

## SCIENCE

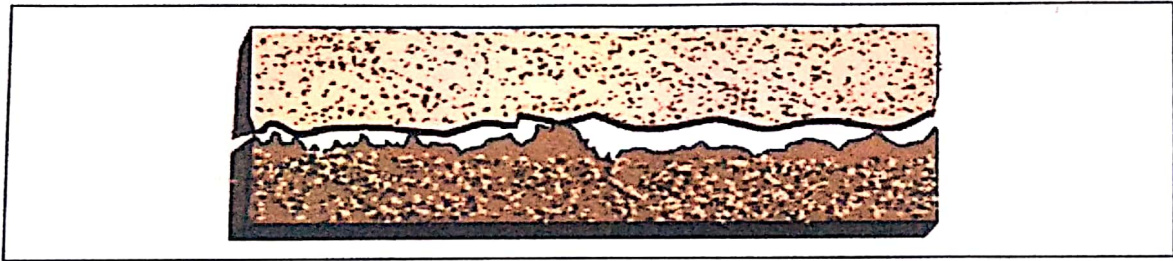
## PHYSICS

### Friction

**Friction:** Friction is the force resisting the relative motion of solid surfaces, fluid layers, and/or material elements sliding against each other. It may be thought of as the opposite of "slipperiness". i.e. it is an opposing force that comes into play when two surfaces come in contact..

**Causes of friction:** The main causes of friction are

- (i) Friction is caused by masses that travel past each other in opposite directions, which produces heat. Adhesion, surface roughness, and deformations cause friction.
- (ii) The surfaces of bodies are never perfectly smooth. Even a very smooth surface seen under a microscope, is found to have depressions and projections as shown in the figure below. The interlocking of the irregularities of the surfaces in contact causes friction.



**Types of friction:** Friction is of three types, namely Static friction, Dynamic or Kinetic or sliding friction and Limiting friction.

**Static Friction:** Static Friction is the friction which is produced between two surfaces in contact with each other at the position of rest. This friction is more powerful than any other type of friction. It is most difficult to overcome the static friction because at this position, the irregularities are most effectively pressed against each other. This type of friction needs a lot of energy to overcome.

**Dynamic or Kinetic or Sliding Friction:** This type of friction arises when two objects in contact are in motion. It is less than Static friction. This friction is less effective than static friction because the irregularities of both surfaces do not get enough time to get locked with each other as the objects are already in motion.

**Limiting friction:** It is the maximum value of static friction which comes into play when a body is just about to slide over the surface of another body. For an applied external force greater than the limiting friction, the body begins to move. Once motion has begun, static friction cannot be considered. A new type of friction called kinetic friction comes into play.

#### **Laws of limiting friction**

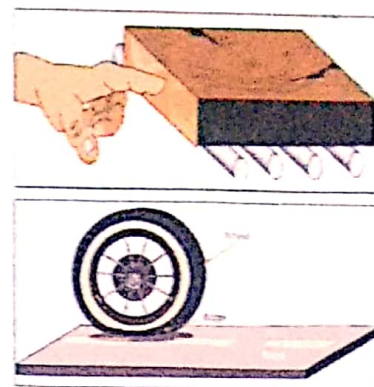
- Limiting friction always opposes the motion of a body over another.
- Limiting friction acts in the direction opposite to the direction of the applied force.
- Limiting friction increases with increase in the weight of the body and vice versa.
- Limiting friction depends upon the material, the nature of the surfaces in contact and their smoothness.
- For any two given surfaces, the magnitude of limiting friction is independent of the shape or the area of the surfaces in contact.



**Drag:** It is the term used to describe the frictional force which is exerted by the fluids on the bodies moving in it. This friction needs a lot of energy to overcome, so bodies of such objects which move in fluids are streamlined to counter the friction offered by fluids.

**Rolling Friction:** Rolling friction is the friction which comes in effect when two bodies are rolling on each other. Rolling movement of both objects don't allow the locking of irregularities, thus it is the smallest force (friction) of all the three types.

When a body rolls over a surface, the frictional force developed between the surfaces is called rolling friction. For example, when a wheel rolls over a surface, the surface of the wheel and the surface on which it rolls are both slightly deformed. A resistance to smooth rolling is produced due to this deformation. This resistance or opposing force is called rolling friction. The deformation of a motor car tyre in contact with the road is an example. The tyre becomes slightly flattened at the point of contact with the road and also the surface in front of the tyre or wheel gets slightly raised forming a kind of moving ridge.



**Friction due to liquids and gases:** Liquids and gases also exert friction. However, friction offered by them is less as compared to that offered by solid surfaces. The best example to demonstrate the friction offered by air is the meteor shower. Each time a comet passes the Sun it loses some of its gas and ultimately only the dust particles and bits of rocks are left in space. When these particles enter the earth's atmosphere, they burn due to the heat produced by air resistance and produce a shower of meteors or shooting stars.

The friction due to water is much less than that between solid surfaces and hence it is difficult to stop ships or boats. To stop a ship the engine is fired in the opposite direction.

**How can friction be decreased?** Friction can be decreased by the following methods

- i. It can be reduced by using lubricants like oil, grease and graphite.
- ii. It can be reduced by using ball bearings or roller bearings.
- iii. It can be reduced by separating the surfaces by an air cushion.
- iv. It can be reduced by streamlining the body. Aeroplanes, boats and fishes are examples of streamlined objects.
- v. It can be reduced by polishing the surfaces.

**How can friction be increased?** Friction can be increased by the following methods

- i. By making both the surfaces very rough.
- ii. By making irregular projections and depressions like those we see on the tyres (grooves).

#### **Advantages of Friction**

- i. Due to friction we are able to walk on the surface of the earth.
- ii. The brakes applied in automobiles work only due to friction.
- iii. Nails, screws and the wooden boards are held together due to force of friction.
- iv. The fibers of thread are held together due to force of friction.
- v. We are able to write on paper because of the friction between the pencil/pen and the paper.

#### **Disadvantages of Force of Friction**

- i. In overcoming friction, a lot of energy is wasted in the form of heat.
- ii. Friction causes wear and tear of the moving parts of a machine.
- iii. Due to friction, speed of automobiles cannot be increased beyond a certain limit.

**Friction is a necessary evil:** Friction is the retarding force which comes into play when a body actually moves or tends to move over the surface of another body. Frictional forces always oppose relative motion and never help it. Even when no relative motion is actually present but there is only a tendency for relative motion, frictional force exists between surfaces. For example, without friction between our feet and the ground, it will not be possible to walk. Any time we want to move an object, friction can make the job far more difficult. Friction can make it difficult to slide a box across the floor, or ride a bicycle or walk through deep snow. In short, life is impossible without friction - It would be impossible to climb, to fix a nail, to drive a car if there is no friction. The tyres of the vehicle are made rough to increase friction. Various parts of a machine are able to rotate due to friction between the belt and pulley.

**Friction is an Evil:** Friction is an evil due to following reasons.

- i. Wear and Tear of the machine parts is due to friction.



- ii. Friction between different parts of the rotating machines produces heat and causes damage to them.
- iii. We have to apply extra power to machines in order to overcome friction. Thus the efficiency of the machines decrease.

**Factors of friction:** The frictional force depends on the following factors -

- i. It depends on the nature of the surface.
- ii. It depends on the smoothness of the surface.
- iii. It depends on the hardness with which two surfaces in contact are pressed against each other.

**Textual questions: page no. 178**

**Q1. What do you understand by the term friction? Explain how it is caused.**

Ans: Friction is the force resisting the relative motion of solid surfaces, fluid layers, and/or material elements sliding against each other. It may be thought of as the opposite of "slipperiness". i.e. it is an opposing force that comes into play when two surfaces come in contact. The surfaces of bodies are never perfectly smooth. Even a very smooth surface seen under a microscope, is found to have depressions and projections. The interlocking of the irregularities of the surfaces in contact causes friction. Friction is caused by masses that travel past each other in opposite directions, which produces heat. Adhesion, surface roughness, and deformations cause friction. Friction is caused due to relative motion between two surfaces.

**Q2. Distinguish between static and dynamic friction.**

Ans: Static friction is the friction that acts between two objects which are not moving in relation to each other. For example, it is the force that prevents a block from sliding down a ramp with a small incline. Dynamic friction is the friction that acts between two objects which are moving in relation to each other. For example, it is the force that makes pushing a heavy box across the floor difficult.

**Q3. What is limiting friction? State the laws of limiting friction.**

Ans: **Limiting friction:** It is the maximum value of static friction which comes into play when a body is just about to slide over the surface of another body. For an applied external force greater than the limiting friction, the body begins to move. Once motion has begun, static friction cannot be considered. A new type of friction called kinetic friction comes into play.

**Laws of limiting friction**

- Limiting friction always opposes the motion of a body over another.
- Limiting friction acts in the direction opposite to the direction of the applied force.
- Limiting friction increases with increase in the weight of the body and vice versa.
- The limiting friction depends upon the material, the nature of the surfaces in contact and their smoothness.
- For any two given surfaces, the magnitude of limiting friction is independent of the shape or the area of the surfaces in contact.

**Q4. How is rolling friction caused?**

Ans: When a body rolls over a surface, the frictional force developed between the surfaces is called rolling friction. For example, when a wheel rolls over a surface, the surface of the wheel and the surface on which it rolls are both slightly deformed. A resistance to smooth rolling is produced due to this deformation. This resistance or opposing force is called rolling friction. The deformation of a motor car tyre in contact with the road is an example. The tyre becomes slightly flattened at the point of contact with the road and also the surface in front of the tyre or wheel gets slightly raised forming a kind of moving ridge.

**Q5. Under what conditions the rolling friction increases?**

Ans: In case of rolling friction the smaller the depression formed at the point of contact of wheel or roller with a given surface, the lesser is the force of rolling friction and if the depressions formed at the point of contact of roller with a given surface are larger the force of friction will be greater. So it is clear in case of rolling friction the force of friction increases under the condition if the depression formed by the roller is larger.

**Textual questions: page no. 182**

**Q1. State the ways of increasing the friction between two surfaces?**

Ans: Friction can be decreased by the following methods

- i. By making both the surfaces very rough.
- ii. By making irregular projections and depressions like those we see on the tyres (grooves).

**Q2. Name four ways by which friction can be reduced between two surfaces in contact?**

Ans: Friction can be decreased by the following methods

- i. It can be reduced by using lubricants like oil, grease and graphite.



- ii. It can be reduced by using ball bearings or roller bearings.
- iii. It can be reduced by separating the surfaces by an air cushion.
- iv. It can be reduced by streamlining the body. Aeroplanes, boats and paper rockets are examples of streamlined objects.
- v. It can be reduced by polishing the surfaces.

**Q3. State two advantages of friction?**

Ans. Some advantages of friction are

- i. Due to friction we are able to walk on the surface of the Earth.
- ii. The brakes applied in automobiles work only due to friction.
- iii. Nails, screws and the wooden boards are held together due to force of friction.
- iv. The fibers of thread are held together due to force of friction.

**Q4. State two disadvantages of friction?**

Ans: (i) In overcoming friction, a lot of energy is wasted in the form of heat. Friction causes wear and tear of the moving parts of machines

(ii) Due to friction, speed of automobiles cannot be increased beyond a certain limit.

**Q5. Why friction is called a necessary evil?**

Ans: Friction is called a necessary evil because in spite of its ill effects, we cannot do without friction. No body would be at rest without friction. No movement (motion) would come to an end without friction. It is because of friction that a nail remains fixed in the wall; buildings are intact in their places.

**Q6(a). What is a lubricant?**

Ans: A solid or liquid material which is applied between the two surfaces in contact in order to reduce the force of friction between them is known as a lubricant. Oil, grease and graphite are examples of lubricants.

