect it from rusting and to make it shine?
   (a) copper
   (b) silver
   (c) gold
   (d) chromium
9. The decomposition of an electrolyte on passing electric current is called
   (a) cathode
   (b) dialysis
   (c) electrolysis
   (d) electroplating
10. In which of these is current not conducted by electrons?
    (a) copper
    (b) aluminium
    (c) tap water
    (d) mercury
11. When electricity is passed through tap water, the gas which evolved are
    (a) H and O
    (b) H and Cl
    (c) O_2 and SO_2
    (d) H, Cl and O

12. An electric current brings about chemical changes in most conducting
    (a) solids
    (b) liquids
    (c) gases
    (d) salts

13. A positively charged body has a ____ of electrons.
    (a) deficit
    (b) excess
    (c) absence
    (d) any of these

14. To make an electric current flow, two components are necessary. First is the circuit and the second is
    (a) electrodes
    (b) electrons
    (c) electromotive force (emf)
    (d) metal

15. Which of these is a conductor of electricity?
    (a) air
    (b) wood
    (c) rubber
    (d) none of these

16. Which of these is a conductor of electricity?
    (a) iron
    (b) brass
    (c) graphite
    (d) all of these

17. Electroplating is based on the phenomenon of
    (a) magnetic effect
    (b) chemical effect of electric current
    (c) flow of electrons
    (d) heating effect

18. A tester is used to test the
    (a) electrical conductivity of liquids
    (b) magnetic effect of emf
    (c) battery / cell power
    (d) electroplating

19. In LED, the shorter lead is attached to ____ terminal and longer lead is attached to the ____ terminal.
    (a) positive, negative
    (b) negative , positive
    (c) any of the (a) or (b)
    (d) none of these

20. The copper gets deposited on the plate connected to the ____ terminal of the battery.
    (a) negative
    (b) positive
    (c) neutral
    (d) none of these

21. The liquid which does not conduct electricity is
    (a) salt solution
    (b) tap water
    (c) distilled water
    (d) HCl solution

22. Who invented voltaic cell?
    (a) Alexandra batter
    (b) Alexinho volta
    (c) Alexandra volta
    (d) Aleixinho batter

23. The flow of electric current, as opposed to conventional current, to be from _____ charged body to the _____ charged body.
(a) negatively, negatively
(b) negatively, positively
(c) positively, positively
(d) positively, negatively

24. Air, distilled water, plastic, wood, paper, cloth and rubber are the examples of
(a) insulators
(b) conductors
(c) semiconductors
(d) material

25. Chromium is extensively used in electroplating because
(a) it does not corrode
(b) it is scratch resistant
(c) both (a) & (b)
(d) it is the cheapest medium of electroplating

Answer Key

1. (d)	2. (a)	3. (c)	4. (c)	5. (b)	6. (d)	7. (c)	8. (d)	9. (c)	10. (c)
11. (a)	12. (b)	13. (a)	14. (c)	15. (d)	16. (d)	17. (b)	18. (a)	19. (b)	20. (a)
21. (c)	22. (b)	23. (b)	24. (a)	25. (c)					

6. Stars and the Solar System

Learning Objectives

* The Universe
* Stars
* Constellations
* Galaxies
* The Moon
* The Solar System
* The Sun
* Planets
* Mercury (Budh)
* Venus (Shukra)
* Earth (Prithvi)
* Mars (Mangal)
* Jupiter (Brihaspati)
* Saturn (Shani)
* Uranus
* Neptune
* Some other Members of the Solar System
    - Asteroids
    - Comets
    - Meteors and Meteorites
* Artificial Satellites
    - Types of Artificial Satellites
    - Uses of Artificial Satellites
* Difference between a Star and a Planet
* Difference Between a Star and a Meteor

The Universe

When we look up, we see the sky. The sky appears blue on a clear day, but it is dark at night.

During day time, we see a bright ball in the sky which appears to move from east to west, we call it the sun. At night we see thousands of stars in the sky. There is the moon whose size changes every day. The stars, the planets, the moon and many other objects in the sky are called celestial objects.

"The space including the celestial bodies and galaxies is called universe." There are millions of galaxies in this universe and each galaxy has billions of stars. The name of our galaxy is Akash - Ganga.

Distance in the Universe

Stars and planets are separated from each other by very large distance. The most commonly used unit for expressing distances between heavenly bodies is the light year (LY).

"The distance travelled by light in one year is called one light year."

As per the definition,

1 light year = Distance travelled by light in one year

= {Distance travelled by light in one second} × {Number of seconds in one year}

1 light year = 300000 km/s × 365 × 24 × 60 × 60s [1 year = 365 × 24 × 60 × 60 s]

= 9460800000000 km

= 9.46×10^{12} km

Thus, 1 light year is equal to a distance of 9460 billion kilometers.

Distances of some stars from the earth are:

Sun : 8.3 light year (150,000,000 km, 15 crore km)

Alpha centauri : 4.3 light year

Sirus : 8.7 light year.

Stars

Stars are the heavenly bodies having light of their own. They continuously emit heat and light. They mostly consist of hydrogen gas. Like sun, they produce energy by the process of nuclear fusion. In this reaction, the hydrogen present inside the stars are converted into helium molecules after fusion, with the release of large amount of energy in the form of heat and light. The sun appears much bigger and brighter as compared to other stars. This is because, it is much nearer to us. The intensity of sunlight is very high during the day time. The stars are much bigger as compared to the sun. They also emit light of much higher intensity than the sun.The nearest star to the earth other than the sun is proxima centuri.

There are about 10,000 billion stars in this universe. Earth moves from east to west. But there is one star, which appears to be stationary when observed from the pole, it is known as pole star or Polaris or "Dhruv Tara". The pole star appears stationary because it lies on the imaginary axis of rotation of the earth. As the pole star lies on the north pole, it is not visible from the south pole of the earth.

The formation of a star takes place in two stages:

(i) Formation of protostar from the contracting cloud of gases such as hydrogen and helium.

(ii) Formation of star from protostar due to nuclear fusion of hydrogen.

Constellations

The stars forming a group that has a recognizable shape is called a constellation. In Indian terminology, constellations are called nakshatras.

All the stars in a constellation stay together.

The shape of a constellation always remains the same.

Constellations appear to move from east to west in the sky. This is because the earth rotates from west to east. Constellations are named after the figure they resemble.

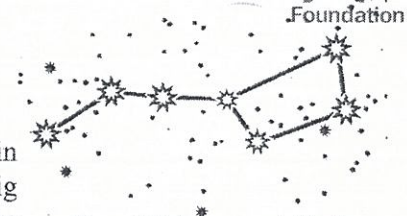
Following are the important constellations:

(i) Ursa Major or Great Bear

(ii) Ursa Minor or Little Bear
(iii) Orion (or the Hunter)
(iv) Cassiopeia

Ursa Major or Great Bear

The ursa major constellation consists of seven bright stars arranged in a pattern resembling a big bear. It consists of the body and tail of a big bear. Ursa major constellation is visible during summer season in the northern sky.



Ursa Major constellation

Fig: 6.1

The pole star (Dhruva Tara) always remains at the same fixed position in the sky. It lies on the northern end of the extended line drawn through the two stars at the end of ursa major.

Ursa Major moves around the Pole Star

Fig:6.2

Ursa Minor or Little Bear

The Indian name of the ursa minor constellation is "laghu saptarishi". Ursa minor (or little bear) contains seven bright stars. The star at the end of the tail is the pole star (Dhruva Tara). Ursa minor constellation is sometimes also called pole star constellation.

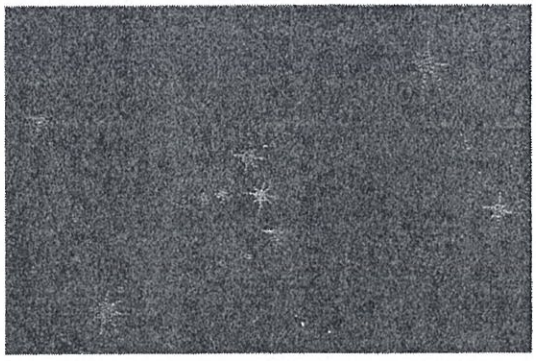
In the northern hemisphere, ursa minor can be seen clearly at night (towards north) in the months of June - July.

Ursa Minor (or Little Bear) constellation

Fig:6.3

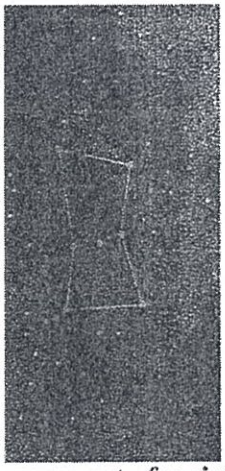
Orion (or the Hunter)

Orion is also known as "kalpurush". The major stars of orion are supposed to form the body of a hunter. The three middle stars represent the belt, and four bright stars (two above and two below the belt) describe the shoulder and legs of the hunter. The orion constellation is visible during the winter season in northern sky.



Orion constellation

Fig:6.4



The arrangement of major stars in orion constellation

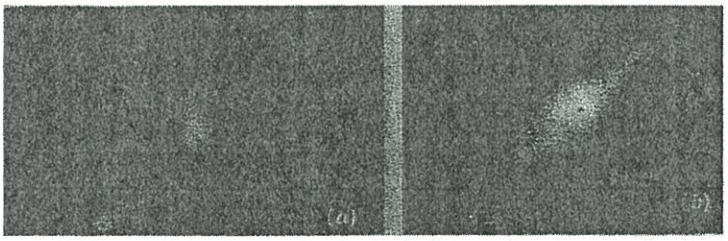
Fig:6.5

Cassiopeia

It is another prominent constellation in the northern sky. It is visible during winter in the early part of the night. It looks like a distorted letter W or M.

Galaxies

Galaxy, in which our earth lies, is known as Milky Way. All the stars that we see at night in the sky is just a small part of our milky way galaxy. The milky way is a spiral galaxy and the sun is located at about 30,000 light years from the nucleus of the galaxy. It lies on orion arm of the galaxy.



The milky way galaxy

Fig:6.6

Like all galaxies, the milky way is held together by gravity. This gravity also holds the stars, gas and dust in orbit around the center of the galaxy. Just as the planets orbit around the sun, the sun orbits around the center of the milky way galaxy. It takes about 2.25 million years to complete one revolution around the milky way by the sun.

The Moon

The moon is the only natural satellite of earth. It is our nearest neighbour in the space.

Shape and Size of the Moon

The moon is almost like a spherical ball. The diameter of moon is about 3500 km and the distance of the moon from earth is 3,84,000 km. The temperature on surface of the moon is either very high or very low. When the sun shines on its surface, the temperature rises to 110°C. Similarly, when no sunlight falls, the temperature drops to as low as –150°C.

Atmosphere

The moon has no atmosphere. Therefore, no form of life exists on the moon. There is no rain, no clouds, no rivers or oceans on the surface of the moon.

Gravity

The gravitational pull on the surface of the moon is six times less than the gravitational pull on the surface of the earth.

Surface Features of the Moon

The surface of the moon is rugged. It is made of very large craters and have very high mountains. Niel Armstrong and Edwin Aldrm, two American astronauts landed on the surface of the moon on 20th July 1969. They found that moon is a waterless and airless desert, having no life.

Motion of the Moon

The moon revolves around the earth. As the earth revolves around the sun, in the same way moon also revolves around the sun along with the earth. The moon revolves around the earth once every $27\frac{1}{3}$ days.

The Time Period Between Two Successive New Moons

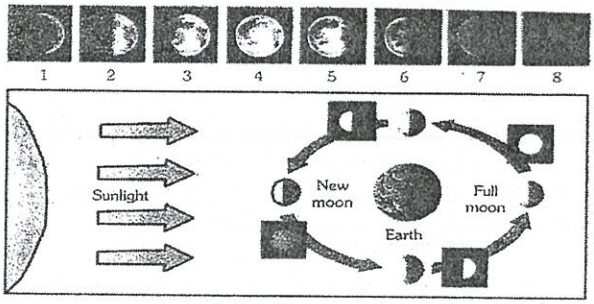
The time period between successive new moon is 29.5 days (709 hours) The difference between this time period and the orbital time period of the moon is due to the motion of the earth around the sun. The earth moves a significant distance in its orbit around the sun during the period at which moon completes its one revolution around the earth.

The Phases of the Moon

The shape of the moon is different in different days. The day on which moon lies between the sun and the earth is known as New Moon Day or "Amavasya". After two days of the New Moon it seems to be very thin and is called the Crescent moon. Thereafter, the moon starts growing bigger. After few days half of the moon is seen. It is called the Gibbous Moon. On the fourteenth day full moon is seen. It is called Full moon or "Purnima". On this day, the earth lies between the sun and the moon. The rays of the sun fall on the face of the Moon and we see the whole moon. These different stages are said to be the phases of the moon. Growing of the moon from New Moon to Full Moon is called waxing and from Full Moon to New Moon, is called waning.

The two weeks period during which purnima wanes into amavasya is called Krishna paksha.

The two weeks period during which amavasya waxes into purnima is called Shukla paksha.



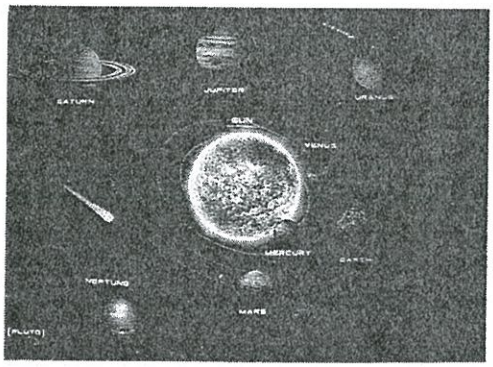
At New Moon, the untlit side of the Moon is towards the Earth, so it is not visible. As it moves through the first quarter of its orbit, a crescent moon (1), halg (2), and then nearly all the unlit side (3) are seen.

At full moon the sunlit side faces the Earth, and the Moon appears round (4),. The phases then continue in the reverse order until the Moon is new again (5), (6), (7), (8). The phase cycle takes 29.5 days —the lunar month.

Fig:6.7

The Solar System

The part of the universe in which we live is called solar system. The sun and the heavenly bodies which revolve around it, forms the solar system. The solar system consists of the sun, the eight planets and their satellities (or moons) and thousands of other smaller heavenly bodies such as asteroids, comets and meteors.



The Solar System

The Sun

The sun is at the centre of the solar system and all members of the solar system lie around the sun in elliptical paths called orbits. The sun holds them together by its great gravitational pull.

The diameter of the sun is about 1.4 million kilometers. It is a huge ball of gases. About 90% of the sun is made up of hydrogen. The hydrogen is constantly converted into helium by a process called nuclear fusion.

In our solar system, earth is the only planet where life exists.

Mercury is very hot during the day and very cold at night.

Venus is covered with a thick atmosphere constitute of mostly carbon dioxide. It is a very hot planet.

Mars is a reddish planet. It has white polar caps which grow larger in winter.

Planets

Planets are the solid heavenly bodies which move around the sun in a closed elliptical paths.

The planets are made of rocks and metal. The planets have no light of their own. The planets shine and become visible to us because they reflect a part of the sunlight falling on them. The eight planets of the solar system are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

Each planet revolves around the sun in its own orbit. Different planets take different time interval to complete one revolution around the sun. For example:

Mercury takes 88 days, earth takes 364 1/4 days and Neptune takes 185 years to complete one revolution around the sun.

Planets also rotate about their own axis it is called period of rotation. The period of rotation for Jupiter is minimum 9 hours and 55 minutes, whereas that for venus is maximum 243 days.

Some planets have one or more natural satellites (or moons). Moon is a natural satellite of the earth.

Identifying planets in the night sky

Planets do not emit light. However, they shine when light from the sun falls on them. Some of the planets can be seen from the earth at night.

- Venus, Mars and Jupiter can be seen in the night sky.
- Venus is the brightest of all the planets in the sky. It appears in the eastern sky before sunrise.
- Mars appears reddish in the sky.
- Jupiter is as bright as venus. It rises in the east and sets in the west in the early morning. It can be seen throughout the night.

Difference between a star and a planet

Property	Star	Planet
1. Composition	Stars are made of highly compressed gases, mainly hydrogen and helium.	Planets are made of solid rocks, liquids and gases.
2. Size	Stars are much bigger than planets.	It is smaller than star
3. Number	There are about 1022 stars in the universe.	There are only eight planets in our solar system.
4. Source of energy	In stars, energy is produced due to nuclear fusion process.	Planets possess only thermal energy due to the hot mass deep inside.

5. Source of light	Stars shine because they have their own light.	Planets do not have their own light, they shine due to the light of the nearest star.
6. Physical appearance	Stars appear to twinkle due to atmospheric refasten of light	Planets do not twinkle.
7. Position in the sky	The position of a star at a particular time at night remains almost unchanged.	The positions of planets appear to change.
8. Movement	All stars seem to move across the sky from east to west except the pole star which remains stationary.	Planets move from west to east except Uranus which moves from east to west.

Difference between a star and a meteor

1. A star has its own light.	1. A meteor has no light of its own but it starts glowing only when it enters the earth's atmosphere due to the air friction.
2. A star is a huge mass of gases.	2. A meteor is made up of solid rocky material and has a tail consisting of dust and gases.

Mercury (Budh)

Mercury is the smallest planet and closest to the sun. It completes its revolution around the sun in 88 days. This planet is not always visible because it is generally hidden in the glare of the sun. It can be seen as a bright spot of light at sunrise and sunset during a particular time of the year. Mercury has no moon.

Venus (Shukra)

Venus (or shukra) is the brightest planet in the sky at Night. It rotates from east to west and completes one revolution in 225 days. Venus is also called the morning star or the evening star or shining planet. Venus has no moons and there is no evidence of life.

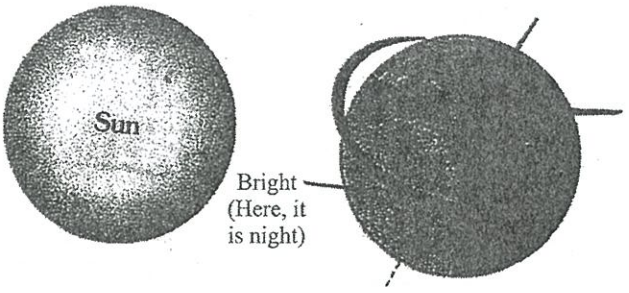
Earth (Prithvi)

The Earth is the planet on which life exist. It takes 365 1/4 days to complete one revolution around the sun and rotates from west to east. It is surrounded by a thin layer of gases called the atmosphere. Ozone layer in the earth's atmosphere absorbs the harmful radiations (ultraviolet rays) coming from the sun and protects life on the earth. Earth rotates about its axis in 24 hours.

Formation of day and night on the earth

At any given point of time, only half of the earth faces the sun. Thus only half of the earth gets sunlight at any point of time. The part of the earth that receives sunlight (i.e. faces the sun)is called day and the other part away from the sun is called night.

Since the earth rotates about its own axis from west to east, gradually the day part of the earth moves towards the night side and the night side towards the day side. The day and night are so formed on the earth.



Formation of day and night on the earth

Fig:6.9

Change of season on the earth

The axis of rotation of the earth is inclined at an angle of 23 1/2° with its orbital plane. Due the elliptical orbital of the earth around the sun, the earth is not always at the same distance from the sun. It is because of tilt of the earth's axis that the position of the northern and southern hemispheres of the earth keeps changing around the year. When the northern hemisphere is tilted towards the sun, it is summer in the northern hemisphere and winter in the southern hemisphere. 21 June is the longest day in the northern hemisphere and shortest day in the southern hemisphere. At this time the southern hemisphere is farther from the sun and the northern hemisphere is nearest to the sun. On 23 December, the sun is closer to the southern hemisphere and farther from the northern hemisphere. As a result, there is winter in the northern hemisphere and summer in the southern hemisphere. At this time the northern hemisphere has shortest day and southern hemisphere has longest day. On march 21 and September 22, the duration of day and night are equal in both the hemispheres. On 21 march, spring season is in the northern hemisphere and autumn is in the southern hemisphere. On 22 September spring is in the southern hemisphere and autumn in the northern hemisphere.

Mars (Mangal)

Mars looks like a bright red star and is called the red planet. The soil on mars contains large amounts of iron oxide, which gives the planets its reddish look. Mars has a thin atmosphere mainly consisting of nitrogen and traces of oxygen. Mars has two moons and has craters like that in the moon. It completes its revolution around the sun in 687 days. Temperature on the surface of mars is about 30°C during the day and –75°C during night.

Jupiter (Brihaspati)

It is the largest planet in the solar system. It is the third brightest object in the sky after the palnet venus and the earth's moon.

Jupiter mainly consists of hydrogen and helium gases. The most distinguishing feature of the Jupiter is its great red spot. It is believed to be a storm in its atmosphere. Jupiter has 28 moons and has faint rings around it.

Saturn (Shani)

It is the second largest planet in the solar system. It is called the 'Planet with Rings' because it is surrounded by distinctive rings of dust and rocks. It appears as a bright yellow planet. The distance of the Saturn from the sun is nearly double the distance between the Jupiter and the sun. Saturn has 30 moons.

Uranus

William Herchel discovered Uranus in 1781 with the help of a telescope. It is the seventh planet from the sun. Its distance from the sun is nearly double the distance of the Saturn from the Sun. Since it is far away from the sun, it is very cold. It rotates from east to west. Hydrogen and methane gases have been detected in the atmosphere of Uranus. It has more than 21 moons.

Neptune

U.J. Leverrier (France) discovered the existence of a planet beyond Uranus in 1846. It is the farthest planet from the sun. it appears as a small bluish circle when viewed through a powerful telescope. Neptune has more than 8 moons.

Some other Members of the Solar System

Asteroids

These are large pieces of rock and debris. Most asteroids lie between Mars and Jupiter. This region is called the asteroid belt. It is believed that asteroids are the remains of a planet that was broken up by a massive colission. They are also known as minor planets.

Comets

Comets are small rock like objects of frozen gases that revolve around the sun. They revolve in elliptical orbits around the sun. Comets are identified by a small solid part (called the head) surrounded by a cloud of glowing gases called the tail.

Halley's comet is a periodic comet. Halley's comet comes close to the sun once every 76 years. It appeared last in 1986. It will appear next in mid 2061.

Meteors and meteroites

Meteors are also called shooting stars. They are rocky metallic particles that revolve around the sun. They may be fragments of asteroids or comets. As they fall through the earth's atmosphere, they burn up due to friction. As a result large amount of heat is generated. This is seen as a streak of light in the sky which disappears within a few seconds. Most meteors burn up fully before they reach the lower atmosphere. Sometimes, the bigger pieces may not burn up fully and fall on the earth's surface. Such pieces are called meteorites.

Natural satellites planets

A solid heavenly body that revolves around a planet is called its natural satellite. Natural satellite of earth is moon. Some planets do not have any satellite, whereas some others have more than one natural satellite. Mercury and Venus do not have any satellite. Earth has only one natural satellite. Saturn has maximum – 30. Jupiter has 28 satellites.

Natural satellites do not have light of their own. However, they reflect sunlight falling on them and there for appear shining.

Artificial Satellites

"A man-made object circulating around a planet is called an artificial satellite."

The first artificial satellite Sputnik - I was launched by the former USSR on October 4, 1957. India launched its first satellite, Aryabhata into space on March 19, 1975. The other satellites launched by India are Bhaskara, APPLE (Ariane Passenger Payload Experiment), Rohini, INSAT - B, EDUSAT, etc.

Types of artificial satellites

Depending upon the nature of their orbit, artificial satellites are classified as follows:

(i) Geostationary satellite (or earth synchronous satellite) A geostationary satellite is used for satellite communication. T.V., cell phone, fax, etc., are a few of the services provided by satellite communication.

(ii) Synchronous satellite

A Synchronous satellite is used for remote-sensing.

A remote sensing satellite passes over a particular location on the earth at the same local time.

Remote - sensing satellites are used for:

- Collecting forestry data.
- Conducting ground water surveys, estimation of crop yield/crop diseases.
- Preparing wasteland maps.

Uses of artificial satellites

Artificial satellites are used for many purposes such as:

(i) weather forecasting.

(ii) studying stars, galaxies and other celestial objects.

(iii) conducting research and scientific experiments.

(iv) television broadcasting.

(v) navigation of ships and airplanes.

(vi) telecommunication services like telephone, internet, fax, cell phones etc.

(vii) for military purposes.

(viii) mapping and surveying natural resources such as minerals and forests.

Did You Know

1. It is believed that the sun loses around 4 million tones of weight every second.
2. Moon is the only heavenly body which appears brighter than venus in the night sky.
3. The distance between one edge to the other edge of the milky way is about 100,000 light years.
4. Only six countries in the world have the technology for developing and launching artificial satellite. India is one of these six countries.
5. The planet would explode, if the gravity do not hold the materials together.

Key Points

1. The stars are the celestial bodies which have light of their own.
2. Stars also have a definite life span.
3. The distance of stars is measured in light years.
4. Stars appear to move from east to west.
5. Constellations are the group of stars which form a definite pattern.
6. The natural satellite of the earth is moon.
7. Asteroids, comets and meteors are the small heavenly bodies, which revolve between the orbits of mars and Jupiter.
8. Smallest planet - Mercury.
   Biggest planet - Jupiter.
   Planet nearest to the sun - Mercury.
   Planet farthest to the sun - Neptune.
9. Venus is the brightest planet.
10. Artificial satellites are used for telecommunications and weather forecasting.

Multiple Choice Questions

1. The pole star is in the constellation of
   (a) Ursa Minor
   (b) Orion
   (c) Ursa Major
   (d) Scorpius
2. The star nearest to the earth is knows as
   (a) proxima centauri
   (b) Orion
   (c) Sirius
   (d) Sun
3. The time taken by a planet to complete one revolution is called
   (a) planet day
   (b) planet year
   (c) period of revolution
   (d) period of rotation
4. Planets appear as bright light in the night sky because
   (a) they have their own light
   (b) they reflect light from the sun
   (c) they reflect light from nearby planet
   (d) none of these
5. The constellation that resembles a 'question mark' in the sky
   (a) Ursa Major
   (b) Ursa Minor
   (c) Scorpio
   (d) Orion
6. The distance of the star Proxima Centauri from the earth is
   (a) 4.3 million km
   (b) 8 1/4 light minutes
   (c) 3 million light years
   (d) 4.3 light years
7. The hottest planet in the solar system is
   (a) Mercury
   (b) Jupiter
   (c) Venus
   (d) Mars
8. Which of the following is a star?
   (a) Diebos
   (b) Orion
   (c) Phobos
   (d) Alpha centauri
9. Asteroids are found between the orbits of
   (a) Mercury and Venus
   (b) Mars and Jupiter
   (c) Jupiter and Saturn
   (d) Saturn and Uranus
10. The stone-like object that on entering the atmosphere of the earth's surface appears as streak of light at night is called
    (a) pole star
    (b) halley comet
    (c) shooting star
    (d) asteroid
11. The sun is located at
    (a) the centre of the solar system
    (b) the centre of the universe
    (c) the centre of the milky way
    (d) none of these
12. The large number of rocks that lie between the orbits of Mars and Jupiter are called
    (a) comets
    (b) meteors
    (c) meteorites
    (d) asteroids

13. The constellation in which the stars form the shape of a hunting man is called
    (a) Scorpion (b) Orion
    (c) Cassiopeia (d) Ursa major
14. Which of these is called the red planet?
    (a) Venus (b) Jupiter
    (c) Mars (d) Saturn
15. Which of these is the largest planet of the solar system?
    (a) Jupiter (b) Saturn
    (c) Uranus (d) Venus
16. The largest asteroid in the universe is
    (a) Halley (b) Ceres
    (c) Orion (d) Sorpius
17. The first satellite launched by India in March 1975 is
    (a) Bhaskara - I (b) INSAT - 2C
    (c) Aryabhata (d) Antariksh
18. The earth rotates from west to east about imaginary axis. So, the stars appear to move from
    (a) east to west (b) west to east
    (c) north to south (d) south to north
19. Stars are classified on the basis of their physical attributes such as
    (a) size (b) temperature
    (c) colour and brightness (d) all of these
20. The planet having maximum number of moons is
    (a) Saturn (b) Venus
    (c) Jupiter (d) Uranus
21. We can observe the different phases of moon because
    (a) the shadow of earth falls on the moon
    (b) moon does not reflect sunlight
    (c) of the relative position of the moon, the earth and the sun
    (d) all the above
22. How much time does the sunlight take to reach the earth?
    (a) 7.5 minutes (b) 7.9 minutes
    (c) 8.3 minutes (d) 8.7 minutes
23. For communication network, we need what type of orbit?
    (a) highly elliptical (b) geostationary
    (c) polar (d) circular
24. Each constellation is made up of different number of stars arranged in different pattern. Orion is one of the constellation. The number of stars of which orion is made up of is
    (a) 5 or 6 (b) 7 or 8
    (c) 9 or 10 (d) 100
25. Which was the first planet to be discovered by the telescope?
    (a) Venus (b) Pluto
    (c) Saturn (d) Uranus

Answer Key

1. (c)	2. (d)	3. (c)	4. (b)	5. (a)	6. (d)	7 (c)	8. (d)	9. (b)	10. (c)
11. (a)	12. (d)	13. (b)	14. (c)	15. (a)	16. (b)	17. (c)	18. (a)	19. (d)	20. (a)
21. (c)	22. (c)	23. (b)	24. (b)	25. (d)					

7. Some Natural Phenomena

Learning Objectives

* Static Electricity
* Charging by Rubbing
* Types of Charges (Positive and Negative) and their Interaction
* Transfer of Charge
* Charges in the Atmosphere of Atmospheric Electricity
* Lightning and Thunder
* Earthquake, its Cause, Damage and Protection

A number of phenomena keep taking place in nature. Many of them are useful or favourable to human beings, and some of them are harmful as well. Lightning and earthquakes are the phenomena that occur in nature. They are called natural phenomena. Such phenomena are not caused by humans but they have adverse effects on humans.

Static Electricity

About 2500 years ago, a Greek named, Thales found that when a piece of amber is rubbed with fur, it attracts small pieces of feathers, straw, leaves and dust. Some other materials such as comb, plastics, glass, hard - rubber, ebonite rod, etc., show the same effect.

It is due to some of the electrons present on the surface of the body that get transferred to other body and are said to be electrically charged.

The electric charge on such bodies cannot flow continuously, therefore it is called static electricity.

During heavy rains and thunderstorms, you must have noticed brief sparks in the sky. These sparks are called lightning and are caused by accumulation of electric charges in the rain clouds.

Charging by Rubbing

When two uncharged bodies are rubbed together, they both get charged and the charges acquired by them are equal and opposite. This happens because one substance loses electrons to become positively charged while the other gains the same number of electorns to become negatively charged.

Types of Charges

Benjamin Franklin (1706 - 1790) found that there are two kinds of electrical charges, i.e., positive and negative.

According to the convention

(i) The electrical charge on a glass rob when it is rubbed with a silk cloth is considered to be positive (+) and

(ii) The electrical charge on an ebonite rod when rubbed with fur or wool is considered to be negative (–)

Transfer of Charge

Electrical charge can be transferred from a charged object to another uncharged object through a metal conductor.

A device that can be used to check whether an object is carrying a charge or not is called an electroscope.

Charges in the Atmosphere or Atmospheric Electricity

In 1752, an American scientist Benjamin Franklin proved that the lightning and thunder are caused by the electrical charge in the clouds.

Franklin's Experiment

Franklin flew a kite made from silk cloth into the clouds on a thundry day. He tied a metallic key to the silk thread of the kite. Whenever, there was a flash of lightning in the clouds, he received an electric shock and the key was found to be warmed up.

From this experiment, Benjamin concluded that the clouds, particularly during rainy season are electrically charged. As the kite reached the clouds, the charge flowed down the wet thread to the metal key. When he touched the metal key, the electric charge passed through his body to the earth giving him an electric shock.

Lightning and Thunder

Lightning is a powerful and sudden flow of electricity (an electrostatic discharge) accompanied by thunder that occurs during electric storm.

The huge masses of clouds get electrically charged due to rubbing of the clouds with air and due to the presence of dust, carbon and other charged particles in the air. When the two clouds carrying opposite charges approach each other, a large quantity of electric charge flows rapidly from one cloud to the other through the air. When this happens, an intense spark of electricity is seen in the sky.

Such rapid flow of charge through air between the two oppositely charged clouds is called electric discharge or lightning. The electric discharge from one cloud to the other lasts for a very short period of time, but it releases a huge amount of heat and light.

An electric discharge can occur not only between two clouds but also between a charged cloud and the surface of earth.

When a charged cloud passes over a tall building or a tree, it induces an opposite charge on them. If the charge built up is large, it leads to an electrical discharge in the form of a lightning strike. When lightning strikes a building or a tree, it can shatter and set them on fire.

Lightning Safety

During lightning and thunderstorm, no open place is safe.

(i) Hearing thunder is an alert to rush to a safer place.

(ii) After hearing the last thunder, wait for some time before coming out of the safe place.

Finding a safe place

A house or a building is a safe place.

If you are travelling by car or by bus, you are safe inside with windows and doors of the vehicle shut.

Do's and Don'ts during a Thunder Storm Outside the house

(i) Do not carry an umbrella over your head as it contains metallic rod in it.

