केन्द्रीय विद्यालय संगठन

KENDRIYA VIDYALAYASANGATHAN

निपुण भारत मिशन

हर बच्चे को उच्च गुणवत्ता वाली शिक्षा

शिक्षा एवं प्रशिक्षण का आंचलिक संस्थान, चंडीगढ़

ZONAL INSTITUTE OF EDUCATION AND TRAINING, CHANDIGARH

अध्ययन सामग्री /STUDY MATERIAL

शैक्षिक सत्र – 2023-24

Session– 2023-24

कक्षा / CLASS – दसवी / X

विषय / SUBJECT – विज्ञान / SCIENCE

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संकलन कर्ता 1. अनुपम एस प्रकाश , प्रशिक्षण सहायक, भौतिक विज्ञान

2. तेजिंदर सिंह, प्रशिक्षण सहायक रसायन विज्ञान

3. रमाकांत उपाध्याय प्रशिक्षण सहायक (जी व वि ज्ञा न)

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INDEX

COURSE STRUCTURE
CLASS X
SESSION- 2023-24

Unit No.	Unit	Marks
I	Chemical Substances-Nature and Behaviour	25
II	World of Living	25
III	Natural Phenomena	12
IV	Effects of Current	13
V	Natural Resources	05
	TOTAL	80
	Internal assessment	20
	GRAND TOTAL	100

Syllabus

Theme: Materials

Unit I: Chemical Substances - Nature and Behaviour

Chemical reactions: Chemical equation, balanced chemical equation, implications of a balanced chemical equation, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, endothermic exothermic reactions, oxidation and reduction.

Acids, bases and salts: Their definitions in terms of furnishing of H^+ and OH^- ions, General properties, examples and uses, neutralization, concept of pH scale (Definition relating to logarithm not required), importance of pH in everyday life; preparation and uses of Sodium Hydroxide, bleaching powder, baking soda, Washing soda and Plaster of Paris.

Metals and nonmetals: Properties of metals and non-metals; Reactivity series; Formation and properties of ionic compounds; Basic metallurgical processes; Corrosion and its prevention.

Carbon compounds: Covalent bonding in carbon compounds. Versatile nature of carbon. Homologous series. Nomenclature of carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes, alkanes and alkynes), difference between saturated hydro carbons and unsaturated hydrocarbons**.** Chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction). Ethanol and Ethanoic acid (only properties and uses), soaps and detergents**.**

Theme: The World of the Living

Unit II: World of Living

Life processes: Living Being, Basic concepts of nutrition, respiration, transport and excretion in plants and animals.

Control and co-ordination in animals and plants: Tropic movements in plants; Introduction of plant hormones; Control and co-ordination in animals: Nervous system; Voluntary, involuntary and reflex action; Chemical co-ordination: animal hormones.

Reproduction: Reproduction in animals and plants (asexual and sexual) reproductive health – need and methods of family planning. Safe sex vs. HIV/AIDS. Child bearing and women ‘s health.

Heredity and Evolution: Heredity; Mendel ‘s contribution- Laws for inheritance of traits: Sex determination: brief introduction: (topics excluded - evolution; evolution and classification and evolution should not be equated with progress).

Theme: Natural Phenomena

Unit III: Natural Phenomena- Reflection of light by curved surfaces; Images formed byspherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula(Derivation not required), magnification. Refraction; Laws of refraction, refractive index. Refraction of light by spherical lens; Image formed by spherical lenses; Lens formula (Derivation not required); Magnification. Power of a lens. Functioning of a lens in human eye, defects of visionand their corrections, applications of spherical mirrors and lenses. Refraction of light through a prism, dispersion of light, scattering of light, applications in daily life (excluding colourof the sunat sunrise and sunset).

Theme: How Things Work

Unit IV: Effects of Current

Electric current, potential difference and electric current. Ohm‘s law; Resistance, Resistivity, Factors on which the resistance of a conductor depends. Series combination of resistors, parallel combination of resistors and its applications in daily life. Heating effect of electric current and its applications in daily life. Electric power, Interrelation between P, V, I and R.

Magnetic effects of current: Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming‘s Left Hand Rule, Direct current. Alternating current: frequency of AC. Advantage of AC over DC. Domestic electric circuits.

Theme: Natural Resources

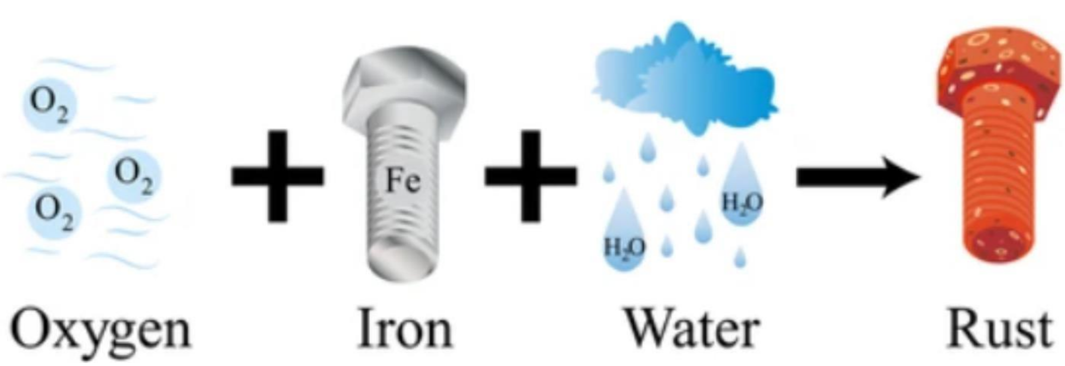
Unit V: Natural Resources

Our environment: Eco-system, Environmental problems, Ozone depletion, waste production and their solutions. Biodegradable and non-biodegradable substances**.**

Chemical Reactions And Equations

Chapter 1

Chemicals of Rusting



CHAPTER 1
CHEMICAL REACTIONS AND EQUATIONS

Chemical Reaction: A chemical reaction is a process in which one or more substances, also called reactants, are converted to one or more different substances, known as products. Substances are either chemical elements or compounds. The following activities are as given below:

1. Magnesium ribbon burns with a dazzling white flame and changes into a white powder. This powder is magnesium oxide. It is formed due to the reaction between magnesium and oxygen present in the air.
2. Take lead nitrate solution in a test tube; add potassium iodide solution to this, and then we observed that lead (II) iodide and potassium nitrate is formed.
3. Take a few zinc granules in a conical flask, add dilute hydrochloric acid or Sulphuric acid to this, and then we observed that hydrogen gas is evolved.
   From the above three activities, that any of the following observations helps us to determine whether a chemical reaction has taken place-
   - Change in state
   - Change in colour
   - Evolution of gas
   - Change in temperature.

Chemical Equations:

Chemical equations are symbolic representations of chemical reactions in which the reactants and the products are expressed in terms of their respective chemical formulae.

Rules for writing chemical equation:

Certain rules have to be followed while writing a chemical equation.

1. The reactants taking part in the reaction are written in terms of their symbols or molecular formulae on the left-hand side of the equation.
2. A plus (+) sign is added between the formulae of the reactants.
3. The products of reaction are written in terms of their symbols or molecular formulae on the right-hand side of the equation.
4. A plus (+) sign is added between the formulae of the products.
5. In between the reactants and the products an arrow sign (⟶) is inserted to show which way the reaction is occurring.
   $A + B \longrightarrow C + D$
   Reactants Products

   In this hypothetical equation, A and B are the reactants, and C and D are the products. The arrow indicates that the reaction proceeds towards the formation of C and D.

Representing the Direction of the Chemical Reaction

The reactants and the products can be separated by one of the following four symbols:

- In order to describe a net forward reaction, the symbol ‗→‘ is used.
- In order to describe a net backward reaction, the symbol ‗← ‘ is used.
- In order to describe a reaction that occurs in both forward and backward directions, the symbol ‗⇄‘ is used.
- In order to describe a state of chemical equilibrium, the symbol ‗⇌‘ is used.

Multiple entities on either side of the reaction symbols describe above are separated from each other with the help of the ‗+‘ symbol in a chemical equation. It can be noted that the ‗→‘ symbol, when used in a chemical equation, is often read as ‗gives rise to‘ or ‗yields‘.

Representing the Physical States of the Reacting Entities

These symbols may be one of the following:

- The symbol (s) describes an entity in the solid state
- The symbol (l) denotes the liquid state of an entity
- The symbol (g) implies that the entity is in the gaseous state.
- The (aq) symbol corresponding to an entity in a chemical equation denotes an aqueous solution of that entity.

In some reactions, a reactant or a product may be in the form of a precipitate which is insoluble in the solution that the reaction is taking place in. The ‗↓‘ symbol is written next to the chemical formula of these entities to describe them as precipitates.

Representing the Input of Energy in a Chemical Equation:

The Greek letter delta in its capitalized form (Δ) is used to state that an input of heat energy is required by the reaction.

An example for which is represented below:

The reaction between hydrogen gas and oxygen gas to form water.

$$\underbrace{2H_2 + O_2}_{\text{Reactants}} \rightarrow \underbrace{2H_2O}_{\text{Products}} \qquad (1)$$

The reacting entities are written on the left-hand side (2 molecules of hydrogen and one molecule of oxygen) whereas the products are written on the right-hand side (2 molecules of water is formed) of the chemical equation.

Equation (1) divided by 2 both sides and we get

$$\underbrace{H_2 + \tfrac{1}{2} O_2}_{\text{Reactant}} \rightarrow \underbrace{H_2O}_{\text{Product}}$$

The reacting entities are written on the left-hand side (1 molecules of hydrogen and half molecule of oxygen) whereas the products are written on the right-hand side (1 molecules of water) of the chemical equation.

It can also be observed that there are coefficients assigned to each of the symbols of the corresponding reactants and products. These coefficients of entities in a chemical equation are the exact value of the stoichiometric number for that entity.

Balanced Chemical Equations:
The law of conservation of mass that mass can neither be created nor destroyed in a chemical reaction. The total mass of the elements present in the products of a chemical reaction has to be equal to the total mass of the elements present in the reactants.

EXAMPLE 1:
Write the chemical equation for the formation of magnesium oxide.
Step 1: Magnesium burns in oxygen to give magnesium oxide. Here, the reactants are magnesium and oxygen. The product is magnesium oxide.
Step 2: Thus, the word equation is
Magnesium + Oxygen ⟶ Magnesium oxide
Step 3: Replacing the names with symbols and formulae, we get the chemical equation as

$$Mg + O_2 \longrightarrow MgO$$

Reactants Products
Step 4: The numbers of atoms of the elements are

Element	Number of atoms in LHS	Number of atoms in RHS
Mg	1	1
O	2	1

To balance oxygen on both sides, multiply RHS by 2, i.e.,
$Mg + O_2 \longrightarrow 2MgO$
Now, the number of oxygen atoms is balanced but the number of magnesium atoms is not. Therefore, multiply magnesium on the LHS by 2. Thus, the equation becomes
$2Mg + O_2 \longrightarrow 2MgO$
this is the balanced chemical equation.