**Q6(b). How does a lubricant reduce friction?**

Ans: The lubricant reduces friction by separating the two surfaces in such a way that the interlocking of irregularities are greatly reduced as the spaces between them are filled with the lubricant.

**Q6(c). What kind of lubricants are used in (i) a sewing machine, (ii) the axle of a tractor?**

- Ans:
- i. In a sewing machine less viscous oils are used as lubricants.
  - ii. In an axle of a tractor more viscous lubricants like grease are used.

**Q7. Name two solid lubricants and state where they are used?**

Ans. Graphite and molybdenum disulfide ( $\text{MoS}_2$ ) are the predominant materials used as solid lubricant. Solid lubricants are useful for conditions when conventional lubricants are inadequate.

**Solid lubricants** are **solid** materials, which reduce coefficient of friction **and** wear and tear by rubbing parts of machines by preventing **direct contact** between **their** surfaces even under high loads.

**Q8. Why friction is called a perverse force?**

Ans: Friction is called a perverse force because without friction we cannot set the bodies in motion or stop the moving bodies. So friction is necessary in day to day life, but on the other hand friction wastes energy, brings about wear and tear and slows down motion. Hence we can say that friction is a friend as well as a foe.

**Textual questions (exercises)**

**Q1. Why are worn out tyres discarded?**

Ans: Special kinds of grooves are made in tyres so that they offer the required amount of friction and automobiles are able to move on the roads properly without slipping. It is for the same reason that the worn-out tyres (the tyres from which grooves have disappeared due to constant use) are discarded as they slip on the roads and can cause serious accidents.

**Q2. Why do carom coins move faster on carom board when dusted with talcum powder?**

Ans: Carom coins move faster on carom board when dusted with the talcum powder because the talcum powder reduces the sliding friction between the coins and the carom board as the talcum powder fills the irregularities and makes the surfaces in contact smoother.

**Q3. Why is the surface of the conveyor belt made rough?**

Ans: The surface of the conveyor belt is made rough because the rough top conveyor belt has cushioning effect, modifies and absorbs vibrations, impacts and simultaneously prevents slip by increasing the friction between the belt and the roller. The surface texture resists the tendency for the material to roll down the conveyor. Rough top conveyor belt is used for transporting light weight goods, such as sacks, boxes and parcels, on inclined surface.



**Q4. Why is the sewing machine always oiled?**

Ans: The sewing machine is always oiled because oil works as lubricant and reduces the force of friction between the machine parts by separating the interlocking of the irregularities as they are filled with oil. It also prevents machine parts from wearing out rapidly thus reduces the unwanted noise produced by the worn out part of the sewing machine.

**Q5. Why do new automobile tyres have deep grooves?**

Ans: New automobile tyres are provided with deep grooves in order to increase the rolling friction because the deep grooves provide larger air gap between the contact surfaces of road and the tyres, due to which it is possible for the tyre to have a strong grip on the road surface and prevent automobiles from slipping.

**Q6. Why does a ball rolling on the ground slow down?**

Ans: Friction pushes the ball in the opposite direction when it is rolling. When a ball combines rotational and translational motion, the friction act in the opposite direction of the motion. Force produced by the frictional force therefore opposes the motion of the ball and hence it comes to rest.

**Q7. Why are the boats and aeroplanes given special shapes?**

Ans: Fluids like various liquids or air also exerts frictional force known as drag. To minimize the effect of this drag, streamlining of the motion of the object in the fluid and in the air is necessary, which can be achieved by modification in the shape of the body. Objects moving in fluids and in air must have a special shape called streamlined shapes or aerodynamic shapes. Streamlined Shape or Aerodynamic Shape is that shape which overcomes the friction of fluids. They have pointed fronts with little broader middle portion with tapering shape at the back.

**Q8. Why do meteors burn on entering into the atmosphere?**

Ans: Meteors burn on entering the atmosphere because the frictional force between air and meteors hitting the atmosphere causes the meteors to heat up to the temperature until it essentially evaporates. A meteor moving through the vacuum of space typically travels at speeds reaching tens of thousands of miles per hour. When the meteor hits the atmosphere, the air in front of it compresses very quickly due to the friction between the air and surface of meteor. When a gas is compressed, its temperature rises and this causes the meteor to heat up so much that it burns. The air burns the meteor until there is nothing left.

**Q9. Why do painters use sand papers in polishing doors?**

Ans: Painters use sand papers in polishing doors in order to knockout the irregularities on the surfaces of doors to make them more smooth which help the painters to apply the paint on the smooth surfaces of the doors easily and without any undulations which in turn helps the paint to spread uniformly throughout the surface.

**Q10. Why is it easier to tie a knot with cotton string as compared silk thread?**

Ans: Every surface has some irregularities on it. Silk feels more slippery to the touch, as it has less friction than typical cotton due to less irregularities. In case of silk thread surface, the irregularities do not get enough time to interlock, so it moves more easily on sliding than a cotton thread which has more irregularities on its surface than silk which interlocks quickly and produces more friction. Hence, it is easy to tie a knot with cotton thread than a silk thread.

## CHEMISTRY

### Chemical effects of electric current

**Electric current:** An electric current is defined as the ordered motion of electric charges. i.e. the rate of flow of charge is called electric current or in other words the magnitude of the current 'I' is the charge flowing in the circuit in one second. Mathematically current is expressed as

$$\text{Current (I)} = \text{Charge (coulomb)} / \text{Time (Second)}$$

$$\text{OR} \quad I = Q/t$$

Where 'Q' is charge and 't' stands for time. The unit of electric current is 'ampere' (A).

$$1 \text{ ampere} = 1 \text{ coulomb/second}$$

One ampere is defined as the current flowing through a conductor when the flow of one coulomb of charge flows in one second. One coulomb is defined as the quantity of charge flowing through a conductor per second.

**Conductors:** Substances which allow electricity to pass through them easily are called conductors. These are made from materials which have low resistances. Metals like copper, aluminium, silver, iron, brass and also salt solutions are good conductors of electricity.



**Insulators:** Substances which do not allow electricity to pass through them easily are called insulators. These are made from materials which have a high resistance. Some substances like air, plastic, cotton, rubber, wood, paper, glass, pure water, etc are insulators.

**Do liquids conduct electricity?**

Some liquids are good conductors and some are poor conductors of electricity. Water conducts electricity in the form of ions. It is a polar solvent and dissolves everything in it. A good electrolyte converts in the form of ions in water and conducts electricity. Electricity is the flow of charged particles. In a liquid, the electrons can pass on charge, so some liquids are very good electrical conductors. Most liquids that conduct electricity are solutions of acids, bases and salts.

**Examples of Liquid Electrical Conductivity:** some of the important ones are as follows:

1. Conductivity of electricity through water (due to the fact the normal water have ions in it).
2. Conductivity of electricity through Ethanol (because ethanol develops opposite ions in the solution).
3. Conductivity of liquid in Ethylene Glycol (because ethylene glycol also gives ions in solution and this creates a region of opposite charges resulting in flow of electrons and then electricity).
4. Conductivity of electricity in Molten Wax.
5. Conductivity of electricity in Molten Sugar solution.
6. Conductivity of electricity in Molten Salt solution.

**LED:** The full form of LED is Light Emitting Diode. It is like a bulb which can glow even at a feeble current supply. Ordinary bulbs cannot glow when the current supply is low. So they consume more current and are therefore, costly. Since LED consumes much lower electricity so, they are economical. LEDs are available in many colours such as, red, green, yellow, blue etc. They find applications for many purposes like in traffic signals, on railway platforms for various indicators etc.

**Electrode:** An electrode is a conductor through which electric current is passed. Found in variable forms, electrodes may be wires, plates, or rods. An electrode may be made up of metals, such as copper, silver, lead, or zinc. However, an electrode may also be made of a nonmetal substance, such as carbon. An electrode passes current between a metallic part and a nonmetallic part of an electrical circuit. Most frequently, conductors that are metallic carry electrical current. In other circuits, however, current is passed through a nonmetallic conductor.

In an electrochemical cell, an electrode is called either an anode or a cathode. An anode is an electrode at which current leaves the cell and oxidation takes place. For example, an anode is the positive electrode in a storage battery. A cathode is described as a negative electrode. Current enters the cell at the cathode and reduction takes place. Electrons are repelled from the cathode.

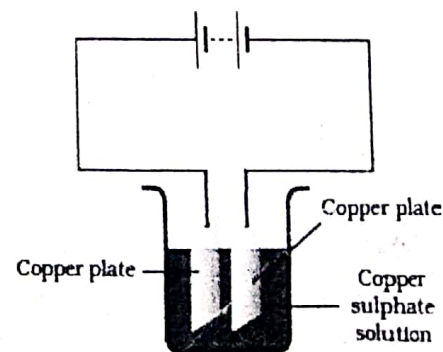
**Difference between anode and cathode:** Cathodes and anodes are types of electrodes that conduct electrical currents either into or out of an electrical device. A cathode typically acts as a positively charged terminal while an anode usually functions as a negatively charged terminal. Cathodes and anodes will sometimes function in reverse polarity in certain types of devices. As a general rule, when a device is discharging electricity, the current flows out of the cathode terminal. When a device is being charged with electricity, the current flows into the cathode causing it to function as the anode while the anode functions as the cathode.

**Electrolyte:** An electrolyte is a liquid substance which acts as a medium to conduct electricity. An electrolyte is full of ions, which are atoms that have some sort of net electric charge, either positive or negative. A diluted electrolyte has a relatively small amount of ions for its volume, while a concentrated electrolyte has a high amount of ions.

**Electroplating:** Electroplating is the process of coating a desired metal on another metal surface using electric current. It is one of the most common applications of chemical effects of electrical current. Metallic plate and the substance requiring coating are dipped in conducting solution with conducting wires. The object to be coated is attached to the negative terminal. When electric current is passed through the solution, the compounds of the solution starts breaking and free metallic particles get deposited on the object at the negative terminal of battery. In this way we can get a coating of desired metal on any object by preparing suitable conducting solution and using suitable electrodes.

**Advantages of electroplating:** Electroplating is a very useful process and has many advantages

1. It is used to coat metal surfaces with another metal having desired properties.





2. It saves certain metal surfaces from rusting, corrosion etc.
3. Coating of chromium on other metals give luster to objects and better corrosion resistance.
4. Cheap metals like iron, aluminium etc. can be coated with costly metals like silver, gold etc. to give them rich look as in case of artificial jewelry.

#### Textual questions:

##### Q1. Fill in the blanks

- (a). Most liquids that conduct electricity are solutions of acids, bases and salts.  
(The solutions of acids, bases or salts are conducting in nature. They allow the current to pass through.)
- (b). The passage of an electric current through a solution causes chemical effects.  
(When an electric current passes through a solution, the solution decomposes into its positive and negative ions. This process of decomposition of the solution is a chemical effect of electric current.)
- (c). If you pass current through copper sulphate solution, copper gets deposited on the plate connected to the negative terminal of the battery  
(When an electric current passes through a copper sulphate solution, the solution decomposes into positively charged copper ions and negatively charged sulphate ions. These positively charged copper ions get attracted towards the plate which is connected to the negative terminal of a battery.)
- (d) The process of depositing a layer of any desired metal on another material by means of electricity is called electroplating.

Ans2. The deflection in the compass needle shows that current is flowing through the wound wire and hence, through the circuit. The circuit is complete since free ends of the tester are dipped in a solution. The solution is certainly a conducting solution. This is the reason why the compass needle shows a deflection.

Ans3. Liquids like lemon juice, salt water and vegetable oil allow electricity to pass through them. Hence, these liquids can be used as in the beaker to show the given effect.