(ii) Do not stand near tall trees, high-rise buildings, electric pole and any metallic structure.
(iii) Do not lie on the ground. Instead squat low on the ground with your heads on your knees and head in between.
(iv) If there is no shelter around, take shelter under shorter trees.
(v) Unplug the TV sets, computers etc. Donot use the wired phone.
(vi) Do not take bath during thunderstorm and avoid contact with running water.
(vii) Do not stand near windows or in balcony having metallic railings.

Lightning Conductors

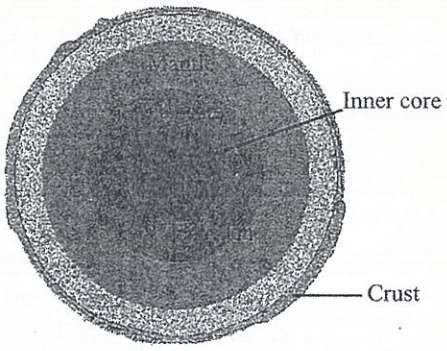
Lightning conductor is a device used to protect buildings from the effect of lightning. A metallic rod, taller than the building, is installed in the walls of the buildings during its construction. One end of the rod is kept out in the air and the other is buried deep in the ground. The rod provides easy route for the transfer of electric charge to the ground.

Earthquakes

An earthquake is a sudden, shaking or trembling of the earth which lasts for a very short time. It is caused by a disturbance deep inside the earth's crust.

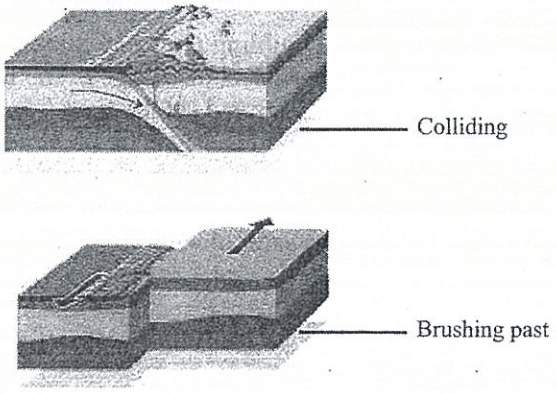
The heavier materials sank deeper to form release of energy by core, and the lighter material floated upwards to form crust. The solid hard crust of earth is called lithosphere. The material of intermediate density between core and crust form the middle layer called mantle.

The outermost layer of the earth is not in one piece. It is fragmented. Each fragment is called a plate. These plates are in continual motion. When they brush past one another, or a plate goes another due to collision, they cause disturbance in the earth's crust. It is this disturbance that shows up as an earthquake on the surface of the earth.



The inner structure of the earth

Fig: 7.1



Movement of earth's plates

Fig: 7.2

Some Important Terms Related to the Earthquake

Seismic focus

The point from where the shock waves of an earthquake originate due to sudden movement or slip of rocks is termed seismic focus. The seismic focus is also called seismic origin or hypercentre. The seismic focus lies with in the crust of the earth at a depth of about 60km.

Epicenter

The point on the surface of the earth, vertically above the seismic focus is called epicenter.

Focal depth

The focal depth of an earthquake is the depth of the seismic focus below the earth's surface.

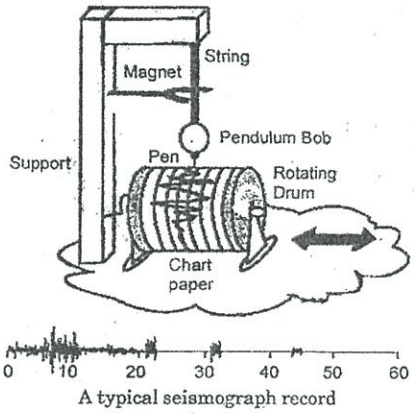
The earthquake having focal length of 60 - 70 km are classified as shallow, those with depth from 70 - 300 km as intermediate and those with depth of more than 700km as deep.

Seismic waves

The waves generated in the lithosphere due to sudden movement in a part of earth's crust are called seismic waves or shock waves.

Seismograph

The instrument which detects and records the intensity of seismic waves generated by an earthquake is called seismograph. or seismometer. The graphical record of the intensity of seismic waves is called seismograms.



A Seismograph

Fig: 7.3

Richter scale

Richter scale is used to describe the magnitude of an earthquake.

It determines the magnitude of an earthquake from the logarithm of the amplitude of wave recorded in seismography.

Causes of Earthquakes

The main causes of earthquakes are:

Volcanic eruptions

Gushing out of molten rocks and hot gases under high pressure through a hole in the earth's crust is called a volcano.

The energy released during a volcanic eruption causes vibrations in the crust. These vibrations cause earthquakes. Such earthquakes occur at the time of eruption or before it.

Man-made explosions

Deep underground mining, blasting of rocks using dynamite, nuclear explosions cause very powerful vibrations. These vibrations cause earthquakes in the area around the site of activity.

Dislocation of earth's crust:

Most destructive earthquakes are caused by dislocation of the crust called faults. The crust may first bend and then break and settle to a new position. During the process of breaking, vibrations are produced. These vibrations are called seismic waves. These seismic waves travel outward along the surface and through the earth at varying speeds. These seismic waves cause tremors in the earth.

Movements of the tectonic plates

Lithosphere is believed to consist of about 12 plates which float over the molten magma in the mantle. Most earthquakes occur at the boundaries where the plates meet.

These boundaries are the locations of considerable geolocial activities.

Magnitude of an Earthquake

The power or magnitude of an earthquake can be found from data recorded by a seismometer. The scale on which the magnitude of an earthquake is measured is called the Richter Scale.

The Richter scale was devised by Charles F. Richter in 1935 and modified in 1965 by Richter and his fellow Beno Gutenberg. This scale gives a measure of the energy released at the earthquake's centre.

The scale is logarithmic, i.e., a change in the value on the scale by one corresponds to 10 times change in the energy associated with the earthquake. An earthquake of magnitude 2.0 to 4.0 on the Richter scale is said to be a mild earthquake. One of magnitude 4.8 to 8.0 is moderate to severe. An earthquake of magnitude greater than 8.0 would be very powerful earthquake and it may cause heavy damage.

Intensity of an Earthquake

The intensity of an earthquake is a measure of how strong a shock was felt at a particular location. The intensity of an earthquake is expressed by the modified mercalli scale.

In this scale, the values are given in the range I to XII. The value I corresponds to an earthquake which is not felt, whereas the value XII corresponds to the earthquake which causes total destruction.

Alaska earthquake of 1964 was valued at X.

Earthquakes and Tsunamis

Earthquake under the ocean floor sometimes generate powerful sea waves called Tsunamis.

These waves travel across the ocean at speeds upto about 1000km/h and may be 30 meters or more high. Tsunamis occur quite frequently in the pacific ocean.

On 26 December, 2004 Tsunami was generated by an earthquake along Indonesia.

Factors Effecting Damage in Earthquake

(i) Magnitude of the earthquake
(ii) Local geological conditions
(iii) Focal depth
(iv) Distance from the epicenter
(v) Design of buildings and other structures
(vi) Density of constructions and population in the affected area.

Damaging Effects of Earthquakes

(i) Cause damage to the buildings, railway tracks, bridges, roads, etc.
(ii) Cause landslides.
(iii) Change the course of rivers and cause floods.
(iv) Damage underground water and gas pipelines. This may lead to fire breakout and large scale burning.

Protection Against Earthquakes

Before the occurrence of earthquake

(a) In highly seismic areas, one should avoid the use of heavy construction materials such as, stones, marble, iron girders etc. Keep the roofs as light as possible.
(b) Minimise the hanging items.
(c) Cupboards and shelves must be fixed to the walls.

When the earthquake strikes

At home:

(a) Stay away from tall and heavy objects that may fall on you.
(b) If you are in bed, do not get up. Protect your head with a pillow.
(c) Take shelter under a table and stay there till the shaking stops.

When outdoors:

(a) Find a clear spot away from buildings, trees and overhead power lines.
(b) If you are in a car or a bus, do not come out. Ask the driver slowly to reach a clear spot. Do not come out till the tremors stop.

Did You Know

1. A charged body attracts an uncharged body.
2. Insulators can be charged with static electricity.
3. Lightning played a major role in the evolution of life on the earth.
4. The location of an earthquake is commonly described by the geographic position of its epicenter and its focal depth.
5. Tsunami is a Japanese word which means huge wave.

Key Points

1. There are two types of electric charges negative charge and positive charge.
2. Electrons carry negative charge whereas protons carry positive charge.
3. An electroscope is an instrument for detecting the presence of electric charge on an object.
4. The bright flash of light which we see in the clouds is called lightning.
5. Earthquake occurs due to sudden movements in earth's crust.
6. The magnitude of an earthquake is expressed on the Richter scale.
7. The intensity of an earthquake is expressed by the modified Mercalli scale.

Multiple Choice Questions

1. When two bodies are rubbed against each other,
   (a) they acquire equal and similar charges.
   (b) they acquire equal and opposite charges.
   (c) they acquire unequal and opposite charges.
   (d) they acquire unequal and similar charges.
2. Like charges
   (a) always attract each other.
   (b) sometimes attract each other.
   (c) always repel each other.
   (d) sometimes attract and sometimes repel each other.
3. Intensity of an earthquake is measured on _____ scale.
   (a) Richter (b) Newton
   (c) Seismic (d) Vector
4. The brilliant flash of light produced in the sky is followed by
   (a) rain (b) snow
   (c) hail (d) thunder
5. The solid hard crust of the earth is called
   (a) Biosphere (b) Lithosphere
   (c) Magma (d) Lava
6. A body can be charged by
   (a) friction (b) induction
   (c) conduction (d) all of these
7. A body can be charged by
   (a) rubbing it against another body.
   (b) touching it to a charged body.
   (c) bringing a charged body near it.
   (d) all of the above
8. The earth's lithosphere is made of how many tectonic plates?
   (a) 10 (b) 15
   (c) 20 (d) 25
9. Lightning conductor is used
   (a) to protect tall buildings from lightning flashes.
   (b) to measure the strength of lightning.
   (c) to protect the building from earthquake.
   (d) to measure the strength of the earthquake.
10. An earthquake of intensity ____ can destroy whole of cities.
    (a) 4.5 – 6.5 (b) 6.5 – 7.0
    (c) 7.0 – 7.9 (d) 8 or above
11. Which of these is NOT true?
    (a) Seismic waves are created during earthquake.

(b) The characteristics of earthquake waves are recorded on seismogram.
(c) The intensity of an earthquake depends on the amount of energy released and the size of seismic waves.
(d) none of these

12. Impacts of an earthquake are
(a) fires and tsunami
(b) landslides and avalanches
(c) shaking and ground rupture
(d) all of these

13. The point at which the earthquake originates is known as
(a) Tectnoic point
(b) Seismic focus
(c) magma wave
(d) mantle

14. Sudden shaking of the earth is called
(a) lightning
(b) thunder
(c) hurricane
(d) earthquake

15. The process of discharging atmospheric electricity into the earth by a lightning conductor is called
(a) short circuiting
(b) electrical neutralization
(c) earthing
(d) both (b) & (c)

16. The flow of heavy charge through air, accompanied by heat and light is called
(a) electric discharge
(b) current flow
(c) electric wave
(d) short circuiting

17. When charged by conduction, a body acquires the ___ charge as the charging body.
(a) equal
(b) opposite
(c) same
(d) none of these

18. A lightning conductor is a
(a) piece of wire with spikes through which current can flow.
(b) substance that can be charged by clouds.
(c) metal rod with spikes, fixed to a building.
(d) copper plate buried in the ground, below a building.

19. To test if a body is charged or not, you will use
(a) a positively charged body.
(b) a negatively charged body.
(c) another uncharged body.
(d) a positively and a negatively charged body.

20. The instrument used for detecting and measuring charge is called
(a) ammeter
(b) electroscope
(c) electrometer
(d) seismometer

21. When a silk cloth is rubbed against a glass rod, silk rod will get
(a) a negative charge
(b) a positive charge
(c) unaffected by rubbing
(d) none of these

22. Tsunami is caused due to
(a) movement in seismic waves
(b) displacement of tectonic plates
(c) earthquake in sea
(d) any of these

23. During a lightning stroke in the forest, one should take shelter
    (a) under a big tree
    (b) in an open park
    (c) under shorter trees
    (d) in open vehicle
24. The point directly above the origin point of an earthquake under the surface of earth is called
    (a) epicenter
    (b) seismic front
    (c) seismic focus
    (d) magma
25. Seismic waves are of two types – surface waves and ____ waves.
    (a) earth
    (b) body
    (c) ground
    (d) bottom
26. Which of these is true about lightning?
    (a) A brilliant flash of light is called a spark.
    (b) A single flash of lightning is called lightning bolt.
    (c) Lightning can lead upto a thunderstorm.
    (d) all of these
27. Each increase of 1 on a Richter scale means a ___ fold increase in energy of an earthquake.
    (a) 10
    (b) 30
    (c) 20
    (d) 50
28. There are two types of surface waves, one is Rayleigh waves. Which one of these is another type of surface wave?
    (a) force waves
    (b) love waves
    (c) war waves
    (d) Richter waves
29. The devastating 2001 earthquake in India had its epicenter at
    (a) Khuch
    (b) Jamnagar
    (c) Bhuj
    (d) Rajkot
30. The branch of physics which deals with the study of charges at rest is called
    (a) static electricity
    (b) stable electricity
    (c) static electrolysis
    (d) none of these

Answer Key

1. (b)	2. (c)	3. (a)	4. (d)	5. (b)	6. (d)	7. (d)	8. (c)	9. (a)	10. (d)
11. (d)	12. (d)	13. (b)	14. (d)	15. (c)	16. (a)	17. (c)	18. (c)	19. (d)	20. (b)
21. (a)	22. (c)	23. (c)	24. (a)	25. (b)	26. (d)	27. (b)	28. (b)	29. (c)	30. (a)

8. Metals and Non- Metals

Learning Objectives

* Metals
* Physical Properties of Metals
* Non- Metals
* Physical Properties of Non -Metals
* Chemical Properties of Metals
* Reactivity Series of Metals
* Metal Displacement Reactions
* Chemical Properties of Non - metals
* Uses of some Common Metals
* Uses of some Common Non - metals

Lavoisier classified on the basis of the properties all elements into metals, non-metals and metalloids. Metals and non-metals are separated in the periodic table by a diagonal line of elements. Elements to the left of this diagonal are metals, and elements to the right are non-metals. Besides these, there is a third category of elements which show the properties of both metals and non-metals. These elements are called metalloids.

Metals

Elements which have 1, 2 and 3 electrons in their outer most shell are called metals. It possess lustre when freshly cut.They are malleable, ductile and good conducts of electricity.

For example: Sodium (Na), Potassium (K), Iron (Fe), Copper (Cu), Aluminium (Al), Gold (Ag), Silver (Ag), Zinc (Zn), Lead (Pb).

Physical Properties of Metals

All metals show similar physical properties except few metals.

1. Under normal condition all metals are solid at room temperature except mercury which is liquid at room temperature.
2. Metals in the pure state possess lustre, i.e., a shining surface.
3. Most metals are silvery-grey in colour except gold and copper, copper is reddish brown and gold is golden yellow in colour.
4. Metals are generally hard except lithium, sodium and potassium. These metals can be easily cut with a knife. Osmium is hard enough to scratch glass. Osmium oxide is an explosive material.
5. They have high tensile strength, i.e., load bearing capacity before they break.
   Due to this property iron is used in the construction of bridges, buildings, railway lines, vehicles, machineries etc.

6. Metals are malleable, i.e., they can be beaten into thin sheets. Silver can be beaten to very thin leaves which are used as silver varak. Aluminium foil is used in the packaging of food materials.
7. Metals are ductile, i.e., they can be drawn into wires. Copper, iron, aluminium, silver and gold can be drawn into very thin wires.
8. Metals are good conductor of heat and electricity.

   Silver (Ag) is the best conductor of electricity whereas mercury (Hg) is a very poor conductor of electricity.
9. Metals have high density except lithium, sodium and potassium which have low densities.
10. Metals are sonorous, i.e., they produce sound on striking hard, that is why metals are used for making school bells and wires for musical instruments.

Non-Metals

Those elements which do not posses lustre and are neither good conductor of heat or electricity are called non-metals.

For example: Hydrogen(H), Oxygen (O), Nitrogen (N), Chlorine (Cl), Bromine (Br), Sulphur (S), Phosphorus (P), Carbon (C) Iodine (I) etc.,

Non metals constitute most of the crust, atmosphere and oceans of the earth and bulk of the tissues of living organisms are composed almost entirely of non-metals.

Physical Properties of Non-metals

1. At room temperature non metals may be solids, liquids or gases.

   For example, carbon, sulphur, phosphorus and iodine are solid, bromine is a liquid while hydrogen, oxygen, nitrogen and chlorine are gaseous non metals.
2. Non metals do not possess any lustre except graphite and iodine which are the only non metals whieh have metallic lustre.
3. Non metals have different colours.

   For example sulphur is yellow, phosphorus is white or red, chlorine is greenish yellow, bromine is reddish-brown. Hydrogen, Oxygen and nitrogen are colourless gases.
4. They are soft and brittle except diamond (an allotropic form of carbon) which is a non metal but is the hardest substance known.
5. They have low tensile strength, i.e., are easily broken.
6. They are neither malleable nor ductile.
7. Non metals are generally bad conductors of heat and electricity except graphite which is good conductor of electricity and is used in making electrodes.
8. They have low densities.
9. Non metals are non-sonorous, i.e., they do not produce sound when hit with a hard object.

Chemical Properties of Metals

Some typical chemical reactions of metals are:

Reaction with oxygen

Most of the metals react with oxygen to form metal oxides.

Metal + oxygen $\longrightarrow$ metal oxide

$2Na + \frac{1}{2}O_2 \xrightarrow{room\ temp} Na_2O$

(Sodium) (Sodium oxide)

$Mg + \frac{1}{2}O_2 \xrightarrow[(burns\ white\ light)]{heat} MgO$

(Magnesium oxide)

$4Al + 3O_2 \xrightarrow[temp]{ordinary} 2Al_2O_3$

(Aluminium) (Aluminium oxide)

$Zn + \frac{1}{2}O_2 \xrightarrow[(burns\ with\ a\ blue\ flame)]{Strong\ heating} ZnO$

(Zinc) (Zinc oxide)

$4Fe + 3O_2 \xrightarrow[(no\ burning)]{Strong\ heating} 2Fe_2O_3$

(Iron) (Ferric oxide)

$Cu + \frac{1}{2}O_2 \xrightarrow[(no\ burning)]{Prolonged\ strong\ heating} CuO$

(Copper) (Copper oxide)

Reaction with water

Different metals react with water under different conditions.

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

(Sodium) (Cold water) (Sodium Hydroxide) Hydrogen

$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(Iron) (Steam) Iron (II, III) oxide Hydrogen

Note :

1. Copper, lead, silver and gold do not react even with steam.
2. Magnesium does not react with cold water. It reacts only with hot water forming Magnesium Hydroxide and Hydrogen.

$Mg + 2H_2O(l) \longrightarrow Mg(OH)_2 + H_2$

(Hot water) Magnesium hydroxide Hydrogen

$Mg + H_2O(g) \longrightarrow MgO(s) + H_2$

Steam Magnesium oxide Hydrogen

The order of reactivity of different metals towards water may by written as:

$[K \rangle Na \rangle Ca \rangle Mg \rangle Al \rangle Zn \rangle Fe \rangle Pb \rangle Cu \rangle Ag \rangle Au]$

Reaction with acids

Metals react with dilute acids to produce salt and hydrogen gas, sodium and potassium react violently with hydrochloric acids (HCl).

$2K + 2HCl \rightarrow 2KCl + H_2$

Potassium — potassium chloride

$2Na + 2HCl \rightarrow NaCl + H_2$

Sodium chloride

Calcium also reacts vigorously though less than sodium and potassium.

$Ca + 2HCl \rightarrow CaCl_2 + H_2$

(Calcium chloride)

Magnesium reacts. quite rapidly but the reaction is less vigorous than that of the calcium.

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

(Magnesium chloride)

Aluminium reacts with dilute hydrochloric acid slowly in the beginning because of the presence of protective layer of aluminium oxide, but after the layer gets dissolved in the acid, the reaction becomes fast.

$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

(Aluminium chloride)

Zinc and Iron reacts slowly with dilute hydrochloric acid

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

(Zinc chloride)

$Fe + 2HCl \rightarrow FeCl_2 + H_2$

(Iron (ii) chloride)

Copper, mercury and silver do not react with dilute hydrochloric acid or dilute sulphuric acid.

Order of reactivity of metals towards dilute hydro chloric acid or dilute sulphuric acid is:

$[K \rangle Na \rangle Ca \rangle Mg \rangle Al \rangle Zn \rangle Fe \rangle Cu \rangle Hg \rangle Ag]$

Note: If dilute nitric acid is used in place of dilute HCl or H_2SO_4, no hydrogen gas is evolved. This is because nitric acid is a strong oxidising agent.

Reaction with bases (alkalis)

Certain metals react with strong bases on heating to form a double soluble salt and hydrogen gas is evolved.

$2Zn + 2NaOH \xrightarrow{heat} Na_2ZnO_2 + H_2$

Sodium zincate (solution)

$2Al + 2NaOH + 2H_2O \xrightarrow{heat} 2NaAlO_2 + H_2$

(Sodium aluminate solution)

Reactivity Series of Metals

The arrangement of metals in a vertical column in order of their decreasing reactivity downwards is called the activity series or reactivity series of metals.

Reactivity series of some common metals.

	Potassium	K	Most reactive metal
	Sodium	Na	
Metals more reactive	Calcium	Ca	
than hydrogen	Sodium	Na	
	Magnesium	Mg	
	Aluminium	Al	
	Zinc	Zn	
	Iron	Fe	
	Nickel	Ni	
	Tin	Sn	
	Lead	Pb	
	Hydrogen	H	
	Copper	Cu	
Metal less reactive	Mercury	Hg	
than hydrogen	Platinum	Pt	
	Gold	Au	Least reactive metal

Metal Displacement Reactions

$\left(\frac{N}{P}\right)$ A reaction in which a more reactive metal displaces a less reactive metal from its salt solution is called a metal displacement reaction

For example

Reaction of zinc with copper sulphate solution

$$Zn + \underset{\text{Copper sulphate (Blue colour)}}{CuSO_4} \rightarrow \underset{\text{Zinc sulphate (Colourless)}}{ZnSO_4} + \underset{\text{copper (Reddish brown)}}{Cu}$$

This reaction shows that zinc is more reactive than copper.

Reaction of copper with silver nitrate solution

$$Cu + \underset{\text{Silver nitrate (Colourless)}}{2AgNO_3} \rightarrow \underset{\text{Copper nitrate (Blue)}}{Cu(NO_3)_2} + \underset{\text{Silver}}{2Ag}$$

This shows that copper is more reactive than silver.

Reaction of iron with copper sulphate solution

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$

Iran — copper (II) Sulphate (blue) — Iron (II) Sulphate (green) — Copper (Reddish (brown)

This shows that iron is more reactive than copper.

Note: No reaction takes place if copper wire is dipped in iron (II) sulphate solution. This again proves that copper is less reactive than iron.

Chemical Properties of Non-metals

Some chemical properties of non-metals are :

Electronegative character

Since large amount of energy is needed to remove one or more electrons from non-metals, therefore non-metals do not form positively charged ions. Thus non-metal readily form negatively charged ions by the gain of electrons. Therefore, non-metals are electronegative elements.

For example

$$Cl + e^- \rightarrow Cl^- \quad ; \quad O + 2e^- \rightarrow O^{2-}$$

$$S + 2e^- \rightarrow S^{2-} \quad ; \quad N + 3e^- \rightarrow N^{3-}$$

Note: Hydrogen is the only non-metal which can lose as well as gain an electron.

$$H + e^- \rightarrow H^- \text{ (anion)}$$

$$H - e^- \rightarrow H^+ \text{ (cation)}$$

Thus, hydrogen can act both as an oxidising as well as reducing agent.

Reaction with oxygen

When heated, non-metals react with oxygen to form oxides. These oxides may be either acidic or neutral. They never form basic oxides.

Acidic oxides

The non metallic oxides which dissolve in water to form acids are called acidic oxides. These oxides turn blue litmus red.

For example

$$2N_2 + SO_2 \rightarrow 2N_2O_3$$

(Nitrogen) (Dinitrogen trioxide)

$$\frac{1}{2}N_2 + O_2 \rightarrow NO_2$$

(Nitrogen dioxide)

$$2N_2 + 5O_2 \rightarrow 2N_2O_5$$

(Dinitrogen pentaoxide)

$$C + O_2 \rightarrow CO_2$$

(Carbon) (Carbon dioxide)

CO_2 dissolve in water to form carbonic acid.

$CO_2 + H_2O \rightarrow H_2CO_3$
(Carbonic acid)

$S + O_2 \rightarrow SO_2$
(Sulphur) (Sulphur dioxide)

SO_2 dissolve in water to form sulphurous acid

$SO_2 + H_2O \rightarrow H_2SO_3$
(Sulphurous acid)

$P + O_2 \rightarrow P_2O_3$
(Phosphorus) (Limited) (Di phosphorus tri oxide)

$P + O_2 \rightarrow P_2O_5$
(Excess) (Phosphorus penta oxide)

Neutral oxides

Non metallic oxides which neither react with acids nor with bases are called neutral oxides. These oxides neither turn blue litmus red nor red litmus blue.

For example

$2C + O_2 \rightarrow 2CO$
(Carbon monoxide)

$2H_2 + O_2 \rightarrow 2H_2O$
(Water)

$N_2 + O_2 \rightarrow N_2O$
(Nitrous oxide)

$N_2 + O_2 \rightarrow 2NO$
(Nitric oxide)

Reaction with halogens

Non metals react with halogens to give covalent halides. These non metal halides are formed by sharing of electrons between atoms of the non metal and the hadides. Hence, they are covalent compounds.

For example :

$P_4 + 6Cl_2 \xrightarrow{heat} 4PCl_3$
(Phosphorus trichloride)

$H_2 + Cl_2 \xrightarrow[sunlight]{Diffused} 2HCl$
(Hydrogen chloride)

$S + 6F \xrightarrow{hightemp} SF_6$
(Sulphur) (Sulphur hexafluoride)

Reaction with hydrogen

Non-metals combine with hydrogen to form covalent hydrides. Since non-metal hydrides do not contain ions, therefore they do not conduct electricity. The hydrides of non-metals may be acidic, basic or neutral depending upon the nature of the non-metal.

For example

1. $8H_2 + S_8 \xrightarrow{713K} 8H_2S$
(Hydrogen sulphide)

H_2S is weakly acidic in nature

2. $N_2 + 3H_2 \xrightleftharpoons{723-773, Fe\ catalyst} 2NH_3$
(Ammonia)

Ammonia is basic in nature

3. $H_2 + O_2 \xrightarrow{electric\ spark} H_2O$
(Water)

Water is neutral in nature

Reaction with acids

Non-metals do not react with acids to produce hydrogen gas. Because non metals are not able to give electrons for the reduction of H^+. However, some non-metals react with concentrated oxidising acids to form the corresponding oxyacids.

For example, Sulphur reacts with conc. nitric acid to give sulphuric acid.

$S + HNO_3 \rightarrow H_2SO_4 + NO_2 + H_2O$
(Conc. nitric acid) (Sulphuric acid) (Nitrogen dioxide)

Displacement reactions

A more reactive non metal displaces a less reactive non metal from the solution of its salt.

For example, Bromine and iodine are displaced when chlorine is passed through the solution of sodium bromide and potassium iodide respectively.

$2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$
(Sodium Bromide) (Sodium chloride) (Bromine)

$2KI + Cl_2 \rightarrow 2KCl + I_2$
(Potassium Iodide) (Potassium chloride) (Iodine)

Oxides of Metals and Non-metals

Both metals and non-metals react with oxygen to form oxides.

The oxides of metals and non-metals differ in their properties.

Oxides of Metals

The oxides of metals are generally basic in nature. When dissolved in water, metal oxides give alkaline (or basic) solutions which turn red litmus blue.

For example, Magnesium burns in air to give magnesium oxide which is basic in nature.

$Mg + O_2 \rightarrow MgO$
(Magnesium) (Magnesium oxide)

$MgO + H_2O \rightarrow Mg(OH)_2$
Magnesium hydroxide
(turns red litmus blue)

Oxides of Non-metals

$\frac{N}{P}$ The oxides of non metals are generally acidic in nature. When dissolved in water, non-metal oxides give acidic solutions, which turn blue litmus red.

For example

Sulphur burms in air to give sulphur dioxide, which is acidic in nature.

$S + O_2 \rightarrow SO_2$

(Sulphur) (Sulphur dioxide)

$SO_2 + H_2O \rightarrow H_2SO_3$

Sulphurous acid

(Turns blue litmus red)

$P_4 + 5O_2 \rightarrow 2(P_2O_5)$

(Phosphorus pentaoxide)

$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$

(Ortho phosphoric acid)

Uses of some Common Metals

Main uses of some metals are

1. Aluminium is used for making electrical wires and cables, domestic utensils, alloys, metallic paints and aluminium foil packaging.
2. Iron is used in the construction of building and bridges.
3. Silver and gold are used in making of jewellery.
4. Copper is used for making electrical wires and cables, utensils, kettles, coins etc, and for making alloys.
5. Mercury is used in thermometers and barometers.
6. Lead is used for making automobile batteries, lead pipes, screen for X-ray machine, for manufacturing many chemical compounds and paints.

Uses of some Non-metals

Non-metals play an important role in our daily life.

For example

1. Carbon in the form of diamond is used for making jewellery, cutting and grinding equipments. and in the form of graphite is used as electrodes in electrolytic cells and dry cells.
2. Hydrogen is used in the hydrogenation of vegetable oils to make vegetable ghee and in the manufacture of ammonia which is used as a refrigerant and also for making fertilizers.
3. Oxygen is essential for breathing to maintain life and also support combustion.
4. Elemental sulphur is used as a fungicide and in making gun powder.
5. Phosphorus is used in the manufacture of match sticks, rat poison, phosphoric acid and fertilizers.
6. Nitrogen is used in the manufacture of ammonia, nitric acid and fertilizers. Due to its inertness, nitrogen is also used to preserve food.
7. Chlorine is used for bleaching, sterilizing water and manufacturing chlorine compounds.
8. Iodine is used for preparing iodised common salt, and tincture of iodine which is used as an antiseptic.

Key Points

1. Metals are those elements which lose electrons to form positive ions.
2. Non metals are those elements which may gain electrons to form negative ions.
3. Metals and non metals are separated in the periodic table by a diagonal line of elements.
4. The arrangement of metals in a vertical column in order of their decreasing reactivity downwards is called the activity series of metals.
5. A reaction in which a more active metal displaces a less active metal from the solution of its salt is called a displacement reaction.

Multiple Choice Questions

1. A metal which exists in liquid state:
   (a) Gallium (b) Mercury
   (c) Sodium (d) Potassium
2. Which of the following property regarding metal is correct?
   (a) Low melting and boiling point
   (b) High melting and boiling point
   (c) Low melting and high boiling point
   (d) High melting and low boiling point
3. Choose the correct one for metal.
   (a) Brittle and ductile (b) Malleable and ductile
   (c) non- malleable and ductile (d) non- malleable
4. A substance composed of two or more metals is called:
   (a) Metalloids (b) Non-metals
   (c) Alloys (d) all of these
5. Which one of the following is a metal?
   (a) Gold (b) Silver
   (c) Aluminum (d) all of these
6. Which one of the following is a non metal?
   (a) Copper (b) Chlorine
   (c) Hydrogen (d) Both (b) and (c)
7. Metals generally forms:
   (a) Basic oxides (b) Acidic oxides
   (c) Neutral oxides (d) None
8. A metal which melts on the palm:
   (a) Zinc (b) Gallium
   (c) Sodium (d) Potassium
9. A metal which is a poor conductor of heat:
   (a) Zinc (b) Gold
   (c) Iron (d) lard
10. The most abundant element in the universe is
    (a) Hydrogen (b) Oxygen
    (c) Silicon (d) Helium
11. The most abundant metal on the earth is
    (a) Aluminium (b) Gold
    (c) Copper (d) Iron

12. A lustrous non metal is
    (a) Sulphur
    (b) Iodine
    (c) Diamond
    (d) Phosphorus
13. Metals are:
    (a) Semi conductor of heat and electricity
    (b) Good conductor of heat and electricity
    (c) Bad conductor of heat and electricity
    (d) Good conductor of heat but bad conductor of electricity
14. Which of the following is a basic oxide?
    (a) CaO
    (b) CO_2
    (c) H_2O
    (d) N_2O
15. Metals can be drawn into thin wires, this property of metal is known as:
    (a) Conductivity
    (b) Ductility
    (c) Malleability
    (d) both (b) and (c)
16. The property due to which non–metals break on hammering is called:
    (a) Ductility
    (b) Malleability
    (c) Brittleness
    (d) Conductivity
17. The tip of lead pencil is made of:
    (a) Lead
    (b) Zinc
    (c) Charcoal
    (d) Graphite
18. Iron burns in air to form:
    (a) FeO
    (b) FeO_2
    (c) Fe_2O_3
    (d) Fe_3O_4
19. Arrange the following metal in increasing order of their reactivity towards water, zinc, Iron, Magnesium, Sodium.
    (a) Iron ⟨ Zinc ⟨ Magnesium ⟨ Sodium
    (b) Iron ⟨ Magnesium ⟨ Sodium ⟨ Zinc
    (c) Magnesium ⟨ Iron ⟨ Sodium ⟨ Zinc
    (d) Sodium ⟨ Iron ⟨ Magnesium ⟨ Zinc
20. Which one the following statement (s) is correct ?