EXAMPLE 2:
The word-equation represented as –
Zinc + Sulphuric acid ⟶ Zinc sulphate + Hydrogen
The above word-equation may be represented by the following chemical equation –
$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

Let us examine the number of atoms of different elements on both sides of the arrow.

Element	Number of atoms in reactants (LHS)	Number of atoms in products (RHS)
Zn	1	1
H	2	2
S	1	1
O	4	4

As the number of atoms of each element is the same on both sides of the arrow is a balanced chemical equation.

EXAMPLE 3:
Let us try to balance the following chemical equation –
$Fe + H_2O \longrightarrow Fe_3O_4 + H_2$

Step I: To balance a chemical equation, first draw boxes around each formula. Do not change anything inside the boxes while balancing the equation.
$Fe + H_2O \longrightarrow Fe_3O_4 + H_2$

Step II: List the number of atoms of different elements present in the unbalanced equation.

Element	Number of atoms in reactants (LHS)	Number of atoms in products (RHS)
Fe	1	3
H	2	2
O	1	4

Step III:

Element	Number of atoms in reactants (LHS)	Number of atoms in products (RHS)
Fe	1 x 3	3
H	2 x 4	2 x 4
O	1 x 4	4

Balanced equation:
$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

As the number of atoms of each element is the same on both sides of the arrow is a balanced chemical equation.

List some Examples of Chemical Equations.

A few examples of chemical equations are listed in bulleted text below.

- $PCl_5 + H_2O \rightarrow H_3PO_4 + HCl$
- $SnO_2 + H_2 \rightarrow H_2O + Sn$
- $TiCl_4 + H_2O \rightarrow TiO_2 + HCl$

- $H_3PO_4 + KOH \rightarrow K_3PO_4 + H_2O$
- $Na_2S + AgI \rightarrow NaI + Ag_2S$
- $Fe + CuCl_2 \longrightarrow FeCl_3 + Cu$
- $CaCl_2 + AgNO_3 \rightarrow Ca(NO_3)_2 + AgCl\downarrow$

TYPES OF CHEMICAL REACTIONS:

1. **Combination Reaction**: A *reaction in which two or more substances combine to form a single new substance.* Combination reactions can also be called synthesis reactions.

1. $CaO(s) + H_2O\ (l) \longrightarrow Ca\ (OH)_2(aq)$
   (Quick lime) (Slaked lime)
2. $Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(l)$
   (Calcium hydroxide) (Calcium carbonate)
3. $C(s) + O_2(g) \longrightarrow CO_2(g)$
4. $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$
5. $CH_4(g) + 2O_2\ (g) \longrightarrow CO_2\ (g) + 2H_2O\ (g)$
6. $C_6H_{12}O_6(aq) + 6O_2(aq) \longrightarrow 6CO_2(aq) + 6H_2O(l) + \text{energy}$
   (Glucose)

2. **Decomposition Reaction**: A reaction in which a compound breaks down into two or more simpler substances.

Most decomposition reactions require an input of energy in the form of heat, light, or electricity.

1. $2FeSO_4(s) \xrightarrow{\text{Heat}} Fe_2O_3(s) + SO_2\ (g) + SO_3\ (g)$
   (Ferrous sulphate) (Ferric oxide)
2. $CaCO_3(s) \xrightarrow{\text{Heat}} CaO(s) + CO_2(g)$
   (Limestone) (Quick lime)
3. $2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$
4. $2Pb(NO_3)_2(s) \xrightarrow{\text{Heat}} 2PbO(s) + 4NO_2(g) + O_2(g)$
   (Lead nitrate) (Lead oxide) (Nitrogen dioxide) (Oxygen)
5. $2AgBr(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Br_2(g)$

3. **Displacement Reaction:** A chemical reaction in which a more reactive element displaces a less reactive element from its aqueous salt solution.

1. $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$
   (Copper sulphate) (Iron sulphate)
2. $Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$
   (Copper sulphate) (Zinc sulphate)
3. $Pb(s) + CuCl_2(aq) \longrightarrow PbCl_2(aq) + Cu(s)$
   (Copper chloride) (Lead chloride)

4. **Double Displacement Reaction:** A chemical reaction in which ions gets exchanged between two reactants which form a new compound is called a double displacement reaction.

1. $Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$
   (Sodium sulphate) (Barium chloride) (Barium sulphate) (Sodium chloride)

5. **Precipitation reaction:** A precipitation reaction is a chemical reaction that occurs in aqueous solution and form precipitates. The insoluble salt that falls out of the solution is known as the precipitate. It can occur when two solutions containing different salts are mixed, and a cation/anion pair in the resulting combined solution forms an insoluble salt. For example,

Aqueous silver nitrate ($AgNO_3$) is added to a solution containing potassium chloride (KCl), and the precipitation of a white solid, silver chloride (AgCl), is observed:

$AgNO_3\,(aq) + KCl\,(aq) \rightarrow AgCl\,(s) + KNO_3\,(aq)$

EXOTHERMIC AND ENDOTHERMIC CHEMICAL REACTIONS:

EXOTHERMIC CHEMICAL REACTIONS: Reactions in which heat is released along with the formation of products are called exothermic reactions. For examples:

$CH_4\,(g) + 2O_2\,(g) \longrightarrow CO_2\,(g) + 2H_2O\,(g)$

$C_6H_{12}O_6\,(aq) + 6O_2\,(aq) \longrightarrow 6CO_2\,(aq) + 6H_2O\,(l) + \text{energy}$

(Glucose)

ENDOTHERMIC CHEMICAL REACTIONS: A reaction that the system absorbs energy from its surrounding in the form of heat.
When ammonium chloride (NH_4Cl) is dissolved in water, an endothermic reaction takes place. The salt dissociates into ammonium (NH_4^+) and chloride (Cl^-) ions. The chemical equation can be written as follows:

$\mathbf{NH_4Cl\,(s) + H_2O\,(l) + Heat \longrightarrow NH_4Cl\,(aq)}$

$\mathbf{N_2 + O_2 \longrightarrow 2NO}$

Other Endothermic Processes:

(i) The melting of ice to form water.
(ii) Evaporation of liquid water, forming water vapour.
(iii) Sublimation of solid CO_2.
(iv) The baking of bread.

OXIDATION: Oxidation refers to the loss of electrons or increase in oxidation state by a molecule, atom, or ion.
REDUCTION: Reduction refers to the gain of electrons or decrease in oxidation state by a molecule, atom, or ion.
REDOX REACTIONS: A reduction-oxidation or redox reaction is a type of chemical reaction in which reduction and oxidation occur at the same time.
OXIDATION: If substance gains oxygen during a reaction, it is said to, be oxidised. For example:
$2Cu + O_2 \longrightarrow 2CuO$

REDUCTION: If substance loses oxygen during a reaction, it is said to, be reduced. For example:

$CuO + H_2 \longrightarrow Cu + H_2O$

REDOX REACTIONS: If one reactant gets oxidised while other gets reduced during a reaction. Such reactions are called oxidation-reduction reaction or Redox reaction.

OX

+2 -2 0 0 +1 -2

$CuO + H_2 \xrightarrow{Heat} Cu + H_2O$

RED

Some other examples of Redox reactions are:

1. $ZnO + C \longrightarrow Zn + CO$

OX

+2 -2 0

$ZnO + C \longrightarrow Zn + CO$

RED

2. $MnO_2 + HCl \longrightarrow MnCl_2 + H_2O + Cl_2$

OX

+4 -2 +1 -1 +2 0

$MnO_2 + HCl \longrightarrow MnCl_2 + H_2O + Cl_2$

RED

Multiple Choice Questions:

Q1. Identify x and y in the following reaction: $Cu + xHNO_3 \rightarrow Cu(NO_3)_2 + yNO_2 + 2H_2O$

(a) 4 and 2
(b) 3 and 5
(c) 2 and 3
(d) 4 and 4

Q2. Which of the following can be decomposed by the action of sunlight?

(a) Potassium bromide
(b) Silver bromide
(c) Magnesium oxide
(d) Sodium chloride

Q3. The carbonate of lead is a white solid. It decomposes when heated to form carbon dioxide and a yellow solid oxide 'X'. What is X?

(a) Zinc oxide
(b) Lead oxide
(c) Silver oxide
(d) Magnesium oxide

Q4. Identify the endothermic process from the following?
(a) $H_2O(l) \rightarrow H_2O(g)$
(b) $CaO\ (s) + H_2O\ (l) \rightarrow Ca\ (OH)_2\ (aq)$
(c) Combustion of methane
(d) Addition of conc. HCl to water

Q5. Which of the following statements about the given reaction are correct?
$2Fe\ (s) + 4H_2O\ (l) \rightarrow Fe_3O_4\ (s) + 4H_2\ (g)$
1. Iron metal is getting oxidized.
2. Water is getting reduced.
3. Water is acting as reducing agent.
4. Water is acting as oxidizing agent.

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

Q6. When Ag is exposed to air it gets a black coating of
(a) $AgNO_3$
(b) Ag_2S
(c) Ag_2O
(d) Ag_2CO_3

Q7. $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$
Identify the substance oxidized in the above equation.
(a) $MnCl_2$
(b) HCl
(c) H_2O
(d) MnO_2

Q8. Zinc reacts with silver nitrate to form which compounds?
(a) $Zn\ (NO_3)_2 + Ag$
(b) $ZnNO_3 + Ag$
(c) $AgNO_3 + Zn\ (NO_3)_2$
(d) $Ag + Zn\ (NO_3)_3$

Q9. In the double displacement reaction between aqueous potassium iodide and aqueous lead nitrate, a yellow precipitate of lead iodide is formed. While performing the activity if lead nitrate is not available, which of the following can be used in place of lead nitrate?
(a) Lead sulphate (insoluble)
(b) Lead acetate

(c) Ammonium nitrate
(d) Potassium sulphate

Q10. The brown gas evolved on heating of copper nitrate is
(a) O_2
(b) NO_2
(c) N_2
(d) NO

Q11. Electrolysis of water is a decomposition reaction. The mole ratio of hydrogen and oxygen gases liberated during electrolysis of water is:
(a) 1: 1
(b) 2:1
(c) 4:1
(d) 1:2

Q12. A substance 'X' is used in white-washing and is obtained by heating limestone in the absence of air. Identify 'X'.
(a) $CaOCl_2$
(b) $Ca(OH)_2$
(c) CaO
(d) $CaCO_3$

Q13. $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$; is an example of
(i) displacement reaction (ii) double displacement reaction
(iii) neutralisation reaction (iv) combination reaction.
(a) (i) and (ii)
(b) (ii) and (iii)
(c) (iii) and (iv)
(d) (i) and (iv)

Q14. A substance X which is a group 2 element is used intensively in the cement industry. This element is present in bones also. On treatment with water, it forms a solution which turns red litmus blue. Element X is
(a) Cu
(b) Ca
(c) Na
(d) Al

Q15. You are given the following chemical reaction:

$$CuO + H_2 \xrightarrow{\text{Heat}} Cu + H_2O$$

This reaction represents:
(a) Combination reaction as well as double displacement reaction
(b) Redox reaction as well as displacement reaction
(c) Double displacement reaction as well as redox reaction
(d) Decomposition reaction as well as displacement reaction

ANSWERS

Q1. (a)	**Q2. (b)**	**Q3. (b)**	**Q4. (a)**	**Q5. (c)**
Q6. (b)	**Q7. (d)**	**Q8. (a)**	**Q9. (b)**	**Q10. (b)**
Q11. (b)	**Q12. (a)**	**Q13. (b)**	**Q14. (b)**	**Q15. (b)**

Assignment:

Q1. What happens chemically when quicklime is added to water filled in a bucket?
Answer. Quicklime reacts with water to form slaked lime and produces lot of heat and hissing sound.
Q2. On what basis is a chemical equation balanced?
Answer. A chemical reaction is balanced on the basis of law of conservation of mass.
Q3. What change in colour is observed when white silver chloride is left exposed to sunlight? State the type of chemical reaction in this change.
Answer. Silver chloride becomes grey. It is a photochemical decomposition reaction.
Q4. A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction?
Answer. $KCl\ (aq) + AgNO_3\ (aq) \longrightarrow AgCl\ (s) + KNO_3\ (aq)$
It is a double displacement reaction. It is also a precipitation reaction as AgCl is a white precipitate.