Ans4. The bulb may not glow because of the following reasons:

- (i) Liquid in the beaker is non-conducting. In such case, the electric current would not be able to pass through the liquid. Hence, the circuit is not complete.
- (ii) Electric current in the circuit is very weak. This can happen if the material used for making the circuit is not a good conductor of electricity or the battery does not have sufficient energy to generate electricity.

Ans5. (i) Liquid A is a better conductor than liquid B.

The amount of current flowing through a conducting solution depends on the conductivity of the solution. With more conductivity, more current passes through the solution and vice-versa. Hence, the conductivity of liquid A is more than the conductivity of liquid B.

Ans6. No, Pure water does not conduct electricity. This is because pure water is devoid of any salts. Pure water can conduct electricity when a pinch of common salt is added to it, as salt solution is conducting in nature.

Ans7. Water may conduct electricity. If the electrical supply for the area is not shut off and water is poured over electrical appliances, then electricity may pass through water and harm the firemen. That is why, in case of a fire, the firemen shut off the main electrical supply for the area before they use the water hoses.

Ans8. Sea water contains more dissolved salts than drinking water. Hence, it is more conducting than drinking water. Because of this reason, the compass needle deflects more in seawater than in drinking water.

Ans 9. No. It is not safe to repair electrical appliances outdoors during heavy downpour. This is because rain water contains dissolved salts. Therefore, rain water can conduct electricity. The electrician may get electrical shocks while working outdoors during rain.

Ans10. Rain water contains dissolved salts. This makes it a conducting solution. There are no dissolved salts present in the distilled water. Hence, rain water can allow electricity to pass through it while distilled water cannot.

Ans11. Examples of electroplated objects are as follows:

- (i) Chromium plating is done on different parts of cars, buses and motor cycles to give them a shiny appearance.
- (ii) A fine layer of gold is deposited on silver ornaments and they are called gold-plated ornaments. Iron used in constructing a building is coated with a layer of zinc. This protects iron from corrosion and rusting.

Ans12. Copper ion is positively charged. It is attracted towards the plate which is connected to the negative terminal of the battery. As copper ions are transferred to the thin copper plate, this thin pure copper plate must be connected to the negative terminal of the battery. Consequently, impure copper rod is connected to the positive terminal of the battery.



# REPRODUCTION IN ANIMALS

**Reproduction:** It is one of the basic characteristics of living beings which differentiates them from non-living objects. Every organism, from bacteria to humans reproduces. Reproduction is defined as **"the ability of an organism to produce new individuals of the same species"**. It is essential for the continuance of the species on the earth. It may occur through different methods and can involve a single organism or two organisms (parents) producing offspring.

**Modes of Reproduction:** There are two main modes of reproduction in animals are

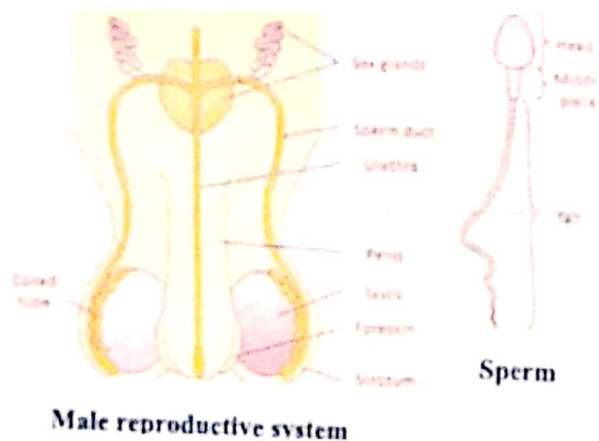
1. **Sexual Reproduction**— It is found in most multicellular animals, like humans.
2. **Asexual Reproduction**— It is found in unicellular and lower animals.

**Sexual reproduction:** It is that type of reproduction which involves the production of a new organism from the existing parents by the fusion of their gametes. It requires two individuals of opposite sexes. Male produces the male gamete called as sperm while as female produces female gametes called as *ovum*. In sexual reproduction, the fusion of a male gamete with female gamete leads to the formation of *zygote*. This zygote can then develop to form a new individual. Human beings, cow, horse, dog, fish, frog etc. reproduce by the sexual reproduction method.

**Asexual Reproduction:** Asexual reproduction is the production of new individuals from a single parent without the involvement of gametes by the mitotic division of cell. Since it does not involve the fusion of gametes, no zygote is formed. Amoeba, hydra, yeast etc. reproduce by asexual reproduction.

**Male reproductive system:** The male reproductive organs include a pair of testes, two sperm ducts, urethra and penis.

a) **Testes:** A man has two testes (singular of testes is testis). These are oval in shape. They lie in a small muscular pouch called scrotum. The function of testes is to produce male gametes called sperms and also to produce the male sex hormone testosterone. The testes of a man make the sperms on reaching the age of 14-15 years and then produce throughout his life. The testes produce millions of sperms. Each sperm has a head, a middle part and a tail. The tail in the sperm helps in its locomotion.



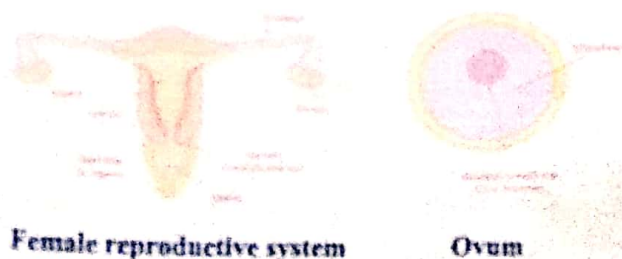
b) **Sperm duct (vas deferens):** The vas deferens is a narrow duct which starts from the testis and joins the urethra. The sperm duct carries sperms to the urethra by the muscular action of its wall. Fluid produced by the seminal vesicles mixes with the sperms to produce semen. This fluid provides nourishment to the sperms.

c) **Urethra:** It is a long tube that arises from the urinary bladder to carry urine. It runs through the penis and opens to the outside through male genital pore. The semen from vas deferens also joins the urethra. Thus, urethra carries urine from the urinary bladder as well as semen (consisting of sperms) from the vas deferens, through the penis.

d) **Penis:** Penis is a long and thick muscular organ. It injects the sperms into the vagina of the female body.

**Female reproductive system:** The female reproductive system consists of a pair of ovaries, a pair of oviducts (fallopian tubes), uterus, vagina. The main functions of the female reproductive system are to produce eggs, receive the sperms, and provide the site for fertilisation, implantation of the growing embryo and development of the foetus.

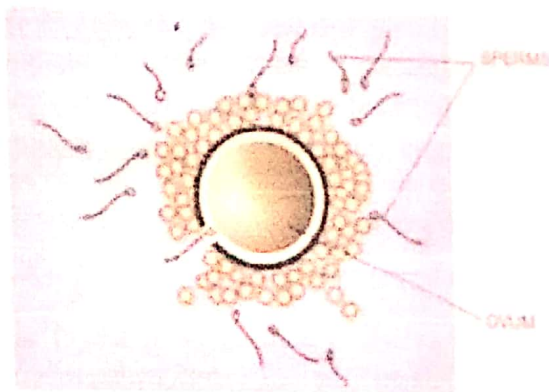
a) **Ovaries:** A woman has two ovaries. The function of ovaries is to make the female gametes called 'Ova' or 'egg' and also to





- 2) make the female sex hormone called estrogen and progesterone. At puberty, the ovaries produce ova required for fertilisation. In human beings, a single matured egg is released into the oviduct by one of the ovaries every month. Like a sperm, an egg is also a single cell.
- b) **Oviducts (fallopian tubes):** Fallopian tube is a thin and coiled muscular tube with a funnel-shaped opening near the ovaries. The ovum (egg cell) released by an ovary goes into the fallopian tube through its funnel-shaped opening. The fertilisation of egg by the sperm to form a fertilised egg called zygote, take place in the fallopian tube.
- c) **Uterus:** The two fallopian tubes connect to a bag-like organ called uterus (womb). The growth and development of a fertilized egg (zygote) into a baby takes place in the uterus.
- d) **Vagina:** The uterus opens into a wide muscular tube called vagina which opens to the outside of the body.

**Fertilisation and the process of formation of zygote:** A zygote is a single diploid cell, created through the merging of two haploid cells. After fertilization, the **zygote** starts to divide, laying the groundwork for the mature organism which will eventually be born, hatched, or grown. During fertilisation process, the sperms are made in the testes of a man and are introduced into the vagina of the women through the penis during copulation. During copulation millions of sperms are introduced into the vagina at one time. The sperms are highly active and mobile, which move up through the cervix into the uterus and pass into the fallopian tubes. One of the fallopian tubes contains an ovum which utilizes only one sperm for fertilization to form a zygote which is referred as fertilization. Thus the fusion of a male gamete with female gamete to form zygote during sexual reproduction is called fertilization.



Fertilisation



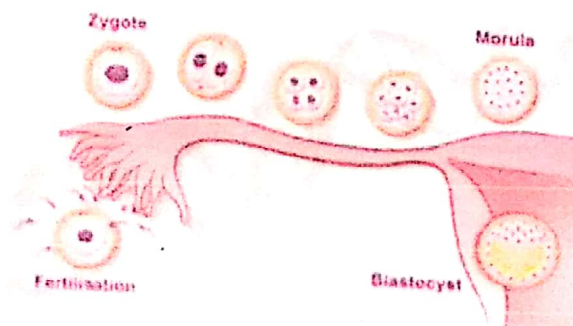
Zygote

**Development of Embryo:** After fertilization, the zygote travels down the oviduct and divides over and over again, to form a ball of cells.

This process is known as cell division. The cells then begin to form different groups that finally develop into different tissues and organs of the body. The developing structure is called the embryo. It gets embedded in the wall of the uterus, where further development occurs. During the development, the different groups of cells change their size and shape, and turn into particular types of cells performing specific functions, such as muscle cells, nerve cells and blood cells.

This is called cell differentiation or cell maturation. It is from these differentiated cells that different tissues and organs develop. On reaching the uterus, the embryo attaches to the wall of uterus by placenta. This is called implantation. The embryo obtains nutrients and oxygen from mother's blood through placenta and continues to grow and develop all its body parts.

At two months stage, the embryo starts resembling the human form and is called foetus. When all body parts assume the right size and forms, the development is complete and the individual is born.



Cell division and implantation of embryo



3  
The period between fertilization and the birth of the baby is called gestation. The woman expecting the baby is termed pregnant. The gestation period is normally 36-40 weeks or around 9-months.

**External and Internal Fertilisation:** The fertilization of an egg by a sperm can take place either inside the body of a female animal or outside its body. This leads to the two modes of fertilization in animals.

a) **Internal fertilization:** The fertilization in which, the female animal's eggs are fertilised by sperms inside her body to form zygote is called internal fertilization. Internal fertilization takes place in mammals (including human beings), birds and reptiles.

b) **External fertilisation :** The fertilization in which fusion of a male and female gamete takes place outside the body of a female is called external fertilization. This is commonly seen in amphibians (like frogs and toads) and fishes, external fertilization takes place.

**Test tube babies:** Test tube babies as the name otherwise suggests, do not grow in test tubes. The couples who are not able to have babies because of have babies because the sperms cannot reach the ovum (unfertilized egg), due to some medical reasons undergo a fertilization procedure called the IVF or in vitro fertilization. The Latin phrase in vitro means 'within the glasses'. The egg cells from the female are surgically removed from the ovaries with a laparoscope. The eggs and the sperm are then placed together in a glass dish containing a special solution, hence the term in vitro fertilization or 'test tube baby.' if one or more eggs are fertilized in the glass dish, the zygotes are allowed to develop for about a week. The embryo is then transplanted into the uterus of the woman where further development takes place and the baby is born.