    Statement1: metals are malleable and ductile

    Statement 2: non metals are malleable and ductile
    (a) Statement 1
    (b) Statement 2
    (c) Both are correct
    (d) Both are incorrect
21. Which one of the following statements are correct?

    Statement 1: metals are lustrous

    Statement 2: non metals are not lustrous
    (a) Statement 1
    (b) Statement 2
    (c) Both statements are correct
    (d) Both statements are incorrect

22. What will happen if copper wire is dipped in iron (II) sulphate solution?
    (a) Copper sulphate is formed
    (b) Copper is formed
    (c) Iron is formed
    (d) No reaction
23. What is the nature of the oxides which is formed when a metal reacts with oxygen?
    (a) Acidic
    (b) Basic
    (c) Neutral
    (d) None of these
24. What is the nature of the oxide which is formed when a non-metal reacts with oxygen?
    (a) Acidic
    (b) Basic
    (c) neutral
    (d) None of these
25. Which non-metal is used as electrodes in electrolytic cells and dry cells?
    (a) Diamond
    (b) Phosphorus
    (c) Graphite
    (d) Hydrogen
26. Acidic solution turns:
    (a) Red litmus blue
    (b) Blue litmus red
    (c) Red litmus green
    (d) No reaction
27. Basic solution turns:
    (a) Red litmus blue
    (b) Red litmus green
    (c) Blue litmus red
    (d) No reacting
28. Which metal is used in thermometers and barometers?
    (a) Mercury
    (b) Iron
    (c) Silver
    (d) Gold
29. Sodium is a:
    (a) Colourless and hard metal
    (b) Silvery white and very soft metal
    (c) Silvery white and hard metal
    (d) Colourless and soft metal
30. Which non metal is the hardest substance known?
    (a) Graphite
    (b) Phosphorus
    (c) Diamond
    (d) Hydrogen

Answer Key

1. (b)	2. (a)	3. b)	4. (c)	5. (b)	6. (d)	7. (a)	8. (c)	9. (b)	10. (b)
11. (a)	12. (b)	13. (b)	14. (a)	15. (b)	16. (c)	17. (d)	18. (c)	19. (a)	20. (a)
21. (c)	22. (d)	23. (b)	24. (a)	25. (c)	26. (b)	27. (a)	28. (a)	29. (b)	30. (c)

9. Combustion and Flame

Learning Objectives

* Combustion and Ignition Temperature
* Conditions for Combustion
* How do we Control Fire?
* Types of Combustion
* Flame - Structure of a Candle Flame
* Fuel and its Types
* Fuel Efficiency
* Pollution due to Burning of Fuels

Combustion

A chemical process in which a substance reacts with oxygen to give off heat is called combustion. The substance that undergoes combustion (or burning) is called fuel. It is said to be combustible in nature. Sometimes, light is also given off during combustion, either as a flame or as a glow.

Ignition Temperature

Each combustion substance must be heated to a certain temperature before it could catch fire. The lowest temperature upto which a substance must be heated before it catches fire is called its ignition temperature, or kindling temperature. Ignition temperature of substance depends upon its chemical nature.

Conditions for Combustion

The following conditions are necessary for the combustion to take place.

The presence of a combustible substance

A substance which burns readily in presenee of oxygen is called combustible substance, like petrol, LPG, wood, paper, etc.

The presence of a supporter of combustion

A combustible substance continues to burn only if there is a continuous supply of air (or oxygen) to support combustion. If oxygen supply is stopped, burning of the substance also stops.

Attaining ignition temperature

Different substances catch fire at different temperatures. A substance which catches fire readily has low ignition temperature e.g. petrol has lower ignition temperature than kerosene.

How do we Control Fire?

Fire can be extinguished by either of the following ways :

1. By removing the combustible substance from the place and the surrounding areas.
2. By cutting the supply of oxygen or air, e.g, spraying water over a burning object, the water vapours formed due to the heat of fire cuts the supply of the air, spraying carbon dioxide and carbon tetrachloride (also called as pyrene) as they immediately vapourise heat to cut off the supply of air.
3. By lowering the temperature of the burning object below its ignition temperature. Soda-acid fire extinguisher is based on the principle of extinguishing fire by cooling the substance below its ignition temperature.

Note: Types of fire extinguisher used can be

- Water sprayer (never used in extinguishing oil fires)
- Soda-acid fire extinguisher
- Foam type fire extinguisher
- Carbon tetrachloride fire extinguisher

Types of Combustion

Classification of combustion on the basis of conditions under which combustion takes place

Rapid combustion

The process in which a substance combines chemically with oxygen at a temperature above its ignition temperature with the evolution of large amounts of heat and light in a short time is called rapid combustion. Burning of hydro-carbon fuels like LPG, kerosene, petrol.

Combustion of hydrocarbons

Methane (CH_4) + Oxygen (O_2) $\xrightarrow{combustion}$ $CO_2 + H_2O$ + Heat + Light

(or natural gas)

Spontaneous combustion

A combustion in which no external heat is given, no light is produced and temperature of the combustible substance remains almost unchanged is called spontaneous (or slow) combustion. Thus a substance undergoes slow combustion without catching fire. Examples are - Digestion of food, oxidation of yellow phosphorus at room temperature.

Incomplete combustion

The combustion that takes place in the presence of insufficient quantity of oxygen (or air) is called incomplete combustion. This is a waste of energy and is hazardous, as it produces carbon monoxide (CO) which is deadly poisonous gas.

Carbon (C) + oxygen (O_2) $\xrightarrow[combustion]{incomplete}$ carbon monoxide (CO) + heat + light.

(limited amount.)

Explosion

A process of combustion where large amount of gases are evolved with the production of a tremendous amount of heat, light and sound is called explosion. Example is the burning of crackers and explosives.

Flame and its Structure

A flame is the shining zone in which a combustible material undergoes combustion to produce heat and light. Only those solid and liquid fuels which vaporize on heating will produce flame. Some of the example of flame producing combustion are as follows:

- Burning a matchstick produces yellow flame.
- Burning LPG produces blue flame.
- Kerosene burnt in a lamp produces yellow smoky flame.
- Kerosene burnt in a stove produces blue and smokeless flame.

Types of Flames

Nonluminous flame

A blue coloured flame which produces very little light is called nonluminus flame. It is obtained when the fuel is burnt completely in sufficient supply of oxygen e.g LPG and kerosene burns with a nonluminous flame in a stove.

Luminous flame

A yellow flame which produces heat and good amount of light is called a luminous flame. It is obtained when the fuel undergoes partial (or incomplete) combustion due to insufficient supply of air (or oxygen).

Structure of a Candle Flame

Candles are made of paraffin wax, obtained from the residue left during the fractional distillation of crude oil. Paraffin wax vaporizes on heating.

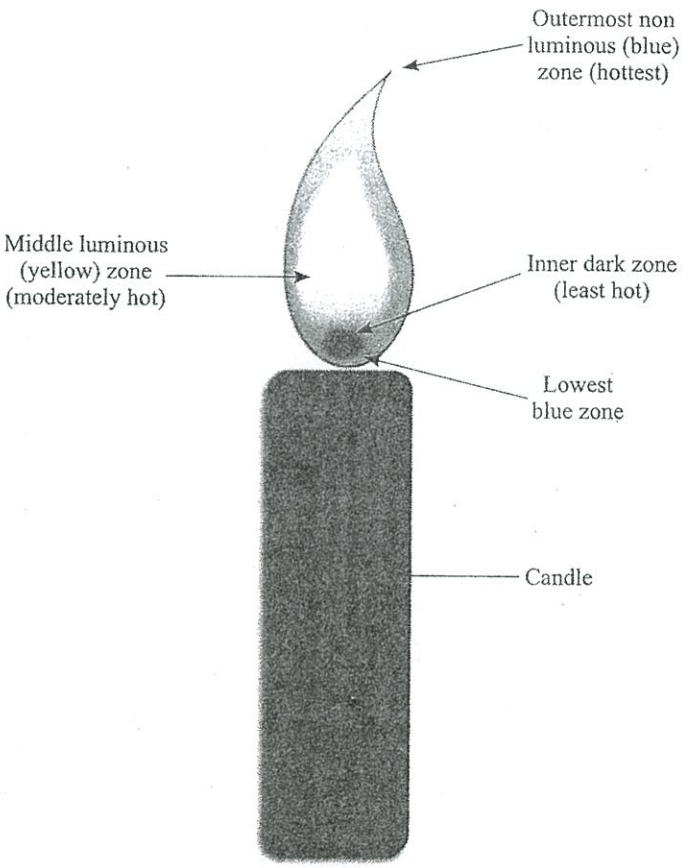
The candle flame is yellow and luminous due to incomplete combustion of wax vapour.

Zones of Candle Flame

According to J.J. Berzelius, a candle flame consists of four zones.

Outermost nonluminous zone of complete combustion

This zone is faintly visible and surrounds the yellow luminous part of the Flame. In this zone, the wax vapour undergoes complete combustion due to the presence of plenty of air oxygen .This zone is the hottest part of the flame and is blue in colour.



Structure of a Candle Flame

Fig: 9.1

Middle luminous zone of incomplete combustion

This zone is bright yellow in colour, and lies below the outermost zone. In this zone, the waste vapour undergoes incomplete combustion because of insufficient air. The incomplete combustion of wax produces carbon particles which get heated and start glowing making the flame luminous. This flame has moderate temperature.

Inner dark zone of no combustion

The dark zone around the cotton wick is called inner dark zone of no combustion. In this zone, very little or no burning takes place because this zone does not get air. This zone is dark due to presence of unburnt carbon particles in the wax vapour. This part of the flame is the least hot.

The lowest blue zone

This zone is located at the base of the flame. The blue colour of this zone is due to the burning of carbon monoxide produced in the dark zone due to incomplete combustion.

Fuel

A combustible substance which on burning produces a large amount of heat and light is called a fuel. Some commonly used fuels are wood, coal, liquefied petroleum gas (LPG), petrol, diesel and kerosene.

Types of Fuels

Fuels are classified on the basis of physical states in which they occur. There are three types of fuels classified on this basis of their nature.

Solid Fuels

Wood, charcoal, coal, coke, paraffin, cow dung cakes, agricultural waste (bagasse) are all solid fuels. These fuels contain mainly carbon, both as free and in combined state. Solid fuel requires more space for storage and leave smoke and ash on burning.

Liquid Fuels

Volatile liquids which produce combustible vapour are called liquid fuels. Some common liquid fuels are kerosene, petrol, diesel, fuel oil, benzene and alcohol. They requires less storage space and leave no solid residue on burning. These fuels are mixtures of hydrocarbons.

Gaseous Fuels

Combustible gases or mixtures of combustible gases are called gaseous fuels. Examples are natural gas, water gas, coal gas, LPG, CNG, biogas (gobar gas), producer gas.

Characteristics of an ideal fuel

An ideal fuel should have the following features.

1. It should be fairly cheap and easily available.
2. It should burn at a moderate rate.
3. It should not produce any poisonous and irritating fumes during burning.
4. It should leave no residue (ash) after burning.
5. It should produce large amount of heat per unit mass.

Fuel Efficiency (Calorific value of a fuel)

The amount of heat produce when a unit mass of a fuel is completely burnt in air (or oxygen) is called its calorific value. This calorific value is expressed in units kilo joule per kilogram, its S.I unit is KJ /g. The more is the calorific value of the fuel, higher is the fuel efficiency. Calorific value of petrol is 47000kJ/kg and that of LPG is 50,000 kJ/kg.

Pollution Due to Burning of Fuel

All carbon-containing fuels such as wood, coal, petrol, diesel, LPG when burnt produce gases like carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen and sulphur. Solid fuels also produces smoke and leave behind ash which cause air and water pollution.

Carbon monoxide

When inhaled in large quantities, it causes nausea, vomiting and unconsciousness. In severe cases, it is fatal.

Carbon dioxide

Released on complete combustion of fuels, the level of CO_2 increases in the atmosphere leading to rise in temperature of the atmosphere called global warming.

Oxides of sulphur and nitrogen

Released by burning coal, diesel and petrol, these gases combine with atmospheric moisture to form dilute solutions of sulphuric and nitric acids and may cause acid rain. This can damage crops, buildings and acquatic life in the form of acid rain.

Soot

These are carbon particles released on burning coal, wood and fuel oil. These solid particles are present in the smoke released due to incomplete combustion of the fuel. When inhaled, they can lead to asthma and other respiratory disorders.

Key Points

1. The substances which burn readily are combustible substances like petrol, LPG, paper.
2. The substances which do not burn are called non-combustible substances like glass, water, sand, etc.
3. Oxygen present in the air is a supporter of combustion.
4. Fire can be extinguished by cutting the supply of air, lowering the ignition temperature, and removing the combustible substance.
5. Burning of phosphorous is an example of slow combustion which do not require heat to burn.
6. A flame of candle is a shining zone in which a combustible gaseous material undergoes combustion producing heat and light.
7. A candle flame has four zones – nonluminous (blue) outermost zone, middle luminous (yellow) zone, inner dark (black) zone and the lowest blue zone.
8. A fuel is a combustible substance which on burning produces a larger amount of heat and light.
   Solid fuel – cow-dung cakes, wood, charcoal, coal, coke, bagasse
   Liquid fuel – petrol, diesel, kerosene.
   Gasesous fuel – Natural gas, LPG, CNG, water gas, coal gas, biogas.

9. An ideal fuel should be safe, economical, burn at a moderate rate, leaves no ash, produce no smoke, should have high calorific value.
10. Calorific value is the amount of heat produced in joules when a unit mass of fuel is burnt completely in sufficient amount of air or oxygen.
11. Burning of fuels causes release of CO_2, CO, SO2 , NO_2 in air that causes air pollution.
12. An excessive increase in the concentration of carbon dioxide leads to an increase in atmospheric temperature that can cause global warming.
13. The oxides of sulphur and nitrogen causes acid rain that damages marble structures. It leads to the loss of soil fertility.
14. We should slow down the use of fossil fuels like petrol, coal, coke and encourages the use of renewable sources of energy like solar energy, wind energy, hydrothermal energy.

Multiple Choice Questions

1. Calorific value of a fuel is the heat energy produced when
   (a) one gram of fuel is completely burnt
   (b) hundred grams of fuel is completely burnt
   (c) one kilogram of fuel is completely burnt
   (d) any amount of fuel is completely burnt
2. Which of the following is the combination of acid rain?
   (a) $H_2SO_4 + HNO_3$
   (b) $H_2SO_4 + NO_2$
   (c) $HNO_3 + SO_2$
   (d) both (b) & (c)
3. Good fuels have
   (a) low ignition temperature and high calorific value
   (b) high ignition temperature and low calorific value
   (c) low ignition temperature and low calorific value
   (d) high ignition temperature and high calorific value
4. Log of wood does not burn very easily but it is easy to burn small pieces of wood dipped in kerosene oil. This is because kerosene oil provides proper
   (a) thermal energy
   (b) heat and air
   (c) ignition temperature
   (d) none of these
5. The chemicals present in fire extinguisher are
   (a) $NaHCO_3$, Na_2CO_3
   (b) H_2SO_4, $NaHCo_3$
   (c) HCl, $Na_2 CO_3$
   (d) HCl, $NaHCo_3$, H_2SO_4
6. Which of these is(are) liquid fuel(s) ?
   (a) LPG
   (b) CNG
   (c) Petrol
   (d) all of these
7. Which poisonous gas is formed as a result of incomplete combustion?
   (a) Coal gas
   (b) CO_2
   (c) CO
   (d) NO_2
8. The hottest zone of a candle flame is
   (a) non-luminous zone
   (b) luminous zone
   (c) dark zone
   (d) blue zone
9. Which of these fuels has the highest calorific value?
   (a) Hydrogen
   (b) Petrol
   (c) Coal
   (d) CNG
10. When a hydrocarbon (present in fuels) burns completely, the products formed are
    (a) CO_2, H_2O, energy
    (b) CO, H_2O, air
    (b) O_2, CO_2
    (d) CO, CO_2
11. The resulting products in the case of incomplete combustion of methane due to insufficient supply of oxygen are
    (a) CO, H_2O
    (b) CO, H_2O, energy
    (c) CO_2, energy
    (d) H_2O, energy

12. For combustion to take place, we need
    (a) combustible substance
    (b) oxygen in sufficient supply
    (c) ignition temperature
    (d) all of these
13. To extinguish a flame, which of these methods is used?
    (a) cut the air supply
    (b) reduce temperature below ignition temperature
    (c) remove the combustible matter
    (d) any one of these
14. The combustion in which a material bursts into flames without the application of heat is called
    (a) rapid combustion
    (b) explosion
    (c) spontaneous combustion
    (d) slow combustion
15. Which of these material represents spontaneous combustion?
    (a) white chlorine
    (b) white phosphorous
    (c) $KMnO_3$
    (d) H_2SO_4
16. Which of these is a solid pollutant?
    (a) SPM
    (b) CO
    (c) CO_2
    (d) SO_2
17. SPM, also called dangerous pollutants, means
    (a) suspended particle mixture
    (b) suspended particulate matter
    (c) suspension powder material
    (d) suspended powdered matter
18. The coldest zone of flame is —— zone.
    (a) luminous
    (b) non-luminous
    (c) blue
    (d) black
19. In which zone is carbon monoxide burns with a blue colour at the base of the wick?
    (a) luminous zone
    (b) black zone
    (c) blue zone
    (d) non-luminous zone
20. The SI unit of calorific value is
    (a) kg/J
    (b) J/kg
    (c) kJ/kg
    (d) J kg s^{-1}
21. The calorific value of petrol is
    (a) 15000 kJ/kg
    (b) 55,000 kJ/kg
    (c) 45,000 kJ/kg
    (d) 1,50,000 kJ/kg
22. A fuel is considered good if it
    (a) has low ignition temperature
    (b) has high calorific value
    (c) is safe to store, easy to handle and pollution free
    (d) all of these

23. Burning of magnesium is an example of which combustion?
    (a) rapid combustion
    (b) explosion
    (c) spontaneous combustion
    (d) slow combustion

24. The most commonly used fire extinguisher is soda-acid fire extinguisher. Cylinder is filled with a solution of
    (a) sodium chloride
    (b) sodium bicarbonate
    (c) sulphuric acid
    (d) $Na_2 HCO_2$

25. Which of these is gaseous fuel?
    (a) wood gas
    (b) LPG
    (c) Coal
    (d) Alcohol

26. Which gas causes greenhouse effect, also called global warming?
    (a) CO
    (b) CO_2
    (c) NO_2
    (d) SO_2

27. Which gas is released during burning of petrol and diesel in the engine of automobiles, causing acid rain?
    (a) NO_2
    (b) CO_2
    (c) SO_2
    (d) SPM

Answer Key

1. (c)	2. (b)	3. (a)	4. (c)	5. (b)	6. (d)	7. (c)	8. (a)	9. (a)	10. (a)
11. (b)	12. (b)	13. (d)	14. (c)	15. (b)	16. (a)	17. (b)	18. (d)	19. (c)	20. (b)
21. (b)	22. (d)	23. (a)	24. (b)	25. (a)	26. (a)	27. (a)			

10. Coal and Petroleum

Learning Objectives

* Natural Resources
* Minerals
* Coal
* Destructive Distillation of Coal
* Petroleum
* Natural Gas and Compressed Natural Gas
* Consequences of Excessive Mining and use of Coal and Petroleum
* Natural Resources are Limited

Coal and petroleum and their products are the most commonly used concentrated sources of energy. They are commonly known as fossil fuels. Both coal and petroleum are formed deep inside the earth by slow reaction. With the rapid technological development, the demand of coal and petroleum is increasing day by day.

Natural Resources

Air, water, soil, forest and minerals are called natural resources. The natural resources can be classified into two groups:

Inexhaustible Natural Resources

The resources which are present in an unlimited quantity in nature and are not likely to get exhausted by human activates are called inexhaustible natural resources.

For example, water, sunlight, wind, etc.

Exhaustible Natural Resources

The resources which are present in a limited quantity in nature and are likely to get exhausted are called exhaustible natural resources.

For example, petroleum, coal, natural gas, forests, minerals, wildlife, etc.

The Minerals

Minerals are the back-bone of industry. Most minerals are obtained from the upper layer of the earth called lithosphere.

Some important minerals are : Rock salt, sand, coal, petroleum, mica, metals and their ores.

Since minerals are the non-renewable resources, these cannot be replenished easily. Therefore, we should use minerals judiciously and economically so that these could last longer.

Coal

Coal is a fossil fuel formed from the decomposition of organic matters that have been subjected to heat and pressure upto one millions of years. It is considered to be non–renewable resource. Coal is a readily combustible black or brownish-black rock. It is composed primarily of carbon and hydrogen along with small quantities of other elements notably sulphur.

Coal
Fig: 10.1

Coal Formation

Coal is a sedimentary rock formed from plants that flourished millions of years ago. An aerobic thermal degradation of wood is also termed as carbonisation.

Carbonisation

Carbonisation is a slow process and may take thousands of years to take place. Thus the slow conversion of wood into coal under the influence of high temperature, high pressure and in the absence of air, is termed carbonisation.

The calorific value of coal depends upon its carbon content. So, it increases in going from wood to anthracite.

Wood → Peat (light brown) → Lignite (Brown) (soft coal) → Bituminous coal (black) (household coal) → Anthracite (bright black) (hard coal)

Least calorific value → → → Highest calorific value.

Uses of coal

Some common uses of coal are :

(i) used as a fuel.
(ii) used for the manufacture of synthetic petrol and synthetic natural gas.
(iii) used in the extraction of metals.
(iv) used for the manufacture of coke, coaltar and coal gas.
(v) used as a source of many organic compounds such as benzene, toluene, phenol, naphthalene etc.

Destructive Distillation of Coal

Coal is not pure carbon. It is a mixture of complex organic compounds.

The breaking up of coal by heating it at 1000 –1400°C in the absence of air (or oxygen) is known as the destructive distillation of coal.

The products obtained from destructive distillation of coal (bituminous) are coke, coal gas, coal tar and ammonical solution.

Coke

It is tough, porous and greyish-black substance. It is an almost pure form of carbon (98%). Coke is obtained from coal by removing moisture and other volatile matter from it.

Thus, coke = coal – (moisture + volatile matter).

Uses of coke

(a) Coke is used as a domestic fuel.

(b) Coke is used as a reducing agent in metallurgy and used for producing fuel gases, such as water-gas ($CO+H_2$) and producer gas ($CO+N_2$).

(c) It is also used for producing carbides, such as calcium carbide (CaC_2), silicon carbide (Sic) and aluminum carbide (Al_4C_3).

Coal Tar

It is black, thick liquid with an unpleasant substances. It is a mixture of about 200 substances.

Coal Tar
Fig:10.2

Uses of coal tar

(a) Products obtained from coal tar are used as starting materials for manufacturing various substances used in everyday life and in industry, like synthetic dyes, drugs explosives, perfumes, plastics, paints, photographic materials, proofing materials etc.

(b) Naphthalene balls used to repel moths and other insets are also obtained from coal tar.

Coal Gas

It is a gas obtained during the processing of coal to get coke.

The main constituents of coal gas are hydrogen, methane and carbon monoxide. Both hydrogen and methane have very high calorific values. As a result, coal gas also has a high calorific value.

Uses of coal gas

Coal gas is used for various purposes:

(a) As an illuminate for domestic /street lighting.

(b) As a domestic/ industrial fuel for heating purposes.

(c) For providing an inert reducing atmosphere in reaction vessels and in certain metal extraction processes.

Petroleum

The name petroleum means oil of rocks, because it is found deep inside the earth trapped in rocks ('petro' means rocks and 'oleum' means oil). It is a viscous, dark coloured fluorescent liquid. It has an unpleasant odour. It is lighter than water.

Petroleum in its crude form cannot be used for any useful purposes. That is why it is called crude oil. More usable forms can be obtained by refining it.

Composition

The hydrocarbons in crude oil are mostly alkenes, cycloalkanes and various aromatic hydrocarbons, while other organic compounds contain nitrogen, oxygen, sulphur, and trace amounts of metals such as iron, nickel, copper and vanadium. The exact molecular composition varies widely from formation to formation but the proportion of chemical elements vary over fairly narrow limits as follows.

Composition of crude petroleum by weight

Element	% range
Carbon	83 to 87%
Hydrogen	10 to 14%
Nitrogen	0.1 to 2%
Oxygen	0.1 to 1.5%
Sulphur	0.5 to 6%
Metals	Less than 1000 ppm

Formation

Petroleum is formed under earth's surface by the decomposition of marine organisms. The remains of tiny organisms that live in the sea, land organisms that are carried down to the sea or rivers and of plants that grow on the ocean bottoms- are enmeshed with the fine sands and silts that settle to the bottom in quite sea basins. Such deposits, which are rich in organic materials serves as source for the generation of crude oil. The process began many millions of years ago with the development of abundant life, and it continues till date. The sediments grow thicker and sink into the seafloor under their own weight. As additional deposits pile up, the pressure on the ones below increases several thousand times, and the temperature rises by several hundred degrees. The mud and sand harden into shale and sandstone; carbonate precipitate and skeletal shells harden into limestone and the remains of the dead organisms are transformed into crude oil and natural gas.

Mining of petroleum

Petroleum occurs at a depth ranging from a few hundred metres to about 2-3 kilometres.

Holes are drilled into the earth's crust and pipes are inserted until the pipes reach the petroleum deposit. Crude oil rushes out of the pipes due to high internal pressure of natural gas. Later, petroleum is pumped out with the help of pumps.

Refining of petroleum

The process of separating petroleum into usable fractions by fractional distillation is called refining of petroleum. It is carried out in a petroleum refinery.

Various constituents of petroleum and their uses

S.No	Constituents of petroleum	Uses
1.	Petroleum gas in liquid form (L.P.G.)	Fuel for home and industry
2.	Petrol	Motar fuel, aviation fuel, solvent for dry cleaning
3.	Kerosene	Fuel for stoves, lamps and for jet aircraft
4.	Diesel	Fuel for heavy motor vehicles, electric generators
5.	Lubricating oil	Lubrication
6.	Paraffin wax	Ointments, candles, vaseline etc.
7.	Bitumen	Paints, road surfacing

Natural Gas and Compressed Natural Gas

Natural gas

The gaseous mixture of lower hydrocarbons which occurs deep inside the earth either alone or covering the crude oil in an oil-field is called natural gas. Natural gas mainly consists of methane. It is an ideal fuel because it does not leave ash after burning, it burns with a blue smokeless flame, and has a high calorific value of about 55KJ/g.

Uses

Natural gas is used as a domestic and industrial fuel for obtaining hydrogen on industrial scale and for manufacturing carbon black.

Compressed natural gas

Natural gas compressed under high pressure to obtain Compressed Natural Gas (CNG).The CNG can be easily transported through pipelines. CNG is now being used as a fuel for automobiles viz, cars, buses, scooters, etc.

On burning, CNG does not produce any smoke. It leaves no ash on burning. Therefore, CNG is considered as a cleaner fuel.

Consequences of excessive mining and use of coal and petroleum

Coal and petroleum both are exhaustible (or non-renewable) source of energy. So, the excessive mining and use of coal and petroleum would lead to the following:

- Both the important sources of energy will get exhausted in near future. This will cause energy crisis.
- Petroleum occurs at much greater depth inside the earth. It is pumped out with the help of powerful pumps. The mining of petroleum will create hollow space deep inside the earth. This might lead to minor/ major earthquakes.
- Similarly, coal is mined from underground coal deposits. Excessive mining of coal creates a large hollow space inside the earth. As a result of this, land may collapse leading to minor earthquakes.

Coal and Petroleum

Petrol, diesel, kerosene, etc., on burning produce carbon dioxide, carbon monoxide, oxides of nitrogen and sulphur,vapour of unburnt hydrocarbon and smoke. These gases and their ill effects are as follows:

Carbon dioxide

Release of excessive amount of carbon dioxide will give rise to the greenhouse effect. Due to the green house effect, temperature on the earth will rise (called global warming) leading to melting of polar ice and glaciers that will cause flooding of low lying areas. The rise in temperature on the earth will affect monsoon and pattern of crop cultivation.

Carbon monoxide

Carbon monoxide is a highly poisonous gas, when inhaled, it combines with haemoglobin, as a result haemoglobin cannot carry oxygen to the body tissues. CO has 200 times more affinity for Haemoglobin than O_2, therefore forms carbanaino haemoglobin which has very high dissociation constant.This causes deficiency of oxygen in the body, leading to suffocation and even death.

Oxides of sulphur and nitrogen

These gases cause respiratory problems, and acid rain. Acid rain causes corrosion of lime, marble and metallic structures.

Some Limited Natural Resources

Coal and petroleum are fossil fuels. It requires millions of years to form petrol and coal from dead and decaying organisms but they are depleting at a very fast rate which will lead to their depletion.

Soon as per the present estimate the existing petroleum reserves might get exhausted in the next fifty years. Coal deposits might last for another 150 to 200 years. This would lead to energy crisis. It is therefore necessary that we use these fuels judiciously. This will result in better environment, smaller risk of global warming and their availability for a longer period of time.

In India, the Petroleum Conservation Research Association (PCRA) advises people how to save petrol and diesel while driving. Their tips indude:

(i) Drive at a constant and moderate speed as far as possible.
(ii) Ensure correct tyre pressure.
(iii) Ensure regular maintenance of the vehicle.
(iv) Switch off the engine at traffic lights or at a place where you have to wait.

Did You Know

1. Calcium and aluminium carbides are very useful and cheap raw materials for petrochemical industry.
2. Silicon carbide is very hard and used as an abrasive.
3. Methane, the main component of the natural gas can be converted to hydrogen by heating it strongly (1250k) in the presence of catalyst.
4. Hydrogen obtained from natural gas is used for the manufacturing of ammonia.

Key Points

1. Coal is a fossil fuel.
2. Coal is formed under the surface of earth where temperature and pressure is very high.
3. Anthracite is of highest rank of coal.
4. Petroleum is a dark, coloured, thick crude oil.
5. Petroleum is formed under earth's surface by the decomposition of marine organisms.
6. Drilling for petroleum under the sea-bed is called off - shore drilling.
7. Coal and petroleum are not only the source of energy but also the major source of a large number of industrial chemicals used in the manufacture of fertilizers, plastics, dyes, synthetic fibres etc.

Multiple Choice Questions

1. Renewable resources need to be conserved because
   (a) they are slowly getting exhausted.
   (b) we are using them faster than they are replenished by nature.
   (c) if we overuse them, nature will stop replacing them.
   (d) all of these
2. A substrata which produces sufficient energy on burning is called
   (a) biogas (b) oxidising agent
   (c) fuel (d) combustion mass
3. It is an important fraction of petroleum. It is farther distilled to get lubricating oil and paraffin wax.
   (a) petroleum (b) heavy oil
   (c) anthracite (d) residue
4. The resources that either never run out, or those that are replaced within a reasonable period of time through natural processes are called as
   (a) Renewable resources (b) non-renewable resources
   (c) exhaustible resources (d) replenishable resources
5. Which of these is NOT a renewable resource?
   (a) air (b) sunlight
   (c) water (d) petroleum
6. Destructive distillation of coal produces
   (a) petrol (b) paraffin wax
   (c) coal gas (d) diesel
7. The best quality of coal is
   (a) peat (b) anthracite
   (c) lignite (d) bituminous
8. Which of the following is a non-polluting fuel for vehicles?
   (a) petrol (b) diesel
   (c) kerosene (d) CNG
9. Which energy is contained in fuels that is locked within the chemical bonds of their constituent molecules?
   (a) potential energy (b) kinetic energy
   (c) heat energy (d) light energy
10. A fossil fuel is
    (a) coal (b) petroleum
    (c) natural gas (d) all of these
11. Which type of coal is used for household purposes
    (a) peat (b) bituminous
    (c) lignite (d) Anthracite

12. In destructive distillation coal is heated strongly to about
    (a) 500°C
    (b) 100°C
    (c) 1000°C
    (d) 3000°C
13. Petroleum and natural gas were formed from
    (a) dead sea animals
    (b) dead trees
    (c) dead weeds and small plants
    (d) heat produced in the sea bed
14. Which of these is not a natural source of energy?
    (a) coal
    (b) electricity
    (c) petroleum
    (d) sun
15. As coal contains mainly carbon, the slow process of conversion of buried vegetation into coal is called
    (a) carbonization
    (b) distillation
    (c) ionisation
    (d) fossilisation
16. The two places in India famous for their oil wells are
    (a) Bihar and MP
    (b) Assam and Maharashtra
    (c) Bihar and Assam
    (d) Rajasthan and Maharashtra
17. Fuels which are obtained from nature are called
    (a) primary fuels
    (b) natural fuels
    (c) exhaustible fuels
    (d) inexhaustible fuels
18. Natural gas mainly contains
    (a) ethane
    (b) hydrogen
    (c) nitrogen
    (d) methane
19. Bituminous coal has about per cent carbon.
    (a) 92
    (b) 65
    (c) 38
    (d) 75
20. Which of these is not a fossil fuel?
    (a) CNG
    (b) LPG
    (c) Petrol
    (d) Hydrogen
21. Fractional distillation of petroleum is done at
    (a) 100°C
    (b) 400°C
    (c) 500°C
    (d) 700°C
22. Which of these is obtained by destructive distillation of coal?
    (a) LPG
    (b) CNG
    (c) Coal gas
    (d) Methane
23. Ammonical liquor is collected during the destructive distillation of coal in
    (a) decliner tube
    (b) as a precipitate
    (c) boiling tube
    (d) test–tube with water

24. The process of separating a mixture of two or more liquids having different boiling points by collecting their vapours art controlled temperature is called
    (a) refining
    (b) fractional distillation
    (c) destructive distilation
    (d) none of these
25. The residue left behind when destructive distillation of coal is carried out is
    (a) coal gas
    (b) coke
    (c) coal tar
    (d) Ammonium compound
26. The process of separating the fractions by fractional distilation known as
    (a) refining
    (b) distilling
    (c) filtering
    (d) none of these
27. Natural gas, chiefly made up of methane, also contains butane and in small proportions.
    (a) ethane
    (b) propane
    (c) diesel
    (d) CNG

Answer Key

1. (b)	2. (c)	3. (d)	4. (a)	5. (d)	6. (c)	7. (b)	8. (d)	9. (a)	10. (d)
11. (b)	12. (c)	13. (a)	14. (b)	15. (a)	16. (b)	17. (b)	18. (d)	19. (d)	20. (d)
21. (b)	22. (c)	23. (d)	24. (b)	25. (b)	26. (a)	27. (b)			

11. Synthetic Fibres and Plastics

Learning Objectives

* Natural and Man - Made Materials
* Polymers
* Synthetic Fibres
* Types of Synthetic Fib res
* Characterstics of Sysnthetic Fibres
* Advantages and Disadvanatages of Using Clothes Made from Synthetic Fibres
* Synthetic Plastics
* Kinds of Sysnthetic Plastics
* Uses of Sysnthetic Plastics
* Plastics as Material of Choice
* Plastics and the Environment
* How to minimize the Damage to the Environment by Plasticsc(or Synthetic Polymers)

Natural And Man-made Materials

Materials may be classified into natural materials and man-made materials.