Q5. Translate the following statement into chemical equation and then balance it Barium Chloride reacts with Aluminium sulphate to give Aluminium Chloride and a precipitate ofBarium Sulphate. State the two types in which this reaction can be classified.
Answer. $3BaCl_2\ (aq) + A1_2\ (SO_4)_3(aq) \longrightarrow 3BaSO_4(s) + 2AlCl_3\ (aq)$
It can be classified as double displacement as well as precipitation reaction.
Q6. Why decomposition reactions are called the opposite of combination reactions? Write equations for these reactions.
Answer. In decomposition reaction, a compound is broken down into simpler compounds or elements, e.g. $CuCO_3\ (s) \longrightarrow CuO\ (s) + CO_2\ (g)$
Combination reaction is a reaction in which two or more elements or compounds combine to form a new compound, e.g. $N_2\ (g) + H_2\ (g) \longrightarrow 2NH_3\ (g)$
Thus, decomposition and combination reactions are opposite to each other.
Q7. What is redox reaction? Identify the substance oxidized and the substance reduced in the following reactions.
(i) $2PbO + C \longrightarrow 2Pb + CO_2$
(ii) $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$
Answer. Those reactions in which oxidation and reduction takes place simultaneously are called redox reactions.
(i) PbO is getting reduced and C is getting oxidized.
(ii) MnO_2 is getting reduced and HCl is getting oxidized.
Q8. Using a suitable chemical equation, justify that some chemical reactions are determined by:
(i) change in colour, (ii) change in temperature.
Answer. (i) $Pb\ (NO_3)_2\ (aq) + 2KI \longrightarrow PbI_2 + 2KNO_3\ (aq)$

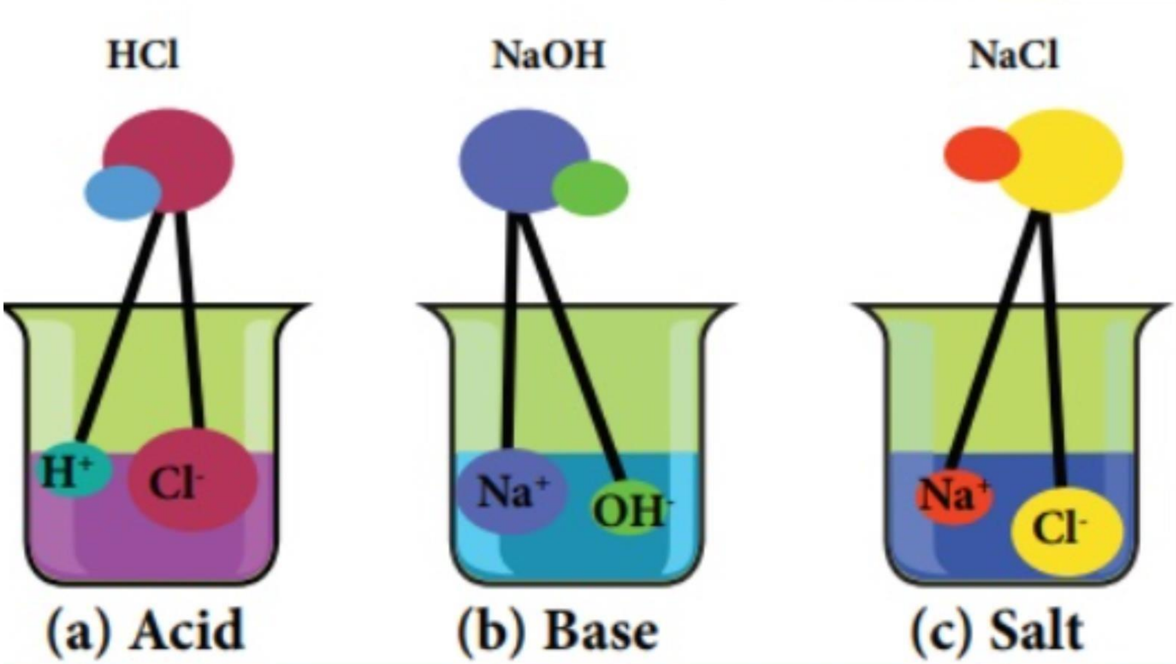
Colourless Yellow ppt.

(ii) $CaO\ (s) + H_2O\ (l) \longrightarrow Ca\ (OH)_2 + heat$

Q9. Write balanced equations for the following mentioning the type of reaction involved.
(i) Aluminium + Bromine ——> Aluminium bromide
(ii) Calcium carbonate——> Calcium oxide + Carbon dioxide
(iii) Silver chloride——>Silver + Chlorine
Answer. (i) $2Al\ (s) + 3Br_2\ (g) \longrightarrow 2AlBr_3\ (s)$
(ii) $CaCO_3\ (s) \longrightarrow CaO + CO_2$
(iii) $2AgCl\ (s) \longrightarrow 2Ag\ (s) + Cl_2\ (g)$

Q10. (a) Why is respiration considered as an exothermic reaction?
(b) Define the terms oxidation and reduction.
(c) Identify the substance that is oxidized and reduced in the following reaction.
$CuO\ (s) + Zn\ (s) \longrightarrow Cu\ (s) + ZnO\ (s)$
Answer. (a) It is because heat is evolved during respiration.
(b) Oxidation is a process in which O_2 is added or H_2 is removed or loss of electrons takes place.
Reduction is a process in which H_2 is added or O_2 is removed or gain of electrons take place.
(c) Zn is getting oxidized, CuO is getting reduced.


Acids
Bases & salts


HCl
NaOH
NaCl
H^+
Cl^-
Na^+
OH^-
Na^+
Cl^-
(a) Acid
(b) Base
(c) Salt


Gastric acid
Lemon juice
Apple juice
Tomato juice
Black coffee
Milk
Pure water
Egg
Baking soda
Hand soap
Ammonia solution
Bleach
Concentrated solutions of alkalis

CHAPTER 2

ACIDS, BASES AND SALTS

Acids: Acids are sour in taste, turn blue litmus red, and dissolve in water to release H^+ ions.
Example: Sulphuric acid (H_2SO_4), Acetic Acid (CH_3COOH), Nitric Acid (HNO_3) etc.
Properties of Acids:

- Acids have a sour taste.
- Turns blue litmus red.
- Acid solution conducts electricity.
- Release H^+ ions in aqueous solution.

Types of Acids: Acids are divided into two types on the basis of their occurrence i.e., Natural acids and Mineral acids.
(i) Natural Acids: Acids which are obtained from natural sources are called Natural Acids or Organic Acids. Methanoic acid ($HCOOH$), Acetic acid (CH_3COOH), Oxalic acid ($C_2H_2O_4$) etc.
(ii) Mineral Acids: Acids that are prepared from minerals are known as Mineral Acids Example; Inorganic acids, man-made acids or synthetic acid are also known as Mineral Acids.
Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3), Carbonic acid (H_2CO_3) Phosphoric acid (H_3PO_4) etc.
Chemical Properties of Acid:
(i) Reaction of acids with metal: Acids give hydrogen gas along with respective salt when they react with a metal.
Examples: Hydrogen gas and zinc chloride are formed when hydrochloric acid reacts with zinc metal.

$$Zn\,(s) + 2HCl\,(aq) \longrightarrow ZnCl_2\,(aq) + H_2\,(g)$$

Test for Hydrogen Gas: The gas evolved after reaction of acid with metal can be tested by bringing a lighted candle near it. If the gas bums with a pop sound, then it confirms the evolution of hydrogen gas. Burning with pop sound is the characteristic test for hydrogen gas.
(ii) Reaction of acids with metal carbonate: Acids give carbon dioxide gas and respective salts along with water when they react with metal carbonates.
Examples: Hydrochloric acid gives carbon dioxide gas, sodium chloride along with water when reacts with sodium carbonate.

$$Na_2CO_3\,(aq) + 2HCl\,(aq) \longrightarrow 2NaCl\,(aq) + CO_2\,(g) + H_2O\,(l)$$

(iii) Reaction of acid with hydrogen carbonates (bicarbonates): Acids give carbon dioxide gas, respective salt and water when they react with metal hydrogen carbonate.
Example: Sulphuric acid gives sodium sulphate, Carbon dioxide gas and water when it reacts with sodium bicarbonate.

$$2NaHCO_3\,(aq) + H_2SO_4\,(aq) \longrightarrow Na_2SO_4\,(aq) + CO_2\,(g) + H_2O\,(l)$$

TYPES OF ACIDS:
Strong Acids: An acid which is completely ionized in water and produces (H^+) is called Strong Acid.
Examples: Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3)

Weak Acids: An acid which is partially ionized in water and thus produces a small amount of hydrogen ions (H^+) is called a Weak Acid.
Example: Acetic acid (CH_3COOH), Carbonic acid (H_2CO_3)

Bases: Bases are bitter in taste, have soapy touch, turn red litmus blue and give hydroxide ions (OH^-) in aqueous solution.
Examples: Sodium hydroxide (caustic soda) – NaOH, Calcium hydroxide – $Ca(OH)_2$
Potassium hydroxide (caustic potash) – (KOH)
Properties of Bases:

- Have a bitter taste.
- Soapy to touch.
- Turns red litmus blue.
- Conducts electricity in solution.
- Release OH^- ions in Aqueous Solution

Types of bases: Bases can be divided in two types – Water soluble and Water-insoluble.
The hydroxide of alkali and alkaline earth metals are soluble in water. These are also known as alkali. For example NaOH, $Mg(OH)_2$, $Ca(OH)_2$

Chemical properties of bases:
(i) Reaction of Base with Metals: When alkali (base) reacts with metal, it produces salt and hydrogen gas.