**Viviparous animals:** Animals that give birth to young ones are known as viviparous animals. In these animals, the development of the embryo takes place inside the body of the mother. Humans, cows, dogs, goats, and tigers are some examples of viviparous animals.

**Oviparous animals:** Animals that lay eggs are known as oviparous animals. In these animals, the development of the embryo takes place in the egg after it is laid. Birds, butterflies, lizards, crocodiles, and snakes are some examples of oviparous.

#### **Modes of Asexual Reproduction:**

a) **Fission:** Fission occurs in lower plants and animals such as the bacteria, blue-green algae and protozoa. In this process, the cell divides after the genetic material has divided. If the cell divides into two it is called binary fission. The DNA or the nucleoid of a mature cell divides first and then the cell divides into two daughter cells of almost the same size. It is seen in bacteria and protozoa's like amoeba and paramecium. If the parent cell divides into many daughter cells, it is called multiple fission. It is seen in the life cycle of the protozoa, plasmodium (the malaria parasite). The nucleus divides many times and then the cytoplasm divides and surrounds the nuclei.

b) **Budding:** In certain fungi and multicellular animals, the parent cell or body gives out a lateral outgrowth called the bud. The nucleus divides and one of the daughter nuclei passes into the daughter cell. The bud grows in size while being attached to the parent body. It then gets separated from the parent by the formation of a wall. It then falls off and grows into a new individual. e.g. hydra.

**Reproductive Cloning:** cloning is a method of reproduction which leads to the creation of a genetically identical copy of a cell or an individual. Reproductive cloning is a technology used to produce an animal that has the same genetic material as another living or previously existing animal.

#### **How Dolly was produced?**

On 27<sup>th</sup> February, 1997, a research article published in the science magazine 'Nature' caused a flutter in the scientific world. It talked about remarkable success achieved by scientist **Dr Ian Wilmut** and his colleagues at the Roslin Institute in Edinburgh, Scotland, in producing a baby sheep without involving the male sperm.

The baby sheep Dolly was developed from a cell taken from the mammary gland of a female sheep (Finn Dorsett Sheep), and an unfertilized egg taken from another female sheep (Scottish Blackface Ewe). The nucleus of the unfertilized egg was removed from it. Therefore, no chromosome remained in the egg shell.

The two cells were then fused together. The egg cell accepted the nucleus of the mammary gland cell and was 'fooled' into thinking that fertilization had taken place. It started developing into an embryo. The embryo was then put inside the uterus of a Scottish Blackface Ewe. It developed into a baby sheep in the uterus and was born in the usual way on 5<sup>th</sup> July, 1996. It took Dr Wilmut 277 attempts to clone Dolly!



4  
Dolly, the famous sheep was the first mammal to be created by reproductive cloning technology, using the technique of Somatic Cell Nuclear Transfer (SCNT). In this technique, the nucleus of an egg cell is removed and in its place the nucleus from an adult cell from another individual is inserted. This cell is then stimulated to divide by an electric shock. Once it reaches a suitable stage, it is transferred to the uterus of a female host where it continues to develop until birth. The cell used as the donor for the cloning of Dolly was taken from the udder (mammary gland) from another sheep.

### Important definitions:

- Unisexual:** The organism that bears only one of the two sexes either male or female is called as unisexual.
- Bisexual or Hermaphrodite:** If both types of sex organs are present in the same individual, that individual is known as bisexual or hermaphrodite. E.g. earthworm, hydra, tapeworm etc.

### Textual questions:

**Q1. Explain the importance of reproduction in organisms.**

**Ans.** Reproduction is a biological process through which living organisms produce offspring similar to themselves. Living organisms reproduce to maintain their number and for the continuation of their species. Thus, reproduction ensures the continuation of similar kinds of individuals and survival of life on the earth.

**Q2. Describe the process of fertilization in human beings.**

**Ans.** Fertilization is the fusion of the male and the female gamete. The male and the female gametes are released from the male and the female reproductive organs. Sperms or male gametes are released from the male reproductive organ. These sperms then enter the female body through the vagina. Then, they travel through the fallopian tubes where they meet the eggs. Hence, the process of fertilization takes place in the fallopian tubes. During fertilization, the haploid nucleus of the sperm and that of the ovum fuse with each other to form the zygote. This zygote divides to form an embryo which in turn develops into a foetus.

**Q3. Choose the most appropriate answer.**

- Internal fertilization occur

**Ans.** In female body

- A tadpole develops into an adult frog by the process of

**Ans.** Metamorphosis.

- The number of nuclei present in a zygote is

**Ans.** one.

**Q4. Indicate whether the following statements true (T) or false (F).**

- Oviparous animals give birth to young ones. (F)
- Each sperm is a single cell. (T)
- External fertilization takes place in frogs. (T)
- A new human individual develops from a cell called gamete. (F)
- Egg laid after fertilization is made up of a single cell. (T)
- Amoeba reproduces by budding. (F)
- Fertilization is necessary even in asexual reproduction. (F)
- Binary fission is a method of asexual reproduction. (T)
- A zygote is formed as a result of fertilization. (T)
- An embryo is made up of a single cell. (F)

**Q5. Give two differences between a zygote and foetus.**

**Ans.**

Zygote	Foetus
1. It is a fertilized egg formed after the fusion of the sperm with the egg.	1. It is a stage of the embryo that shows all the main recognizable body parts of a mature organism.
2. The zygote divides several times to form an embryo.	2. An embryo gradually develops into a foetus.



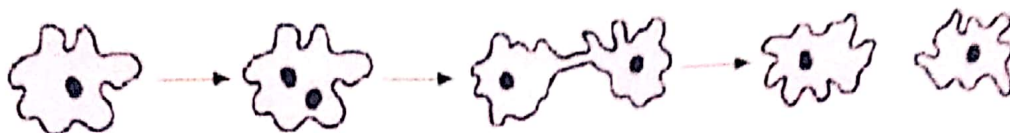
Q6.  
Ans.

Define asexual reproduction. Describe two methods of asexual production in animals.

Asexual reproduction is a mode of reproduction that does not involve the fusion of the male and the female gametes. It requires only one parent, and the offsprings produced are exact copies of their parents.

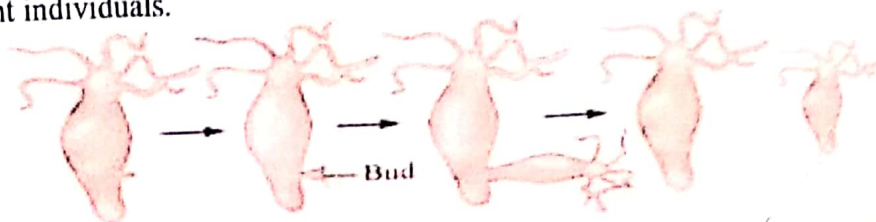
Two methods of asexual reproduction in animals are:

- a) **Binary fission:** It is a type of asexual reproduction in which a single cell divides into two halves. Organisms that reproduce through binary fission are bacteria and Amoeba. In Amoeba, the division of cells can take place in any plane. It involves the division of its nucleus into two nuclei, which is followed by the division of its body into two halves. Each half of the body receives a nucleus.



#### Binary fission in Amoeba

- b) **Budding:** Budding involves the formation of a new individual from the bulges, known as buds formed on the parent body. This method of reproduction is common in Hydra. In Hydra, the cells divide rapidly at a specific site and develop as an outgrowth, called the bud. These buds, while being attached to the parent plant, develop into smaller individuals. When these individuals become mature enough, they detach from the parent's body and become independent individuals.



#### Budding in Hydra

- Q7. In which female reproductive organ does the embryo get embedded?

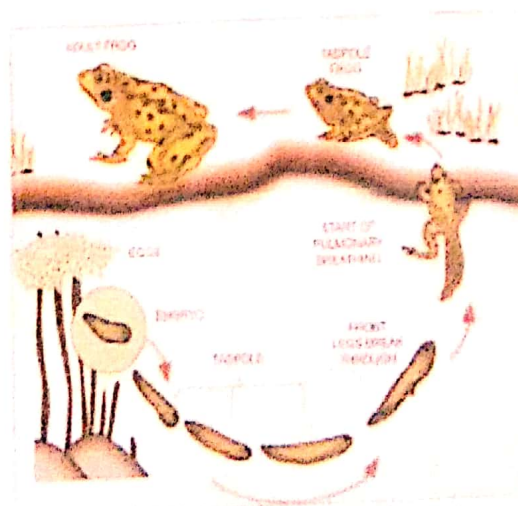
Ans. The embryo gets embedded in the wall of the uterus. The embryo while it is still attached to the uterus gradually develops various body parts such as hands, legs, head, eyes, etc. The embryo is then called a foetus.

- Q8. What is metamorphosis? Give examples.

Ans. Metamorphosis is a biological process of transforming a larva into an adult. This involves relatively sudden and abrupt changes in the animal's structure. Frogs and insects are

examples of organisms showing metamorphosis. The life cycle of a frog has three distinct stages: EGG → TADPOLE → ADULT

**Life cycle of a frog:** The tadpole that emerges from the egg of a frog contains gills, a tail, and a small circular mouth. They can swim freely in water. The tadpole grows and involves abrupt changes in its structure and develops into a mature frog. A tadpole's metamorphosis begins with the development of limbs, lung development, and finally the absorption of the tail by the body.





**Q9. Differentiate between internal fertilization and external fertilization**

Internal fertilization	External fertilization
<ol style="list-style-type: none"><li>1. It involves the fusion of the male and the female gamete inside the female body.</li><li>2. Chances of the survival of the offspring are more. Therefore, a small number of eggs are produced.</li><li>3. Humans, cows, hens are organisms showing internal fertilization.</li></ol>	<ol style="list-style-type: none"><li>1. It involves the fusion of the male and the female gamete outside the female body.</li><li>2. Chances of survival of the offspring are less. Therefore, a large number of eggs are produced.</li><li>3. Fish, frog, toad are organisms showing external fertilization.</li></ol>



## POLLUTION OF AIR AND WATER

**Composition of air:** Earth's atmosphere is 78% nitrogen, 21% oxygen, 0.9% argon, and 0.03% carbon dioxide with very small percentages of other elements. Our atmosphere also contains water vapour. In addition, Earth's atmosphere contains traces of dust particles, pollen, plant grains and other solid particles.

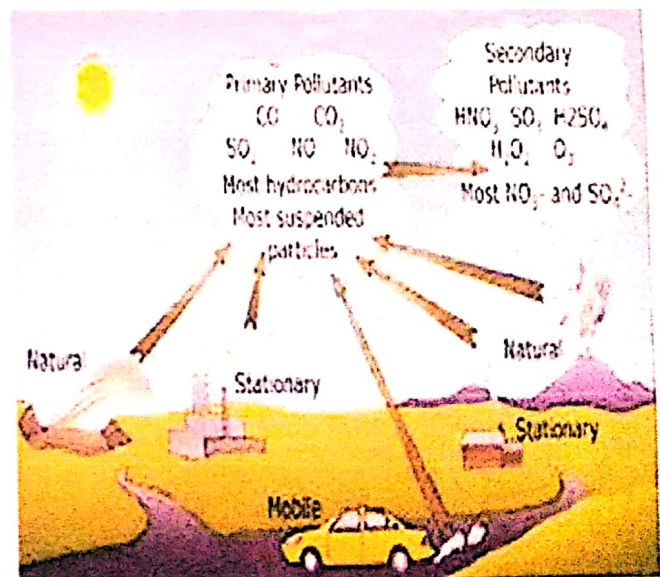
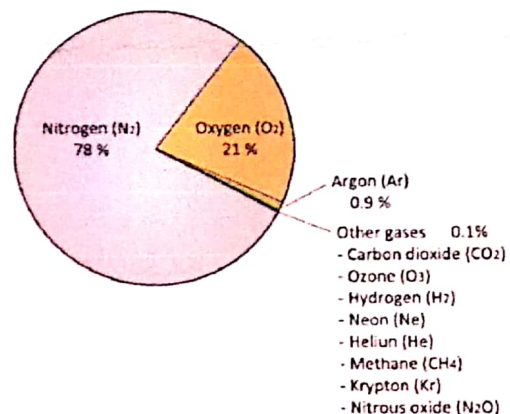
i.e. Nitrogen ( $N_2$ ): 78.09%, Oxygen ( $O_2$ ): 20.95%, Argon (Ar): 0.93%, Carbon dioxide ( $CO_2$ ): 0.038%, Others (less than 0.002% each): Neon (Ne), Helium (He), Krypton (Kr), Hydrogen ( $H_2$ ), Xenon (Xe).