Natural Materials

The materials which occur in nature (e.g from plants, animals or the ground) and used by us are called natural materials.

For example: wood, cotton, coal, graphite, diamond etc.

Man-made Materials

The materials obtained from nature or natural materials through chemical processes are called man-made materials.

For example: plastics, cement, fertilizers, fibres, paints, detergents etc.

Clothing Materials

Clothing materials either obtained from plants or from animals are called as natural fibres.

For example: wood and silk are animal fibres. Cotton and jute are plant-fibres.

The synthetic fibres on the other hand are man-made. All these fibres consist of long chains of smaller molecules.

Polymers

Polymers are long chain compound of similar or dissimilar smaller units. These smaller units are called monomers

For example: If a simple molecule is A, then its polymer is represented as:

A—A—A—A—A—A—A—A—A or simply as, —(—A—)$_n$—

The polymer of ethene (CH_2 =CH_2) is polythene which may be represented by the formula

$$\left[-(CH_2-CH_2)_n-\right]$$

Polymers can be classified into two types

Natural Polymers

The polymers which occur in nature are called natural polymers.

Examples are: cellulose, silk, wool, proteins etc.

Man-made or Synthetic Polymers

The polymers which are not found in nature and can be made in laboratories/factories are called man made polymers or synthetic polymers.

For example: nylon, polythene, rayon, teflon, polyvinyl chloride (PVC) etc.

All synthetic fibers are made from small organic molecules or from their suitable compounds. These small molecules are obtained from petroleum and natural gas.

For example: Methane, Methanol, Ethane, Ethanol, Propane, butane, vinyl chloride etc.

Synthetic Fibres

Fibres that are made by man are called man-made or synthetic fibres. Synthetic fibres consist of many small repeating units called monomers. These monomers combine to form one large unit called a polymer.

Types of Synthetic Fibres

Fibres are classified according to their origin and chemical structure.

Rayon (or artificial silk)

Rayon is made from cellulose obtained from wood pulp.

Properties:

(a) It absorbs sweat.

(b) It is shiny, lustrous and resembles silk.

Uses:

(a) in the textile industry for making fabrics

(b) in the manufacture of carpets.

(c) for the manufacture of tyre cord.

(d) for making bandages and surgical dressings.

Nylon

Nylon is a synthetic fibre. It is actually a polyamide fibre. Nylon is prepared from adipic acid and hexa methylene diamine by the process of polymerisation.

Properties:

(a) Nylon fibres are elastic and lustrous.
(b) Nylon does not absorb water. So, it is easy to wash.
(c) Nylon is wrinkle resistant.
(d) Nylon is not attacked by fungus, moth etc.

Uses:

(a) Nylon is used for making ropes, fishing nets, parachute fabrics and tyre cord.
(b) Nylon is used as a plastic for making machine parts.

Polyester

Terylene and Decron are synthetic fibres called polyesters. Polyesters are prepared by the reaction leading to the formation of ester bond between their repeated units.

Properties:

(a) Polyester fibres are quite strong.
(b) Polyester fibres absorb very little water.
(c) Polyesters are wrinkle resistant.

Uses:

(a) for manufacturing sarees, dress materials, curtain clothes etc.
(b) for making blends with other fibers such as ethylene with cotton gives terycot and wool with ethylene gives terywool.
(c) for making sail for sail boats, water hoses and conveyor belts.

Acrylic

These are the synthetic fibers which resemble to natural wool.

Properties:

(a) It is warm, soft and light.
(b) It is flexible

Uses: It is used for making sweaters, shawls, blankets and carpets.

Characteristics of Synthetic Fibers

Some of the characteristics properties of synthetic fibers are:

(i) Synthetic fiber does not get wet. So, the fibers made from synthetic dry quickly.
(ii) Synthetic fibers are cheaper.
(iii) Synthetic fibers are durable.
(iv) Synthetic fibers can be drawn to very fine thickness. So these are light in weight.
(v) Synthetic fibers are strong, have high tensile strength and are abrasion resistant.

Advantages of Using Clothes Made from Synthetic Fibers

Clothes made up of synthetic fibers are very popular because they do not shrink, they last longer as compared to the fabrics made from natural fibers. They dry quickly and need very little or no ironing, thats why they are called wash and wear fabrics.

Disadvantages of Synthetic Fibers

The disadvantages of synthetic fibers are:

(i) Synthetic fibers do not absorb water or sweat. Due to this reason, clothes made of synthetic fibre are very uncomfortable in hot and humid weather.

(ii) Synthetic fibers are non-biodegradable. Therefore they cause soil pollution.

(iii) Synthetic fibers melt and burn easily. Therefore we cannot wear the clothes made of synthetic fiber while working near flame/fire.

(iv) In dry weather, the fabrics made from synthetic fibers tends to develop static electricity.

These disadvages are partly removed in the blends of synthetic and natural fibre, such as polyester and cotton blends commonly called terycot.

Synthetic Plastics

Plastics are synthetic materials that can be moulded into different shapes based on their reaction of heat. Some common plastics are Bakelite, Nylon, Terylene , Polyvinyl chloride (PVC) etc.

Plastics are polymers made from small molecules, different plastics have different arrangement of molecules. The polymers in which smaller molecules are linked to each other in linear (straight) arrangement are called linear polymers.

A linear polymer can be represented as:

—p—o—l—y—m—e—

The polymers in which smaller molecules are linked in such a way that all linear chains are also linked to each other are called **cross-linked** polymers.

The cross-linked polymer can be represented as

```
   |   |   |   |
—  p  —  o  —  l  —  y  —
   |   |   |   |
—  p  —  o  —  l  —  y  —
   |   |   |   |
—  p  —  o  —  l  —  y  —
   |   |   |   |
—  p  —  o  —  l  —  y  —
   |   |   |   |
```

Kinds of Synthetic Plastics

Plastics are of two types:

(i) Thermoplastics (ii) Thermosetting plastics

Thermoplastics

Thermoplastics materials are in high demand because they can be repeatedly used by softening and remolding. PVC, polystyrene, nylon, polythene are some common thermoplastics. It is used in making toys, combs, various types of containers and pipes etc.

Thermosetting plastics

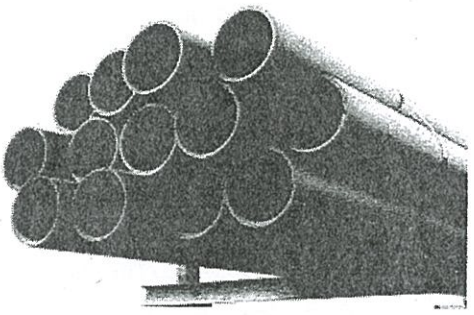
A plastic substance which once mould into a shape cannot be used again and again is called thermosetting plastic. This is due to the formation of crosslinks between the adjacent polymer chains on heating. It is used in making electrical switches, floor tiles, kitchenware, handles of pressure cooker.

For example: Bakelite, melamine.

Uses of Synthetic Plastics

Uses of some common synthetic plastics are as follows

Polythene (polyethylene)



Polyethylene (PE) resins are milky white, translucent substances derived from ethylene. Its monomer unit is ethylene ($CH_2 = CH_2$). Polyethylene is made in low and high density forms. Low density polyethylene (LDPE) has a density ranging from 0.91 to 0.093g/. cm^3 (0.60 to 0.61oz/ $(in))^3$. LDPE is the most widely used of all plastics, because it is inexpensive, flexible, extremely tough, and chemical-resistant. LDPE is molded into bottles, garment bags, frozen food packages, and plastic toys. High density polyethylene (HDPE) has a density that ranges from 0.94 to 0.97g/.cm^3(0.62 to 0.64oz/(in))^3. It is stiffer, stronger and less transparent than low-density polyethylene. HDPE is molded into grocery bags, car fuel tanks, pack and piping.

Polyvinyl chloride (PVC)

PVC is prepared from the organic compound vinyl chloride. Its monomer unit is vinyl chloride ($CH_2 = CH - Cl$). PVC is most widely used for the amorphous plastics. PVC is light weight, durable and waterproof, chlorine atoms bonded to the carbon is the backbone of its molecules that gives PVC its hard and flame-resistant properties. It has rigid form, is weather-resistant and is extruded into pipe, house siding and gutters. Rigid PVC is also blown into clear bottles and is used to form other consumer products, including compact discs and computer casings.

Polystyrene

Polystyrene is obtained from the monomer styrene. Polystyrene is a thermoplastic and lighter than polythene. It is used for making hot drink cups, toys, household articles, as safe packaging material, as an insulator, for making Styrofoam (or thermoses)

Acrylic(Perspex)

It is a highly transparent plastic resembling glass, it is soft and can be scratched. It dissolves in organic solvents.

It is used for making lenses, aircraft, window screws and points.

Teflon

Teflon is a polymer of tetra fluoro ethylene (PTFE). It is quite inert, has very high melting point and has very low coefficient of friction.

It is used for making non-stick cookware and tapes, in chemical industry as corrosion proof coating.

Bakelite

Bakelite is a **thermosetting polymer.** It is obtained by reacting phenol with formaldehyde in presence of a catalyst. Bakelite is hard and stiff. It is an insulator and does not allow electricity to flow through it.

It is used for making electrical switches, plugs, gear wheels, table top laminates, combs, fountain pen bodies.

Melamine

Melamine is also a thermosetting polymer. It is hard and a high polish polymer, melamine is used for making unbreakable dinner-ware and decorative objects.

Plastics as Materials of Choice

Due to various qualities plastics are used in our everyday life.

Plastics are Non Reactive

They do not react with water, air and do not corrode easily. So they are used to store various materials, including many chemicals.

Plastics are Light, Strong and Durable

Synthetic plastics are much lighter in weight as compared to wood, metals etc. Synthetic plastics vary in their tensile strength from material to material.

Plastics are Cheaper

Plastics are cheaper than metals. So they are widely used in industry and household articles.

Plastics are Poor Conductors of Heat and Electricity

Synthetic plastics and synthetic fibers are insulators. They do not allow heat and electricity to flow through them. So they are used in making a cover for electrical wires, cables and appliances. Electric switches are made from bakelite.

Plastics and the Environment

During our daily routine we generate a lot of waste of various kinds. Materials that can decompose through natural processes are called biodegradable. Materials that cannot be decomposed easily by natural processes are called non-biodegradable material.

Non-biodegradable materials take years to decompose and thus lead to environmental hazards. Plastic is a non-biodegradable material. Some of the harmful effects of plastics on the environment are as follows:

(i) When they get buried underground, they prevent rain water from seeping into the ground. This deprives the growth of plant in that area.

(ii) When burnt, plastics release fumes causing air pollution. These fumes and gases can cause respiratory diseases when inhaled.

(iii) When thrown in water bodies, plastics cause water pollution, thereby harming aquatic life.

How to Minimize the Damage of the Environment by Plastics (or synthetic polymers)

To minimize the damage of the environment by the excessive use of plastics, these are the following suggestions:

(i) Avoid using things made of plastic.

(ii) Use shopping bags made of jute/cotton in place of plastic bags.

(iii) Recycle the plastics.
(iv) Do not throw plastic bags in the water bodies and in the open place.
(v) Remember the 4R formula to minimise damage to the environment by plastics. These are:
1. Reduce 2. Reuse 3. Recycle 4. Recover

Do You Now

1. The process involving chemical combination of a large number of simple molecules to form a giant molecule is called polymerisation.
2. Rayon is obtained from natural source, yet it is a man-made fibre.
3. Nylon was the first synthetic (man-made) fibre produced. It was discovered by Wallace Carothers in 1935.
4. PET is also a polyester. It is used for making bottles, storage container, jars.
5. Uniforms of firemen have a coating to make them fire-resistant.

Key Points

1. Fibers are hair-like structure. These are vegetable, mineral or synthetic in origin.
2. Animal fibers are resistant to most organic acids.
3. Synthetic fibers are produced from chemical substances.
4. Rayon is a man-made fibre prepared from cellulose.
5. Thermoplastics can be repeatedly soften and remolded.
6. Thermosetting plastic cannot be repeatedly soften and remolded.
7. Synthetic plastics on burning produce poisonous fumes, therefore they causes severe air pollution.
8. The bags made from recycled plastics are not safe for the storage of food items because certain additives and colouring materials added to these may be toxic or poisonous.

Multiple Choice Questions

1. Which of these is a natural fibre?
   (a) Polyester (b) Cotton
   (c) Rayon (d) Nylon
2. Regarding nylon, which of the following options is correct?
   (a) Protein (b) Polyester
   (c) Polyamide (d) Cellulose
3. Terylene, Terene and Dacron are different types of which fibre?
   (a) Polyester (b) Rayon
   (c) Nylon (d) None of hose
4. Which of these fibers is derived from chemicals?
   (a) Rayon (b) Cotton
   (c) Nylon (d) Silk
5. Which of these fibers is made from wood?
   (a) Rayon (b) Nylon
   (c) Terylene (d) Cotton
6. Rayon is prepared by
   (a) Solvay's (b) Haber's process
   (c) Electrolysis (d) Viscose process
7. Polythene is a polymer used to make
   (a) Tyres (b) Shoes
   (c) Plastic containers (d) Textiles
8. Nylon is used in making of
   (a) Conveyor belts (b) Fishing nets
   (c) Combs (d) Toothbrush bristles
9. Human-made fibres made from polymers are
   (a) Monomers (b) Synthetic fibres
   (c) Plastic fibres (d) Artificial fibres
10. Which of these is a thermosetting plastic?
    (a) Polystyrene (b) Polythene
    (c) Bakelite (d) PVC
11. Which of them is a polymer?
    (a) Bakelite (b) Polystyrene
    (c) Polythene (d) All of these
12. A substance becomes soft on heating and can be mould into different shapes. It is called
    (a) Rubber (b) Nylon
    (c) Rayon (d) Polythene

13. Monomers are the basic unit of
    (a) Polymers
    (b) Chemicals
    (c) Bad conductor of electricity
    (d) Inflammable
14. Which one of the following is a fireproof plastic?
    (a) Bad conductor of heat
    (b) Water soluble
    (c) Bad conductor of electricity
    (d) Inflammable
15. Which one of the following can't catch fire?
    (a) Melamine
    (b) Bakelite
    (c) Polythene
    (d) Teflon
16. Which of these can be used as a substitute for glass of windows in cars?
    (a) Fibre optic
    (b) Glass fibre
    (c) Teflon
    (d) Perspex
17. On the basis of activity, the strongest fibre is
    (a) Nylon
    (b) Polyester
    (c) Silk
    (d) Rayon
18. Which of the following is a monomer of polythene?
    (a) Chlorine
    (b) Methane
    (c) Ethane
    (d) Iodine
19. Which fibre is called as artificial silk?
    (a) Rayon
    (b) Nylon
    (c) Polyester
    (d) Acrylic
20. PVC stands for
    (a) Plastic very common in use
    (b) Plastic vinyl chloride
    (c) Poly vinyl chloride
    (d) Polymer vinyl chloride
21. A paper strip is immersed in NaOH and then in carbon disulphide (Cs_2). The liquid obtained is
    (a) Nylon
    (b) Viscose
    (c) Plastic
    (d) Cellulose
22. NaOH and —— are solutions used in the preparation of rayon.
    (a) H_2SO_4
    (b) HCl
    (c) CO_2
    (d) $C_{12}O_6H_{12}$
23. Which fibre is used in making of conveyor belts?
    (a) Polyester
    (b) Rayon
    (c) Nylon
    (d) Acrylic
24. Which type of plastic cannot be reheated again to form new shapes?
    (a) Thermoplastic
    (b) Thermosetting
    (c) Both (a) and (b)
    (d) Nylon

25. Which substance is used in coating for making non-sticky utensils?
    (a) Formica
    (b) Melamine
    (c) Teflon
    (d) Perspex

26. Which synthetic fibre resembles wool?
    (a) Acrylic
    (b) Viscose
    (c) Nylon
    (d) Rayon

Answer Key

1. (b)	2. (b)	3. (a)	4. (c)	5. (a)	6. (d)	7. (c)	8. (a)	9. (b)	10. (c)
11. (d)	12. (d)	13. (c)	14. (b)	15. (a)	16. (d)	17. (a)	18. (c)	19. (a)	20. (c)
21. (b)	22. (a)	23. (b)	24. (b)	25. (c)	26. (a)				

12. Cell - Structure and Functions

Learning Objectives

* Microscope An Instrument to See Cells
* Discovery of Cell
* Plant and Animal Cell
* Structure and Function of Cell
* Classification and Function of Cell

The Cell

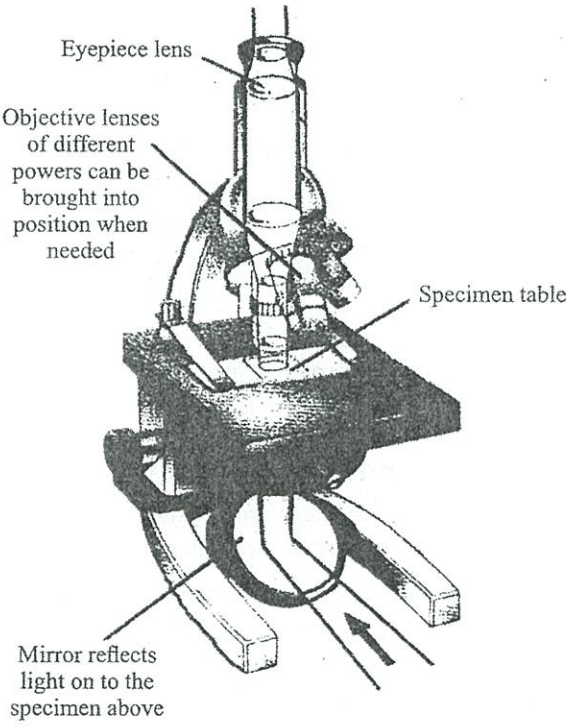
The cell is the basic structural and functional unit of all living organisms. It is the smallest unit of life and is also known as the building block of life. Each cell performs some metabolic functions which are essential to remain alive. It takes-in nutrients, convert them into energy, carry out specialized functions, and then reproduce as necessary.

Microscope: An Instrument to See Cells

The simplest microscope is a magnifying glass. Magnification of simple microscope is around 10 - 25. Simple microscope helps us to see small things but not microscopic details. Cells, being micros copic structures, are only visible under a powerful microscope such as compound microscope. The magnification of compound microscope is about 5000. Compound microscope has the following advantages :

- For testing blood, stool and septum of patients.
- For the study of cells and tissues of plants and animals.

The specimen to be examined with a compound microscope is placed on the specimen table under the objective lens. Light is foused on the object by adjusting the eye piece.



Laboratory Model of a Compound Microscope

Discovery of Cell

In 1665, an English scientist named **Robert Hooke** discovered the cell. He observed thin slices of cork

under a microscope. From his observations, he found that the cork is made up of box-like compartments, forming a honey–comb like structure. He called these compartments as cells.

In 1838 – 39, a German scientist Schleiden and Schwann developed the cell theory. According to this theory, cells are the basic structural functional unit of life-like bricks which are basic structural unit of buildings. New cells asise from pre–existing cells.

It is capable of performing all biological activities in any living organism.

Organisms Show Variety in Cell Number, Shape and Size

Number of Cells

Certain organisms consists of only one cell. These single celled organism are called unicellular organisms. Examples: Amoeba, Paramecium.

Organisms containing two or more cells are called multicellular organism.

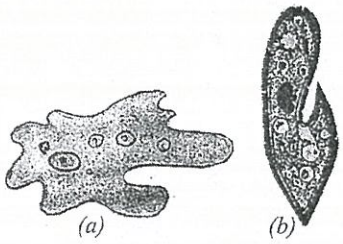
Examples: Human beings, most animals, plants and some micro-organisms like fungi are multicellular as they are composed of more than one cell.

Size of the Cells

Most cells are microscopic and are invisible to the naked eye. The smallest cell discovered is a bacterium *Mycoplasma* with size 0.1 to 0.5 micrometeres. The largest cell is of an *ostrich egg* which is 170mm × 130mm.

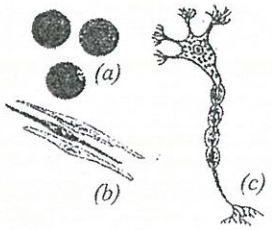
Shape of Cells

Cells can be oval, spherical, rectangular, polygonal or irregular depending upon their functions. In humans, red blood cells are disc shaped, nerve cells are branched, muscle cells are spindle-shaped.



(a) Amoeba (b) Paramecium

Fig: 12.2



(a) Spherical red blood cells of humans, (b) Spindle shaped muscle cell (c) Long branched nerve cell

Fig: 12.3

Structure and Function of Cell

All cells have a basic structure comprising of three main parts, namely, the cell membrane or the plasma membrane, cytoplasm and nucleus.

Cell membrane (or the Plasma Membrane)

The outer most lining of an animal cell is the plasma membrane. It encloses and protects the cell while separating it from other cells. It is selectively permeable in nature, i.e, it allows only selected molecules to remain inside the cell.

Functions

1. It gives definite shape and size to the cell.
2. It is selectively permeable.
3. It provides mechanical protection to the internal structures of a cell.

Cytoplasm

It is a thick, jelly-like fluid inside the cell membrane. It occupies the space between the cell membrane and the nucleus. There are many small cytoplasmic bodies in cytoplasm. These are called cell organelles.

Functions

1. It is the physical basis of all metabolic activities.
2. Various cell orgenelles perform specific functions in the cytoplasm.
3. It keeps the cell fully expanded and provides turgidity.

Nucleus

A square or oval shaped body floating in the cytoplasm is called the nucleus. It is surrounded by double membrane called nuclear membrane.

Functions

1. It controls all the functions of a cell directly or indirectly; hence it is called the brain of the cell.
2. It controls cell division.

Nucleus is made up of the following parts:

Nuclear membrane

It is the membrane surrounding nucleus having pores which separate contents of nucleus from cytoplasm.

Nucleoplasm

The fluid present in nucleus is called nucleoplasm.

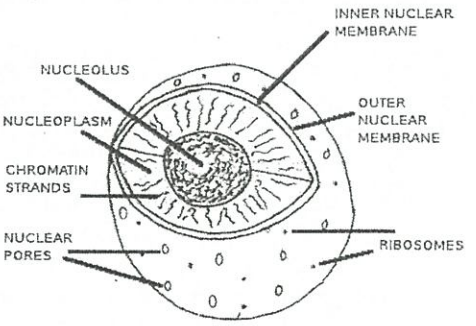
Nucleolus

Small spherical body made up of nucleoprotein. RNA is also present in nucleus.

Chromatin material

Several thread like structures forming a network are present in nucleoplasm. The chromatin material is in the form of chromosomes which carry genes in it.Chromatin material of nucleolus transmit characters from one generation to other.

All the living matter in a cell is called protoplasm. Protoplasm includes cytoplasm, nucleus and other organelles. Most of the protoplasm is made of compound of only 4 elements: carbon, hydrogen, nitrogen and oxygen. Some of the compounds present in protoplasm are water, carbohydrates, proteins, fats, nucleic acids, minerals and salts.



Structure of Nucleus

Fig: 12.4

Cell organelles

The various cell orgenelles present in cell are:

(a) **Mitochondria:** It is commonly called as power house of the cell, because they help in cellular respiration to release energy from food. Mitochondria is oval or rod shaped organelle bounded by two membranes. Mitochondria uses glucose and oxygen to produce energy.

(b) **Endoplasmic reticulum:** It is an irregular, interconnected network of flattened sacs made interconnected to each other. It helps in protein synthesis and also in transport of various substances.

(c) **Plastids:** These organelles are present only in plant cells. Plastids are of three types:

(i) **Chloroplasts:** Green coloured plastids. The green colour is due to the presence of chlorophyll pigment. They are commonly known as the kitchen of the cell because chloroplasts are the site of photosynthesis, i.e., process of making food.

(ii) **Leucoplasts:** Colourless plastids are leucoplasts. They are present in the roots and underground modified stems.

(iii) **Chromoplasts:** These are coloured plastids. These are present mainly in flowers, petals and fruits. They impart colour to fruits like tomato.

(d) **Golgi bodies:** They are known as dictyosomes in plants. They are flattened, layered and sac-like organelle and look like a stack of books. They are located near the nucleus. They are mainly secretary in function.

(e) **Vacuoles:** The fluid is filled organelles present in cell are vacuoles. Plant cells have large vacuoles. The vacuole is filled with a liquid called cell sap which contains dissolved suger & salts. Most of the animal cells lack vacuoles. Some possess it but they are much smaller than those found in plant cells. For examples: Amoeba contains food vacuoles which store food particles.They maintain turgidity of plant cells. Vacuoles also serve as a waste deposit box in which unwanted materials may be digested.

(f) **Lysosomes:** Small spherical bodies bounded by single membrane are lysosomes. They sacrifice themselves to destroy and digest various materials. Hence, they are called suicidal bags.

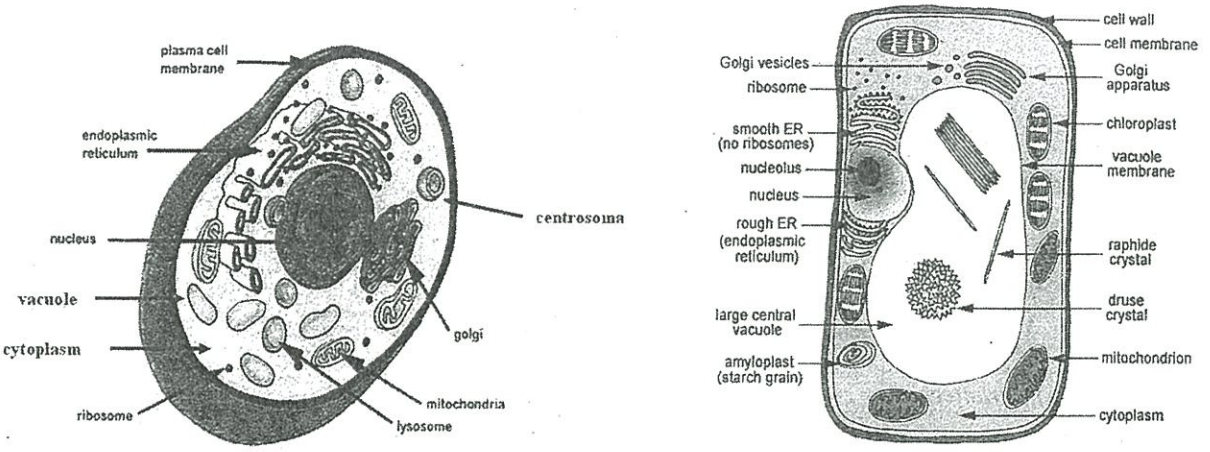
(g) **Ribosomes:** These are small rounded bodies which are present free or found attached with endoplasmic reticulum. Ribosomes are the site of protein synthesis.

(h) **Centrosome:** It occurs close to nucleus and help in cell division. It occurs only in animal cells.

Comparision of Plant and Animal Cell

Similarities and differences between plant cell and animal cell

Feature	Animal cell	Plant cell
Cytoplasm	Present	Present
Vacuoles	Present (in some)	Present
Mitochondria	Present	Present
Golgi apparatus	Present	Present
Endoplasmic reticulum	Present	Present
Ribosomes	Present	Present
Plastids	Absent	Present
Nucleus	Present	Present
Nuclear membrane	Present	Present
Plasma membrane	Present	Present
Cell wall	Absent	Present



(a) *Animal Cell* (b) *Plant Cell*

Fig:12.5

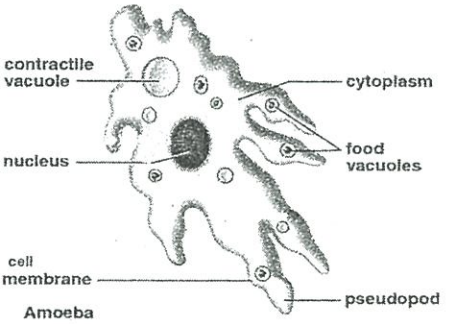
Classification of Organisms on the Basis of Number of Cells Present

Unicellular organism

The organisms made up of a single cell called unicellular organism. Most of the microorganisms, such as bacteria is made of single cell.

Some unicellular organisms

Amoeba: Amoeba is a unicellular aquatic animal. Amoeba has irregular shape and has projections on its body called pseudopodia. With the help of pseudopodia, amoeba catches its prey and digest it in food vacuole.



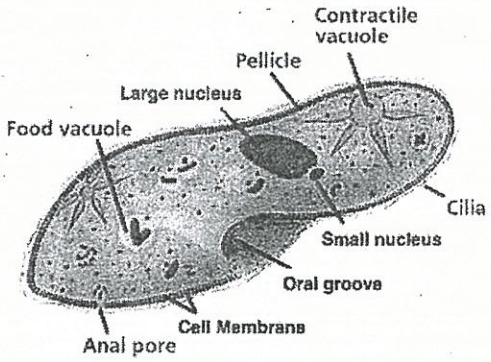
Pseudopodia

Fig:12.6

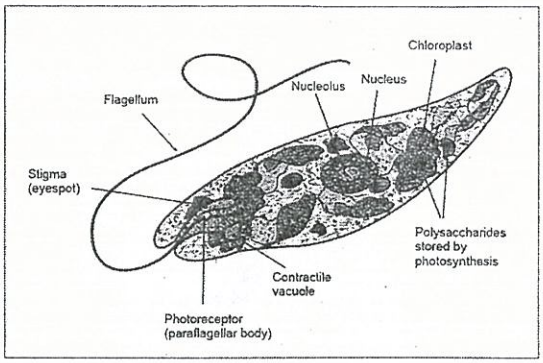
Paramecium: Paramecium is a slipper-shaped unicellular aquatic animal. Its body is covered with small hair like projections called cilia. It has two nuclei – macronucleus and micronucleus. Cilia helps in its fast locomotion.

Euglena: Euglena is a spindle-shaped green coloured unicellular aquatic animal.

It has a long thread-like structure called flagellum at its anterior end. Flagellum helps it in its movement. It takes food through gullet. The contractile vacuoles help absorption and excretion of water.



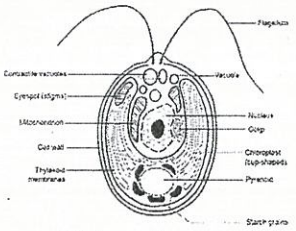
(a) *Paramecium*



(b) *Euglena*

Fig:12.7

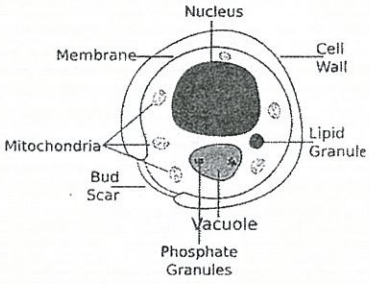
Chalamydomonas: Chlamydomonos is a unicellular aquatic plant. A whip-like structure called flagella help it to float in water. Its green colour is due to the presence of chloroplast in the cell.



Chlamydomonas

Fig:12.8

Yeast: Yeast is also a unicellular organism. It belongs to the fungi group. It causes fermentation of food containing carbohydrates. Yeast help in bread production in baking industries.