Examples: Sodium hydroxide gives hydrogen gas and sodium zincate when reacts with zinc metal.
$2NaOH (aq) + Zn (s) \longrightarrow Na_2ZnO_2 (aq) + H_2 (g)$

(ii) Reaction of Base with Oxides of Non-metals: when a base reacts with non-metal oxide, both neutralize each other resulting respective salt and water.
Examples: Sodium hydroxide gives sodium carbonate and water when it reacts with carbon dioxide.
$2NaOH (aq) + CO_2 (g) \longrightarrow Na_2CO_3 (aq) + H_2O (l)$
(iii) Neutralisation Reaction: An acid neutralizes a base when they react with each other and respective salt and water are formed.
Examples: Sodium chloride and water are formed when hydrochloric acid reacts with sodium hydroxide (a strong base).
$HCl (aq) + NaOH (aq) \longrightarrow NaCl (aq) + H_2O (l)$
(iv) Reaction of Acid with Metal Oxides: Metal oxides are basic in nature. Thus, when an acid reacts with a metal oxide both neutralize each other. In this reaction, the respective salt and water are formed.
Examples: When an acid, such as hydrochloric acid, reacts with calcium oxide, neutralization reaction takes place and calcium chloride, along with water is formed.
$2HCl (aq) + CaO (aq) \longrightarrow CaCl_2 (aq) + H_2O (l)$

Salts: Salts are the ionic compounds which are produced after the neutralization reaction between acid and base. Salts are electrically neutral. There are number of salts but sodium chloride is the most common among them. Sodium chloride is also known as table salt or common salt. Sodium chloride is used to enhance the taste of food.

Acid + Base → Salt + Water

$HCl\ (aq) + NaOH\ (aq) \longrightarrow NaCl\ (aq) + H_2O\ (l)$

Characteristics of salt:

- Most of the salts are crystalline solid.
- Salts may be transparent or opaque.
- Most of the salts are soluble in water.
- Solution of the salts conducts electricity in their molten state also.
- The salt may be salty, sour, sweet, and bitter.
- Neutral salts are odourless.
- Salts can be colourless or coloured.

Example: Sodium chloride ($NaCl$), Sodium Sulphate (Na_2SO_4), Calcium chloride ($CaCl_2$), Calcium sulphate ($CaSO_4$), Zinc chloride ($ZnCl_2$) and Zinc sulphate ($ZnSO_4$)

Neutral, Acidic and Basic Salts:

(i) Neutral Salt: Salts produced because of reaction between a strong acid and strong base are neutral in nature. The pH value of such salts is equal to 7, i.e. neutral.

Example: Sodium chloride, Sodium sulphate. Potassium chloride, etc.

Sodium chloride (NaCl): It is formed after the reaction between hydrochloric acid (a strong acid) and sodium hydroxide (a strong base).

$HCl\ (aq) + NaOH\ (aq) \longrightarrow NaCl\ (aq) + H_2O\ (l)$

Sodium Sulphate (Na_2SO_4): It is formed after the reaction between sodium hydroxide (a strong base) and Sulphuric acid (a strong acid).

$H_2SO_4\ (aq) + 2NaOH\ (aq) \longrightarrow Na_2SO_4\ (aq) + 2H_2O\ (l)$

Potassium Chloride (KCl): It is formed after the reaction between potassium hydroxide (a strong base) and hydrochloric acid (a strong acid).

$HCl\ (aq) + KOH\ (aq) \longrightarrow KCl\ (aq) + H_2O\ (l)$

(ii) Acidic Salts: Salts which are formed after the reaction between a strong acid and weak base are called Acidic salts. The pH value of acidic salt is lower than 7. For example: Ammonium chloride, Ammonium sulphate etc.

Ammonium chloride is formed after reaction between hydrochloric acid (a strong acid) and ammonium hydroxide (a weak base).

$HCl\ (aq) + NH_4OH\ (aq) \longrightarrow NH_4Cl\ (aq) + H_2O\ (l)$

Ammonium sulphate is formed after reaction between ammonium hydroxide (a weak base) and Sulphuric acid (a strong acid).

$H_2SO_4\ (aq) + 2NH_4OH\ (aq) \longrightarrow [NH_4]_2SO_4\ (aq) + 2H_2O\ (l)$

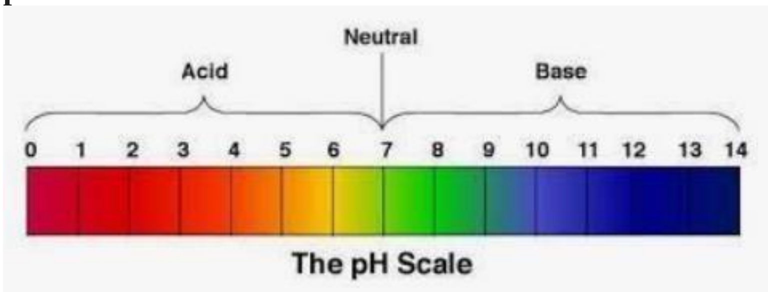
(iii) Basic Salts: Salts which are formed after the reaction between a weak acid and strong base are called Basic Salts. For example; Sodium carbonates, Sodium acetate, etc.
Sodium carbonate is formed after the reaction between sodium hydroxide (a strong base) and carbonic acid (a weak acid).

H_2CO_3 (aq) + 2NaOH (aq) $\longrightarrow$ Na_2CO_3 (aq) + $2H_2O$ (l)

Sodium acetate is formed after the reaction between a strong base, sodium hydroxide (a strong base) and acetic acid, (a weak acid).

CH_3COOH (aq) + NaOH (aq) $\longrightarrow$ CH_3COONa (aq) + H_2O (l)

pH Scale:



Strength of Acid and Base: Acids in which complete dissociation of hydrogen ion takes place are called Strong Acids. Similarly, bases in which complete dissociation of hydroxide ion takes place are called Strong Bases.
In mineral acid, such as hydrochloric acid, Sulphuric acid, nitric acid, etc. hydrogen ion dissociates completely and hence, they are considered as strong acids. Since inorganic acids hydrogen ions do not dissociate completely, so they are weak acids.

pH is equal to the logarithm to the base 10, inverse of hydrogen ion concentration.
pH = -log $[H^+]$ = log $\{1/[H^+]\}$ = 10^{-pH}
Similarly, pOH = -log $[OH^-]$ = log $\{1/[OH^-]\}$
And pH + pOH = pKw = 14
Higher the hydronium ion concentration present in the solution, lower is its pH value.
For water or neutral solutions: pH = 7
for acidic solutions: pH < 7
for basic solution: pH > 7
Importance of pH everyday life:
(i) pH in our digestive system: Dilute HCl (Hydrochloric acid) helps in digestion of food (proteins) in our stomach. Excess acid in stomach causes acidity (indigestion). Antacids like magnesium hydroxide [Mg $(OH)_2$] also known as milk of magnesia and sodium hydrogen carbonate (baking soda) are used to neutralize excess acid.

(ii) Tooth decay caused by acids: The bacteria present in our mouth converts the sugar into acids. When the pH of acid formed in the mouth falls below 5.5, tooth-decaying starts. The excess acid has to be removed by cleaning the teeth with good quality toothpaste because these kinds of toothpaste are alkaline in nature.

(iii) Soil of pH and plant growth: Most of the plants have a healthy growth when the soil has a specific pH (close to 7) range which should be neither alkaline nor highly acidic.

Some Important Chemical Compounds

1. Common Salt (Sodium Chloride): Sodium chloride (NaCl) is also known as Common or Table Salt. It is formed after the reaction between sodium hydroxide and hydrochloric acid. It is a neutral salt. The pH value of sodium chloride is about 7. Sodium chloride is used to enhance the taste of food. Sodium chloride is used in the manufacturing of many chemicals.

$$HCl\ (aq) + NaOH\ (aq) \longrightarrow NaCl\ (aq) + H_2O\ (l)$$

2. Sodium Hydroxide (NaOH): Sodium hydroxide is a strong base. It is also known as caustic soda. It is obtained by the electrolytic decomposition of solution of sodium chloride (brine). In the process of electrolytic decomposition of brine (aqueous solution of sodium chloride), brine decomposes to form sodium hydroxide. In this process, chlorine is obtained at anode and hydrogen gas is obtained at cathode as by products. This whole process is known as Chloro – Alkali process.

$$2NaCl\ (aq) + 2H_2O\ (l) \longrightarrow 2NaOH\ (aq) + Cl_2\ (g) + H_2\ (g)$$

3. Bleaching Powder ($CaOCl_2$): Bleaching powder is also known as chloride of lime. It is a solid and yellowish white in colour. Bleaching powder can be easily identified by the strong smell of chlorine.

When calcium hydroxide (slaked lime) reacts with chlorine, it gives calcium oxychloride (bleaching powder) and water is formed.

$$Ca\ (OH)_2\ (aq) + Cl_2\ (aq) \longrightarrow CaOCl_2\ (aq) + H_2O\ (l)$$

Aqueous solution of bleaching powder is basic in nature. The term bleach means removal of colour. Bleaching powder is often used as bleaching agent. It works because of oxidation. Chlorine in the bleaching powder is responsible for bleaching effect.

Use of Bleaching Powder:

- Bleaching powder is used as disinfectant to clean water, moss remover, weed killers, etc.

- Bleaching powder is used for bleaching of cotton in textile industry, bleaching of wood pulp in paper industry.
- Bleaching powder is used as oxidizing agent in many industries, such as textiles industry, paper industry, etc.

4. Baking Soda ($NaHCO_3$): Baking soda is another important product which can be obtained using byproducts of chlor – alkali process. The chemical name of baking soda is sodium hydrogen carbonate ($NaHCO_3$) or sodium bicarbonate.

Preparation Method: Baking soda is obtained by the reaction of brine with carbon dioxide and ammonia. This is known as Solvay process.

$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$

Properties of Sodium Bicarbonate:

- Sodium bicarbonate is white crystalline solid, but it appears as fine powder.
- Sodium hydrogen carbonate is amphoteric in nature.
- Sodium hydrogen carbonate is sparingly soluble in water.
- When baking soda is heated, it decomposes into sodium carbonate, carbon dioxide and water.
  $2NaHCO_3 + heat \rightarrow Na_2CO_3 + CO_2 + H_2O$
- Sodium carbonate formed after thermal decomposition of sodium hydrogen carbonate decomposes into sodium oxide and carbon dioxide on further heating.
  $Na_2CO_3 \rightarrow Na_2O + CO_2$

Use of Baking Soda:

- Baking soda is used in making of baking powder, which is used in cooking as it produces carbon dioxide which makes the batter soft and spongy.
- Baking soda is used as an antacid.
- Baking soda is used in toothpaste which makes the teeth white and plaque free.
- Baking soda is used in cleansing of ornaments made of silver.
- Since sodium hydrogen carbonate gives carbon dioxide and sodium oxide on strong heating, thus, it is used as a fire extinguisher.