**Air Pollution:** The contamination of air by the addition of unwanted and toxic substances like dust smoke etc. which have harmful effects on both living and non-living things is called air pollution. The substances which contaminate the air are called as air pollutants. e.g. smoke, dust, carbon dioxide, carbon monoxide nitrogen oxide, chlorofluorocarbons (CFCs) etc. Air pollutants are particulate pollutants and the gaseous pollutants. Particulate pollutants include dust particles, soot, aerosol and smoke. Gaseous pollutants include carbon monoxide, nitrogen dioxides, hydrogen sulphide.

**Causes of air pollution:** The various causes of air pollution are

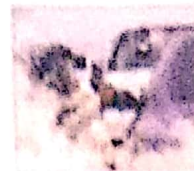
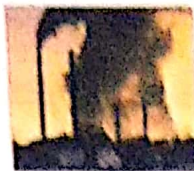
1. , trucks, jet airplanes and other combustion engine vehicles cause air pollution by releasing the harmful gases like carbon monoxide, nitrous oxide and gaseous oxide.

### Composition of Air





2. Factories, office buildings, homes and power-generating stations burn fossil fuels, which cause air pollution.
3. Petroleum refineries release hydrocarbons and various particulates that pollute the air.
4. Pesticides used to kill indoor and outdoor pests, insecticides used to kill insects and herbicides use to kill weeds all cause air pollution.
5. Radioactive fallout causes air pollution from the nuclear energy dispersed, which is a dust.
6. Dust from fertilizers used to help plants grow causes air pollution.
7. Mining causes air pollution by releasing a variety of particles.
8. Mills and plants, include paper mills, chemical plants, iron mills, steel mills, cement plants and asphalt plants, release emissions into the air causing air pollution.
9. Natural volcanic eruption also adds certain gases, volcanic dust etc. to the air to pollute it.



## Air Pollution



**Smog:** The mixture of particulates with gaseous oxides of sulphur present in atmosphere is called smog. The principal source of smog is the combustion of industrial and household fuels (coal and petroleum). Because of the presence of  $\text{SO}_2$  and carbon (soot) particles, smog has a reducing character. It occurs in winter months particularly in early morning hours. It causes severe lung and throat irritation.

**Harmful effects of smog:** The harmful effects of smog are

- i. Smog causes respiratory problems like asthma attacks, bronchitis, heart related disorders.
- ii. Being noxious, it causes irritation to eyes, throat and nose.
- iii. It reduces visibility and affects road as well as air traffic.
- iv. It damages plants; Ozone is very toxic to leafy vegetation such as tomatoes, tobacco and grape plantation. Ozone also damages old growth forests closer to sea level. Small animals incur respiratory and other health stress disorders.
- v. Other materials like electronic and electrical equipments get affected.
- vi. Extreme and unexpected conditions due to smog have caused death.

**Acid rain:** Acid rain is an effect of air pollution. The acid rain is caused when sulphur dioxide and nitrogen oxides from the burning of fossil fuels such as, petrol, diesel, and coal combine with water vapour in the atmosphere and fall as rain. These gases can also be emitted from natural sources like volcanoes. Acid rain causes extensive damage to water, forest, soil resources and even human health.

**Harmful effects of acid rain:**

- i. Acid rain chemically strips waterways of necessary nutrients and lowers the pH to levels where plants and animals cannot live.
- ii. Acidic rain damages the bark and leaves of trees and harms the fine root hairs of many plants which are needed to absorb water.
- iii. Metallic surfaces exposed to acid rain are easily corroded.
- iv. Textile fabrics, paper and leather products lose their material strength or disintegrate by acid rain.

### Effect of Air Pollution on the Human Body



- dizziness
- Headaches
- Eye irritation
- Nasal irritation
- Coughing and shortness of breath
- Sore throat
- Possible lung cancer and other lung diseases
- Chest pains, increased colds, allergies



- v. Building materials such as limestone, marble, dolomite, mortar and slate are weakened on reaction with acid rains because of the formation of soluble compounds. Thus, acid rain is dangerous for historical monuments.

**Greenhouse effect:** The Greenhouse effect is the rise in temperature that the Earth experiences because certain gases in the atmosphere (referred to as greenhouse gases), trap energy from the Sun. Without these gases heat would escape back into space and living on Earth would be inhospitable with average temperature being about 60°F lower. Because of the way they warm our world these gases are referred to as greenhouse gases.

Some greenhouse gases occur naturally, while others result from human activity. The various natural greenhouse gases are: water vapour, carbon dioxide, nitrous oxide, ozone and methane. Carbon dioxide, methane and nitrous oxide, levels in the atmosphere are added by human activities of industry, transport, agriculture, organic and solid waste combustion. Very powerful greenhouse gases that are not naturally occurring include hydrofluorocarbons (HFCs) perfluorocarbons (PFCs) and sulphurhexafluoride ( $\text{SF}_6$ ), which are generated in a variety of industrial processes.

**Global warming:** The gradual increase of overall earth's temperature due to the increase of Greenhouse Gases such as water vapour, carbon dioxide, methane, ozone etc. is called Global Warming. The temperature of the earth is increased in the level of 0.6°C. Following steps can control the global warming to greater extent.

- 1) Reducing deforestation
- 2) Planting more trees
- 3) Slowing down the growth of greenhouse gases into atmosphere
- 4) Improving the efficiency of energy usage
- 5) Cutting down use of fossil fuel

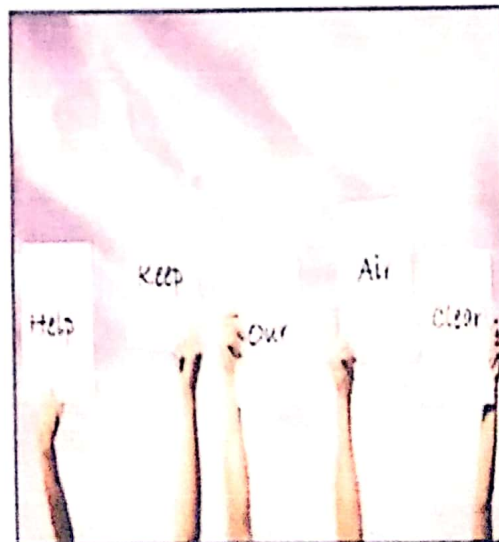
**Harmful effects of global warming:**

- i. Global warming can cause sea levels to rise dramatically.
- ii. Global warming can reduce rainfall in some areas of the Earth leading to droughts
- iii. It can also cause unprecedented excess rainfall causing floods.
- iv. It is serious threat to the existence of life on earth as it could result in wide ranging effects on agriculture, forests, plants, animals and forms of precipitation.
- v. Tropical diseases like malaria, dengue fever, yellow fever and encephalitis etc will spread to other parts of the world.

**Control of air pollution:** In order to control air pollution following measures are being taken:-

- i. Automobiles should be treated with catalyst to cut down CO emissions.
- ii. Substituted bio-fuels should be utilized to cut down the harmful emissions.
- iii. To prevent the increasing concentrations of  $\text{CO}_2$  in the atmosphere forests are being developed and stress is given ongoing green everywhere and recycling.
- iv. Nitrogen oxides are also now being converted into  $\text{N}_2$  by use of catalyst in fuels.
- v. Scrubbers are being used to remove sulphur oxides introduced in air.
- vi. Alternative sources of energy are being used in place of thermal power plants using burning of coal, like hydroelectric and nuclear power plants.
- vii. Methods are being employed to reduce the presence of Carbon and other particulates in the atmosphere.

**Water pollution:** Water pollution is the change or alteration caused to the natural water resources due to the release of pollutants in it. Major water bodies like sea, rivers, lakes, ponds, and ocean and also the underground is affected due to water pollution. The major causes for the water pollution is release of industrial wastes and sewage into the water bodies, excess fertilizers and other chemicals washed away from the





land and mixing with water, releases of oil and other non-soluble substances in water, fecal release in water, etc. Hence water pollution affects the life of aquatic plants and animals, eutrophication, land plants as water is required for their survival, bio-magnifications, and causes several diseases in animals and human beings.

**Causes of Water Pollution:** There are several causes of water pollution which are as follows:

- i. In urban areas, the wastewater sewerage etc. is let out untreated and causes large scale water pollution.
- ii. Most of the rivers and other sources of fresh water are polluted by industrial wastes or effluents.
- iii. Traces of fertilizers and pesticides are wasted into the nearest water bodies at the onset of the monsoons or whenever there are heavy showers.
- iv. Intensive and ever increasing usage of chemical fertilizers, pesticides, and other chemicals cause water pollution.
- v. Flood-plain cultivation is another significant contributor to water pollution.
- vi. Religious faiths and social practices also add to pollution of river waters.
- vii. Carcasses of cattle and other animals are disposed in the rivers.
- viii. Mass bathing in the river during religious festival is another environmentally harmful practice.
- ix. Plastic bags are also very dangerous and further add to the pollution load to the river water.

**Sources of Water Pollution:** The various sources of water pollution are: factories, refineries, waste treatment facilities, mining, pesticides, herbicides and fertilizers, human sewage, oil spills, failing septic systems, soap from washing your car, oil and antifreeze leaking from cars, household chemicals, and animal waste.

**Potable water:** Potable water is water which is fit for consumption by humans and other animals. It is also called drinking water, in a reference to its being fit for drinking. Water may be naturally potable, as is the case with pristine springs, or it may need to be treated in order to be safe. In either instance, the safety of water is assessed with tests which look for potentially harmful contaminants.

**Water purification:** Water purification is the process of removing undesirable chemicals, materials, and biological contaminants from raw water. A common method of purifying water and making it fit for drinking constitutes the following steps.

- i. **Sedimentation:** water from its source is allowed to flow into the sedimentation tanks. It is allowed to stand for a while so that the suspended solid impurities settle down. This process is called as sedimentation. Chemicals like alum may also be added to the water to weigh down the suspended impurities.
- ii. **Filtration:** After sedimentation water is allowed to flow into a tank containing layers of sand and gravel. This removes the fine particles of impurities from the water and is known as filtration.
- iii. **Chlorination:** Finally, a little amount of chlorine gas is added to the water. It dissolves and kills any remaining bacteria. This process is called as chlorination. The chlorinated water is then supplied to the nearby areas through pipelines.
- iv. **Boiling:** The water which we get from the taps is further boiled at the home for drinking purposes which kills all the microorganisms that comes in contact with the water during its supply through pipelines.