Yeast

Fig:12.9

Multicellular Organisms

The organisms made up of more than one cell are called multicellular organisms. These organisms have specialized cell structures for performing different types of functions. Multicellular organisms are either unisexual or bisexual. The bisexual organisms are called hermaphrodites, in which both the male and female sex are present in a single organism.

A living example of the attempts to become multicellular organisms is represented by the slime moulds, which are transformed from single cells to multicellular organisms under adverse condition.

Another example is found among the green alga *volvox* and its relatives. The ranges of size goes from the single cell *chlomydomonas* to the 16-cell Gonium, Eudorina and finally to the largest species of *volvox*, which may consist of 50,000 or more cells. Biologists have thought that new genes would be required for the transition to multicellularity. But a comparison between the genomes of the 2000-cell *volvox* and a single celled *chlamydomonas* indicates that the biological complexity can arise without major changes in genome content.

Prokaryotic and Eukaryotic Cell

The eukaryotic cells are those cells, whose nucleus is bounded by the nuclear membrane. These cells are very complex and nucleus can be easily differentiated from the rest of the cell. eg human beings, elephant, amoeba, plants, fungi, etc.

The prokaryotic cells are those cells, whose nucleus is not bounded by nuclear membrane. The nucleus and cytoplasm cannot be differentiated. For example, bacteria, blue green algae.

Do You Know?

1. The most primitive and earliest forms of life forms on the earth are prokaryotic single celled organisms.
2. The specific function within the cell is carried out by certain structure called organelles.
3. *Euglena* is the connecting link between plants and animals.
4. Yeast is the only unicellular fungi known. All other fungi are multi cellular in nature.
5. The biological electron transfer reactions leading to the production of ATP molecules occur in mitochondria.
6. The life span of cells within the human body are different. It varies from few days to years. Life span of RBC (red blood cell) is 120 days.
7. The self-destruction of cell, when it undergoes infection or get damaged is called apoptosis.

Key Points

1. The essential part of maintenance of life process is nutrition, respiration, transpotation of materials within the body, from one part to another.
2. There are two modes of nutrition, autotrophic (organism can prepare its own food by photo synthesis) and heterotrophic organism depends on other organism for obtaining number.
3. Human beings have very complex digestive system, which digest the food.
4. Respiration breaks down the complex food molecule into simpler form and release energy in the form of ATP.
5. Respiration is of two types: aerobic (require O_2)and anaerobic (do not require O_2).
6. In human beings, the respiratory system is well defined and very complex.
7. In plants, transportation takes place with the help of well defined tissue called xylem and phloem.
8. In human, excretion of waste material takes place in the form of soluble nitrogen compounds, with the help of kidney. The excretion product in humans is urea.
9. In plants, excretion takes place in the form of gums, resins, falling of leaves, ripening of fruits, etc.

Multiple Choice Questions

1. The egg of a hen is a
   (a) tissue (b) cell
   (c) organ (d) organ system
2. The structural and functional unit of all living beings is
   (a) Cell (b) Amoeba
   (c) Bacteria (d) Nucleus
3. Which of these is multicellular?
   (a) Amoeba (b) Paramecium
   (c) Bacteria (d) Mushroom
4. Which of these is not present in animal cells?
   (a) Plastid (b) Large vacuoles
   (c) Cell wall (d) All of these
5. Which instrument is used to see onion peel cells on a slide?
   (a) Stethoscope (b) Bioscope
   (c) Microscope (d) Telescope
6. Cell organelle that contains chlorophyll and is present in plant cells is
   (a) Mitochondria (b) Chloroplast
   (c) Large Vacuole (d) Nucleus
7. Which of these is not present in an animal cell?
   (a) Mitochondria (b) Cell membrane
   (c) Chloroplast (d) Nucleus
8. A cell contains
   (a) cytoplasm (b) nucleus
   (c) chromosome (d) all of these
9. Which of these is called as the control centre of a cell?
   (a) nucleus (b) cytoplasm
   (c) mitochondria (d) protoplasm
10. A cell can be
    (a) Eukaryotic cell (b) Prokaryotic cell
    (c) both (a) and (b) (d) none of these
11. Which organelles are responsible for energy production in a cell?
    (a) mitochondria (b) vacuoles
    (c) chloroplast (d) golgi bodies
12. Which of these is a jelly-like substance found in a cell?
    (a) chloroplast (b) cytoplasm
    (c) cell membrane (d) plastid

13. The substance used to stain the cheek cells of human being to observe them clearly under a microscope is
    (a) water
    (b) ink
    (c) iodine
    (d) all of these
14. The cytoplasm and the nucleus together make up the
    (a) chloroplast
    (b) protoplasm
    (c) mitochondria
    (d) cell
15. The spiral band in the spirogyra cell is
    (a) nucleus
    (b) cytoplasm
    (c) mitochondria
    (d) chloroplast
16. Which of these is not asserted in the cell theory?
    (a) Cells are the basic structural units of a living organism.
    (b) All cells are identical in shape and size.
    (c) New cells are formed due to division in odd cells.
    (d) The way an organism functions depends on the way the cells work.
17. The cell with cytoplasm in it is
    (a) parenchyma
    (b) sclerid
    (c) sclerenchyma
    (d) cork cell
18. In which of these does a single cell NOT performs all life functions?
    (a) amoeba
    (b) mosquito
    (c) euglena
    (d) bacteria
19. Similar type of cells specialized for a particular function form a/an
    (a) organ
    (b) cell membrane
    (c) tissue
    (d) golgi body
20. Which of these unicellular organisms has no definite shape?
    (a) amoeba
    (b) euglena
    (c) bacteria
    (d) paramecium
21. The cork-piece slide shows
    (a) living cells
    (b) dead cells
    (c) cells with cytoplasm
    (d) no cells
22. The material between cell membrane and nucleus is called
    (a) cytoplasm
    (b) chloroplast
    (c) mitochondria
    (d) vacuole
23. Columnar epithelium cells are
    (a) cube like
    (b) cylindrical
    (c) column-like
    (d) falt
24. Align and branched animal cell is :
    (a) Mused cell
    (b) Reeve cell
    (c) Epithelial cell
    (d) Cartilage cell

25. Which is the longest cell in human body?
(a) Nerve cell
(b) Brain cell
(c) Skin cell
(d) None of these

26. Which is the largest cell in the world?
(a) turkey cell
(b) peafowl
(c) hen
(d) ostritch egg

27. Glandular cells in epithelium have
(a) epithelial cells
(b) goblet cells
(c) turkey cells
(d) Both (a) and (c)

28. Which the following unicellular organism has 2 nucleuses?
(a) Paramecium
(b) Euglena
(c) Amoeba
(d) Chlymadomonas

29. Slides can be prepared and studied under
(a) dissecting microscope
(b) compound microscope
(c) both (a) and (b)
(d) none of these

30. The smallest cell in living word is
(a) Red blood cell
(b) Mycoplasma
(c) Yeast
(d) None of these

Answer Key

1. (b)	2. (a)	3. (d)	4. (d)	5. (c)	6. (b)	7. (c)	8. (d)	9. (a)	10. (c)
11. (a)	12. (a)	13. (b)	14. (b)	15. (d)	16. (b)	17. (a)	18. (b)	19. (c)	20. (a)
21. (a)	22. (a)	23. (c)	24. (b)	25. (a)	26. (d)	27. (d)	28. (a)	29. (b)	30. (d)

13. Microorganisms

Learning Objectives

* Micro-organisms
* Bacteria
* Fungi
* Algal
* Protozoa
* Viruses
* Where do Micro-organisms Live
* Micro-organism and us
* Food Poisoning
* Food Preservation
* Nitrogen Cycle

Micro-organisms

The living organisms which cannot be seen by the naked eyes and can be seen only through a microscope are called micro-organisms or microbes.

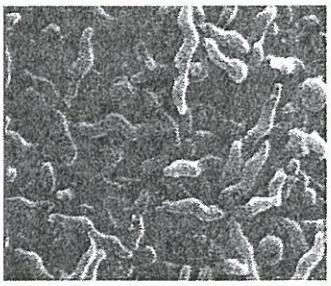
A micro-organism may be unicellular or multicellular. Micro-organisms can be found in air, water, soil, desert, marshy lands and also inside the bodies of other living organisms.

Microorganisms are capable of existing in extreme conditions of temperature and dryness by forming a hard outer covering called cyst.

Micro-organisms are classified into five major groups: Bacteria, Fungi, Algae, Protozoa and Viruses.

Bacteria

Bacteria are single celled microorganisms. They have a rigid definite cell wall like plant cells. They are found almost every where specially in soil, hot springs and organic matter. They reproduce by binary fission and grow very rapidly in favourable conditions. They can also reproduce sexually, in which they exchange genetic information through DNA. Some bacteria are useful in making curd and other help in nitrogen fixation and decomposing organic maternal. *Lactobacillus* and *Streptococcus* are examples of bacteria. Based on their shape, bacteria are of four types, **Bacillus** (rod shaped), **coccus** (spherical shaped), **spirilla** (spiral shaped) and **vibrio** (comma shaped). Some of the human diseases like cholera, tuberculosis (TB), typhoid and diptheria are caused by bacteria.



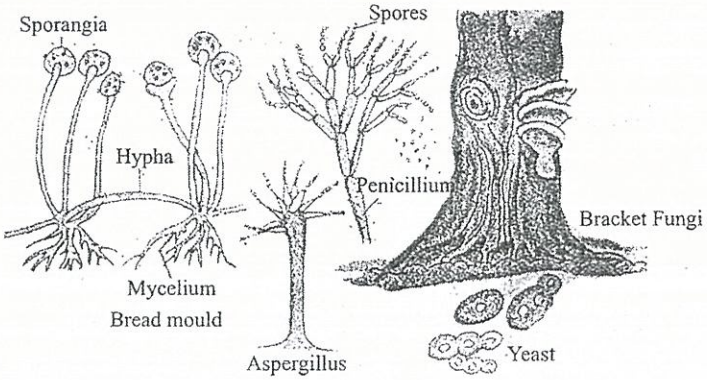
Spiral Bacteria

Road Shaped Bacteria

Fig :13.1

Fungi

These are single celled or multicellular organisms, which do not have chlorophyll and depend on others for their food. They are normally saprophytes, which feed on dead decaying matter. But some of them are parasitic in nature and cause disease. Some of the disease caused by fungi are ringworm and athlete foot. They need warm and moist condition for their growth.



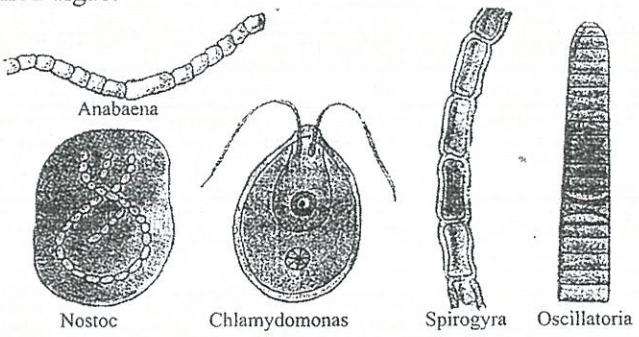
Fungi

Fig :13.2

For example, yeast, moulds on bread, *Penicillium, aspergill*us and *Alternaria.*

Algae

They are multicellular organisms. They are large group of simple, plant-like organisms that do not hove proper root stems and leaves. They are often present in ponds. *Chlamydomonas* and *spirogyra* are examples of single of celled algae.



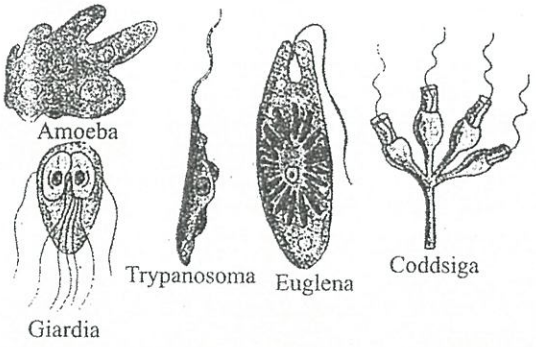
Algae

Fig :13.3

Protozoa

They are the single cellular microorganisms, which have been classified as animal. They are found in ponds, lakes, drains, rivers and sea water. They are moths parasitic in nature and causes diseases like malaria and dysentery, *Plasmodium* is the parasite of the malaria.

For example, *Amoeba, Paramecium and Entamoeba.*

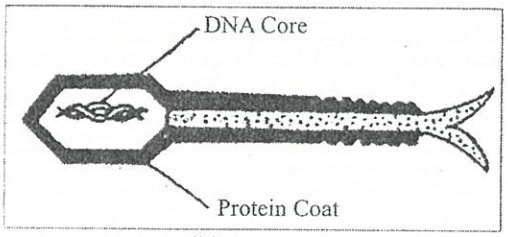


Protozoa

Fig :13.4

Viruses

These are the smallest microorganisms, which can develop inside the body of host organisms, they behave like both living and non-living. When they enter the body of host organisms, they behave like living and outside they behave like non-living organisms. Thus they are said to be on the border line of living and non-living. They are able to grow inside the body of host organisms only, as they can multiply in the cell. They cause diseases like, common cold, flu, polio, chickenpox and small pox. The other one is HIV virus, which causes AIDS. These viruses are 10-100 times smaller than the bacteria. They can be observed under the microscope only.



Viruses

Fig :13.5

Where do Micro-organisms Live?

Micro-organisms can survive under all types of environment, ranging from ice cold climate to hot springs and deserts to marshy lands. They are also found inside the bodies of animals including humans. Some micro-organisms grow on other organisms while others exist freely. Micro-organisms like amoeba can live alone, while fungi and bacteria may live in colonies.

Microorganisms based on their behaviour can be divided into two classes:

(1) Friendly microorganisms (2) Harmful microorganisms

Friendly Mitcro-organisms

The micro-organisms which are useful for various purposes of human beings are called friendly micro-organisms.

In food industry

Bacterium Lactobacillus promotes the formation of curd from milk. The bacterium Renin is used in cheese production. Yeast is used in the preparation of bakery products (bread, cakes) and food items like, idli, dosa, dhokla.

Yeast reproduces rapidly giving out CO_2 during respiration which in used to in raise the level of dough.

In beverage industry

Certain microorganisms are used in industry to manufacture alcohol from sugar or starch and wine from fruit juices by a process called fermentation. Yeast can convert sugar into alcohol by a process called fermentation. Yeast contains the enzyme zymase and invertase.

$$\text{Sugar} \xrightarrow{\text{Zymase}} \text{Glucose} + \text{fructose}$$

$$\text{Glucose} \xrightarrow{\text{Invertase}} \text{Ethylalcohol} + \text{carbon dioxide}$$

Fermentation was discovered by Louis Pasteur in 1857.

A dilute solution of acetic acid is called vinegar. Bacteria can turn alcohol into acetic acid (vinegar). On a commercial scale, yeast is used to manufacture alcohol which in turn reacted upon by Acetobector aceti (a bacterium) to convert it into acetic acid.

Medicinal purposes

Some bacteria and fungi have medicinal value, they are used to produce antibiotics and vaccines. Antibiotics are the medicines that kill or prevent the growth of harmful micro-organisms. They are also used to prevent microbial infection in animals and to control many plant diseases. Some micro-organisms that are used to produce antibiotics are streptomyces and penicillium. Streptomyces is a bacterium from which antibiotic such as chloram phenicol is produced.

Vaccine

If dead or weakened microbes for a particular disease are introduced in a healthy body, the body produces suitable substances called antibodies. These antibodies remain in the body for a long time and protect us from that disease causing microbes. The substances injected to trigger the body to develop defensive mechanism (by producing antibodies) is called vaccine. So, vaccine is a special kind of medicine that provides immunity to a particular disease.

The process of giving vaccine to people is known as vaccination. Disease such as cholera, tuberculosis, small pox and hepatitis can be prevented by vaccination. A new born baby is vaccinated against several diseases such as diphtheria, polio, tetanus and tuberculosis.

Increasing soil fertility

Some microorganisms can fix N_2 gas from atmosphere to form nitrogen compounds which add fertility to soil.

(a) The blue-green algae can fix the atmospheric nitrogen as nitrogen compounds in the soil.

(b) Symbiotic bacteria living in the root nodules of the leguminous plants absorb atmospheric nitrogen and convert it into nitrogenous compound enclosing soil fertility.

Cleaning of environment

There are some microorganisms, which decompose the organic wastes and reduce the complex harmful matter into the simpler harmless form cleaning the environment. These matter get added up into the soil and increase its nutrient content, helping the growth of new plant. In addition, they also help in recycling of nutrients present in the nature, which can be used as food by the green plants.

Harmful Microorganisms

Microorganisms may be harmful in many ways:

Disease causing microorganisms are called pathogens. A pathogen transmits disease through air, water, food, direct contact, insects, etc. A medium that transmits pathogens from an infected individual to a healthy one is known as a carrier.

Bacteria

Diseases such as tuberculosis and cholera are causes by bacteria. Tuberculosis is caused by *Mycobacterium tuberculosis* and transmitted through air. It can be prevented by vaccination.

Cholera is caused by *Vibrio Cholerae* and is transmitted through contaminated food and water. It can be prevented by drinking boiled water and maintaining hygiene.

Citrus canker is an other plant disease caused by bacteria, it is transmitted through air and occur in citrus trees like lime, orange , lemon.

In animals, Anthrax is caused by *Bacillus anthracis* and is transmitted by grazing on grass infected by the bacterium. It can be prevented by vaccination.

In plants, crown gall disease is caused by *Agrobacterium tumefactiens* and is transmitted through soil and water. Typhoid caused by bacterium *Salmonella typhimurium,* is transmitted through contaminated water.

Protozoa

In humans, malaria is caused by Plasmodium and is transmitted by the female anopheles mosquito. Malaria can be prevented by keeping the surroundings clean and preventing the multiplication of mosquitoes. Using mosquito repellents is another way to prevent the spread of malaria.

Fungi

In humans, candiasis is caused by *Candida albicans* and athlete's foot is caused by *Trichophyton*. These diseases are transmitted through direct contact with the infected person. They can be prevented by maintaining hygiene and by avoiding direct contact with the infected person.

In plants, Black rust of wheat is cause by *Puccinia graminis* and is transmitted through air and infected seeds. It can be prevented by planting resistant varieties of crops and by spraying the plants with chemicals that fill the microbes.

Viruses

Measles is caused by *Paramyxo* virus and polio is caused by *Polio* virus. Measles is transmitted through sneezing and coughing. Polio is transmitted from person to person through the fecal-oral route. Both these diseases can be prevented by vaccination.

In animals, foot and mouth disease is caused by a virus. It is transmitted through air and contact with infected animals. It can be prevented by vaccination.

In plants, Yellow Vein Mosaic of lady's finger (okra) is caused by virus. It is transmitted by insects. It can be prevented by planting resistant varieties and removing of infected plants and weeds.

Food poisoning due to action of enzymes present in food or due to growth of bacteria/fungi food gets spoiled. The spoiled food can be identified by its unpleasant smell, changed colour and bad taste.

Food poisoning can be caused by

(i) Microorganisms such as bacteria (*Salmonella, Aspergillus, Staphylococci, Clostridium botulinum* etc) and fungi present in the spoiled food.

(ii) The traces of pesticides.

(iii) The toxins produced in the food released by bacteria and fungi.

(iv) The metal salts produced by the action of food with the material of the container or cooking utensils.

Symptoms of food poisoning are:

(i) Fever	(ii) Diarrhoea	(iii) Vomiting
(iv) Headache	(v) Abdominal palm	(vi) Loose motions

Food Preservation

The process by which spoilage of perishable foods is prevented using chemical or physical methods is called food preservation."

Some methods of food preservation are as follows:

Chemical Methods

In this method, some chemicals are added as food preservatives to control the growth of micro-organisms. Salt, sugar and edible oils are common preservatives; sodium benzoate and sodium meta bisulphite are some examples of chemical preservatives.

Use of common salt

Adding common salt to meat, fish, fruits, etc., stops the growth of micro-organisms.

Use of sugar

Adding sugar to jams, and squashes inhibits moisture and prevents the growth of micro-organisms. Sugar absorbs the moisture present in the fruits.

Use of oil and vinegar

Adding oil and vinegar to pickles acts as a barrier, preventing the growth of micro-organisms. They make the environment unfeasible for microorganisms to grow.

Physical Methods

(i) Heating and cooling: Boiling kills microorganisms while refrigerating prevents the growth of microorganisms.

(ii) Pasteurization: Boiling to a very high temperature 70°C to kill the bacteria present and cooling suddenly to a very low temperature to prevent other bacteria from growing is called pasteurization. Milk can be preserved by pasteurization.

(iii) Canning: Food can be stored in air tight containers. This will prevent contact with the microorganisms and hence prevent spoilage.

(iv) Sun drying (or Dehydration): Vegetables like spinach, cauliflower, peas can be preserved by this method. It leads to lessening or removal of moisture which doesn't allow microorganisms to grow.

Advantages of Food Preservation

The advantages of food preservation are

1. It decreases the food wastage.
2. It increases the storage period (shelf-life) of perishable food materials.
3. It ensures the availability of non-seasonal food materials.
4. It ensures the availability of perishable food material even at distant places.

Nitrogen fixation

The process of conversion of free atmospheric nitrogen into useful nitrogen compounds is called nitrogen fixation.

There are two ways by which atmospheric nitrogen is fixed.

(i) Natural fixation of nitrogen (ii) Artificial fixation of nitrogen

Natural Fixation of Nitrogen

Natural fixation of nitrogen is done in two ways:

By symbiotic bacteria

Certain plants such as peas, beans, pulses, etc., (called leguminous plants) have the bacterium *Rhizobium* on the nodules of their roots. The bacterium rhizobium can take up atmospheric nitrogen and convert it into nitrates which get mixed up with soil after the decay of such plants.

During lightening

During rains, when lightening strikes, nitrogen and oxygen of the air react to form nitric aid (through various steps).This nitric acid comes down to the earth with rain water and reactswith lime stone in the soil to form nitrates. These nitrates are absorbed by plants through their roots and help them to make proteins.

Artificial fixation of nitrogen

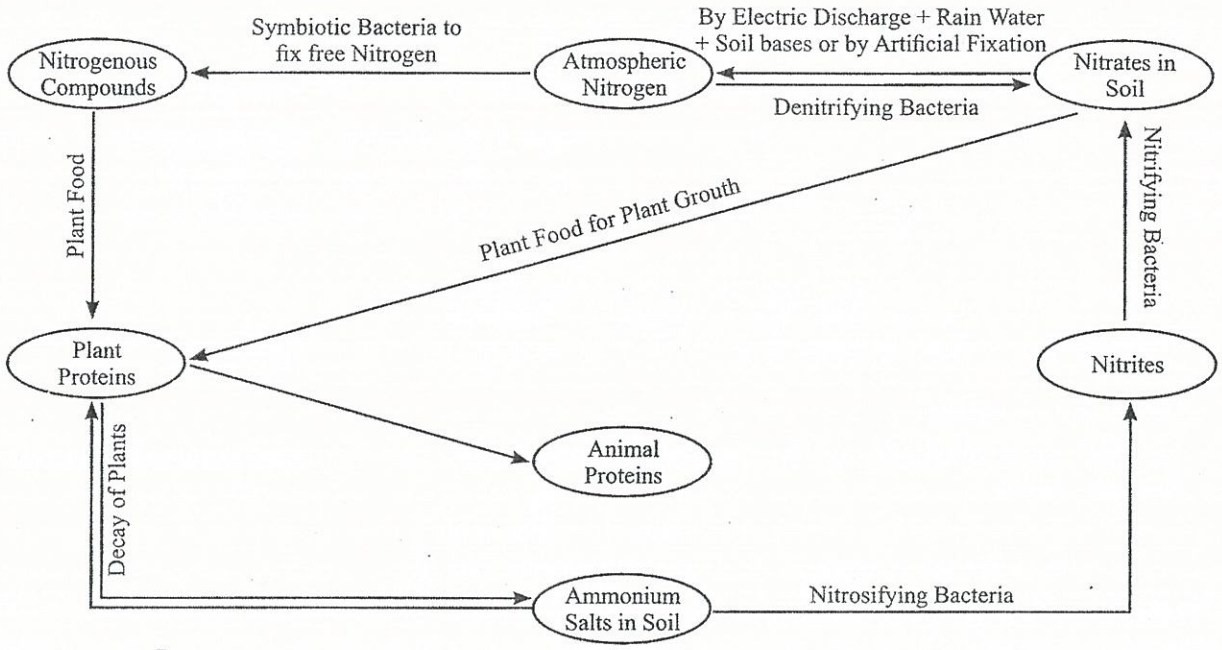
Large amounts of free atmospheric nitrogen is used for the production of many chemical compounds such as ammonia, nitric acid, etc.

Ammonia and nitric acid are used in the manufacture of many fertilizers such as ammonium nitrate, urea, calcium cyanamide, etc. These fertilizers provide nitrogen to plants which then covert the nitrogen into proteins.

Nitrogen Cycle

Some bacteria and blue green algae present in the soil fix nitrogen gas from the atmosphere and convert it into nitrogenous compounds. On the other hand, certain bacteria convert compounds of nitrogen present in the soil into free nitrogen gas which is released to the atmosphere. The circulation of N_2 element through living things (plants and animals) and non-living environment (air, soil and water) is called nitrogen cycle in nature .

Due to this nitrogen cycle, the percentage of nitrogen in the atmosphere remains almost constant around a value of 78% by volume.



Nitrogen Cycle in Nature

Fig : 13.5

Do you Know

1. Bacteria reproduces every 9.5 minute and E.coli reproduces every 20 minutes.
2. The first antibiotic penicillin was discovered by Alexander Flemming in 1929 from the mould *Penicillium notatum*. Other well known antibiotics are Streptomycin, Tetracycline, Erythromycin and Gramicidin.
3. Edward Jenner discovered the first vaccine against smallpox in 1798.
4. Diseases which can get transmitted from one person to another by direct or contact indirect are called communicable or infectious diseases like Tuberculosis, Cholera, Typhoid, Malaria, Dysentery etc.
5. Diabetes, Bronchitis, Cataract, etc., are non-communicable disease, i.e., which do not get transmitted from one person to another by direct or indirect contact.
6. The bacterium *Staphylococci* causes food poisoning by producing a heat-resistant toxin in the food. Being heat resistant, this toxin remains in the food even when the bacteria have been killed during cooking.
7. The bacterium *clostridium botulinum* causes a rare but dangerous form of food poising known as Botulism. This infection is generally found in canned food (food packed in tinned canes).
8. The non leguminous plants which can fix nitrogen are Alums and Ginkgo.
9. Erosion of the top soil will disturb the nitrogen cycle.
10. Wearing a head phone for an hour or so can increase the bacteria in your ears by 700 times, as these head phone creates a warm, and moist environment in ear canal, which is ideal for breeding of bacteria.

Key Points

1. Microorganisms are very small life forms, which cannot be seen by the naked eyes.
2 They are found in all types of climatic conditions.
3. They are either unicellular or multicellular.
4. The microorganism includes bacteria, fungus, algae, virus and protozoa.
5. Virus is considered both as living and nonliving.
6. Microorganisms are used for production of medicine.
7. Microorganisms clean our environment by decomposing the waste material.
8. A *Rizobium* bacterium helps in fixing atmospheric nitrogen into the soil and increases the fertility of the soil.
9. There are some harmful bacteria and other microorganisms, which cause diseases.
10. Some of the microorganisms can manufacture their own food by the process of photosynthesis, such as, blue-green algae.

Multiple Choice Questions

1. Microorganisms can be grouped as
   (a) Bacteria and fungi
   (b) Viruses
   (c) Algae and protozoa
   (d) All of these
2. Which of the following cannot be classified as either living or non-living micro-organism?
   (a) Fungi
   (b) Viruses
   (c) Bacteria
   (d) Protozoa
   (d) Protozoa
3. Which of these is not a fungus?
   (a) Virus
   (b) Yeast
   (c) Mushroom
   (d) Mould
4. Which of the following make their own food by photosynthesis?
   (a) Virus
   (b) Bacteria
   (c) Algae
   (d) Protozoa
5. Spongyness of bread is because of
   (a) Bread mould
   (b) Orange mould
   (c) Freshness
   (d) None of these
6. Which of the following is responsible for making bread soft and lighter ?
   (a) Sugar and salt
   (b) Finely grounded
   (c) Co_2 gas given off during fermentation of sugar
   (d) Alcohol released during fermentation of sugar
7. In food preservation process, the technique used is/are
   (a) Killing the microbes
   (b) Making them inactive
   (c) Both (a) and (b)
   (d) None of these
8. Which of these micro-organisms do not have a regular cell structure?
   (a) Viruses
   (b) Bacteria
   (c) Protozoa
   (d) Algae
9. A drop of greenish pond water seen under a microscope has
   (a) green colour creatures
   (b) green water colour
   (c) microorganisms
   (d) none of these
10. Which of these are found as both unicellular and multicellular ?
    (a) Bacteria
    (b) Algae
    (c) Viruses
    (d) Moulds
11. The bacterium found in curd is called
    (a) Lactobacillus
    (b) Bacillus
    (c) Acetobacter
    (d) Salmonella typhi

12. Microorganisms spread though
    (a) air
    (b) water
    (c) cuts
    (d) all of these
13. What in the shape of Lactobacillus, the bacterium used for making cheese and curd?
    (a) Curved
    (b) oval
    (c) Cylindrical
    (d) spiral
14. A lukewarm sugar solution of yeast when seen under a microscope after a day shows that
    (a) Sugar is present
    (b) Yeast cell is present
    (c) Bacteria are present
    (d) A chain of yeast cells are present
15. A chain of yeast cells in a warm sugar solution means
    (a) Yeast cells are reproduced by budding
    (b) Yeast cells got multiplied
    (c) Yeast cells form a chain
    (d) None of these
16. Microorganisms are classified into how many classes?
    (a) 3
    (b) 4
    (c) 5
    (d) 6
17. Which of the following increase the fertility of soil ?
    (a) Rod-shaped
    (b) Spherical
    (c) Spiral
    (d) Any of these shapes
18. Protozoan's are unicellular—— organisms.
    (A) Lactobacillus bacteria
    (B) Rizobium bacteria
    (C) Spirogyra algae
    (D) Blue – green algae
    (a) A & B
    (b) B & C
    (c) A & D
    (d) B & D
19. The softening of dough mixed with yeast is called
    (a) Baking process
    (b) transformation
    (c) Fermentation
    (d) distillation
20. Orange mould is a fungus found growing on decaying
    (a) Citrus fruit
    (b) Malta
    (c) Orange
    (d) All of these
21. Vinegar is made from which of these bacteria?
    (a) A centobacteraceti
    (b) Pseudomonas putida
    (c) Lactobacillus
    (d) None of these
22. Which of these disease is caused by *Plasmodium*?
    (a) Tuberculosis
    (b) Typhoid
    (c) Malaria
    (d) Headache

23. Dead or weakened germs that help protect the body against future attack by the germs are called
    (a) Antibiotics
    (b) Vaccine
    (c) Medicine
    (d) None of these

24. *Amoeba*, guardian *paramecium* are examples of
    (a) Bacterium
    (b) Virus
    (c) Protozoan
    (d) Fungi

25. Microorganisms are useful in
    (a) Food and beverage industry
    (b) Making medicines and vaccines
    (c) Cleaning the environment
    (d) All of these

26. Pasteurization of milk consists of heating it to a temperature of ———— and suddenly cooling below ———— to kill the microorganisms found in it.
    (a) 10^0C, 70^0C
    (b) 70^0C, 10^0C
    (c) 100^0C, -10^0C
    (d) 120^0C, 0^0C

Answer Key

1. (d)	2. (b)	3. (a)	4. (a)	5. (d)	6. (c)	7. (c)	8. (a)	9. (c)	10. (b)
11. (a)	12. (d)	13. (c)	14. (d)	15. (a)	16. (c)	17. (d)	18. (b)	19. (c)	20. (d)
21. (a)	22. (c)	23. (b)	24. (c)	25. (d)	26. (b)				

14. Reproduction in Animals

Learning Objectives

* Modes of Reproduction
* Sexual Reproduction
  - In Animals
  - In Humans
* Fertilisation (External and Internal)
* Fertilisation in Humans
* Viviparous and Oviparous Animals
* Young ones to Adults
* Asexual Reproduction in Animals
* Cloning

The production of new organisms from the existing organisms of the same species is known as reproduction.

Modes of Reproduction

Reproduction is the biological process, which helps us to produce new offspring or individuals of similar types. It is a fundamental feature of all living organisms.

There are two modes of reproduction: sexual and asexual.

Sexual Reproduction

The production of a new organism from parents by making use of their sex cell (or gametes) is called sexual reproduction. The two organisms are male and female of a particular species.

Asexual Reproduction

The production of a new organism from a single parent without the involvement of sex cells is called sexual reproduction.

For example, the division of a bacterial cell into two daughter cells by binary fission.

Sexual Reproduction

In sexual reproduction, two parents – one male and other female – are required. Males and females of such animals have different reproductive organs. Each parent produces a special reproductive cell called gamete. The male gamete is called **sperm** and female gamete is called **ovum** or egg. Such organisms are called **unisexual.**

For example: Cockroaches, frogs, fish, birds, reptiles, humans, cats, dogs etc.