4. Washing Soda (Sodium Carbonate)
Preparation Method: Sodium carbonate is manufactured by the thermal decomposition of sodium hydrogen carbonate obtained by Solvay process.

$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$

$2NaHCO_3 + Heat \rightarrow Na_2CO_3 + CO_2 + H_2O$

The sodium carbonate obtained in this process is dry. It is called Soda ash or anhydrous sodium carbonate. Washing soda is obtained by rehydration of anhydrous sodium carbonate.

$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3 .10H_2O$

since there are 10 water molecules in washing soda, hence, it is known as Sodium Bicarbonate decahydrate.
Sodium carbonate is a crystalline solid and it is soluble in water when most of the carbonates are insoluble in water.

Use of sodium carbonate:

- It is used in the cleaning of cloths.
- In the making of detergent cake and powder.
- In removing the permanent hardness of water.
- It is used in glass and paper industries.

(v) Plaster of Paris: Calcium sulphate hemihydrate [$CaSO_4$. ½ H_2O]

$CaSO_4.2H_2O \xrightarrow{373K}$ **$CaSO_4$. ½ H_2O** + $3/2H_2O$

Plaster of Paris

$CaSO_4.1/2H_2O + 3/2H_2O \longrightarrow CaSO_4.2H_2O$ (Gypsum)

Multiple Choice Questions:

Q1. Which of the following acids is present in sour milk?
(a) Glycolic acid
(b) Oxalic acid
(c) Lactic acid
(d) Citric acid

Q2. Which of the following statements is not correct?
(a) All metal carbonates react with acid to give a salt, water and carbon dioxide
(b) All metal oxides react with water to give salt and acid
(c) Some metal react with acids to give salt and hydrogen
(d) Some non-metal oxides react with water to form an acid

Q3. Which of the following statements is incorrect about bases?
(a) Bases are bitter in taste
(b) They are soapy to touch
(c) They are corrosive in nature
(d) All bases are alkali

Q4. Mixing of acid or base with water results in …… in the concentration of ions per unit volume.

(a) Decreases
(b) Increases
(c) No change
(d) Reverse change

Q5. What is pH?
(a) The positive logarithm of the hydroxide ion concentration
(b) The positive logarithm of the hydrogen ion concentration
(c) The negative logarithm of the hydroxide ion concentration
(d) The negative logarithm of the hydrogen ion concentration

Q6. Which of the following statements is correct about an aqueous solution of an acid and a base?
1. Higher the pH, stronger the acid.
2. Higher the pH, weaker the acid.
3. Lower the pH, stronger the base.
4. Lower the pH, weaker the base.

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

Q7. The chemical formula of washing soda is ………
(a) $NaHCO_3$
(b) $Na_2CO_3.10H_2O$
(c) $CaOCl_2$
(d) NaOH

Q8. Baking soda is a mixture of
(a) Sodium carbonate and acetic acid
(b) Sodium carbonate and tartaric acid
(c) Sodium hydrogen carbonate and tartaric acid
(d) Sodium hydrogen carbonate and acetic acid

Q9. What happens, when a solution of an acid is mixed with a solution of a base in a test tube?
1. The temperature of the solution increases.
2. The temperature of the solution decreases.
3. The temperature of the solution remains the same.
4. Salt formation takes place.

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

Q10. Which of the following salts does not contain water of crystallization?

(a) Blue vitriol
(b) Baking soda
(c) Washing soda
(d) Gypsum

ANSWERS

Q1. (c)	**Q2. (b)**	**Q3. (d)**	**Q4. (a)**	**Q5. (d)**
Q6. (d)	**Q7. (b)**	**Q8. (c)**	**Q9. (d)**	**Q10. (b)**

Assignment:

Q1. Name the natural source of each of the following acid
(i) Citric acid (ii) Oxalic acid
(iii) Lactic acid (iv) Tartaric acid
Answer. (i) Lemon and orange (ii) Tomatoes and Guava
(iii) Sour milk (curd) (iv) Tamarind

Q2**.** A student detected the pH of four unknown solution A, B, C and D as follows 11, 5, 7 and 2. Predict the nature of the solution.
Answer. A is basic ‗B‘ is acidic ‗C‘ is natural and ‗D‘ is strongly acidic.

Q3. How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?
Answer. Bring a burning matchstick near the gas. It burns with ‗pop‘ sound showing that it is hydrogen.

Q4. (a) Write the name given to bases that are highly soluble in water. Give an example.
(b) How is tooth decay related to pH? How can it be prevented?
(c) Why does bee sting cause pain and irritation? Rubbing of baking soda on the sting area gives relief. How?
Answer. (a) Alkali, e.g. NaOH (Sodium hydroxide).
(b) Lower the pH more will be tooth decay. Acid reacts with $Ca_3(PO_4)_2$ and cause tooth decay. It can be prevented by brushing teeth after every meal.
(c) It is due to formic acid. Sodium hydrogencarbonates (Baking soda) neutralizes formic acid giving relief.

Q5. A white powder is added while baking breads and cakes to make them soft and fluffy. Write the name of the powder. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking.
Answer. Baking powder. It consists of sodium hydrogencarbonates and tartaric acid.
Sodium hydrogencarbonates gives CO_2 which makes cake soft and fluffy. Tartaric acid neutralizes the bitterness due to sodium carbonate produced.
$2NaHCO_3 (s) \longrightarrow Na_2CO_3 (s) + CO_2 (g) + H_2O (l)$

Q6. A student dropped few pieces of marble in dilute hydrochloric acid, contained in a test-tube. The evolved gas was then passed through lime water. What change would be observed in lime water? What will happen if excess of gas is passed through lime water? With the help of balanced chemical equations for all the changes explain the observations.

Answer.

$CaCO_3$ (s) + 2HCl (dilute) $\longrightarrow$ $CaCl_2$ (s) + CO_2 (g) + H_2O (l)

Lime water turns milky due to liberation of CO_2.

Ca $(OH)_2$ (aq) + CO_2 (g) $\longrightarrow$ $CaCO_3$ (s) + H_2O (l)

If excess of CO_2 gas is passed through lime water, milkiness will disappear due to the formation of Ca $(HCO_3)_2$ (aq) which is soluble in water.

$CaCO_3$ (s) + CO_2 (g) + H_2O (l) $\longrightarrow$ Ca $(HCO_3)_2$ (aq)

Q7. 15 mL of water and 10 mL of Sulphuric acid are to be mixed in a beaker

(i) State the method that should be followed with reason.

(ii)What is this process called?

Answer.

(i) The acid is to be added slowly in water to prevent the mixture to be splashed. The reaction is highly exothermic; therefore, constant cooling should be done.

(ii) The process is called dilution**.**

Q8. Choose strong acids and weak acids from the following:

CH_3COOH, H_2SO_4, H_2CO_3, HNO_3

Answer. H_2SO_4 and HNO_3 are strong acids.

CH_3COOH and H_2CO_3 are weak acids.

Q9. A white coloured powder is used by doctors for supporting fractured bones.

(a) Write chemical name and formula of the powder.

(b) When this white powder is mixed with water a hard solid mass is obtained. Write balanced chemical equation for the change.

Answer. (a) Calcium sulphate hemihydrate ($CaSO_4 .1/_2 H_2O$)

(b) $CaSO_4 .1/_2 H_2O + 3/_2 H_2O \longrightarrow CaSO_4 . 2H_2O$

Q10**.** How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?

Answer. Bring a burning matchstick near the gas. It burns with _pop‘ sound showing that it is hydrogen.

METALS & NON-METALS

Physical properties

metals are Solid at room temperature	Non Metals are present in three states solid , liquids and gases
Metals has lustrous and can be polished	they are not lustrous except diamond
Metals are generally hard	Non Metals are soft
metals have high density	

CHAPTER 3

METALS AND NON-METALS

Metals: Elements that are electropositive in nature are called metals. It means metals lose electrons to form positive ions, e.g. copper.

Physical Properties of Metals:

- **Hardness:** Most of the metals are hard, except alkali metals, such as sodium, potassium; lithium, etc. are very soft metals. These can be cut by using a knife.
- **Strength:** Most of the metals are strong and have high tensile strength. Because of this, big structures are made using metals, such as copper (Cu) and iron (Fe). (Except Sodium (Na) and potassium (K) which are soft metals).
- **State:** Metals are solid at room temperature except for mercury (Hg).
- **Sound:** Metals produce ringing sound, so, metals are called Sonorous. Sound of metals is also known as Metallic sound. This is the cause that metal wires are used in making musical instruments.
- **Conduction:** Metals are a good conductor of heat and electricity. This is the cause that electric wires are made of metals like copper and aluminium.
- **Malleability:** Metals are malleable. This means metals can be beaten into a thin sheet. Because of this property, iron is used in making big ships.
- **Ductility:** Metals are ductile. This means metals can be drawn into thin wire. Because of this property, a wire is made of metals.
- **Melting and Boiling Point:** Metals have generally high melting and boiling points. (Except sodium and potassium metals which have low melting and boiling point.)
- **Density:** Most of the metals have a high density.
- **Colour:** Most of the metals are grey in colour. But gold and copper are exceptions.

Chemical Properties of Metals

1. Reaction with oxygen: Most of the metals form respective metal oxides when reacting with oxygen.

Metal + Oxygen → Metal Oxide

Examples:

Reaction of Potassium with Oxygen: Potassium metal forms potassium oxide when reacts with oxygen.

$4K + O_2 \longrightarrow 2K_2O$

Reaction of Sodium with Oxygen: Sodium metal forms sodium oxide when reacts with oxygen.

$4Na + O_2 \longrightarrow 2Na_2O$

Lithium, potassium, sodium, etc. are known as Alkali-metals. Alkali metals react vigorously with oxygen.

Reaction of Copper metal with Oxygen: Copper does not react with oxygen at room temperature but when burnt in air, it gives oxide.

$2Cu + O_2 \longrightarrow 2CuO$

Silver, gold and platinum do not combine with the oxygen of air even at high temperature. They are the least reactive.

2. Reaction of metals with water: Metals form respective hydroxide and hydrogen gas when reacting with water.

Metal + Water → Metal hydroxide + Hydrogen

Most of the metals do not react with water. However, alkali metals react vigorously with water.

Reaction of Sodium metal with Water: Sodium metal forms sodium hydroxide and liberates hydrogen gas along with lot of heat when reacting with water.

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

Reaction of Calcium metal with Water: Calcium forms calcium hydroxide along with hydrogen gas and heat when react with water.

$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

Reaction of Magnesium metal with Water: Magnesium metal reacts with water slowly and forms magnesium hydroxide and hydrogen gas.

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

When steam is passed over magnesium metal, magnesium oxide and hydrogen gas are formed.

$Mg + H_2O \longrightarrow MgO + H_2$

Reaction of Aluminium metal with Water: Reaction of aluminium metal with cold water is too slow to come into notice. But when steam is passed over aluminium metal, aluminium oxide and hydrogen gas are produced.

$2Al + 3H_2O \rightarrow Al_2O_3 + 2H_2$

Reaction of Zinc metal with Water: Zinc metal produces zinc oxide and hydrogen gas when steam is passed over it. Zinc does not react with cold water.