**Ways to Prevent Water Pollution:** A few ways to prevent water pollution are:

- Toxic products like paints, automobile oil, polishes, and cleaning products should not be disposed off in water resources.
- Non-degradable products like sanitary napkins and diapers etc should not be flushed down the toilet to nearby water source.
- We should refrain from throwing litter into streams, lakes, rivers, or seas.
- We should try using environment friendly household products like toiletries, soap-based household cleaning material, and washing powder as far as possible.
- We should try using natural fertilizers and pesticides as far as possible, or we should not overuse them or over-water gardens and lawns.
- We should prevent leakages of toxic fluids like antifreeze and oils to the water sources.
- We should actively conserve water by turning the tap off when we do not need running water, such as while brushing teeth.

**Textual questions: Page – 162**

**Q1. Define air pollution.**

**Ans:** The contamination of air by the addition of unwanted and toxic substances like dust smoke etc. which have harmful effects on both living and non-living things is called air pollution.

**Q2. What are the pollutants and name them?**

**Ans:** The substances which contaminate the air, water, and soil are called pollutants. e.g. smoke, dust, carbon dioxide, carbon monoxide, nitrogen oxide, sulphur dioxide, chlorofluorocarbons (CFCs) etc.

**Q3. Name the various sources of air pollutants?**

**Ans:** The various sources of air pollutants are automobile exhausts, factories, industries, burning of fossil fuels etc.

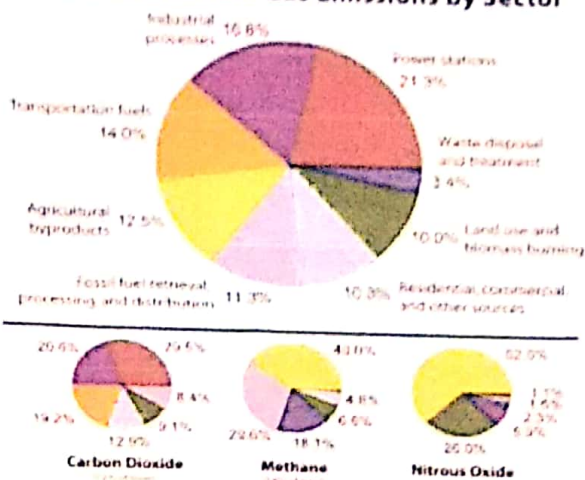
**Q4. Define smog and what are its ill effects?**

**Ans:** Smog: It is a combination of smoke and fog. The mixture of particulate matter with gaseous oxides of sulphur present in atmosphere is called smog. The principal source of smog is the combustion of industrial and household fuels. Because of the presence of  $\text{SO}_2$  and carbon (soot) particles, smog has a reducing character. It occurs in winter months particularly in early morning hours.

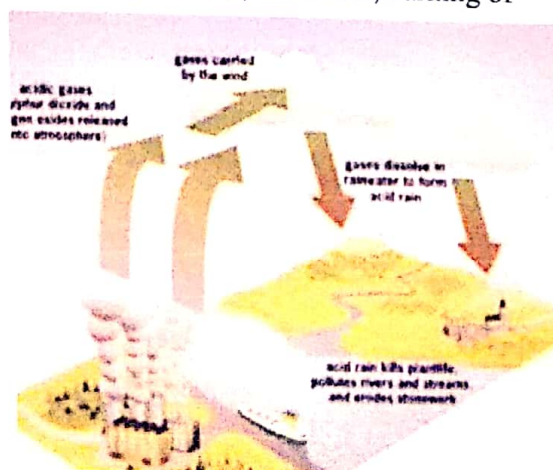
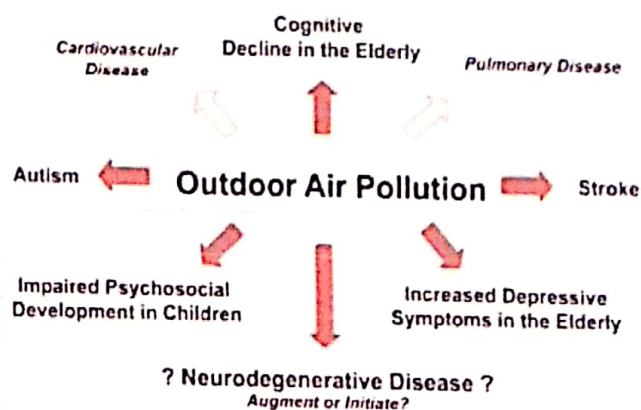
**Harmful effects of smog:** The harmful effects of smog are

- Smog causes respiratory problems like asthma attacks, bronchitis, heart related disorders.
- Being noxious, it causes irritation to eyes, throat and nose.
- It reduces visibility and affects road as well as air traffic.

**Annual Greenhouse Gas Emissions by Sector**



**Impact of Air Pollutants on Human Health: The Central Nervous System**





- iv. It damages plants; Ozone is very toxic to leafy vegetation such as tomatoes, tobacco and grape plantation. Ozone also damages old growth forests closer to sea level. Small animals incur respiratory and other health stress disorders.
- v. Other materials like electronic and electrical equipments get affected.
- vi. Extreme and unexpected conditions due to smog can cause death.

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**Q1. What do you understand by the greenhouse effect?**

**Ans:** A part of the Sun's energy that reaches the earth's surface is absorbed, while the rest is reflected or radiated from the surface of the earth in the form of heat. The heat that is radiated is absorbed by some gases in the atmosphere and thus prevented from escaping into space. The phenomenon by which the atmosphere traps the heat radiated by the earth is called the greenhouse effect.

**Q2. Define global warming and name the various gases which lead to the global warming.**

**Ans:** The increase in the temperature of the earth's atmosphere due to the trapping of radiated heat is called global warming. The various gases which lead to the global warming are carbon dioxide, methane, nitrous oxide, ozone and compounds called chlorofluorocarbons (CFCs).

**Q3. What are the ill effects of global warming?**

**Ans:** The various ill effects of global warming are:

- i. Global warming can cause sea levels to rise dramatically.
- ii. Global warming can reduce rainfall in some areas of the earth leading to droughts
- iii. It can also cause excess rainfall, causing floods.
- iv. It is serious threat to the existence of life on earth as it could result in wide ranging effects on agriculture, forests, plants, animals and forms of precipitation.
- v. Tropical diseases like malaria, dengue fever, yellow fever and encephalitis etc. will spread to other parts of the world.

Page – 168

**Q1. What are the factors responsible for pollution of the river?**

**Ans:** The factors which are responsible for the pollution of the river are

- i. Presence of large number of industries around the river.
- ii. Addition of various toxic chemical effluents disposed of in the river.
- iii. Addition of solid waste materials to the river.
- iv. Addition of household sewage to the river.
- v. The river is also polluted by the huge number of Hindu devotees while performing their religious rituals.

**Q2. What steps can be taken to restore the river Ganga to its past glory.**

**Ans:** The various steps that should be taken to restore the river Ganga to its past glory are

- i. Treating domestic sewage in the treatment plants before disposing in the river.
- ii. Treating industrial waste before disposing off in the river.
- iii. Avoiding and reducing the rituals of disposing off the crematoria to the river.
- iv. Banning the construction of houses and buildings on the banks of the river.

**Q3. How would the disposal of garbage, etc. affect the living organisms in the river?**

**Ans:** The garbage contains harmful chemical like arsenic, lead and fluorides which may lead to poisoning in aquatic life. The chemical wastes disposed in the river causes the oxygen dissolved in it to be utilized by the bacteria and the water is devoid of dissolved oxygen. Thus reduction in the oxygen in water causes the aquatic plants and animal life almost impossible to survive.

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**Q1. Why do we need to filter water before drinking?**

**Ans:** Water needs to be filtered before using it for drinking purposes, as it may contain unwanted, toxic dissolved and suspended impurities which may cause certain water borne diseases..

**Q2. Where do you get your drinking water from?**

**Ans:** We get our drinking water from the water treatment plants of the water works department where water is treated and purified by undergoing certain purification processes and by the addition of certain disinfectants to make it fit for drinking.



**Q3. What will happen if we drink polluted water?**

**Ans.** If we will drink polluted water we will feel sick and suffer from diseases like jaundice, typhoid, cholera, viral fever and viral dysentery. Moreover, drinking polluted water may also lead to some fatal diseases and even to death.

**Exercises page 171-172**

**Q1. What are the different ways in which water gets contaminated?**

**Ans.** Water gets contaminated by the addition of:

1. Water gets contaminated when sewage is disposed of in rivers, lakes, ponds etc.
2. Excessive use of pesticides and fertilisers also causes water pollution. They get washed away with rainwater and get mixed with river water.
3. Wastes from industries when dumped into rivers, pollute river water. The toxic substances in water makes it unfit for use.
4. Lack of sanitation facilities in rural area pollutes water. Human beings and animals defecate near water resource resulting in contamination of water.
5. Washing and bathing near water bodies lead to discharge of detergents.
6. Spillage of oil and its products threaten the aquatic life. It kills aquatic animals and disturbs marine food chain.

**Q2. At an individual level, how can you help reduce air pollution?**

**Ans.** At an individual level we can help in reducing air pollution by following methods:

1. We can plant trees to reduce the level of carbon dioxide and nurture the ones already present in the neighborhood and spread the message to others.
2. We can get our vehicles serviced well to reduce incomplete combustion of fuels.
3. We can also reduce air pollution by saying no to fire crackers, cigarettes, etc.
4. Avoiding the use of cars as much as possible and by using public transport whenever possible.
5. By using clean fuels such as LPG and CNG instead of diesel and petrol.
6. Controlling the emissions from vehicles and household chimneys.

**Q3. Clear and transparent water is always fit for drinking. Comment.**

**Ans.** No, clear and transparent water is not always fit for drinking. Water might appear clean, but it may contain some disease causing micro-organisms and other dissolved impurities. Hence, it is advised to purify water before drinking. Purification can be done by water purifying systems or by boiling the water.

**Q4. You are a member of the municipal body of your town. Make a list of measures that would help your town to ensure the supply of clean water to all its residents.**

**Ans.** To ensure the supply of clean water to all residents the following steps must be taken:

1. First of all, procurement of required amount of water for all residents should be ensured.
2. The main water source must be built in clean surroundings and should be maintained properly.
3. Chemical methods such as chlorination must be used for purifying water.
4. The area around water pipes must also be clean. Open defecation in water resources by slum dwellers should be strictly prohibited.
5. Wastage of water by leakage at various places should be taken into account. The leakage should be repaired immediately on war-footing.
6. Municipal body must keep ready sufficient number of water tankers to meet any emergency.
7. People should be made aware and motivated to keep water resources clean.

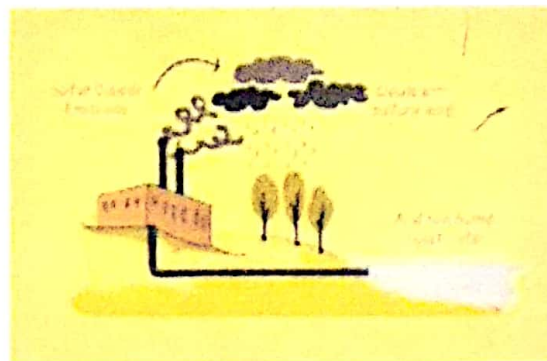
**Q5. Explain the differences between pure air and polluted air.**

**Ans.** Pure air is free from harmful gases which can be poisonous in nature. Pure air has balanced quantity of all its constituent gases and it is free from germs. This type of air is fit for breathing. On the other hand polluted air has poisonous gases and other suspended impurities like dust and smoke. It is unfit for consumption. This may also contain carbon monoxide, sulphur dioxide, nitrogen oxides, and fumes from automobiles. Thus air which is free from all these can be termed as pure air.