Some organisms have both the male and the female sex organs present in the same body. Such organisms are called hermaphrodites or bisexual. For example, earthworm, leeches and hydra.

Male Reproductive System

Male human reproductive system contain following parts:

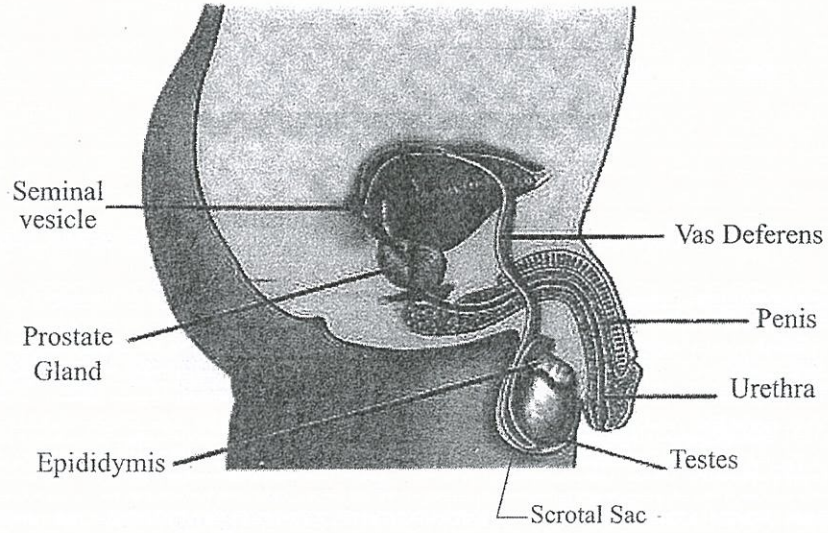
Testes: These are two in number and oval in shape. They lie within the scrotum. The testes produce male gametes called sperms.

Vas deferens – (Sperm duct): This duct starts from the testis and joins the urethra. It carries sperms to the urethra by the muscular action of its wall.

Urethra: Vas deferens carrying the sperms through muscular action of its wall receives the fluid secreted by the **seminal vesicles**.This fluid provides nourishment to the sperms. The mixture of sperms and the fluid is called **semen**. This duct opens into the urethra.

It stores the semen containing sperms, the male gamete.

Penis : Urethra leads to a muscular organ called penis. It is used for ejecting sperm and also for passing urine. The tail of the sperm helps in movement of the sperm to reach the egg in the female sex organ.



The Reproductive System of the Human Male

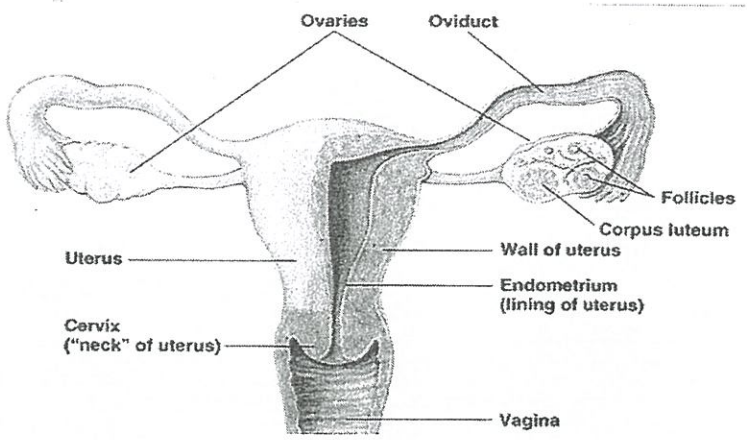
Fig :14.1

Sperm : Human sperm is unicellular, has a head, a middle piece and a tail. Human male starts producing sperms at the age of 14 -15 years.

Female Reproductive System

Female human reproductive system contains following parts:

Ovaries : Ovaries are two in number, which are situated in the abdominal cavity. These produce one mature ovum each after every four weeks.



The Reproductive System of the Human Female

Fig :14.2

Oviduct (Fallopian tube): A single matured egg is released into the oviduct by one of the ovaries every month. They carry the egg towards uterus.

Uterus: Uterus is the part where sterilized embryo develop into baby foetus.

Vagina: The uterus opens into vagina which is a wide muscular tube.

Like a sperm, an egg is also a single cell. It contains a nucleus and cytoplasm. The egg may be very small in humans, much larger in ducks and hens. Ostrich egg is the largest. Human female starts producing eggs (ova) at the age of 11 - 12 years.

Fertilization

When the sperm (from male partner) and ovum (from female partner) fuse together, a new cell, called **zygote** is formed.

The process of fusion of the sperm and the ovum (or egg) is called fertilization of the egg.

Fertilization takes place in two different ways:

External fertilization

When the fusion of male gametes with female gametes takes place outside the body of the female partner, the fertilization is called external fertilization.

In frogs and fishes, the male and female partners release their gametes in water and the fertilization takes place in water.

Internal fertilization

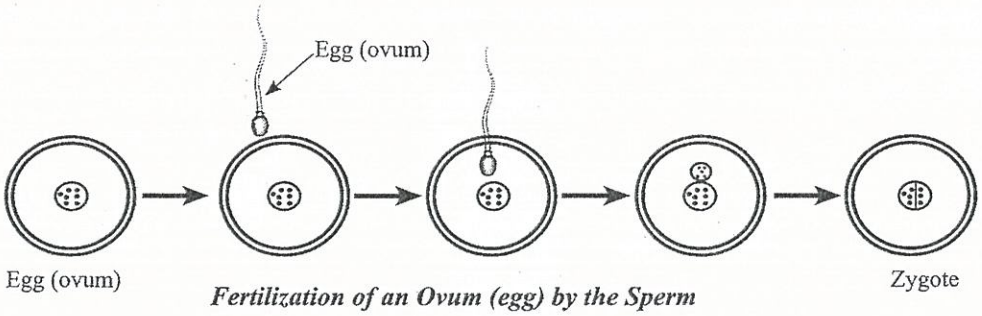
When the fusion of the gametes of the male and the female takes place inside the body of the female partner, the fertilization is called internal fertilization.

In cats, dogs, humans, cattles, hens, insects, birds, reproduction takes place through internal fertilization.

Fertilization in Humans

In humans, fertilization occurs in the body of female partner. The process of reproduction starts with mating during which the male releases male sex cells (sperms) into the body of the female.

When sperms come in contact with an ovum (the egg), one of the sperms may fuse with the egg. Such a fusion of the sperm with the egg is called fertilization. During fertilization the nucleus of the sperm and the egg fuse to form a single nucleus. The fertilized egg is called zygote.



Fertilization of an Ovum (egg) by the Sperm

Fig :14.3

Development of embryo

After the formation of zygote, it divides repeatedly to give rise to a ball of cells called embryo. The embryo then gets embedded in the wall of the uterus. The cells then begin to form groups. These groups then develop into different tissues and organs of the body.

The embryo continues to develop like this in the uterus. It gradually give rise to body parts - hands, legs, head, eyes, ears etc.

The stage of the embryo when all the body parts can be identified is called **foetus.** When the foetus gets fully developed, the mother gives birth to the body.

Test Tube Baby

In certain cases, women oviducts are blocked. Such women cannot bear babies because sperms are not able to reach the egg for fertilization.

For such parents, the medical science has developed a technique called Invitro Fertilization or IVF (Fertilization outside the body).

In this method, a freshly released egg and sperms are collected and kept together for a few hours outside the body in a laboratory. If fertilization of the egg by the sperm is successful, the zygote is allowed to develop for about a week. The developed zygote is then placed in the mother's uterus. The further development of zygote and embryo takes place in the uterus of the mother. The baby is born at the appropriate time like other babies. The babies born through the IVF are called **test tube babies.**

Viviparous and Oviparous Animals

The animals which give birth to young ones are called viviparous animals. For example, cat, dog, cow, buffalo, human beings.

The animals which lay eggs which later develop into the young ones are called oviparous animals. For example : crow, hen, butterflies, lizard, frog.

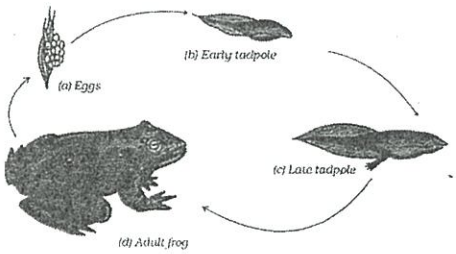
Metamorphosis (young ones to adults)

In some animals, the young ones may look very different from the adult. For example, in case of frog, fertilized egg (zygote) develops into tadpole (larva) which later develops into adult frog.

The tadpole (larva) which is very different from the adult frog and is unable to jump, transforms into adult frog that is capable of jumping and swimming.

The process of transformation of the larva into an adult through drastic changes is called metamorphosis. Like frog, metamorphosis is also found in silk moth and butterfly.

Egg (of silk moth) —Hatching→ caterpillar (Larva) Silk moth (Adult) —Meta morphosis→ Pupa (chrysalis) —Metamorph oses→ silk moth (Adult)



Life Cycle of Frog

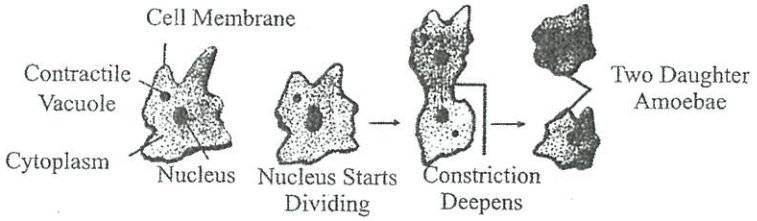
Fig :14.5

Asexual Reproduction in Animals

There are various methods of asexual reproduction:

By Binary Fission

When one mature cell splits into two daughter cells, the process is called binary fission. In binary fission, first the nucleus divides into two nuclei. The cytoplasm then divides into two parts each containing a nucleus. Further stretching leads to the formation of two daughter cells. These cells so formed grow into mature cells and then undergo similar binary fission.



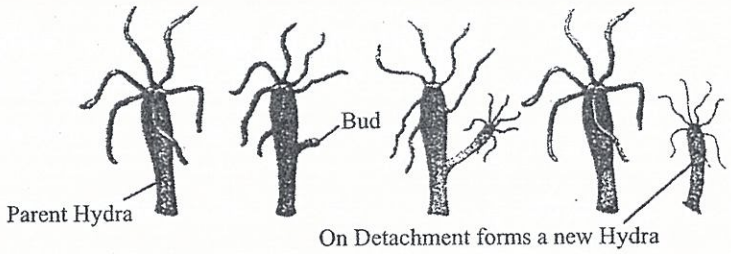
Binary Fission in Amoeba

Fig :14.6

By Budding

In this case of asexual reproduction, the organisms, like hydra, develops a bulge called bud. This bud develops into adults hydra like structure, which then get separated from the parent hydra and leads an independent life.

Another example of asexual reproduction by budding is seen in yeast.

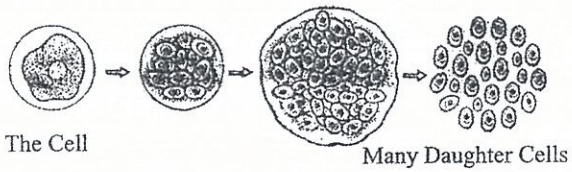


Reproduction in Hydra by Budding

Fig:14.6

By Multiple Fission

When a cell produces many daughter cells, the fusion is called multiple fission. Sometimes, a cyst or a protective coating is formed around the cell. The cell divides many times within the cyst to produce many daughter cells. The cyst is then broken to release many cells.



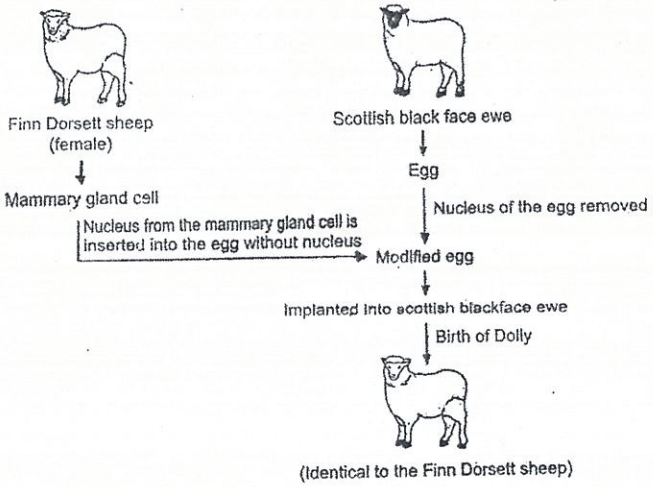
Multiple Fission in Malarial Parasite

Fig:14.7

Cloning

Cloning is the production of an exact copy of a cell, any other living part or a complete organism.

For example: Production of Dolly sheep by Ian Wilmut and his colleagues in Edinburg, Scotland. Cloning is an artificial method invented by man to produce organisms without sexual or asexual reproduction.



A flow Sheet of the Process Applied in Cloning

Fig:14.8

Do You Know?

1. Hydra is a bisexual animal. It produces female organ (ovary) and a male organ (testis) to reproduce by sexual reproduction also.
2. A disease called Cirrhosis is more prominent in men without hair on his chest.
3. During the entire lifetime, a female oyster produces 100 million young ones and a hen lays 19 dozen eggs in a year.
4. Fish, frogs, reptiles and birds do not give birth to young ones.
5. Mammals like, humans, give birth to young ones.
6. Formation of an individual from the zygote is called development.

Key Points

1. The production of new individuals from the parents of the same species is called reproduction.
2. The two modes of reproduction are:
   (i) Asexual reproduction
   (ii) Sexual reproduction.
3. The process of fusion of the sperm and the egg is called fertilization.
4. The animals which give birth to young ones are called viviparous animals.
5. The animals that lay eggs which later develop into young ones are called oviparous animals.
6. Asexual reproduction involves only one parent.
7. Different methods of asexual reproduction are:
   (i) binary fission
   (ii) budding

Multiple Choice Questions

1. Which of the following is a hermaphrodite animal?
   (a) Frog (b) Sheep
   (c) Earthworm (d) Snake
2. Which of these are male reproductive organs in human beings?
   (a) Testes (b) Sperms
   (c) Ova (d) Ovaries
3. Animals reproduce by
   (a) asexual mode (b) sexual mode
   (c) both (a) and (b) (d) vegetative mode
4. Turkey and ostrich reproduces by
   (a) laying eggs (b) giving birth to young ones
   (c) both (a) and (b) (d) none of these
5. Sperm and egg fuse together to form
   (a) Infant (b) Placenta
   (c) Embryo (d) Zygote
6. Animals that give birth to babies are called
   (a) Oviparous (b) Viviparous
   (c) Metapherous (d) Hermaphrodite
7. In _____the offspring grows out of the parent's body.
   (a) Hydra (b) Amoeba
   (c) Paramecium (d) Human
8. The transformation of larva into an adult through drastic changes is called
   (a) Osmoporesis (b) Dialysis
   (c) Metamorphosis (d) Transformation
9. Onset of sexual maturity in human beings is called
   (a) Adolescence (b) Maturity
   (c) Reproduction (d) Puberty
10. _____ reproduction involves the production of new organisms by just one parent.
    (a) External (b) Asexual
    (c) Monosexual (d) Sexual
11. In humans, fertilization occurs in
    (a) oviduct (b) uterus
    (c) ovary (d) vagina
12. Hormones are secreted by
    (a) exocrine glands (b) cells
    (c) endocrine glands (d) tissues

13. The fusion process of sperm and ovum is known as
    (a) Metamorphosis (b) Fertilization
    (c) Reproduction (d) Cultivation
14. Which of the following organisms reproduces by binary fission ?
    (a) Hydra (b) Yeast
    (c) Amoeba (d) Sea anemone
15. In a mosquito, the eggs hatch to produce
    (a) Pupa (b) Larva
    (c) Embryo (d) Adult mosquito
16. Amoeba reproduces by
    (a) budding (b) fragmentation
    (c) binary fussion (d) sexual reproduction
17. Which of these reproduces by budding process?
    (a) Hydra (b) Spirogyra
    (c) Sponge (d) Mushroom
18. In multicellular organisms, development of the embryo occurs by
    (a) cell division (b) cell differentiation
    (c) both (a) & (b) (d) none of these
19. Humans start becoming sexually mature at the age of
    (a) 10 - 16 (b) 3 - 5
    (c) 13 - 18 (d) 25 - 30
20. The baby sheep DOLLY was cloned and developed from a cell taken from the ____ gland of a female sheep, and an unfertilized egg taken from another female sheep.
    (a) Pituitary (b) Endocrine
    (c) Exocrine (d) Mammary
21. Which of the following animals does not show metamorphosis?
    (a) Fish (b) Frog
    (c) silk moth (d) Mosquito
22. The natural process of giving birth to young ones of their own kind is termed as
    (a) production (b) metamorphosis
    (c) reproduction (d) fertilization
23. Which one is the reproductive organ in flowering plants?
    (a) Leaf (b) Flower
    (c) Bud (d) Seed
24. Which of these is a hermaphrodite?
    (a) Flower (b) Bird
    (c) Amoeba (d) Man

25. Flower has the ____ which produces the egg cell and the ___ which produces the male gamete in the same flower.
    (a) stamen, sepal
    (b) pistil, stamen
    (c) stamen, pistil
    (d) pistil, whole
26. Which of these reproduce by external fertilization?
    (a) starfish
    (b) jelly fish
    (c) frog
    (d) all of these
27. Which of these reproduce by internal fertilization?
    (a) Bird
    (b) Whale
    (c) Human
    (d) All of these
28. Which of these is NOT a viviparous animal?
    (a) Goat
    (b) Tiger
    (c) Snake
    (d) Dog
29. How many weeks does it take for an embryo of a hen to develop into a chick?
    (a) one week
    (b) two weeks
    (c) three weeks
    (d) 12 days
30. Which reproduction system is common in flowering plants and humans ?
    (a) Sperm ducts
    (b) Ovary
    (c) Anther
    (d) Style

Answer Key

1. (c)	2. (a)	3. (c)	4. (a)	5. (d)	6. (b)	7. (a)	8. (c)	9. (d)	10. (b)
11. (a)	12. (c)	13. (b)	14. (c)	15. (b)	16. (d)	17. (a)	18. (c)	19. (a)	20. (d)
21. (b)	22. (c)	23. (b)	24. (a)	25. (b)	26. (d)	27. (d)	28. (c)	29. (c)	30. (d)

15. Crop and Management

Learning Objectives

* Crop Plants
* Horticultural Crops
* Crop Seasons
    - Kharif
    - Rabi
* Agricultural Implements
* Basic Practices of Crop Production
*Food from Animal Sources
    - Dairying
    - Poultry
    - Fisheries
    - Apiculture

Crop Plants

"When plants of the same kind are grown and cultivated at one place on a large scale, it is called crop plants or crop." The product of cultivated plants is called crop produce. The main crops grown in India are →

- Cereals (or grain), crops (rice,wheat, maize, barley and ragi)
- Fibre crops (jute, cotton)
- Pulses or legumes (grams, peas, beans)
- Oil seeds (mustard, groundnut, sunflower, soyabean)
- Root crops (sweet potato, carrot)
- Tuber crops (potato, tapioca, ginger)
- Sugar crops (sugarcane, beetroot)
- Plantation crops (coffee, tea, rubber, coconut)
- Fruits [Banana, grapes , guava, vegetables (tomato, cabbage), orange, mango]

Horticultural Crops

"Large scale cultivation of vegetables, fruits and plants is called horticulture and these crops are called horticultural crops. Horticulture is derived from the two words "hortus" means garden, and culture means cultivation.

It has eight areas of study:

(i) **Arboriculture** : It is the study of selection, planting, caring and removal of individual trees, shrubs, vines and other perennial woody plants.

(ii) **Floriculture** : It involves the production and marketing of floral crops.

(iii) **Landscape Horticulture**: It involves the production, marketing and maintenance of landscape plants.
(iv) **Olericulture**: It involves the production and marketing of vegetables.
(v) **Pomoculture**: It involves the production and marketing of fruits.
(vi) **Viticulture**: It involves the production and marketing of grapes.
(vii) **Oenoculture**: It involves the production and marketing of wine and winemaking.
(viii) **Postharvest physiology**: It involves maintaining and preventing the spoilage of horticulture crops.

Crop Seasons

India has two crop seasons:
(i) kharif (ii) Rabi

Kharif Crops

The meaning of the word Kharif is summer or monsoon and the crops are harvested in autumn, i.e., the crops which are sown during rainy season are called Kharif crops. Kharif crop season lasts from June/ July to September/October.

For example, millets, paddy, maize, groundnut, cotton, soyabean, sugarcane and turmeric.

Rabi Crops

It is also known as the spring harvest or winter crops, i.e,the crops which are sown during winters are called Rabi crops. Its season lasts from October/November to March/April. The major crops of this season are wheat, barley, mustard, peas, oats, potato, etc.

Agricultural Implements

"Various tools needed during agricultural practices are called agricultural implements."

Some commonly used implements are :
(i) plough (ii) seed drill (ii) Hoe (iv) khurpa (v) cultivator

Plough: The plough is used for loosening and turning of the soil. Ploughs are made of wood or iron. The tractor driven plough is called cultivator. Nowadays, the ploughs made of iron are being used.

Seed drill: A seed-drill is used for sowing the seeds. The seed-drill sows the seeds uniformly at proper distances and depths. It also covers the seeds with soil after sowing. This prevents the loss of seeds by the action of wind, flowing water, birds, etc.

Hoe: The implement called hoe is used for removing weeds and for loosening the soil.

Trowel (khurpa) and Harrow: Trowel and harrow are used for loosening the soil and removing the weeds simultaneously.

Basic Practices of Crop Production

Various tasks performed by a farmer to produce a good crop are called basic practices of crop production. The basic practices of crop production are:

1. Selection of location and analysis of the nature of soil
2. Preparation of soil

3. Selection of seeds for sowing
4. Irrigation
5. Application of fertilizers and manures
6. Protection from weeds or weeding
7. Protection of crops
8. Harvesting
9. Storage of food grains

Selection of location and nature of soil: For healthy growth, plants need air, sunlight, water and nutrients. Therefore, the most important step in agriculture is the right choice of soil and its location. For this, the important steps are:

(i) The crop field should be open so that sufficient air and sunlight is available to the plants.
(ii) The field should be fenced from all the sides so that stray cattle cannot harm the crop.
(iii) The soil should contain all the nutrients needed by the crop. The soil may be tested for its quality in any soil testing.

Preparation of soil: It is one of the most important aspects of farming, as the soil needs to be prepared for the farming according to the requirement of the crops. Preparation of soil involves the following three steps:

(a) Ploughing (b) Levelling (c) Manuring

Ploughing: The process of loosening and turning up of the soil is called tilling or ploughing.

Ploughing causes ventilation of soil and makes it suitable for the growth of small organisms living in it. Loosened soil help the roots to penetrate the soil easily. It also help in bringing the fertile, nutrient rich soil to the top layer so plant can use it easily.

Traditional ploughs made of wood or iron are driven by animals. Nowadays, ploughing is done with tractor-driver cultivator. The use of cultivator saves labour and time.

Levelling: The ploughed land is levelled and pressed lightly with the help of a wooden plank or iron leveller. This is done to break or crush the dry soil into smaller pieces, protect upper layer of the soil from erosion by wind or water and prevent water logging and promote uniform irrigation.

Manuring: Mixing soil with manure is called manuring. Manure is a mixture of organic substances obtained from the vegetable and animal wastes decomposed by microbes. The manure is added to the soil to make up the deficiency of mineral nutrients.

Some important manures are:

- **Farmyard manure:** It consists of animal dung, straw, leaves, etc.
- **Green manure:** It consists of agricultural waste commonly from the leguminous crops which is phloughed back into the soil.
- **Compost manure:** Compost is made from the cattle-shed wastes, dry leaves, etc.

Selection of Seeds and Sowing

After preparation of soil, seeds are selected. Seeds should be of good quality, disease & resistant and high yield. Seeds are then sown in the field by any of the two methods given below:

By scattering them in the field by hand

This method is called broadcasting.

By using seed drills

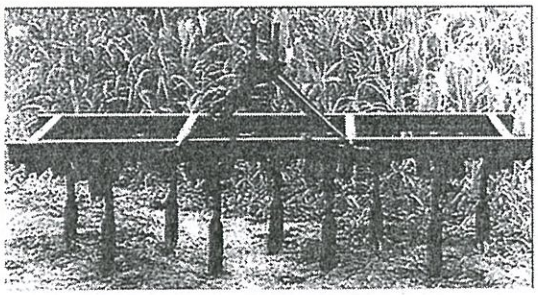
Sowing by using a seed-drill saves time and labour. Seeds are placed in the seed bowl. As the plough moves, it makes furrows in the soil and the seeds are sown.

Most of the crops like wheat, gram, maize, millet, etc., are grown by sowing seeds directly into the soil.

Transplantation

For certain crops such as rice, tomato, onion, chilly, etc., seeds are not directly sown in the main field. In such cases, the seeds are first sown in a small seed bed called nursery.

When the seedlings (new plants) have 4-5 leaves, then the healthy seedlings are transferred or transplanted into the main field. It ensures the selection of better and healthy seedlings for the unification of crops.



A Seed Drill

Fig:15.1

Irrigation

The watering of crops at different intervals is called irrigation. The time and frequency of irrigation vary from crop to crop, soil to soil and season to season.

Sources of irrigation

There are many sources of irrigation such as:

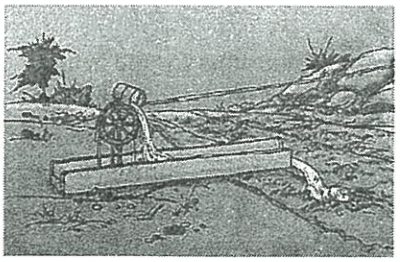
- Wells and tube wells
- Ponds, lakes and rivers
- Dams and canals

Methods of irrigation

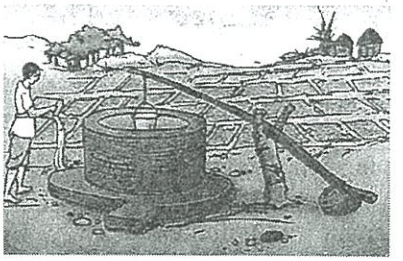
Various methods of irrigation can be classified into the following two classes:

(i) Traditional methods of irrigation (ii) Modern methods of irrigation

(i) **Traditional methods of irrigation:** Traditional methods of drawing water from wells or lakes involve the use of chain pumps, pulley systems (MOAT), lever systems (dhekli) or water wheels driven by cattle (rahat) etc. This water is taken to the fields for irrigation.



(a) *Chain Pump*

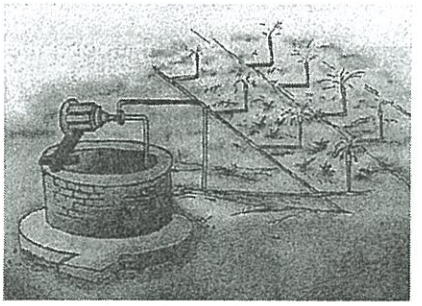


(b) *Dhekli*

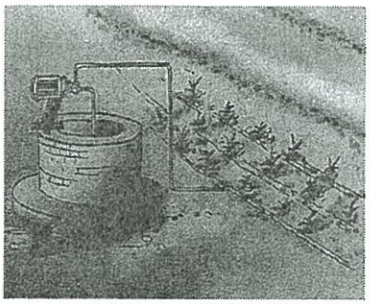
Fig:15.2

(ii) Modern methods of irrigation: Some modern mewthods of irrigation are :

- **Sprinkler system:** This system of irrigation is more useful for uneven dry lands. In this method, a network of pipes is attached to a main pipe line. Each pipe has a ro tating sprinkler nozzle attached. Water pumped through the main pipe line escapes these nozzles at high speed under high pressure and is sprayed all over the crops.
- **Drip system :** In this method, water falls drop by drop near the roots of the plants.This method is used in areas where water is scarce. This method is used for fruit and flower plants.
- **Lift irrigation system:** Sometimes, in some places water cannot be provided to the fields as the level of the field is higher than that of source of water. In such places, a lift irrigation scheme is installed to lift water for irrigation purposes from rivers, canals and surface water bodies. It requires construction of an intake well which in turn sup plies water through an intake pipe.



Sprinkler System



Drip System

Fig:15.3

- Water-logging: When excess of water is supplied to the soil, it becomes wet. Water accumulates around the plant, this is called excessive irrigation or water-logging. It is very harmful to the plant in the following ways:
  (i) Water logging increases the amount of salts in the soil and damages the soil fertility.
  (ii) Excess water and wet soil do not permit proper aeration to the seed and root of the plants.

Application of Fertilizers and Manures

The substances which are added to the soil in the form of nutrients for the healthy growth of plants are called manures and fertilizers. Manure and fertilizer are used to maintain the fertility of the soil.

A fertilizer is a man-made inorganic compound or a mixture of compounds which add specific nutrients to the soil. Examples are urea, sulphur phosphate and NPK (nitrogen, phosphorus, potassium). Excess use of fertilizers causes the soil to be highly acidic or alkaline making it less fertile. It also causes water and soil pollution.

Protection from Weeds or Weeding

Weeds are unwanted plants that grow along with crops and compete with them for air, water and sunlight. This can result in a decrease in crop yield. Amaranths and cynodon (doob grass), chenopodium, grass, wild (javi) oat are some common weeds. Some weeds may by poisonous for animals and humans too.

The process of removing weeds is called weeding. It may be done in the following two ways:

Manual weeding

Manual weeding is the removal of weeds by uprooting them manually or cutting them close to the ground with a khurpa or trowel. This is done during tilling of the land.

Using weedicides

Weedicides are chemicals used to kill weeds. The chemicals are diluted with water and sprayed over the field.2,4-D(2,4- dichlorophenoxy acetic acid),MCPA(2– methyl, 4 – chloro,1– phenoxy acetic acid) and butachlor are examples of weedicides.

Protection of Crops from Birds, Animals and Diseases

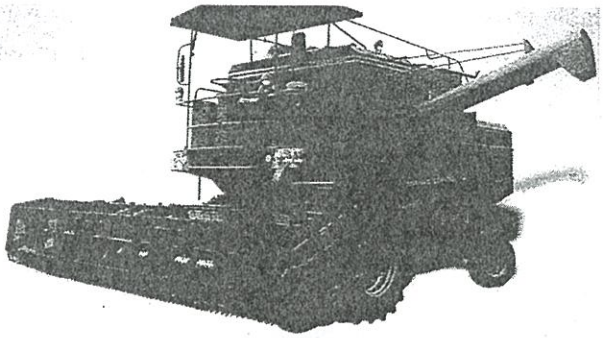
Crops are to be protected from animals, birds and pests (insects and rodents). This is done in the following ways:

- Crops can be protected from stray animals by putting up a fence all around the field.
- Birds can by scared away from the field by beating drum or with the help of a scarecrow.
- Plants are also damaged by diseases caused by fungi, viruses and bacteria. Plants can be protected from disease by using the following methods:
- By sowing disease-resistant variety of seeds
- By treating seeds with fungicides before sowing
- By spraying insecticides, pesticides or fungicide on the plants with the help of sprayers

Note: Pesticides kill pests but do not harm the plants, the chemicals which can kill only insects are called insecticides. Some common insecticides are BHC (gammaxene), malathion , dimecron and polythion.

Harvesting

The process of cutting (reaping) and gathering of a matured crop is called harvesting. The harvested grains are called crop produce or crop yield, the process of separating grains from the harvested crop is called threshing.



Combine

Fig:15.4

After threshing the grains are to be separated from the chaff and hay, the process of separating grains from the chaff and hay with the help of wind is called winnowing. Harvesting is done either manually with a sickle or using a machine called combine or harvester. Combine can also be used in threshing.

Storage of Food Grains

Before the food grains are stored, they are dried in the sun to remove the excess moisture. The dried food grains are then stored in a suitable storage.

(i) On the domestic level, food grains are stored in small containers made of tin coated iron or mud/ clay.

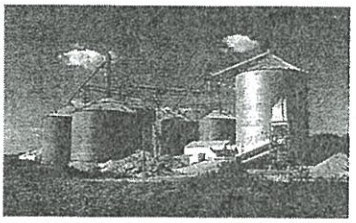
(ii) On commercial scale, food grains such as wheat, rice, gram etc. are stored either in gunny bags or in grain silos.

The gunny bags filled with the food grains are stacked in a large godown about 60-70cm away from the walls, and on the wooden platforms about 10-15cm above the ground. Pathways (called alleys) for inspection or fumigation are provided in between the stacks.

When the quantity of food grains is large, then it is stored in grain-silos.

Grain-silos are specially designed, tall cylindrical storage. These silos can store different stocks of food grain at different levels, the required food grain can be taken out from the openings provided in these silos.

(a) ***Storage in Open using Gunny Bag Covered with Plastic Sheets***



(b) ***Grain Storage in Grain-silos***

Fig:15.5

In cold storage, perishable food materials can be stored safely at low temperature. Lowering of temperature helps in increasing their shelf-life due to the following reasons.

- Low temperature slows down the growth of bacteria, yeast and moulds, and inhibits the action of enzymes present in the food material.
- Low temperature helps the food materials to retain their nutritive value.

At homes, the perishable food materials are stored in an ice box or in a refrigerator.