$Zn + H_2O \longrightarrow ZnO + H_2$

Reaction of Iron with Water: Reaction of iron with cold water is very slow and comes into notice after a long time. Iron forms rust (iron oxide) when reacts with moisture present in the atmosphere. Iron oxide and hydrogen gas are formed by passing of steam over iron metal.

$2Fe + 3H_2O \longrightarrow Fe_2O_3 + 3H_2$

Both calcium (Ca) and magnesium (Mg) are heavier than water but still float over it: Both calcium and magnesium float over water surface because hydrogen gas is evolved when these metals react with water. It is in the form of bubbles which stick on the metal surface. Therefore, they float over it.

$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

Other metals usually do not react with water or react very slowly. Lead, copper, silver and gold do not react with steam. Thus, the order of reactivity of different metals towards water may be written as:
K > Na > Ca > Mg > Al > Zn > Fe > Pb > Cu > Ag > Au

3. Reaction of metals with dilute acid: Metals form respective salts when reacting with dilute acid.
Metal + dil. acid → Metal salt + Hydrogen

Reaction of Sodium metal with dilute hydrochloric acid: Sodium metal gives sodium chloride and hydrogen gas when react with dilute hydrochloric acid.

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

Reaction of Magnesium metal with dilute hydrochloric acid: Magnesium chloride and hydrogen gas are formed when magnesium reacts with dilute hydrochloric acid.

$Mg + 2HCl \longrightarrow MgCl_2 + H_2$

Reaction of Zinc with dilute Sulphuric acid: Zinc sulphate and hydrogen gas are formed when zinc reacts with dilute Sulphuric acid. This method is used in the laboratory to produce hydrogen gas.

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

Hydrogen (H_2) gas is not evolved when metal is treated with nitric acid (HNO_3):
Nitric acid is strong oxidising agent and it oxidizes the hydrogen gas (H_2) liberated into water (H_2O) and itself get reduced to some oxide of nitrogen like nitrous oxide $(N_2O)_3$ nitric oxide (NO) and nitrogen dioxide (NO_2).

Copper, gold, silver are known as noble metals. These do not react with water or dilute acids. The order of reactivity of metal towards dilute hydrochloric acid or Sulphuric acid is in the order; K > Na > Ca > Mg > Al > Zn > Fe > Cu > Hg > Ag

Metal Oxides

Chemical Properties: Metal oxides are basic in nature. The aqueous solution of metal oxides turns red litmus blue.

Reaction of Metal oxides with Water: Most of the metal oxides are insoluble in water. Alkali metal oxides are soluble in water. Alkali metal oxides give strong base when dissolved in water.

Reaction of Sodium oxide with Water: Sodium oxide gives sodium hydroxide when reacts with water.

$$Na_2O + H_2O \longrightarrow 2NaOH$$

Reaction of Potassium oxide with Water: Potassium oxide gives potassium hydroxide when reacts with water.

$$K_2O + H_2O \longrightarrow 2KOH$$

Reaction of Zinc oxide and Aluminium oxide: Aluminium oxide and zinc oxide are insoluble in water. Aluminium oxide and zinc oxide are amphoteric in nature. An amphoteric substance shows both acidic and basic characters. It reacts with base like acid and reacts with an acid like a base.

When zinc oxide reacts with sodium hydroxide, it behaves like an acid. In this reaction, sodium zincate and water are formed.

$$ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$$

Zinc oxide behaves like a base when reacts with acid. Zinc oxide gives zinc chloride and water on reaction with hydrochloric acid.

$$ZnO + 2HCl \longrightarrow ZnCl_2 + H_2O$$

In a similar way, aluminium oxide behaves like a base when reacts with acid and behaves like acid when reacts with a base.

Aluminium oxide gives sodium aluminate along with water when reacts with sodium hydroxide.

$$Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$$

Aluminium oxide gives aluminium chloride along with water when it reacts with hydrochloric acid.

$Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$

Reactivity Series of Metals: The order of intensity or reactivity of metal is known as Reactivity Series. Reactivity of elements decreases on moving from top to bottom in the given reactivity series.
In the reactivity series, copper, gold, and silver are at the bottom and hence, least reactive. These metals are known as Noble metals. Potassium is at the top of the series and hence, most reactive.
Reactivity of some metals is given in descending order:
K > Na > Ca > Mg > Al > Zn > Fe > Pb > Cu > Hg > Ag > Au
4. Reaction of metals with solution of other metal salts: Reaction of metals with the solution of other metal salt is displacement reaction. In this reaction, more reactive metal displaces the less reactive metal from its salt.
Metal A + Salt of metal B → Salt of metal A + Metal B
Examples:
Iron displaces copper from copper sulphate solution.

$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

Similarly, aluminium and zinc displace copper from the solution of copper sulphate.

$2Al + 3CuSO_4 \longrightarrow Al_2 (SO_4)_3 + 3Cu$

$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

In all the above examples, iron, aluminium and zinc are more reactive than copper. This is why they displace copper from its salt solution.
When copper is dipped in the solution of silver nitrate, it displaces silver and forms copper nitrate.

$Cu + 2AgNO_3 \longrightarrow Cu (NO_3)_2 + 2Ag$

In the reaction, copper is more reactive than silver and hence, displaces silver from silver nitrate solution.
Silver metal does not react with copper sulphate solution because silver is less reactive than copper and not able to displace copper from its salt solution.

$Ag + CuSO_4 \longrightarrow$ No reaction

Similarly, when gold is dipped in the solution of copper nitrate, no reaction takes place because copper is more reactive than gold.

$Au + Cu(NO_3)_2 \longrightarrow$ No reaction

In similar way, no reaction takes place when copper is dipped in the solution of aluminium nitrate because copper is less reactive than aluminium.

$Al(NO_3)_3 + Cu \longrightarrow$ No reaction

Non-Metals: Elements that are electronegative in nature are called non-metals. It means non-metals gain electrons to form negative ions, e.g. iodine

Physical properties of non-metals

- **Hardness:** Non-metals are not hard rather they are generally soft. But the diamond is an exception; it is the hardest naturally occurring substance.
- **State:** Non-metals may be solid, liquid or gas.
- **Luster:** Non-metals have a dull appearance. Diamond and iodine are exceptions.
- **Sonority:** Non-metals are not sonorous, i.e., they do not produce a typical sound on being hit.
- **Conduction:** Non-metals are a bad conductor of heat and electricity. Graphite which is allotrope of carbon is a good conductor of electricity and is an exception.
- **Malleability and ductility:** Non-metals are brittle.
- **Melting and boiling point:** Non-metals have generally low melting and boiling points.
- **Density:** Most of the non-metals have low density.
- **Colour:** Non-metals are in many colours.

Carbon in the form of graphite is non-metal which conduct electricity.

Carbon in the form of diamond is a non-metal which is extremely hard. Diamond is a non-metal which has a very high melting point and boiling point.

Iodine is non-metal which is lustrous having a shining surface.

Chemical properties of Non-metals:
1. Reaction of Non-metals with Oxygen: Non-metals form respective oxide when reacting with oxygen.
Non-metal + Oxygen → Non-metallic oxide
when carbon reacts with oxygen, carbon dioxide is formed along with the production of heat.

$C + O_2 \longrightarrow CO_2 + \text{heat}$

When carbon is burnt in an insufficient supply of air, it forms carbon monoxide. Carbon monoxide is a toxic substance. Inhaling of carbon monoxide may prove fatal.

$$2C + O_2 \longrightarrow 2CO + heat$$

Sulphur gives sulphur dioxide when reacting with oxygen. Sulphur catches fire when exposed to air.

$$S + O_2 \longrightarrow SO_2$$

When hydrogen reacts with oxygen it gives water.

$$2H_2 + O_2 \longrightarrow 2H_2O$$

Non-metallic Oxide: Non-metallic oxides are acidic in nature. The solution of non-metal oxides turns blue litmus red.
Carbon dioxide gives carbonic acid when dissolved in water.

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

Sulphur dioxide gives sulphurous acid when dissolved in water.

$$SO_2 + H_2O \longrightarrow H_2SO_3$$

Sulphur dioxide gives Sulphuric acid when reacts with oxygen.

$$SO_2 + 2O_2 \longrightarrow 2SO_3$$

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

2. Reaction of Non-metal with Chlorine: Non-metal gives respective chloride when they react with chlorine gas.
Non-metal + Chlorine → Non-metal chloride
Hydrogen gives hydrogen chloride and phosphorous gives phosphorous trichloride when reacting with chlorine.

$$H_2 + Cl_2 \longrightarrow 2HCl$$

$$P_4 + 6Cl_2 \longrightarrow 4PCl_3$$

3. Reaction of Non-metals with Hydrogen: Non-metals reactive with hydrogen to form covalent hydrides.

Non-metal + Hydrogen → Covalent Hydride
Sulphur combines with hydrogen to form a covalent hydride is called Hydrogen sulphide.

$$H_2 + S \longrightarrow H_2S$$

Nitrogen combines with hydrogen in presence of an iron catalyst to form covalent hydride ammonia.

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

Non-metals do not react with water (or steam) to evolve Hydrogen gas.

Non-metals do not react with dilute acids.

4. Reaction of Metal and Non-metal: Many metals form ionic bonds when they react with non-metals. Compounds so formed are known as Ionic Compounds.

Ions: Positive or negative charged atoms are known as ions. Ions are formed because of loss or gain of electrons. Atoms form ions obtain by the electronic configuration of the nearest noble gas.
Positive ion: A positive ion is formed because of the loss of electrons by an atom.

Following are some examples of positive ions:
Sodium forms sodium ion because of the loss of one electron. Because of the loss of one electron, one positive charge comes over sodium.

$$Na \longrightarrow Na^{+} + e^{-}$$

Magnesium forms positive ion because of the loss of two electrons. Two positive charges come over magnesium because of loss of two electrons.

$$Mg \longrightarrow Mg^{2+} + 2e^{-}$$

Negative ion: A negative ion is formed because of the gain of an electron.
Some examples are given below:
Chlorine gains one electron in order to achieve a stable configuration. After the gain of one electron, chlorine gets one negative charge over it forming chloride ion.