**Q6. Explain the circumstances leading to acid rain. How does acid rain affect us?**

**Ans.** Burning of fossil fuels such as coal and diesel releases a variety of pollutants such as sulphur dioxide and nitrogen dioxide into the atmosphere. These pollutants react with water vapours present in the atmosphere to form sulphuric acid and nitric acid respectively. These acids fall on the earth with rain making rain water acidic and harmful.



**Effects of acid rain:**

- (i) Acid rains damage crops.
- (ii) It corrodes buildings and structures especially those made of marble such as Taj Mahal.
- (iii) It makes water unfit for drinking and spoils vegetation and soil.

**Q7. Which of the following is not a greenhouse gas?**

- (a) Carbon dioxide
- (b) Sulphur dioxide
- (c) Methane
- (d) Nitrogen

**Ans.** Sulphur dioxide and Nitrogen

**Q8. Describe the Green House Effect in your own words.**

**Ans.** Greenhouse effect may lead to global warming, i.e., an overall increase in the average temperature of the Earth. Greenhouse effect is caused by greenhouse gases. Examples of greenhouse gases include carbon dioxide, methane, and water vapour. When solar radiations reach the Earth, some of these radiations are absorbed by earth and then released back to the atmosphere. Greenhouse gases present in the atmosphere trap these radiations and do not allow heat to leave. This helps in keeping our planet warm and thus, helps in human survival. However, an indiscriminate increase in the amount of greenhouse gases can lead to excessive increase in the Earth's temperature leading to global warming.

**Q9. Prepare a brief note on global warming that you have to make in your class/ at home.**

**Ans.**



**Q10. Describe the threat to the beauty of the Taj Mahal.**

**Ans.** Increasing air pollution posed a threat to the beauty of the Taj Mahal. Excessive poisonous gases and smoke has started to discolour (yellowing) the white marble of the Taj Mahal. Acid rains due to increasing air pollution has started corroding the marble, thus making Taj Mahal lose its beauty.

**Q11. Why does the increased level of nutrients in the water affect the survival of aquatic organisms?**

**Ans.** An increase in the level of nutrients in a water body flourishes the growth of microorganisms like algae which use up the dissolved oxygen from the water. When algae die, they become food for decomposers such as bacteria. These also use the dissolved oxygen, thus reducing oxygen content even further. Their thick growth also stops sunlight from reaching the water. This enrichment of water by nutrients which leads to excessive plant growth and depletion of oxygen is known as eutrophication. Decrease in oxygen in water, becomes trouble for other aquatic organisms and they start dying due to insufficient amount of oxygen to breathe.



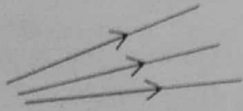
## LIGHT

**Introduction:** Light is a form of energy which produces the sensation of sight in us. Light is made up of stream of particles emitted from a source.

**Some important terms:-**

i. **Ray of Light:-** Light travels in a straight line. The path travelled by the light is represented by a straight line. One such line is known as ray of light.

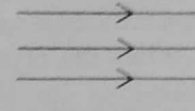
ii. **Beam of light:-** A group of light rays travelling together is called beam of light. Beam of light may be diverging, converging or parallel.



*Divergent beam of light*



*Convergent beam of light*



*Parallel beam of light*

iii. **Luminous object:-** The object which emits its own light is called a luminous object. E.g. sun, stars, electric bulb etc.

iv. **Non-Luminous object:-** The object which does not possess its own light is called non-luminous object. E.g. earth, moon, table etc.

v. **Rectilinear propagation of light:-** Light travels in a straight path. This is known as rectilinear propagation of light.

vi. **Medium:-** Any substance through which light can pass is called a medium. It can be transparent, translucent.

vii. **Reflection of light:-** When light travelling in a medium falls on a surface, then it returns back in the same medium. This process of sending the light rays is known as reflection of light. So reflection of light is the phenomenon of bouncing of light in the same medium, in which it travels when it falls on a surface.

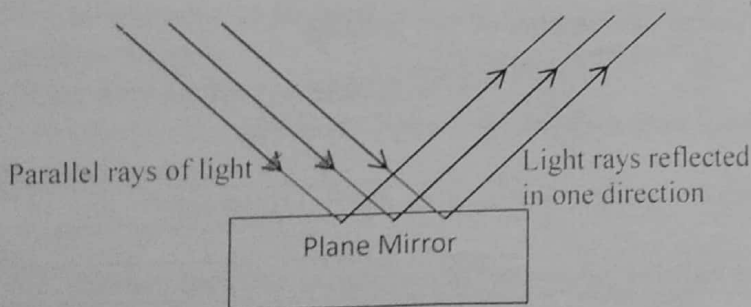
### **Regular reflection**

The phenomena due to which a parallel beam of light on striking a smooth and highly polished surface is reflected back as a parallel beam of light is called regular reflection of light. Images are formed by regular reflection.

### **Irregular reflection**

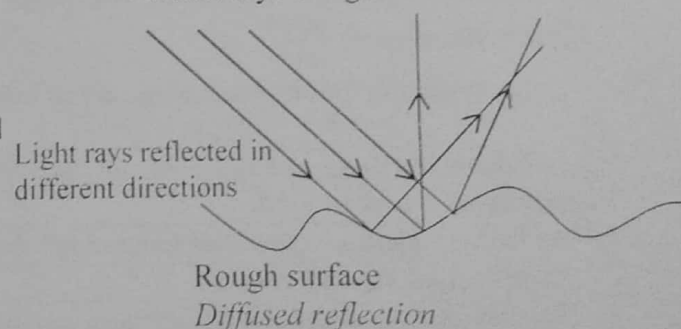
The phenomena due to which a parallel beam of light on striking a rough surface gets reflected in various directions is called irregular or diffused reflection.

*copy.*



*Regular reflection*

### **Parallel rays of light**

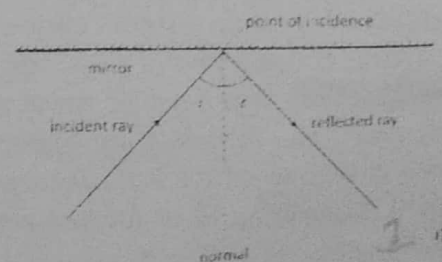


*Diffused reflection*

### **Terms related to reflection of light**

i. **Incident ray:-** The ray which falls on the reflecting surface is known as incident ray.

ii. **Reflected ray:-** Any ray which is reflected back by the reflecting surface is known as reflected ray.





iii. **Point of incidence**:- The point of the reflecting surface at which the incident ray falls is known as the point of incidence.

iv. **Normal**:- It is a line drawn perpendicular to the reflecting surface at the point of incidence.

v. **Angle of incidence**:- The angle between the incident ray and the normal at the point of incidence is known as angle of incidence. It is denoted by  $i$ .

vi. **Angle of reflection**:- The angle between the reflected ray and the normal at the point of incidence is known as angle of reflection. It is denoted by  $r$ .

#### **LAWS OF REFLECTION:-**

i. The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane.

ii. The angle of incidence is equal to the angle of reflection.

$$\text{i.e. } \angle i = \angle r$$

**Image**:- When we look into the mirror, we see our face in it. The picture of our face in the mirror is known as image of our face.

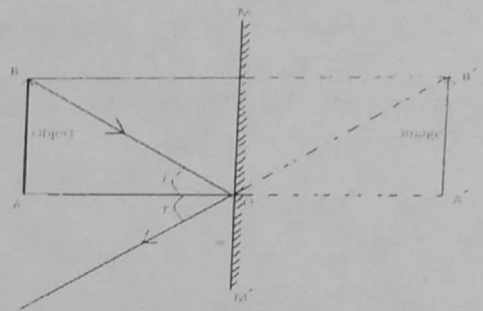
Images are of two types- real and virtual.

i. **Real image**:- The image of an object formed by the actual intersection of light rays after reflection or refraction is known as real image. Real image is always inverted and can be taken on the screen. Image produced by a projector on a wall is a real image.

ii. **Virtual Image**:- When the rays of light do not meet actually after reflection or refraction but appear to meet, then the image so formed is known as virtual image. It is always erect. Virtual image cannot be obtained on a screen. Image formed by the plane mirror is a virtual image.

#### **IMAGE FORMED BY A PLANE MIRROR:-**

Mirrors are formed by depositing a silver layer on one side of a glass sheet and the silver layer is protected by a coat of red paint on the back side of the mirror. When a beam of light falls on the plane mirror most of the light rays enter the glass plate and get reflected from the silvered surface at the back of the mirror. The image formed by a plane mirror  $MM'$  of an object  $AB$  is shown. The properties of image formed by the plane mirror are the following:



1. Image formed by a plane mirror is virtual and erect.

2. Size of image is equal to the size of the object i.e.  $A'B' = AB$

3. The distance of the image from the mirror (Behind it) is equal to the distance of the object from the mirror (in front of it)

$$\text{i.e. } OA' = OA.$$

4. Image formed by a plane mirror is laterally inverted. It means, the right hand of a boy in front of the mirror will be the left hand of his image in the mirror.

**Multiple images**:- When two mirrors are inclined to each other at an angle, many images of the object are seen. This is because the image formed in one mirror acts as the object for the other. Many images formed in this manner are called multiple images.

$$\text{No of images (n)} = \frac{360^\circ}{\text{Angle between the mirrors } (\theta)} - 1$$

(1 is subtracted because of the loss of one image due to overlapping of two images)

$$\begin{aligned} \text{Eg if } \theta = 90^\circ, \text{ then } n &= \frac{360^\circ}{90^\circ} - 1 \\ &= 4 - 1 \\ &= 3 \end{aligned}$$

Uses of plane mirrors:-

Plane mirrors are often used,

1. As looking glass.
2. As reflectors in solar cookers.
3. To provide false dimensions.
4. In a barbers shop it shows customer, the back of his head.
5. For the construction of periscope, Kaleidoscope.

**Kaleidoscope**:- It is a device based on the principle of multiple reflections. It consists of mirrors inclined to each other. The mirrors form multiple images of objects in front of them. This creates beautiful patterns which change when the Kaleidoscope is rotated or shaken. Designers of wall papers, fabrics and artists use Kaleidoscope to get ideas for new patterns.



**Dispersion of light:-** The phenomena of splitting of white light into its component colours on passing through a transparent medium like glass prism is called Dispersion of light. A band of 7 colours formed on a white screen when white light passes through a prism is called Spectrum of white light. Rainbow is formed due to dispersion of light.

**Refraction of light:-** The phenomena of bending of light at the interface of two media when it passes from one transparent medium to another transparent medium.

**Laws of refraction of light:-**

1. Incident ray, Refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie on the same plane.
2. The ratio of sine of angle of incidence to the sine of angle of refraction is constant for the given pair of media in contact and for a light given colour.

$$\frac{\sin i}{\sin r} = \text{constant}$$

**THE HUMAN EYE:-**

The human eye is a light sensitive organ which enables us to see the beautiful world around us. The eyeball is almost like a spherical ball. It has a diameter of about 2.5 cm.