On commercial scale, the perishable food materials are stored in either deep freezers or cold storages.

Buffer stock of food : "The huge reserve stock of food grains built by the government by purchasing food grains from the farmers is called buffer stock of food grains. It is for emergency requirements. Such buffer stock also helps to maintain price-line of the food grains in the open market.

Food from Animal Sources

The rearing of animals on large scale for food is called animal husbandry. Plants and animals are the major sources of our food.

- **Dairying**: Rearing of cattle for producing milk and milk products on a large scale is called dairying. Most of the food obtained from animals contain very little of car bohydrates but a good amount of fat. Milk yielding animals or milch animals include cow, buffalo, goat, sheep, etc.
- **Poultry:** Rearing and breeding of poultry for eggs and meat is called poultry farming. Poultry includes birds like chicken, hen, ducks, geese etc.
- **Fisheries:** The production of fish on a large scale by farming fish culture in fish nurseries is known as pisciculture.
- The fish which breeds in seawater is termed marine fish, whereas the fish which breed in water bodies such as pond, river, lake, etc., is called freshwater fish. Fish liver oil is rich in vitamin A & vitamin D.
- **Apiculture:** The rearing of honey-bees on large scale is called apiculture.
- Honey is produced by honeybee from the nector of flowers and kept in beehive.
- Life cycle of honeybee lasts for 16 days and has four stages :

$$\text{Egg} \xrightarrow{(3\,days)} \text{Larva} \xrightarrow{6\,days} \text{Pupa} \xrightarrow{7\,days} \text{Honeybee}$$

Key Points

1. Agriculture is a process of production of food on a large scale to fulfill the needs and requirement of the growing population.
2. There are two crop seasons-kharif and Rabi.
3. The soil should be prepared well before sowing of seeds.
4. Seeds should be sown at the proper depth so that they get sufficient amount of sunlight and water.
5. Water should be supplied at regular intervals to fulfil the requirement of the crops. It is known as irrigation.
6. Removal of unwanted plants from the crops is necessary in order to facilitate the proper growth and development of the crops.
7. Harvesting and gathering of crop should be done after the crop is fully matured.
8. Separation of grains from chaff is known as threshing.
9. Food materials obtained from the animals and animals reared for this purpose is known as animal husbandry.

Multiple Choice Questions

1. Which of these is not a kharif crop?
   (a) rice (b) maize
   (c) wheat (d) ground nut
2. Anil added some material from the packets to the beakers containing moist soil and gram seeds. Only the seeds of one beaker showed fast growth. The material added is
   (a) fertilizer (b) manure
   (c) soil (d) water
3. Ploughing is done for
   (a) harvesting (b) preparation
   (c) weeding (d) irrigation
4. Which one of these is not a type of fertilizer?
   (a) nitrogenous fertilizer (b) phosphate fertilizer
   (c) potassic fertilizer (d) none of these
5. What is the full form of FYM ?
   (a) Farm yield manure (b) Foreign yard manure
   (c) Farm yard manure (d) Full yield manure
6. Which crop is cultivated by transplantation method of sowing?
   (a) paddy (b) wheat
   (c) maize (d) barley
7. ——— crops are the plants that are grown for producing products that are the sources of income for an economy.
   (a) Food (b) Cash
   (c) Ragi (d) Kharif
8. Which one of these is a cash crop?
   (a) Sugarcane (b) Oil seeds
   (c) Jute fibre (d) All of these
9. Tomatoes are cultivated by the practice called
   (a) Transpiration (b) Translocation
   (c) Transportation (d) Transplantation
10. The crops grown in India in *rainy season* are called
    (a) rabi crops (b) kharif crops
    (c) zayed crops (d) food crops
11. The crops that are grown in India in *winter and summer season* are alled
    (a) Zayed crops (b) Rabi crops
    (c) Kharif crops (d) Cash crops
12. The crops that are grown in India in summer season are called
    (a) Zayed crops (b) Hot crops
    (c) Rabi crops (d) Kharif crops

13. Which one of these does not belong to group?
    (a) Weed
    (b) Insect
    (c) Urea
    (d) Fungus
14. Which of these is not a fungal disease of plants?
    (a) Rust
    (b) Wilt
    (c) Smut
    (d) Blight
15. Which of the flouring machines can be used to harvest a crop and also to beat out the grain from the chaff?
    (a) Harvester
    (b) Combine
    (c) Thresher
    (d) Harrow
16. Which of these is NOT true about ploughing?
    (a) It loosens the soil.
    (b) It prevents soil erosion.
    (c) It aerates the soil.
    (d) It allows easy penetration of roots into the soil.
17. Separation of healthy seeds of wheat from unhealthy seeds can be done by
    (a) water
    (b) using threshing
    (c) putting seeds in water
    (d) winnowing
18. When seeds of wheat are pat in water, the healthy seeds will
    (a) sink to the bottom
    (b) float on the top
    (c) float in centre
    (d) none of these
19. The two crops which are not grown by sowing their seeds directly into the soil in large fields are
    (A) Peas
    (B) Tomatoes
    (C) Chillies
    (D) Maize
    (a) A & B
    (b) B & C
    (c) A & C
    (d) Only C
20. The unwanted plants that grow along with the main crop in the field are called
    (a) Cereal
    (b) Tiny creeds
    (c) Weedicides
    (d) Weeds
21. Compost lacks which of the following nutrients?
    (a) Nitrogen
    (b) Phosphorous
    (c) Potassium
    (d) All of these
22. Compost is rich in
    (a) Organic
    (b) Nitrogen
    (c) Potash
    (d) Urea
23. A traditional method of sowing by scattering is called
    (a) Spreading
    (b) Broadcasting
    (c) Telecasting
    (d) Threshing

24. Separation of grains from chaff is the process called
    (a) Broadcasting
    (b) Threshing
    (c) Winnowing
    (d) separation

25. Ammonium phosphate is a fertilizer of which type?
    (a) Nitrogenous fertilizer
    (b) Phosphatic fertilizer
    (c) Potassic fertilizer
    (d) Organic fertilizer

26. The tender green plants of certain types (leguminous) are ploughed into the soil. The manure formed is called
    (a) reen manure
    (b) FYM
    (c) Compost
    (d) Fertilizer

27. Which of these is the traditional method of irrigation still used in some poor villages of India?
    (a) Basin
    (b) Drip
    (c) Moat
    (d) Sprinkler

Answer Key

1. (d)	2. (a)	3. (b)	4. (d)	5. (c)	6. (a)	7. (b)	8. (d)	9. (c)	10. (b)
11. (b)	12. (a)	13. (c)	14. (b)	15. (a)	16. (b)	17. (c)	18. (a)	19. (d)	20. (d)
21. (d)	22. (a)	23. (b)	24. (c)	25. (b)	26. (a)	27. (c)			

16. Conservation of Plants and Animals

Learning Objectives

* Deforestation and its Causes
* Consequences of Deforestation
* Forest - A Renewable Natural Resource
* Conservations of Forests and Wildlife
*Biosphere Reserve
* Ecosystem
* Flora and Fauna
* Endemic Species
* Wildlife Sanctuary
* National Park
* Species Categorised under World Conservation Union (WCU)
* Red Data Book
* Migration
* Recycling of Paper
* Reforestation

The nature has provided us with abundant natural gifts also called natural resources e.g. water, air, land, forests etc. While water, air and land support life, forests and wild animals add to the beauty of nature.

Deforestation and its Causes

The large scale cutting of trees and clearing of forests is called deforestation. Trees in the forest are cut for the following purposes:

(i) Building houses and factories
(ii) Procuring land for cultivation
(iii) Making furniture or using wood as fuel

Some natural causes of deforestation are forest fires and severe droughts.

Consequences of Deforestation

Deforestation may lead to several consequences

(i) Lesser rainfall, resulting in the lowering of water table
(ii) A rise in temperature leading to global warming
(iii) Danger to wild life
(iv) Increased air pollution and soil erosion.
(v) Increased changes of natural calamities such as floods due to soil erosion and droughts due to lesser rains.

Forest – A Renewable Natural Resource

Forests have a wide variety of plants and trees. These are one of the most useful renewable resources available on the earth. They are very useful to us because they

- control floods
- help in replenishing ground water
- provide many medicinal plants, fruits and berriers
- purify the air and control air pollution
- provide many products which are the source of steady income of tribal people living in that area
- avoid soil erosion and maintain fertility of the soil
- provide many useful materials such as wood, rubber, gum, resin, edible oils, kattha, honey, bamboo, honeybee wax, lac etc.

Conservation of Forest and Wildlife

Some of the ways in which forests can be conserved are given below:

Laws to conserve forests

The Forest (Conservation) Act aims at preserving and conserving natural forests and meeting the needs of people living in or near the forests.

Reforestation

Reforestation is the act of planting more trees to replace the cut ones. It can happen naturally if the deforested area is left undisturbed.

(a) Reforestation may take place naturally also.

(b) While replacing the destroyed trees, the trees of the same species should be planted.

Reduce, Recycle and Reuse (3 R's)

By reducing our usage of paper, we can save many trees in a year. Paper can also be reduced and recycled. By doing this, we save our forests as well as conserve water and energy.

Discourage Killing of Animals

We should not buy animal parts such as bones, teeth, feathers of wild animals, as by doing so we encourage the killing of these animals.

Conservation Programmes

Some organizations help in conservation of forests through their projects, programmes and joint efforts with the government. One such famous conservation programme started by the government of India is known as the Van Mahotsave Programme. It is celebrated every year during the first week of July when thousands of saplings of different plant species are planted all over the country.

Under the 1972 Wildlife (protection) Act, our government has created and protected areas like National Parks, Wildlife Sanctuaries and Biosphere Reserve.

Biosphere Reserve

Biosphere reserve is a protected area to conserve biodiversity. A special feature of biosphere reserve that local people or tribal are integral part of it. Twelve biosphere reserves setup in our country are:

(i) Nilgiri (ii) Nokocok (iii) Gulf of Mannar (iv) Simlipal (v) Great Nicobar (vi) Nanda devi (vii) Dibru Salkhowa (viii) Debong Deband (ix) Sunderbans (x) Manas (xi) Pachamarhi (xii) Kanchanjung.

A biosphere reserve may also contain other protected areas in it, for example, the Pachmarhi Biosphere Reserve consists of:

(i) One natural park name Satpura.

(ii) Two wildlife sanctuaries named Bori and Pachmarhi.

A biosphere reserve is divided into 3 zones :

1. The innermost (core zone)
   - Strict protection of wildlife
   - No economic or human activity is allowed
2. Middle zone (buffer zone) : only limited, human activity (research tourism education) is allowed
3. Outermost zone (transition zone) : Several non destructive human activities (settlements) of bubals, crop cultivation) allowed.

Ecosystem

A self sustaining functional unit of biosphere consisting of living (biotic) and nonliving (abiotic) components are called an ecosystem.

Biotic components of an ecosystem are: plants, animals, microorganisms, humans etc.

Abiotic components of an ecosystem are: air, sunlight, minerals, temperature, rainfall etc.

All ecosystems are interconnected and inter-related.

The functions of an ecosystem are:

- Fixation of solar energy
- Transfer of matter and energy from producers (plants) to consumer

Flora and Fauna

Plants and animals in a particular area are called flora and fauna of that area.

The flora and fauna of Pachmarhi biosphere reserve are:

Fauna: Chinkara, Blue Bull, Barking Deer, Cheetal, Wild Dog etc.

Flora: Sal, Teak, Mango, Jamun, Silver ferns, Arjun etc.

Endemic Species

The species of plants and animals which are found exclusively in a place or biota are called the endemic species.

An endemic species is unique to that place or region and is not found naturally anywhere else.

The endemic species of Pachmarhi biosphere reserve are:

(i) Endemic Flora: Sal, wild mango.

(ii) Endemic Fauna: Bison, Indian giant squirrel, Flying squirrel.

Wildlife Sanctuary

An area which is strictly reserved for the protection of wild animals in their natural environment is called a wild life sanctuary. It aims only at conservation of species. There are more than 500 wild life sanctuaries in our country. The wild life sanctuaries have the following features:

1. The boundary of a sanctuary is not limited by state legislation.
2. The killing, hunting or capturing of any species is prohibited.
3. Private ownership may be allowed to continue in a sanctuary.
4. Forestry and other activities may be permitted, but to the extent that they do not affect wildlife adversely.

National Park

A national park is a large area dedicated to conserve the environment, its natural resources and the wildlife therein. In a national park,

- private rights are non existent.
- visitors are allowed to enter only for study, cultural and recreative purposes.
- forestry operations, grazing of animals and hunting of animals are prohibited.
- exploitation of habitat or wildlife is banned.

There are 89 national parks in our contry. The national park at Satpura is the first reserve.

Forest of India

Satpura Tiger Reserve was developed to ensure the survival and maintenance of the tiger population in country.

Some well known national parks and sanctuaries in our country are:

1. Jim Corbett national park, Uttarakhand (Tiger)
2. National Botanical garden, West Bengal (rare species of plants)
3. Kanha national park, M.P. (Tiger)
4. Nandon Kanan Biological park near Bhubaneshwar (captive breeding of white tiger)
5. Baratpur Bird Sanctuary, Rajasthan (winter home of migratory birds, most commonly Siberian crane)
6. Madumalai sanctuary Tamil Nadu (Indian elephant)
7. Sultanpur Lake bird Sanctuary, Haryana (Birds)
8. Bandipur Sanctuary, Karnataka (Indian elephant)
9. Sasan Gir Sanctuary, Gujarat (Asiatic lion, chital sambhar)
10. Similipal biosphere reserve, Orissa (Tiger)
11. Sariska National Park, Rajasthan (Tiger)
12. Kaziranga National Park, Assam (One-horned Rhinoceros)
13. Satpura National Park (Madhya Pradesh)
14. Dachigam National Park (Tiger)
15. Ranthambore National Park (Rajasthan)

Species Categorized under World Conservation Union: (WCU)

The international union of conservation of nature and natural resources (IUCN) presently called WCU (world conservation union) has classified species of plants and animals into the following categories:

Endangered Species

Any species in danger of extinction and whose survival is unlikely if the causal factors continue operating is called endangered species.

Examples: Tiger, Elephant, Rhinoceros, Indian wild ass, snowleopard, Asiatic Lion, Desert cat, Lion –Tailed macaque, Kashmir stag, Namdapha flying squirrel

Vulnerable Species

The species which are likely to move into the endangered category in the near future, if the casual factors continue operating are called vulnerable species.

For example: golden langur, chinkara deer, blood pheasant

Rare Species

Species with small population that are not at present endangered but are at a risk of becoming so, because of their small population.

Example: Pig tailed macaque, snow leopard, hornbill.

Threatened Species

The endangered species, vulnerable species and rare species are collectively called threatened species.

Extinct Species

The species which no longer exist any where, e.g., Dinosaur, Dodo, Cave lion ,Caspian figer and lrish dur.

Project Tiger

Till the year 1910, India had a huge population of tigers counted to about 40,000. However, due to excessive hunting and deforestation their number came down to only 1920 in the year 1973. Realizing this, the Central Government of India with support from world wide fund (WWF) set up a project called Project T ger in 1972. Its objective was to increase their population by developing reserved areas.

Initially, nine tiger reserves were identified in different parts of the country. Subsequently, the number of tiger reserves was increased to 27 to preserves the key species.

Red Data Book

It is a source book which keeps a record of all endangered animals and plants. Separate data book for plants, animals and other different species are being maintained.

The first red data book of animals was published in 1991. Through this book IUCN (International Union of Conservation of Nature and Natural Resources), presently WCU i.e. (Word Conservation Union), is trying to create awareness about the endangered species.

Migration

The seasonal movement of animals from one habitat to another to over come unfavorable conditions is called migration. Animals migrate between their wintering and breeding habitats. Common migrating creatures are whale, fish, butterflies, turtles and birds.

Migrating birds follow established migratory routes.

One of the most common migrating bird which comes to India every year for a few months is the Siberian crane.

Why do birds migrate?

Birds migrate from one place to another for the following reasons:

(i) To escape from the inhospitable climate.

(ii) To enable themselves to find plenty of food throughout the year.

For example:

(i) In winter when food sources are limited in northern areas, birds fly towards south where the weather is mild and food is in plenty.

(ii) To lay their eggs in more hospitable place.

Recycling of Paper

Trees are used in making papers. About 17 full grown trees, are used to make one tonne of paper. So wastage of paper is also a cause of deforestation. Therefore, we should recycle and save the papers. If we save papers, we can save many trees in a year. In this way recycling and saving of papers is directly related to avoid the deforestation.

Reforestation

Redevelopment of forests by planting more trees in place of the trees destroyed is called reforestation.

Do You Know

1. A biosphere reserve is much larger than any national park or a sanctuary.
2. The plants and animals found in Pachmarhi Biosphere Reserve are similar to those found in upper Himalayan mountains and in the loer Western Ghats.
3. The species of plants and animals which have been lost for ever are called extinct species. For example, Brahmkamal and Sarpgandha plants have become extinct.
4. If the deforested area is left undisturbed, it gets developed on its own in due course.

Key Points

1. Biodiversity, or biological diversity, denotes the number and variety of different organisms and ecosystems in a certain area.
2. Deforestation means large-scale removal of forest prior to its replacement by other land uses.
3. The greatest threat to biodiversity is loss of habitat as humans develops land for agriculture, grazing livestock, industry and habitation.
4. Protected areas are areas of land or sea especially dedicated to the protection and maintenance of biodiversity.
5. Zoological gardens or parks and zoos are places where the wild animals are kept in a protected environment.

Multiple Choice Questions

1. Project tiger was launched in India in
   (a) 1989 (b) 1970
   (c) 1973 (d) 1998
2. The plants found in a particular region are called
   (a) Flora (b) Fauna
   (c) Species (d) Local plants
3. If all trees in a forest are cut, it will lead to
   (a) erosion of soil (b) desertification
   (c) both (a) and (b) (d) none of these
4. Cattles should be stopped from _____ in order to conserve forests.
   (a) overgrazing (b) wandering
   (c) eating grass (d) all of these
5. Which one of these is not included in wildlife?
   (a) elephant (b) leopard
   (c) horse (d) lion
6. Which one of the following is not a conservation category of wildlife?
   (a) extinct (b) endangered
   (c) endemic (d) vulnerable
7. Wildlife conservation in natural habitats is done in
   (a) sanctuaries (b) national parks
   (c) biosphere reserves (d) all of these
8. Wildlife in India is diverse because of diverse
   (a) species (b) habitat
   (c) culture (d) climate
9. Which of these is not caused by deforestation?
   (a) desertification (b) global warming
   (c) storms (d) reduction in groundwater
10. If all animals disappeared from an area, they are called
    (a) extinct (b) endangered
    (c) vulnerable (d) endemic
11. Total number of national parks in India are
    (a) 15 (b) 25
    (c) 55 (d) 89
12. Which of these animals is an endangered species?
    (a) tiger (b) elephant
    (c) peacock (d) monkey

13. Dodo is a/an
    (a) endangered species
    (b) extinct species
    (c) vulnerable species
    (d) critically endangered species
14. WWF stands for
    (a) world wide fund
    (b) wild world forest
    (c) world wild fund
    (d) world wresting foundation
15. WWF works in the field of
    (a) wildlife conservation
    (b) forest conservation
    (c) child labour abolition
    (d) water conservation
16. Different species are classified into different threat categories for different countries in the book named
    (a) yellow data book
    (b) blue data book
    (c) red data book
    (d) green data book
17. Which of these is endangered animal?
    (a) dodo
    (b) Asiatic lion
    (c) gorilla
    (d) Sikkim stag
18. In India, Asiatic lions are found in
    (a) Gir forest
    (b) Sunderbans
    (c) Sahara Desert
    (d) Assam
19. The flora and fauna of a country are among the most important ___ natural resources.
    (a) renewable
    (b) non-renewable
    (c) perishable
    (d) exhaustible
20. Species which are confined to a restricted area on the earth are known as
    (a) epidemic species
    (b) endemic species
    (c) geographical species
    (d) local species
21. A large protected area, set aside for conservation of wildlife, plants and animal species and the traditional life of the tribals living there, is termed as
    (a) Biological reserve
    (b) Botanical reserve
    (c) Geographical reserve
    (d) Biosphere reserve
22. The National Park which is located in Rajasthan is:
    (a) Corbett National Park
    (b) Kanha National Park
    (c) Satpura National Park
    (d) Sariska National Park
23. Animals that begin to die, as they cannot adjust themselves to environmental changes, resulting in their population becoming very small, are called as
    (a) extinct
    (b) endangered
    (c) critically endangered
    (d) vulnerable

24. Forests can be conserved by way of
    (a) planned harvesting of trees
    (b) afforestation and control of overgrazing
    (c) protection from fire, pests and insect
    (d) all of these
25. Wildlife can be conserved by
    (a) habitat preservation
    (b) building wildlife sanctuaries
    (c) implementing hunting regulations
    (d) all of these
26. The wide range of different animal species, plants, grass, birds in an area constitute ____ of that area.
    (a) biodiversity
    (b) biosphere
    (c) flora and fauna
    (d) both (a) and (c)
27. Illegal hunting of animals are called
    (a) encroaching
    (b) poaching
    (c) phishing
    (d) hunting
28. IUCN stands for
    (a) international unity of conserving nature
    (b) internation union for cultivating nature
    (c) international union for conservation of natural resources
    (d) internation union for controlling natural hazards
29. Which of the following wild animals is not listed in the Red Data Book in India?
    (a) Black bunch
    (b) Flying squirrel
    (c) Tiger
    (d) Leopard
30. Which organization maintains a Red List?
    (a) UNO
    (b) WWF
    (c) IUCN
    (d) Red Book Society

Answer Key

1. (c)	2. (a)	3. (c)	4. (a)	5. (c)	6. (d)	7. (d)	8. (b)	9. (c)	10. (a)
11. (d)	12. (a)	13. (b)	14. (a)	15. (a)	16. (c)	17. (b)	18. (a)	19. (a)	20. (b)
21. (d)	22. (d)	23. (b)	24. (d)	25. (d)	26. (d)	27. (b)	28. (c)	29. (b)	30. (c)

17. Pollution of Air and Water

Learning Objectives

* Pollution
* Pollutant
* Types of Pollution
* Effects of Air Pollution (Green House Effect)
* Prevention of Air Pollution
* Acid Rain
* Case Study - The Taj Mahal
* Water Pollution
* How does Water get Polluted?
* Harmful Effects of Water Pollution
* Prevention of Water Pollution
* Conservation Of Water
* What is Portable Water and how is Water Purified ?

Pollution

"The contamination of environment with harmful (toxic and poisonous) substances due to certain natural phenomena and human activities is called environmental pollution or simply as pollution."

Pollutant

Any substance that causes pollution is called a pollutant. When the concentration of pollutant increases, it becomes harmful for the environment.

For example: All fertilizers are helpful in increasing the crop yield but when used in excess, they contaminate ground and surface water.

Types of Pollutants

Gaseous Pollutants

All pollutants which are in the gaseous state under normal condition are called gaseous pollutants.

Example: Oxides of sulphur and nitrogen, chlorine gas, and carbon monoxide, etc.

Particulate Pollutants

Very small particles of solid and liquid suspended in air are called particulates.

Some common particulates present in the air are dust, smoke, fume, mist, fly ash, pesticides, insecticides, cement. dust, asbestos dust, pollen grains, etc.

The two metals, lead and mercury are very harmful for human beings. The inhalation of such particles cause 'scarring' or 'fibrosis' of the lung leading to disease called 'pneumoconiosis'.

Nonbiodegradable Pollutants

"The substances which are not broken down to simpler and harmless substance by the action of water, soil and/or enzymes are called nonbiodegradable substances."

Substances such as metallic oxides - particulate of mercury, lead, arsenic etc., insecticides, pesticides, DDT etc. are all nonbiodegradable pollutants.

These are very serious pollutants.

Biodegradable Pollutants

"The substance which are broken down to simpler and harmless substance by the action of water, soil or enzyme etc. are called biodegradable." Organic pollutants are biodegradable.

Types of Pollution

Pollution can be classified into the following types:

1. Air pollution
2. Water pollution
3. Soil (or land) pollution
4. Noise pollution

Air pollution

"The contamination of air by harmful toxic gases, smoke and dust etc. is called air pollution."

The substances which cause pollution of the air are called air pollutants.

Air pollutants may be of two types:

- Gaseous air pollutants: -

  Examples: Oxides of sulphur, sulphides, vapour of organic solvents and acid fumes.

- Solid air pollutants:

  Examples: Smoke, dust, cement, Asbestos, lead oxide, mercury, unburnt hydrocarbons.

Harmful effects of air pollutants: The harmful effects of air pollutants depend on the type of air pollutant and is as follows.

Oxides of sulphur (SO_2 SO_3): Oxides of sulphur are highly suffocating. Its lower concentration causes irritation in the throat and higher concentration increases mucus formation.

Oxides of nitrogen (NO): Oxides of nitrogen cause lung congestion, and produce smog. These gases also contribute to acid rain.

Carbon monoxide (CO): Carbon monoxide is a highly poisonous gas. Carbon monoxide combines with haemoglobin and decreases its oxygen - carrying capacity. As a result blood becomes oxygen - deficient causing unconsciousness or death.

Chlorofluorocarbons: Chlorofluorocarbons are used in sprays, shaving foams and as refrigerant in old model refrigerators and air conditioners. CFC damage the ozone layer present in the upper atmosphere. As a result, animals and vegetation on the earth are getting badly affected.

Vapour of organic solvents: Organic solvents such as thinner, are used in paints and varnishes. The vapour of such solvents cause irritation in eyes, nose and throat.

Hydrogen sulphide: (H_2S) Hydrogen sulphide gas has a smell of rotten eggs. It is poisonous. If inhaled in large quantity, it causes headache in human beings. Many animals are also affected by it.

Particulate Matter

Particular matter in the air causes many respiratory problems in human beings like:

(i) Particles of lead oxide present in the automobile exhaust can cause brain damage in children.

(ii) Particles of mercury cause a disease called **minamata.**

(iii) Asbestos fibre causes a disease called **silicosis** or asbestosis.

1. Suspended particulate matter (SPM) – They are finely divided solid or liquid particulates suspended in air due to smoke or dust.
2. **(a) Dust :** consist of tiny particles of earth. They produce allergic reactions in human body and diseases like bronchitis.

   (b) Smoke: Is mainly particles of carbon in air. Smoke attacks lungs and causes respiratory diseases

   (c) The minute ash particles formed by burning of coal carried in to air by the gases produced during burning, is called fly ash.

Effects of Air Pollution: (Green House Effect)

Burning of fossil fuels produce large quantity of carbon dioxide. The increased concentration of carbon dioxide in the air has resulted in an increase in the earth's temperature. Due to presence of CO_2 layer around the earth, it allows sun's heat rays to be trapped within the earth's atmosphere the CO_2 cover allows shorter wavelength heat rays from the sun to enter earth surface but does not allows the longer wavelength heat rays to go out resulting in green house effect. This phenomenon of rise in temperature due to the increased concentration of carbon dioxide in the air is called green house effect. It leads to global warming.

Harmful effects of global warming

(i) Change in the pattern of crop cultivation.

(ii) Affect the mansoon rains adversely.

(iii) Melt the polar ice. This melting of ice will raise the level of water in seas and oceans.

As a result, many low - lying areas will get submerged under the water.

The green house effect / global warming can be reduced by

(i) Planting more trees (afforestation)

(ii) Reducing the consumption of fossil fuels.

Prevention of Air Pollution

Air pollution can be prevented by the following steps:

Planting Trees

Trees absorb excess carbon dioxide and also help in reducing the dust particle in air.

Proper Maintenance of Automobiles

Regular pollution check should be done for all automobiles.

Use of Proper Fuels for Automobiles

Addition of lead to petrol makes petrol burn with less smoke and fumes, but it increases the amount of lead in the atmosphere. So, the use of unleaded petrol or less polluting fuels suit in CNG (Compressed natural gas) is preferable. The exhaust gases in vehicles should be passed through a **catalytic converter**. A catalytic converter converts harmful carbon monoxide and nitrogen oxides to harmless carbon dioxide, nitrogen dioxide and water.

By replacing wood, coal and kerosene with LPG for domestic use, we can reduce air pollution to a large extent.

Acid Rain

The burning of fossil fuels containing sulphur, nitrogen and carbon produces acidic oxides of these elements. Carbon dioxide and oxides of carbon, dissolve in water droplets to produce carbonic acid (a weak acid.

The oxides of sulphur and nitrogen react with water to form sulphuric acid (H_2SO_4) and nitric acid (HNO_3) respectively.

These acids come down to earth with rain water.

Carbonic acid is not a major component of acid rain because it is not as soluble in water as the oxides of sulphur and nitrogen.

"The rain water containing dissolved oxides of sulphur and nitrogen is called acid rain."

Damaging effects of the acid rain:

- Acid rain damages the nutrition level of leaves of the plants.
- Acid rain promotes corrosion of metallic structures, such as railway bridges etc.
- Acid rain leads to the loss of soil fertility.
- Acid rain harms the aquatic life i.e. it kills fish and other marine animals and plants.
- Acid rain damages the structures made of marble, cement and /or of lime i.e. historical monuments such as Taj Mahal.

Case Study - The Tajmahal

Discolouring of the white marble of Taj Mahal is due to the oxides of sulphur and nitrogen released by the industrial units around it and by Mathura Refinery. These oxides react with water vapour in the atmosphere forming sulphuric acid and nitric acid. These acids come down as acid rain and corrode the marble of the monument.

Water Pollution

Water pollution is degradation of the quality of water either due to addition of undesirable substances or removal of desirable substances that makes it unfit for use by humans, animals, industries and growth of natural biodata.

How does water get polluted?

The main reasons for the pollution of water in the rivers and lakes are:

(i) Discharge of toxic industrial wastes into rivers and lakes.

(ii) Excessive use of fertilizers and pesticides in agriculture.

(iii) Discharge of untreated domestic sewage into rivers and lakes. The untreated sewage contains food wastes, detergent, micro-organisms such as bacteria, viruses, fungi and parasites.

(iv) Contamination of water bodies with toxic metals such as, lead, arsenic, cadmium, mercur, nickel, etc.

Harmful Effects of Water Pollution

(i) It makes water unfit for drinking.

(ii) Aquatic animals and plants may also get affected by disease - causing pathogens and when such animals or plants are consumed, serious health problems can occur. In some cases, it may also prove fatal.

(iii) Aquatic eco systems can be destroyed when water bodies receive excess of unwanted nutrients resulting in eutrophication. **Eutrophication** is the process of nutrient enrichment of aquatic ecosystems and the subsequent overgrowth of plants on the surface of water Eutrophication happens when waste water released from fertilizer factories and run offs from agricultural fields bring unwanted nutrients into water bodies. This result in the rapid growth of algae and demand for oxygen increase. These algae soon cover the entire surface of water and prevent sunlight from entering, thus destroying other plants and aquatic animals living in the water.

Prevention of Water Pollution

Water pollution can be prevented by the following steps:

(i) Sewage should be treated in sewage treatment plants before being discharged into water bodies.

(ii) Bathing and washing near water bodies should be avoided.

(iii) Industrial wastes should be treated free of toxic chemicals before being discharged into water bodies.

(iv) Wells should be properly covered.

(v) The use of pesticides and fertilizers should be limited and only eco - friendly products must be used.

(vi) Pollution control rules enforced by the government should be strictly followed.

Conservation of Water

Water can be conserved by the following methods:

By maintaining the water cycle

The water cycle can be maintained in perfect form by:

(a) conserving forests

(b) planting more trees

(c) constructing check - dams to prevent flow of rain water into rivers and finally to sea.

(d) adopting water - harvesting technique to replenish the ground water.

(e) saving water: use modern methods of irrigation such as sprinklers, drip irrigation method.

(f) constructing dams and reservoirs to control floods and use water for irrigation during dry season.

By preventing water pollution

Water pollution can be prevented by disposing sewage and industrial wastes into rivers/lakes only after proper treatment.

Water is a precious natural resource. We should conserve it and should follow the mantra: reduce, reuse and recycle.

What is Potable Water and how is Water Purified?

The water that is suitable for human consumption is called potable water or drinking water. Drinking water should be:

(i) Colourless
(ii) Odourless

It should also be free from:

(i) any suspended impurities
(ii) any harmful germs
(iii) large quantity of salts
(iv) any harmful salt such as nitrates, cyanides, urea etc.

The settling of the suspended particles under the action of gravity is called sedimentation. People in big cities get purified river or lake water through a network of water pipe lines.

Removal of suspended impurities

Water is pumped from a river or a lake into a large tank. Here, it is mixed with a small quantity of alum and allowed to stand for some time. The suspended particles of clay etc. settle down slowly at the bottom of the tank. The upper layer of water is then sent for filtration.

Filtration

The water after sedimentation is filtered through thick layers of sand and gravel. Here, the fine suspended impurities get removed.

Aeration

Air under pressure is then blown into the filtered water. The process called aeration, kills harmful micro - organisms present in the filtered water.

Chlorination

The filtered and aerated water is chlorinated by adding chlorine to it. Chlorine kills all harmful germs. Thus, chlorination of water is done to make it free from all harmful micro - organisms.

The purified and chlorinated water is supplied to the users through a network of water pipes.