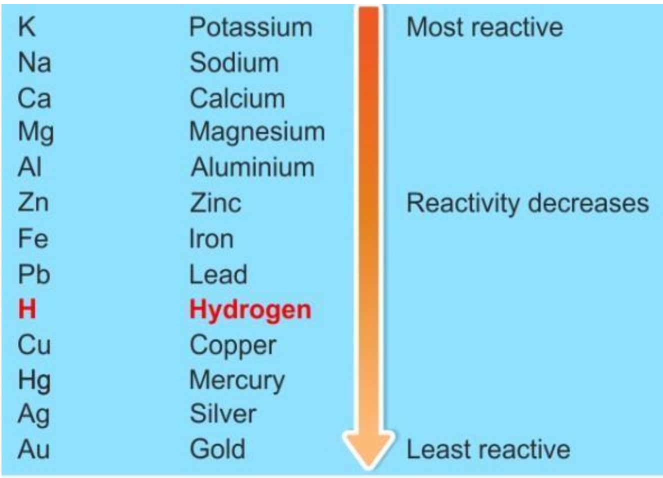
$$Cl + e- \longrightarrow Cl^{-}$$

Difference between Metals and Non-metals:

Metals	Non-metals
1. Metals generally occur as hard solid substances.	1. Non-metals generally occur in all the three forms of matter- solid, liquid and gases.
2. Metals are malleable and ductile.	2. Non-metals are not malleable and ductile.
3. Metals produce ringing sound on striking which is called their sonorous property.	3. Non-metals do not show this sonorous property.
4. Metals are good conductors of heat and electricity.	4. Non-metals are poor conductors of heat and electricity with the exception of graphite which is a good conductor of heat and electricity.

Reactivity series: The arrangement of metals in a vertical column in the order of decreasing reactivity is called reactivity series of metals. The most reactive metals are placed at the top and least reactive metals are placed at the bottom of the reactivity series.

The reactivity series is:



Ionic Compounds: The compounds formed by transfer of electrons from a metal to a non-metal are known as Ionic Compounds. Sodium Chloride (NaCl), Magnesium chloride ($MgCl_2$)

Ionic Bonds: Ionic bonds are formed because of transfer of electrons from metal to non-metal. In this course, metals get positive charge because of transfer of electrons and non-metal gets negative charge because of acceptance of electrons. In other words, bond formed between positive and negative ion is called Ionic Bond.

Some examples are given below:
Formation of Sodium Chloride (NaCl): In sodium chloride, sodium is a metal (alkali metal) and chlorine is a non-metal.
Atomic number of sodium = 11

Electronic configuration of sodium: 2, 8, 1
Number of electrons in outermost orbit = 1

Atomic number of chlorine = 17
Electronic configuration of chlorine: 2, 8, 7
Electrons in outermost orbit = 7

$Na \longrightarrow Na^+ + e^-$

2, 8, 1   2, 8

$Cl + e^- \longrightarrow Cl^-$

(2, 8, 7)   (2, 8, 8)

$Na^{\times} :Cl^{\cdot} \longrightarrow Na^+ Cl^- \longrightarrow NaCl$

Sodium has one valence electron and chlorine has seven valence electrons. Sodium requires losing one electron to obtain stable configuration and chlorine requires gaining one electron in order to obtain stable electronic configuration. Since, sodium chloride is formed because of ionic bond, thus, it is called Ionic compound. In similar way, Magnesium chloride ($MgCl_2$) is formed.

$Mg \longrightarrow Mg^{2+} + 2e^-$

2, 8, 2   2, 8

$2Cl + 2e^- \longrightarrow 2Cl^-$

(2, 8, 7)   (2, 8, 8)

Properties of Ionic Compounds:
Properties of ionic compounds are as follows.

(i) Physical nature: Ionic compounds are solids and hard due to the strong attracting force between the positive and negative ions. These compounds are generally brittle and break into pieces on pressure.

(ii) Melting and boiling point: Ionic compounds have high melting and boiling points because amount of energy can break the strong inter-ionic attraction.

(iii) Solubility: Ionic compounds are soluble in water but insoluble in solvents like kerosene, petrol, etc.

(iv) Conduction of Electricity: Conduction of electricity through a solution is possible when there is movement of charged particles. Ionic compounds in the solid state do not conduct electricity because movement of ions in the solid is not possible due to their rigid structure.

A solution of an ionic compound in water contains ions, which move to the opposite electrodes when electricity is passed through the solution. Ionic compounds conduct electricity in the molten state as in the molten state the electrostatic forces of attraction between the oppositely charged ions overcome due to the heat. Thus, the ions move freely and conduct electricity.

Corrosion and its prevention:

Corrosion is an electrochemical process in which redox reactions occur between the metal and water, oxygen and sulphur dioxide, etc. It is a ***spontaneous and irreversible*** process in which the metal changes into chemical compounds such as oxide, sulphide and hydroxides, etc.

For example, due to corrosion or rusting, the iron changes into red iron oxide (rust) in the presence of moisture and oxygen present in the air. The rusting of iron when it comes in contact with water and oxygen which leads to the formation of a brown coat over its surface is a type of corrosion. The chemical reaction involved in rusting is shown below;

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

$$2Fe_2O_3 + xH_2O \rightarrow Fe_2O_3.xH_2O \text{ (rust)}$$

Methods to prevent corrosion, some of them are described below;

(i) Electroplating:

- In this method, an electric current is used to create a thin layer of metal over another metal. It is done to make cheaper metals more appealing as well as to protect them from corrosion.

- This method requires two different metals, an electrolytic solution, and two electrodes in a tank and a battery or source of current that will pass the required current into the solution to carry out the electrolysis.

- When current is passed one electrode gets a positive charge and another gets the negative charge. The ions of the positively charged metal shift to the surface of the negatively charged metal to create a thin layer. For example, when we take brass and copper for electroplating, the copper metal slowly gets deposited or covers the brass and thus a thin coating of copper covers the surface of the brass. Here, the electrolytic solution must contain copper sulphide.

(ii) Galvanization: In this method, iron is coated with a layer of zinc. The iron is dipped in the molten zinc. The layer of zinc protects the iron from corrosion. This method has been in use for more than 200 years.

(iii) Painting and Greasing: In this method, a layer is created over the metal surface by painting or greasing. This layer of paint or grease protects the metal from corrosion. Carbon fibre coating can be used for this purpose.

(iv) Selection of Material: Select the materials that are not affected by corrosion. For example, stainless steel and aluminium are resistant to corrosion.

(v) Dry and clean: Keep the metal surface dry and clean.

Multiple Choice Questions:

Q1. Gold is used for making jewellery. What are the properties of gold make it a suitable metal for making jewellery?

(a) Ductility
(b) Malleability
(c) Lustrous
(d) All of these

Q2. Aluminium is used for making cooking utensils. What are the following properties of Aluminium are responsible for the same?

1. Good thermal conductivity
2. Good electrical conductivity
3. Ductility
4. High melting point

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

Q3. Which of the following oxide of iron would be obtained on prolonged reaction of iron with steam?

(a) Fe O
(b) Fe_2O_3
(c) Fe_3O_4
(d) Fe_2O_3 and Fe_3O_4

Q4. The correct order of increasing chemical reactivity is

(a) Fe < Zn < Mg < K
(b) Zn < Fe < Mg < K
(c) Fe < Mg < Zn < K
(d) Zn < Fe < K < Mg

Q5. Which of the following metal will not give H_2 (g) with H_2O?

(a) Na (s) + $2H_2O \rightarrow$
(b) Mg (s) + $H_2O \rightarrow$
(c) Zn (s) + $2H_2O \rightarrow$
(d) Cu (s) + $2H_2O \rightarrow$

Q6. Few particles of Zn are dropped in the $CuSO_4$ solution, the correct observation is…..

(a) Blue colour of $CuSO_4$ solution fades
(b) Solution changes to red colour
(c) Solution becomes black
(d) Solution becomes silvery white

Q7. Which of the following non-metal is liquid at room temperature?

(a) Mercury
(b) Carbon
(c) Phosphorous
(d) Bromine

Q8. The combination of carbon monoxide and hydrogen is known as

(a) Carbon gas
(b) Coal gas
(c) Carbonic gas
(d) Water gas

Q9. Which of the following are not ionic compounds?

1. KCl
2. HCl
3. CCl4
4. NaCl

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

Q10. Which one of the following properties is not generally exhibited by ionic compounds?

(a) Solubility in water
(b) Electrical conductivity in solid state
(c) High melting and boiling points
(d) Electrical conductivity in molten state

ANSWERS

Q1. (d)	**Q2. (d)**	**Q3. (c)**	**Q4. (a)**	**Q5. (d)**
Q6. (a)	**Q7. (d)**	**Q8. (d)**	**Q9. (b)**	**Q10. (b)**

Assignments:

Q1. Write one example of each of
(i) a metal which is so soft that, it can be cut with knife and a non-metal which is the hardest substance.
(ii) A metal and a non-metal which exist as liquid at room temperature.
Answer.
(i) Sodium, carbon (diamond).
(ii) Mercury is liquid metal, bromine is liquid non-metal.

Q2. Mention the names of the metals for the following:
(i) Two metals which are alloyed with iron to make stainless steel.
(ii) Two metals which are used to make jewellery.
Answer.
(i) Nickel and chromium.
(ii) Gold and platinum.

Q3. Write the electron dot structures for
(a) Potassium and chlorine.
(b) Calcium and sulphur.
(c) Calcium and chlorine.
Answer. (a) KCl (b) CaS (c) $CaCl_2$

Q4. You are given samples of three metals. Sodium, magnesium and copper. Suggest any two activities to arrange them in order of decreasing activity.
Answer. Activity 1: Sodium reacts with cold water vigorously to form sodium hydroxide and hydrogen gas
$Na\ (s) + H_2O\ (cold) \longrightarrow NaOH\ (aq) + H_2\ (g)$
Magnesium does not react with cold water but with hot water to form magnesium hydroxide and hydrogen gas.
$Mg\ (s) + H_2O\ (Hot) \longrightarrow Mg\ (OH)_2\ (aq) + H_2\ (g)$
Hence sodium is more reactive than magnesium.
Activity 2: $Mg\ (s) + CuSO_4\ (aq) \longrightarrow Mg\ SO_4\ (aq) + Cu\ (s)$
$Cu\ (s) + MgSO_4\ (aq) \longrightarrow$ No reaction