The outer part of the eye is composed of three layers of tissues namely Sclera Choroid and Retina. The structure and function of each part of eye are as follows:-

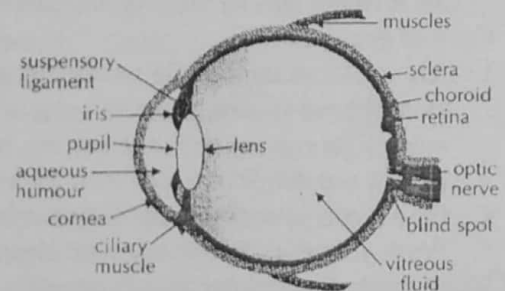
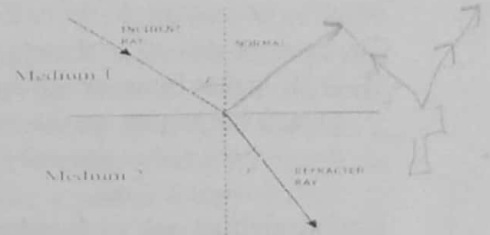
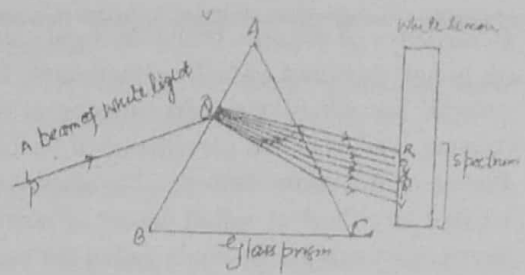
1. **Sclera:-** It is the outer most covering of the eye. It is made of white tough fibrous tissues. It protects the vital internal parts of eye from external injuries.
2. **Choroid:-** The dark grey pigmented layer attached to the sclera on its inner side is called the choroid. It is richly supplied with blood vessels.
3. **Cornea:-** It is the transparent white portion of the eye which covers the transparent bulge on the surface of the eyeball. It allows the light to enter into the eyeball.
4. **Retina:-** It is the innermost delicate membrane having a large number of cells called 'rods' and 'cones'. The cones are sensitive to intensity of colour, while the rods are sensitive to the intensity of light.
5. **Iris and pupil:-** Behind the cornea is the Iris. It lends colour to the eye. The iris has a central circular aperture called pupil. The iris regulates the amount of the light entering the eye by adjusting the size of the pupil in the following way.
  - a) If the light is dim, the iris expands the pupil in order to allow more light to enter the eye.
  - b) If the light is bright, the iris contracts in order to make the pupil decrease the amount of light entering the eye. The iris consists of muscles that expand and contract the pupil.
6. **Eye lens:-** Behind Iris lies a double convex lens made up of a transparent, flexible jelly like material. This lens is held in position with the help of ciliary muscles. It focuses the image of the objects on the retina of the eye.

**The other part of the eye are:-**

Crystalline lens, suspensory ligaments, ciliary muscles, optic nerve, aqueous humour, and blind spot.

**Working of human eye:-**

The light coming from an object enters the eye through the cornea and the pupil
↓
The lens focuses the light rays to form a real, inverted and highly diminished image on the retina
↓
The sensory cells (rods and cones) of the retina get activated and generate electric signals
↓
Optic nerves send electric signals to the brain
↓
The brain interprets these signals and renders the erect image of the object.





**Persistence of vision:-** When the light coming from an object falls on the retina of the eye, the impression of an image does not vanish immediately from the retina. The impression of the image lasts for  $\frac{1}{16}^{\text{th}}$  of a second. So, when stationary images of a moving object are flashed on the eye perceives this object as moving. This is called persistence of vision.

**Power of accommodation:-** The ability of the eye lens to adjust its focal length, so as to see the objects located anywhere is called power of accommodation. The minimum distance at which eye can see objects very clearly without strain is called the near point of the eye. The near point is about 25 cm. The farthest point up to which the eye can see objects clearly without strain is called the farpoint of the eye. For normal eye, the far point is infinity.

**Defects of Vision and their correction:-** Sometimes, the eye may gradually lose its power of accommodation. In such conditions, the person cannot see the objects clearly and comfortably. The vision becomes blurred due to the defects of eye.

The common defects of the eye are the following:-

a) **Near-sightedness or myopia:-** A person suffering from myopia or near-sightedness can see nearby objects but cannot see distant objects distinctly. In a myopic eye, the image of distant object is formed in front of the retina and not at the retina itself. To correct a myopic eye, the person has to use spectacles with a concave lens.

b) **Far-sightedness or hypermetropia:-** A person suffering from hypermetropia can see distant objects clearly but cannot see nearby objects distinctly. In a hypermetropic eye, the image of nearby objects is formed behind the retina and not at the retina itself. To correct a hypermetropic eye, the person has to use spectacles with convex lens.

c) **Cataract:-** It is a leading cause of blindness among the adults of 45 years of age and older. The eye lens becomes hazy and the vision of eye decreases. Due to this, light rays do not pass easily through the lens to focus on the retina. As a result, things look foggy or cloudy. Cataract can be corrected by removing the affected lens by surgery and placing the suitable lens there.

**Care of eye:-**

1. Always sit straight while reading or writing. Do not read while lying down, it strains the eyes.
2. Do not read in dim light or very bright light. Insufficient light causes eye strain and headaches. Too much light can injure the retina. So, read in a good light.
3. Do not watch television or read for a longtime. Sit atleast six feet away from television set.
4. Do not rub your eyes with dirty hands or dirty cloth. Germs can enter the eye and cause infection.
5. Wash your eyes frequently with clean water.

**Visually challenged (or blind) people:-**

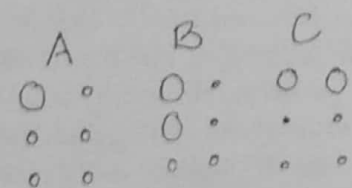
The people who cannot see are called visually challenged or blind.

Technological aid for visually challenged people:-

**Braille system:-** Visually challenged people can read books printed in Braille.

Braille is a system of representing characters by raised dots. Combination of raised dots in a six-dot 'cell' make up different characters.

This system was invented by Louis Braille.



## TEXTUAL QUESTIONS

Q1. If we are in a dark room, then it is not possible for us to see objects in the room. However, objects outside the room are visible to us. An object becomes visible when light reaches our eye after being reflected from the object. If there is no light in the room, then the objects inside the room cannot reflect any light. Hence, we cannot see in a dark room. If there is light present outside the room, then we can see the objects outside the room.

Q2. Regular reflection takes place from a smooth or a regular surface. In regular reflection, all reflected rays are parallel to each other for parallel incident rays. Irregular or diffused reflection takes place from an irregular surface. In diffused reflection, the reflected rays are not parallel to each other for parallel incident rays. This happens because of the presence of irregular microscopic surfaces. Hence, parallel incident rays reflect in different directions. However, each ray obeys the laws of reflection. Therefore, laws of reflections are not violated in diffused or irregular reflections.



(d) Marble floor with water spread over it  $\rightarrow$  Regular reflection

Marble floor with water spread over it is an example of a regular surface. This is because water makes the marble surface smooth. Hence, regular reflection will take place from this surface.

(e) Mirror  $\rightarrow$  Regular reflection

Mirror has a smooth surface. Therefore, it will give a regular reflection.

(f) Piece of paper  $\rightarrow$  Diffused reflection

Although a piece of paper may look smooth, but it has many irregularities on its surface. Due to this reason, it will give a diffused reflection.

Q4. Laws of reflection:

(i) The angle of reflection is always equal to the angle of incidence.

(ii) The incident ray, the reflected ray and the normal to the reflective surface at the point of incidence all lie in the same plane.

Q5. Place a plane mirror on the table. We take a paper sheet and make a small hole in its centre. Make sure that the light in the room is not bright and hold the sheet normal to the table. Take another sheet and place it on the table in contact with the vertical mirror. Draw a normal line on the second sheet from the mirror. Now, light a torch on the mirror through the small hole such that the ray of light falls on the normal at the bottom of the mirror. When the ray from this hole is incident on the mirror, it gets reflected in a certain direction. We can easily observe the incident ray, reflected ray and the normal to the mirror at the point of incidence on the sheet placed on the table. This shows that the incident ray, the reflected ray, and the normal to the surface at the point of incidence all lie in the same plane.

Q6. (a) A person 1 m in front of a plane mirror seems to be 2 m away from his image.

(Object distance and image distance are the same from a plane mirror. The image of a person 1 m in front of a mirror is 1 m back to the mirror. Hence, the image is  $1 + 1 = 2$  m away from the person.)

(b) If you touch your left ear with your right hand in front of a plane mirror, it will be seen in the mirror that your right ear is touched with your left hand.

(This is because of lateral inversion of images formed in a plane mirror.)

(c) The size of the pupil becomes large when you see in dim light.

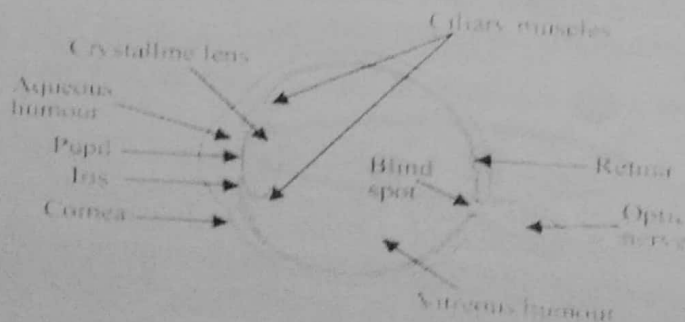
(In dim light, the amount of light entering the eye is very little. To increase the amount of light, the pupil expands.)

(d) Night birds have less cones than rods in their eyes.

(Night birds can see in the night, but not in the day. They have on their retina a large number of rod cells and only a few cones.)

Q9. Construction of a kaleidoscope: Three rectangular mirror strips of dimensions  $15\text{cm} \times 4\text{cm}$  ( $l \times b$ ) are joined together to form a prism. This prism is fixed into a circular cardboard tube. The circular cardboard tube should be slightly longer than the prism. This circular tube is now closed at one end with a cardboard disc. This disc has a hole in it through which we can see. At the other end of the circular tube, a plane glass plate is fixed. It is important that this glass plate touches the prism mirrors. On this glass plate, several small and broken pieces of coloured glass are placed. This end is now closed by a round glass plate allowing enough space for the coloured glass pieces to move

Q10.





Q11. Laser light is harmful for the human eyes, because its intensity is very high. It can cause damage to the retina and lead to blindness. Hence, it is advisable not to look at a laser beam directly.

Q12. To protect our eyes, the given points should be taken into account:

(i) Visit an eye specialist regularly.

(ii) Avoid reading in dim light and very bright light.

(iii) Avoid direct exposure of sunlight to the eye.

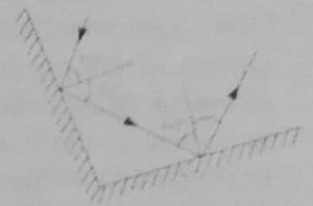
(iv) Clean your eyes with cold water quickly if dust particles or small insects enter your eye. Do not rub your eyes.

(v) Maintain a distance of at least 25 cm between the book and your eyes while reading.

Q13. If the reflected ray is at an angle of  $90^\circ$  to the incident ray, then the angle of incidence is  $45^\circ$ . According to the law of reflection, the angle of incidence is equal to the angle of reflection. Therefore, the angle of incidence and the angle of reflection both are  $90^\circ/2 = 45^\circ$ .

Q14. Infinite or multiple images of the candle will be formed because of multiple reflections between the mirrors. When two mirrors are placed parallel to each other, then infinite number of images are formed.

Q15. The first law of reflection is used to obtain the path of reflected light. It can be observed that the given ray of light will reflect from the second mirror at an angle  $60^\circ$ .



Q16. A plane mirror forms a virtual image behind the mirror. The image is as far behind the mirror as the object is in front of it. A cannot see his image because the length of the mirror is too short on his side. However, he can see the objects placed at points P and Q, but cannot see the object placed at point R (as shown in the given figure).



17. (a) Image of the object placed at A is formed behind the mirror. The distance of the image from the mirror is equal to the distance of A from the mirror. Image of A is shown in the given figure.

(b) Yes. Paheli at B can see this image.

(c) Yes. Boojho at C can see this image.

(d) Image of the object at A will not move. It will remain at the same position when Paheli moves from B to C.