Purification of water at home

Small quantity of water can be made fit for drinking and cooking by following methods:

By filtration

Any suspended impurity in the water from well, river or lake can be removed by filtering water through a fine muslin cloth, gravel, sand and charcoal.

By boiling

The filtered water can be made germ - free by boiling it to 100°c for 10 – 15 minutes and cooling it before use.

By treating with some chemicals

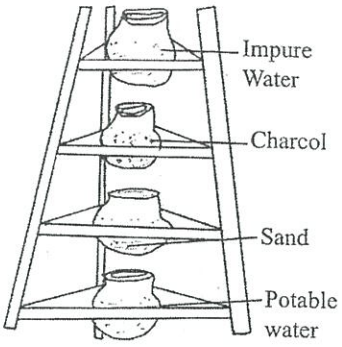
The filtered water can also be made germfree by adding a small quantity of any of the chemicals, such as, potassium permanganate, bleaching powder or chlorine tablets. They kill microorganisms making the water safe for drinking.

Domestic water filters and purifiers

The simplest form of domestic water filter consists of a porous pot made of clay / ceramic. This porous pot acts as a filter and removes all suspended impurities from the water.

Water purifiers a part from removing suspended impurities also remove harmful salts (by ion exchange resins) and kill harmful micro - organisms (by ultraviolet radiation). This purified water is once again filtered through micro filters before its delivery.

Water purification by reverse osmosis (RO) is also used for purifying water for domestic use. In this method, saline water containing high salt content is taken in a tank fitted with a semipermeable membrane. A high pressure is applied on the saline water. Pure water passes through the membrane to the other side and can be used for drinking purposes.



Method to obtain potable water

Fig: 17.1

Do You Know

1. Sea water is not fit for drinking, cooking and washing because it contains high concentration of salts. It induces vomiting.
2. Hot water may also act as a pollutant. This causes lowering of dissolved oxygen and affect the animals and plants in the water body.
3. Carbon dioxide, methane, water vapour are some green house gases.
4. Ozone gas has a strong irritating smell. When inhaled it causes headache and nausea.

Key Points

1. Our environment comprises both living and non living things.
2. A pollutant is a waste material that pollutes air, water or soil.
3. Any undesirable change into air is known as air pollution.
4. Any undesirable change into water is called water pollution.
5. Acid rain occurs because of air pollution.
6. Global warming is the rise in temperature on the earth due to the green house effect.
7. Eutrophication is loss of dissolved oxygen from water in water bodies.

Multiple Choice Questions

1. Which of these causes water pollution?
   (a) sewage
   (b) industrial waste
   (c) fertilizers and pesticides
   (d) all of these
2. Using less water and preventing it from getting polluted is called ———— of water.
   (a) restoration
   (b) preservation
   (c) conservation
   (d) treatment
3. Which of these can cause acid rain?
   (a) CO
   (b) CO_2
   (c) SO_2
   (d) N
4. Which of these processes can NOT remove germs from water?
   (a) boiling
   (b) filtration through clay pot
   (c) reverse osmosis
   (d) exposure to UV light
5. Chloroflurocarbons damage the ———— layer present in the atmosphere
   (a) Ozone
   (b) oxygen
   (c) green
   (d) UV
6. Which of the following gases combines with the blood and prevents it from carrying oxygen to the body?
   (a) CO_2
   (b) NO_2
   (c) CO
   (d) NO_3
7. Which of the following is not a pollutant unless present in excess?
   (a) sulphur dioxide
   (b) carbon monoxide
   (c) nitrogen dioxide
   (d) carbon dioxide
8. Which of these methods does not result in conservation of water?
   (a) use of drip irrigation
   (b) recycling of water
   (c) cutting vegetation so that less water is lost by transpiration
   (d) planting of trees
9. Water is renewed continuously in nature through
   (a) biological cycle
   (b) water cycle
   (c) nitrogen cycle
   (d) green house effect
10. SPM stands for
    (a) suspended particle mixture
    (b) sand particles matter
    (c) suspended particulate matter
    (d) none of these
11. CFCs are compounds used in
    (a) refrigerators
    (b) air conditioners
    (c) aerosols
    (d) all of these

12. Other than CO_2 which of these contribute towards the green house effect?
    (a) methane
    (b) nitrous oxide
    (c) water vapour
    (d) all of these
13. Several countries have signed _____ protocol to reduce the emission of green house gases to conserve ozone layer from getting depleted in the atmosphere.
    (a) Kyoto
    (b) Tokyo
    (c) Korean
    (d) Shanghai
14. Which one of these causes is not a man-made pollution?
    (a) combustion
    (b) industrialization
    (c) dust storm
    (d) urbanization
15. Which of the following are used in electric water filters to kill all the harmful micro-organisms present in tap water and make it absolutely safe for driving?
    (a) infrared radiation
    (b) gamma radiation
    (c) visible radiation
    (d) ultraviolet radiation
16. Volcanic eruption is a natural cause of air pollution.
    (a) false
    (b) true
    (c) partially false
    (d) none of these
17. Global warming can be reduced by
    (a) minimizing the use of diesel and petrol as fuels
    (b) maximizing the use of LPG, unleaded petrol, ethanol
    (c) planting of more trees and stopping deforestation
    (d) all of these
18. Which of the following will reach the earth in greater amounts if the amount of chloroflouro carbons released into the air incases
    (a) infrared rays
    (b) x rays
    (c) gamma rays
    (d) ultraviolet rays
19. Which disease can be possible due to drinking of polluted water?
    (a) cholera
    (b) jaundice
    (c) typhoid
    (d) all of these
20. Corrosion of marble is also called
    (a) marble - disorder
    (b) marble cancer
    (c) marble erosion
    (d) marvelous
21. Which of these gases is present in highest percentage in air?
    (a) nitrogen
    (b) oxygen
    (c) carbon dioxide
    (d) argon
22. Sculptures/monuments and buildings are destroyed by
    (a) ozone layer
    (b) carbon dioxide
    (c) acid rain
    (d) CFCs

23. Biological pollution in water is caused by
    (a) coal mines
    (b) domestic sewage and animal excreta
    (c) chemical effluents from factories
    (d) oil spills
24. A substance used for disinfecting water is
    (a) potassium permanganate
    (b) coal
    (c) sodium
    (d) oxygen
25. The ozone layer in our atmosphere protects us from the harmful effects of ultra violet rays which can cause
    (a) typhoid
    (b) skin disease
    (c) night blindness
    (d) deafness
26. Which of these are causes of air pollution?
    (a) mining activities
    (b) plant spores
    (c) volcanos
    (d) all of these
27. Which of these metals is/are found generally in the contaminated water bodies?
    (a) arsenic and lead
    (b) cadmium
    (c) mercury and nickel
    (d) all of these
28. Chlorination of water is done
    (a) to kill all harmful microorganisms
    (b) to remove the odour of water
    (c) to clean the impurities in water
    (d) to make it tasty

Answer Key

1. (d)	2. (c)	3. (d)	4. (b)	5. (a)	6. (c)	7. (d)	8. (c)	9. (b)	10. (c)
11. (d)	12. (d)	13. (a)	14. (c)	15. (b)	16. (b)	17. (d)	18. (c)	19. (d)	20. (b)
21. (a)	22. (c)	23. (b)	24. (a)	25. (b)	26. (d)	27. (d)	28. (a)		

Questions Based on Achiever's Section

1. **Statement 1:** A boy pushes a toy car on the floor. After reaching a distance, the car will be stopped without application of any visible force.

   Statement 2: Frictional force is the force exerted by a surface when an object moves across the surface.

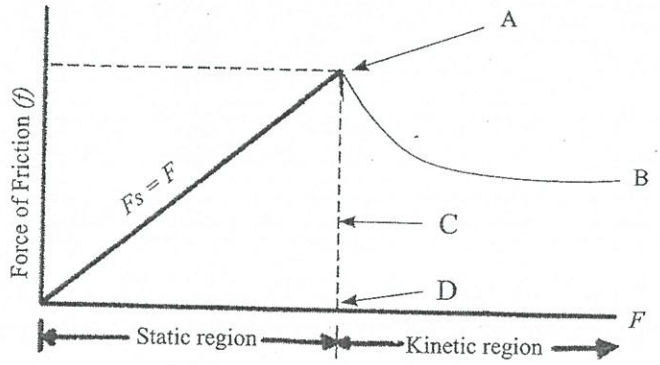
   (a) Statement 1 is true but statement 2 is false.
   (b) Statement 2 is true but statement 1 is false.
   (c) Both statement 1 and statement 2 are true.
   (d) Both statement 1 and statement 2 are true and statement 2 is the correct reason for statement 1.

2. **Statement 1:** The atmospheric pressure changes from place to place and from tine to time.

   Statement 2: The temperature and quantity of water vapour in air changes from place to place and time to time.

   (a) Statement 1 is true but statement 2 is false.
   (b) Statement 2 is true but statement 1 is false.
   (c) Both statement 1 and statement 2 are true.
   (d) Both statement 1 and statement 2 are true and statement 2 is the correct reason for statement 1.

3. **See the figure given below and find the position where static friction is maximum.**



Static and Sliding Friction

   (a) A
   (b) B
   (c) C
   (d) D

4. **Statement 1:** The phenomenon of the persistence of vision is employed in the cinematography.

   Statement 2: The image formed on the retina of an eye persists for 1/16th of a second.

   (a) Statement 1 is true but statement 2 is false.
   (b) Statement 2 is true but statement 1 is false.
   (c) Both statement 1 and statement 2 are true.
   (d) Both statement 1 and statement 2 are true and statement 2 is the correct reason for statement 1.

5. Which of the following suggestions should not be followed for the caring of eyes?
   1. We should always read in dim light.
   2. Always read at the normal distance.
   3. Look at the sun for sometime, everyday in the morning.
   4. We should work in dazzling light.

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

Directions (6 to 10): Fill in the blanks with the appropriate answers.

6. The speed of sound in steel is _____ the speed of sound in air.
   (a) faster than (b) slower than
   (c) equals to (d) can't say

7. The sound is produced due to the _____ in the medium.
   (a) reflection (b) refraction
   (c) disturbance (d) None of these

8. _____ is the voice box at the upper end of the wind pipe.
   (a) Larynx (b) Anvil
   (c) Vocal cords (d) Cochlea

9. Magnetic, electrostatic and gravitational forces are _____ forces.
   (a) contact (b) non-contact
   (c) attractive (d) repulsive

10. _____ is a direct reading instrument which is used for measuring atmospheric pressure.
    (a) Multimeter (b) Richter scale
    (c) Aneroid barometer (d) None of these

11. Which of the following is not an application of electroplating?
    1. To give a shiny appearance to bath taps, bicycle handle bars, wheel rims etc.
    2. To prevent the food, kept in an iron can, to come into direct contact with iron.

    (a) Only 1 (b) Only 2
    (c) Both 1 and 2 (d) Neither 1 or 2

12. Which of the following is the name of a constellation?
    1. Great Dear 2. Little bear 3. Hunter

    (a) Only 1 (b) Only 2
    (c) Both 1 and 2 (d) Both 2 and 3

13. Find the correct arrangement of the following planets of solar system for their distances from the sun.
    (a) Jupiter < Venus < Saturn < Neptune
    (b) Venus < Jupiter < Saturn < Neptune
    (c) Neptune < Saturn < Jupiter < Venus
    (d) Saturn < Venus < Neptune < Jupiter

14. Given below are some physical properties of metals. Which of the following is not true?
    1. Metals in the pure state possess lusture.
    2. Metals have low tensile strength.
    3. Metals are non-sonorous.

    (a) Only 1 (b) Only 2
    (c) 1 and 2 (d) 2 and 3

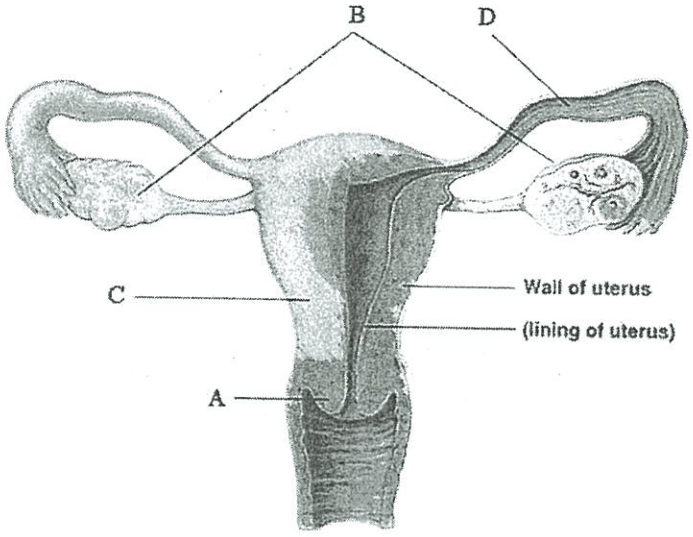
15. An ideal fuel

1. Should burn at a moderate rate.
2. Should not produce any poisonous and irritating fumes during burning.
3. Should leave residue after burning.

Which of the options goes with in line given in the question.

(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Both 2 and 3

Directions (16 to 18): Answer the questions given below on the basis of diagram given.



Reproductive System of the Human Female

16. Which of the following produce one mature ovum each after four weeks.

(a) A
(b) B
(c) C
(d) D

17. In which of the following sterilized embryo develop into baby foetus?

(a) A
(b) B
(c) C
(d) D

18. Which of the following carry the eggs toward uterus?

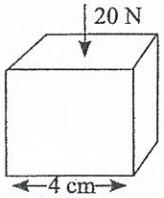
(a) A
(b) B
(c) C
(d) D

Answer Key

1. (d)	2. (d)	3. (a)	4. (d)	5. (d)	6. (a)	7. (c)	8. (a)	9. (b)	10. (c)
11. (d)	12. (d)	13. (b)	14. (d)	15. (c)	16. (b)	17. (c)	18. (d)		

High Order Thinking Skills (HOTS)

1. Which of the following is a non – contact force?
   (a) muscular
   (b) friction force
   (c) elastic spring force
   (d) electrostatic attraction
2. A force of 20N is distributed uniformly on one surface of a cube of edge 4 cm. The pressure on this surface is



   (a) 12,500 Pa
   (b) 5000 Pa
   (c) 2400 Pa
   (d) 1250 Pa
3. When we say sound travels in a medium, we mean
   (a) the disturbance travels in the medium.
   (b) the medium itself travels.
   (c) the source travels in the medium.
   (d) the particles of the medium travels.
4. The voices of a man, a woman and a child are different due to differences in
   (a) lungs
   (b) larynx
   (c) vocal cords
   (d) wind pipe
5. A bulb in an electric circuit glows due to
   (a) Chemical effect of current.
   (b) Conduction of current.
   (c) Magnetic effect of current.
   (d) Heating effect of current
6. In a cell, electrons move from:
   (a) positive electrode to negative electrode
   (b) negative electrode to Positive electrode
   (c) electrons do not move, only negative charge moves from one place to another.
   (d) both (a) and (b)
7. The streaks of bright light seen during lightning is essentially the path followed by
   (a) UV rays from the sun
   (b) Accumulated electric charge
   (c) Cosmic rays
   (d) None of these
8. Which of the following is the safest way to protect yourself from lightning?
   (a) Open an umbrella for cover
   (b) Take shelter under a green tree
   (c) Squat low on ground
   (d) Run to a covered shed

9. The persistence of the eye is only for

(a) $\frac{1}{16}$th of a second

(b) $\frac{1}{10}$th of a second

(c) $\frac{1}{12}$th of a second

(d) $\frac{1}{20}$th of a second

10. The Braille code used by the blind people use dot patterns for words. How many dot patterns or characters are used for this code?

(a) 52

(b) 36

(c) 63

(d) 26

11. Nocturnal animals like owl and bat have

(a) large pupil

(b) large cornea

(c) retina with large number of rods

(d) all of these

12. Light year is a unit of

(a) time

(b) illuminance

(c) intensity of light

(d) distance

13. The only moon in the solar system with active volcano is

(a) Moon

(b) Io

(c) Ganymede

(d) Titan

14. Ozone is present in

(a) Troposphere

(b) Ozonosphere

(c) Stratosphere

(d) Ionosphere

15. Stars appear to move from east to west because

(a) earth rotates in west to east direction.

(b) stars actually move from east to west.

(c) stars actually move from west to east.

(d) earth rotates in east to west direction

16. GSLV means

(a) Global Satellite Launching Vehicle

(b) Geosynchronous Satellite Launch Vehicle

(c) Geostationary satellite landing vehicle

(d) Global Satellite Launching Vehicle

17. The process of taking out threads from the silk conoon is called

(a) rearing

(b) searing

(c) scouring

(d) reeling

18. Which of the following products can't be decomposed easily?

(a) Acrylic

(b) Plastic

(c) Polyethene

(d) All of these

19. Which of the following statements is NOT true?

(a) Polymer occur in nature.
(b) Cotton thread is stronger than nylon thread.
(c) Cellulose is made of glucose units.
(d) Nylon is used to make parachute.

20. Non metals contain _____ number of electrons in their outermost shell.

(a) 1, 2 or 3
(b) 10, 20, or 30
(c) 8, 9 or 10
(d) 5, 6 or 7

21. $P_4 + 6Cl_2 \rightarrow$

(a) P_2Cl_5
(b) $4PCl_3$
(c) $2P_2Cl_4$
(d) PCl_6

22. Mercury is used in thermometers because

(a) it is a liquid.
(b) it does not wet the glass.
(c) it expands on heating.
(d) all of these

23. The combustion in a match stick is started by this chemical :

(a) Potassium chloride
(b) Antimony sulphide
(c) Phosphorous
(d) Sodium sulphate

24. Which of the following is most harmful for human body?

(a) CO
(b) CO_2
(c) Oxides of nitrogen
(d) Lead compounds

25. Fly ash is produced by the burning of

(a) petroleum
(b) natural gas
(c) coal
(d) all of these

26. What should be the characteristic of rocket fuel?

(a) Light and compact
(b) High calorific value
(c) Should burn rapidly
(d) all of these

27. Acid rain is caused by

(a) Deforestation
(b) CO_2
(c) CO
(d) Oxides of sulphur and nitrogen

28. A family consumes 12Kg of LPG in 30 days. Calculate the average energy consumed per day if the calorific value of LPG is 50 KJ/ Kg.

(a) 20,000 J/ day
(b) 10,000 J/ day
(c) 15,000 J/ day
(d) 25,000 J/ day

29. Exposure to excess of ultraviolet rays can affect the

(a) skeletal system
(b) immune system
(c) nervous system
(d) digestive system

30. Carbon particles and smoke from factories

(a) increase the rate of respiration in plants.
(b) decrease the rate of photosynthesis in plants.
(c) increase the absorption of CO_2 by plants.
(d) decrease the rate of transpiration in plants.

31. Teflon is a
(a) natural fibre
(b) synthetic fibre
(c) polymer
(d) cellulose

32. Which of the following methods of cultivation causes salinisation of soil?
(a) excessive irrigation
(b) broadcasting
(c) crop rotation
(d) transplantation

33. Eutrophication means
(a) decreasing the growth of algae
(b) toxication of water by fertilisers
(c) increasing the fertility of the soil
(d) all of the above

34. Which of the following organelle acts as digestive system within the cell?
(a) Golgi bodies
(b) Centrosomes
(c) Lysosomes
(d) Mitochondria

35. If the contents of a leaf tissue are carefully fractioned, which of the fraction could be called alive?
(a) Mitochondria
(b) E R
(c) cell wall
(d) Ribosomes

36. A bacteria cell divides once in every minute. It takes one hour to fill a cup. How much time will it take to fill half the cup?
(a) 39 minutes
(b) 59 minutes
(c) 69 minutes
(d) 29 minutes

37. The fungus that altered the course of history by reducing the population of Ireland from eight million in 1845 to six million a decade later was
(a) Penicillium glucum
(b) Phytophthora
(c) Synchytrium
(d) Olpidium

38. Which of the following are the uses of IUCN Red List ?
(a) Developing awareness about the importance of threatened biodiversity
(b) Identification and documentation of endangered species
(c) Providing a global index of the decline of biodiversity
(d) All of these

39. Soil erosion can be prevented by
(a) allowing herbivorous animals to graze excessively
(b) growing plants to form a soil cover
(c) increasing fertility
(d) making the land slopy

40. What is the role of sperms in reproduction?
(a) They stimulate ovum.
(b) They form foetus.
(c) They fertilize the egg.
(d) They help in puberty changes in male.

Hints and Solutions

1. (d)

The electrostatic attraction between two bodies, such as when silk and glass rod are rubbed, is a non–contact force since the bodies need not touch each other.

2. (a)

Pressure = Force/Area

$$= \frac{20N}{(4\times10^{-2})\times(4\times10^{-2})m^2}$$

$= 1.25 \times 10^4$ Pa = 12,500 Pascal

3. (a)

In a wave motion (like sound wave), the particles of the medium do not travel. It is the disturbance (energy) which travels along the path.

4. (c)

Two vocal chords, stretched across the larynx in such a way that it leaves a narrow slit between them for passage of air. The length of vocal chords and the width of the slit is different in man, woman and child, thus producing different sounds.

5. (d)

Due to the heating effect of current, the filament of the bulb gets heated to a high temperature and it starts glowing.

6. (b)

In cells, electrons move from negative electrode to positive electrode as an electron has a negative charge. But by convention, flow of charges are measured only through positive charges. When an electron moves from point A to B, an equal amount of positive charge moves from point B to A. So, the direction of charge is from positive electrode to negative electrode.

7. (b)

The accumulated charges on clouds pass through air which is a poor conductor of electricity. When the negative and positive charges meet, they produce streaks of bright light.

8. (c)

Squatting low on ground will make you the smallest target to be struck. In all other cases, you are exposed to the atmosphere.

9. (a)

It is a phenomenon where the brain continues to sense the image even after the object has been removed. This lasts for $1/16^{th}$ of a second.

10. (c)

The dots are arranged in cells of two vertical rows of three dots each to form 63 characters.

11. (d)

The nocturnal animals need more light to see at night the large cornea and pupil allow more light into their eyes.

12. (d)

Light year is used to measure distance travelled by the light from the sun to the earth in one year.

1 Light year = 9.46×10^{12} Km

17. (d)

Reeling of silk is done in special machines to obtain threads from silk cocoons.

18. (d)

All these are synthetic/ chemical–based products which are non–biodegradable in nature, such as nylon and polyester.

19. (b)

Nylon is a synthetic fibre that is more durable than a natural fibre like cotton.

23. (b)

Phosphorous applied on the head of a match stick has a very low ignition temperature of 35°C. During rubbing, the heat produced due to friction is sufficient to attain this temperature resulting in combustion.

24. (d)

Lead compound are highly toxic in nature and can cause numerous ailments in human beings and animals. They are absorbed by soil and find their way in food chain.

25. (c)

When coal is burnt in sufficient quantity in big factories, it leaves 10% to 20% of ash. This ash is carried upward due to air and causes pollution problems.

26. (d)

Liquid ammonia, liquid hydrogen and alcohol are suitable as rocket fuels.

27. (d)

SO_2 gas released during the burning of coal and oxides of nitrogen released during combustion of petrol dissolve in rain water and form rain acids.

28. (a)

Energy released = 12×50KJ = 600KJ

$\therefore$ Energy consumed per day = $\frac{600}{30}$KJ = 20,000J/day

34. (c)

Lysosomes are called digestive organs of the cell which are capable of engulfing of food materials and other substances. These are hydrolysed inside lysosomes by certain enzymes.

35. (a)

Mitochondria contains DNA. Thus, it is called semiautonomous organelle and it can survive the fractionation process.

36. (b)

At the 59^{th} minute it is half filled. All the bacteria divide and double. Hence the cup gets filled in the 60^{th} minute.

37. (b)

The diseases known as potato blight had destroyed potato crops on a massive scale in Ireland, resulting in the starvation of many people and emigration of many other to USA.

Model Test Paper - 1

1. The crop in which transplantation is necessary to grow is
   (a) Wheat (b) Maize
   (c) Paddy (rice) (d) Jowar
2. Malaria is caused by
   (a) Protozoa (b) Virus
   (c) Bacteria (d) Algae
3. Rhizobium bacteria
   (a) Help in digestion (b) Help in fixation of nitrogen
   (c) Caused various diseases (d) All of these
4. The fibre that burns readily with the smell of burning paper is
   (a) Polyester (b) Silk
   (c) Acrylic (d) Rayon
5. The plastic which cannot be recycled is
   (a) Terylene (b) Polystyrene
   (c) Bakelite (d) Polythene
6. Which of the following statement is correct?
   (a) Zinc is more reactive than copper
   (b) Copper is more reactive than Zinc
   (c) Zinc is more reactive than Iron
   (d) Iron is more reactive than Zinc
7. The metal which is soft and can be cut with knife is
   (a) Mercury (b) Sodium
   (c) Iron (d) Copper
8. The natural solid fuel is
   (a) Coal (b) Coke
   (c) Charcoal (d) LPG
9. The major constituents of coal gas are
   (a) Carbon monoxide, hydrogen (b) methane, hydrogen
   (c) Carbondi-oxide methane (d) methane

10. Which of the following has the lowest ignition temperature?
    (a) Petrol (b) Coal
    (c) Kerosene (d) LPG
11. The dark zone of candle flame is
    (a) Outer zone of complete combustion
    (b) Zone of partial combustion
    (c) Inner zone
    (d) None of these
12 Why do animals usually migrate?
    (a) For nutrition (b) For respiration
    (c) For excretion (d) For reproduction
13. Global woarming may be due to an
    (a) Increase in levels of oxygen
    (b) decreace in levels of oxygen
    (c) Decreace in levels of carbon dioxide
    (d) Increase in levels of carbon dioxide
14. Which of the following is not a unicellular organism?
    (a) Yest (b) Plant
    (c) Euglena (d) Paramecium
15. Ribosomes are the centre for
    (a) Fat synthesis (b) Sugar
    (c) Protein (d) Starch
16. Binary fission is seen in
    (a) Plasmodium (b) Hydra
    (c) Mucor (d) Amoeba
17. A fusion of male and female gametes usually takes takes place inside the
    (a) Fallopian tube (b) Ovary
    (c) Zygote (d) Uterus
18. Larynx is called
    (a) Respiratory box (b) Voice box
    (c) Music box (d) None of these
19. Most Adolescents gain their maximum height around the age of
    (a) 11-15 years (b) 15-17 years
    (c) 17-18 years (d) 18-22 years
19. State of motion is described by
    (a) Position of rest (b) Position of motion
    (c) Both by (a) and (b) (d) None of these
21. The coolies while lifting heavy luggage keep a wound round cloth on their heads to
    (a) Increase the force (b) Reduce the pressure
    (c) Reduce the load (d) Avoid luggage to slip off

22. Force of friction acts on the moving body in
(a) the same direction
(b) the opposite direction
(c) perpendicular direction
(d) none of these

23. The hearing range of human ear is
(a) 20 Hz–20, 000 Hz
(b) Less than 20 Hz
(c) More than 20, 000 Hz
(d) 10, 000 Hz–20, 000 Hz

24. The process of depositing a thin layer of any superior metal over an object of a cheaper metal with the help of electricity is called
(a) Electro-refining
(b) Electro metallurgy
(c) Electrolysis
(d) Electroplating

25. Which of the following is an insulator?
(a) Distilled water
(b) Wood
(b) Plastic
(d) All of these

26. The magnitudes of a few earthquakes, measured on Richter scale are given below. Which of these will cause maximum damage?
(a) 3.0
(b) 5.0
(c) 7.0
(d) 8.0

27. The splitting of white light into seven constituent colours when falls on a prism is called
(a) Reflection
(b) Refraction
(c) Dispersion
(d) Scattering

28. A polished surface reflects a parallel beam of light in
(a) One direction
(b) Two directions
(c) Three directions
(d) Four directions

29. Friction between two flat surfaces can be reduced by
(a) painting
(b) greasing
(c) using ball bearing
(d) decreasing the area

30. Out of the following which is a part of animal cell?
(a) Cell wall
(b) Cell membrane
(c) Nuclear membrane
(d) nuclear

Model Test Paper-1

Answer

1.(c)	2.(a)	3.(b)	4.(d)	5.(c)	6.(a)
7.(b)	8.(a)	9.(b)	10.(a)	11.(c)	12.(a)
13.(d)	14.(b)	15.(c)	16.(d)	17.(a)	18.(b)
19.(d)	20.(d)	21.(b)	22.(b)	23.(a)	24.(d)
25.(d)	26.(d)	27.(c)	28.(a)	29.(c)	30.(a)

Model Test Paper - 2

1. The first artificial satellite launched in the space by Russia in 1957 was
   (a) INSAT 1A (b) INSAT 2A
   (c) Sputnik 1 (d) Apple
2. The soil rich in iron and magnesium and derived from basalt rocks is ideal for growing cotton and sugarcane.
   (a) Red (b) Alluvial
   (c) Laterite (d) Black
3. Which one of the following is a weed?
   (a) Chenopodium (b) Millet
   (c) Grass (d) Maize
4. Which one of the coal varieties has the highest percentage of carbon?
   (a) Anthracite (b) Peat
   (c) Bituminous (d) Lignite
5. Which of these is the main constituent of LPG?
   (a) Methane (b) Propane
   (c) Ethane (d) Butane
6. Which of these microorganisms causes Cholera?
   (a) Vibrocholerae (b) Mycobacterium
   (c) Varicella zoster (d) Bacilli
7. It is a viral disease caused by the biting of infected animals through their saliva. The name of disease is
   (a) Polio (b) Rabies
   (c) Chickenpox (d) Malaria
8. Rearing of fish on large scale for commercial purpose is called
   (a) Sericulture (b) Silviculture
   (c) Apiculture (d) Pisiculture
9. Who was the chief character behind the Green Revolution which had changed agricultural practices the world over?
   (a) Michael Faraday (b) Norman Ernest Borlaug
   (c) Alexander Fleming (d) Neils Henrik

10. Which of these statements is correct about synthetic fibres?
Statement 1: It does not absorb water or sweat.
Statement 2: It is non biodegradable.
(a) Both 1 and 2 are correct
(b) 1 is correct and 2 is incorrect
(c) 1 is incorrect and 2 is correct
(d) Both 1 and 2 are incorrect

11. Which of these is a natural polymer?
(a) Nylon
(b) Silk
(c) Terelyne
(d) Rayon

12. Which one of these helps in holding the eye lens in its positon?
(a) Cornea
(b) Pupil
(c) Ciliary muscles
(d) Iris

13. Hypermetropia (also called short sightedness) is caused due to
(a) Increase of the focal length of eye lens
(b) Thickening of the eye ball
(c) Decrease of the focal length of eye lens
(d) Elongation of eye ball

14. One light year is equal to
(a) 9.46×10^{12} km
(b) 11.2×10^{12} km
(c) 6.56×10^{12} km
(d) 8.56×10^{12} km

15. There are some sounds which cannot be heard by human ears. These sounds have wave frequency, either less than 20 Hz or more than 20 KHz. The sound whose frequency is less than 20 Hz is called
(a) Plane sound
(b) Infrasonic sound
(c) Ultrasonic sound
(d) None of these

16. Calculate the frequency of a sound wave whose time period is 0.025 secand?
(a) 20 Hz
(b) 50 Hz
(c) 40 Hz
(d) 25 Hz

17. The filament of electric bulb is made up of
(a) Nichrome
(b) Tungsten
(c) Copper
(d) Silver

18. The non-metal found in liquid state is
(a) Cu
(b) Br
(c) Pb
(d) Ag

19. What is the name of male hormone?
(a) Estrogen
(b) Adrenalin
(c) Testosterone
(d) Thyroxine

20. The n on-metal found in liquid state is
(a) Cu (b) Br
(c) Pb (d) Ag

21. What is the name of male hormone?
(a) Estrogen (b) Adrenalin
(c) Testosterone (d) Thyroxine

22. The release of an egg from an ovary is called
(a) Fertilization (b) Ovulation
(c) Menopause (d) menstruation

23. The force between two charged bodies is called
(a) Muscular force (b) Frictional force
(c) Electrostatic force (d) Gravitational force

24. If a given force is applied on a smaller area of contact, the pressure exerted by it
(a) Increases (b) Decreases
(c) Does not change (d) None of these

25. The pressure exerted by liquids due to increase in depth
(a) Reduces (b) Remains same
(c) Increases (d) None of these

26. The water which is fit for drinking is called_____ water
(a) Portable (b) Potable
(c) Disposable (d) filtered

27. Which of the following is not a planet of the sun?
(a) Saturn (b) Earth
(c) Mercury (d) Sirius

28. Highest percentage of which of these gases is present in air?
(a) Nitrogen (b) Oxygen
(c) Argon (d) Carbon dioxide

29. An eye lens focuses light behind the eye at
(a) Cornea (b) Iris
(c) Retina (d) Ciliary muscle

30. A characteristic of sound that depends on the amplitude is
(a) Speed (b) Pitch
(c) Quality (d) Loudness

Model Test Paper-1

Answer

1.(a)	2.(b)	3.(a)	4.(a)	5.(d)	6.(a)
7.(b)	8.(d)	9.(b)	10.(a)	11.(b)	12.(c)
13.(c)	14.(a)	15.(b)	16.(a)	17.(b)	18.(b)
19.(c)	20.(b)	21.(c)	22.(b)	23.(c)	24.(a)
25.(c)	26.(b)	27.(d)	28.(a)	29.(c)	30.(d)

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