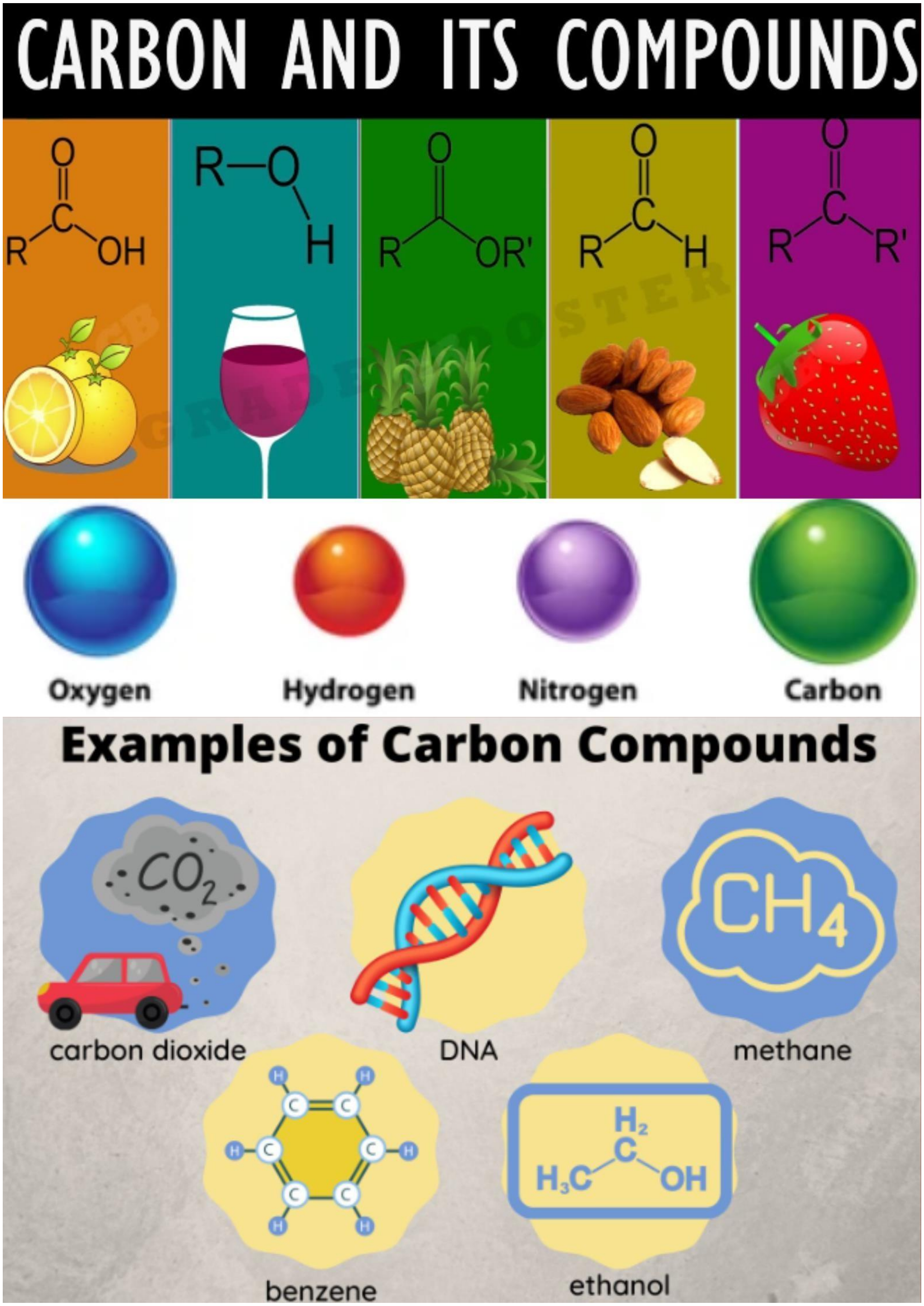
Q5. Give reason for the following:
(a) School bells are made up of metals.
(b) Electric wires are made up of copper.
Answer.
(a) It is because metals are sonorous, i.e. they produce sound when struck with a hard substance.
(b) It-is because copper is good conductor of electricity.

Q6. (a) Define activity series of metals. Arrange the metals gold, copper, iron and magnesium in order of their increase in reactivity.
(b) What will you observe when:
(i) Some zinc pieces are put in copper sulphate solution.
(ii) Some silver pieces are put into green coloured ferrous sulphate solution.
Answer.
(a) The series of metals in which metals are arranged in decreasing order of their reactivity.
Au < Cu < Fe < Mg is increasing order of reactivity.
(b) (i) The blue solution will become colourless and reddish brown copper metal will be deposited.
$Zn\ (s) + CuSO_4\ (aq) \rightarrow Zn\ SO_4\ (aq) + Cu\ (s)$
$Ag\ (s) + FeSO_4\ (aq) \rightarrow$ No reaction
Reaction will not take place because Ag is less reactive than iron.

Q7. Name the following:
(a) A metal, which is preserved in kerosene.
(b) A lustrous coloured non-metal.
(c) A metal, which can melt while kept on palm.
(d) A metal, which is a poor conductor of heat.
Answer.
(a) Sodium is preserved in kerosene (b) Iodine is lustrous coloured non-metal
(c) Gallium (d) Lead

Q8**.** Give reason for the following:
(a) Aluminium oxide is considered as an amphoteric oxide.
(b) Ionic compounds conduct electricity in molten state.
Answer.
(a) It is because it reacts with acids as well as bases to produce salts and water. Al is less electropositive metal. So, it forms amphoteric oxide which can react with acid as well as base.
(b) Ionic compounds can conduct electricity in molten state because ions become free to move in molten state.
Q9. State reasons for the following:
(i) Sulphur is a non-metal (ii)Magnesium is a metal
Answer**:** (i) Sulphur is a non-metal because it is a poor conductor of heat and electricity.
(ii)Magnesium is a metal because it is a good conductor of heat and electricity.
Q10. Write two differences between calcination and roasting.
Answer

Calcination	Roasting
It is carried out by heating ore in the absence of air.	It is carried out by heating ore in the presence of air.
(ii) It converts carbonate ores into oxides.	(ii) It converts sulphide ores into oxides.


CARBON AND ITS COMPOUNDS
R—O
H
O
C
R
OH
OR'
H
R'
Oxygen
Hydrogen
Nitrogen
Carbon
Examples of Carbon Compounds
CO2
CH4
carbon dioxide
DNA
methane
H2
C
H3C
OH
benzene
ethanol

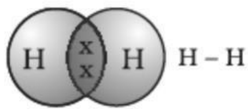
CHAPTER 4

CARBON AND ITS COMPOUNDS

1. BONDING IN CARBON – THE COVALENT BOND

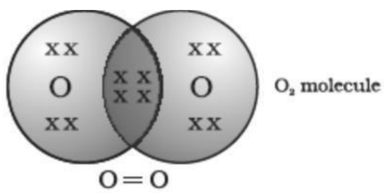
1. Covalent Bond: The chemical bond formed by the sharing of electrons between two atoms is called covalent bond.

(i) Single covalent bond: A covalent bond formed by sharing of one pair of electrons between two atoms is known as single covalent bond. For example, two hydrogen atoms share their electrons to form a molecule of hydrogen, H_2.



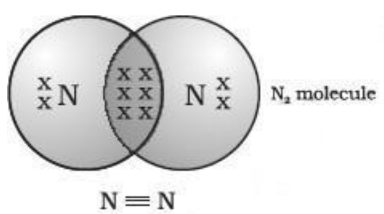
Single bond between two Hydrogen atoms

(ii) Double covalent bond: The covalent bond formed by sharing of two pairs of electrons between two atoms is known as double covalent bond. For example, the two electrons contributed by each oxygen atom give rise to two shared pairs of electrons. This is said to constitute a double bond between the two atoms.
The electron dot structure of O_2 and its double bond.



Double bond between two oxygen atoms

(iii) Triple covalent bond: The covalent bond formed by the sharing of three pairs of electrons between two atoms is known as triple covalent bond. In the case of a diatomic molecule of nitrogen, each nitrogen atom in a molecule of nitrogen contributes three electrons giving rise to three shared pairs of electrons. This is said to constitute a triple bond between the two atoms.
The electron dot structure of N_2 and its triple bond.



Triple bond between two nitrogen atoms

Covalent compounds exist as solids, liquids and gases. They are generally soluble in non-polar solvents like ether, benzene etc. and generally insoluble in polar solvents like water.
Molecules of covalent compounds are held together by relatively weaker forces as compared to ionic compounds. Therefore, covalent compounds have relatively lower melting and boiling points.

Covalent compounds are poor conductors of electricity because they contain neither the ions nor free electrons necessary for conduction.

2. VERSATILE NATURE OF CARBON

The nature of the covalent bond enables carbon to form a large number of compounds.
Two factors noticed in the case of carbon are –
(i) Catenation: Carbon has the unique ability to form bonds with other atoms of carbon, giving rise to large molecules. The self-linking property of carbon atoms through covalent bonds to form long chains of carbon, branched chains of carbon or even carbon atoms arranged in rings.
In addition, carbon atoms may be linked by single, double or triple bonds.
Compounds of carbon, which are linked by only single bonds between the carbon atoms, are called saturated compounds.
Compounds of carbon having double or triple bonds between their carbon atoms are called unsaturated compounds.
(ii) Tetravalency: Carbon has a valency of four, it is capable of bonding with four other atoms of carbon or atoms of some other mono-valent element. Compounds of carbon are formed with oxygen, hydrogen, nitrogen, sulphur, chlorine and many other elements giving rise to compounds with specific properties which depend on the elements other than carbon present in the molecule.

Homologous Series: It is a family of organic compounds having the same functional group in which the formula of successive members differs by $–CH_2$ group. For example,
For alkanes CH_4, C_2H_6, C_3H_8, C_4H_{10} etc.
For alkenes C_2H_4, C_3H_6, C_4H_8 and C_5H_{10} etc.
For alkynes C_2H_2, C_3H_4, C_4H_6 and C_5H_8 etc.

For example, the chemical properties of CH_3OH, C_2H_5OH, C_3H_7OH and C_4H_9OH are all very similar. Hence, such a series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called a homologous series.
The melting and boiling points increase with increasing molecular mass.

5. Nomenclature of Carbon Compounds

S.No.	Class of Example compounds	Prefix/Suffix	Example	Structure
1.	Halo alkane	Prefix -Chloro, -Bromo	Chloropropane Bromopropane	$CH_3CH_2CH_2Cl$ $CH_3CH_2CH_2Br$
2.	Alcohol	Suffix - ol	Propanol	$CH_3CH_2CH_2OH$
3.	Aldehyde	Suffix - al	Propanal	CH_3CH_2CHO
4.	Ketone	Suffix - one	Propanone	CH_3COCH_3
5.	Carboxylic acid	Suffix - oic acid	Propanoic acid	CH_3CH_2COOH

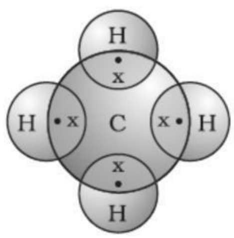
6.	Alkenes	Suffix - ene	Propene	$CH_3CH = CH_2$
7.	Alkynes	Suffix - yne	Propyne	$CH_3C = CH$

Some functional groups in carbon compounds:

Hetero atom	Class of compounds	Formula of functional group	Examples
Cl/Br	Halo- (Chloro/Bromo) alkanes	-Cl, -Br (substitutes for hydrogen atom)	Chloroethane (C_2H_5Cl) Bromoethane(C_2H_5Br)
Oxygen	1. Alcohol	-OH	Ethanol (C_2H_5OH)
	2. Aldehyde	-CHO	Ethanal (CH_3CHO)
	3. Ketone	>C = O	Propanone (CH_3COCH_3)
	4. Carboxylic acid	-COOH	Ethanoic acid (CH_3COOH)

Saturated and Unsaturated Carbon Compounds

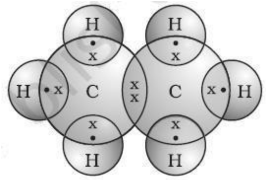
The carbon compounds which contain only carbon and hydrogen are called hydrocarbons. Among these, the saturated hydrocarbons are called alkanes. Methane, Ethane, Propane etc. Methane has a formula CH_4. Hydrogen has a valency of 1. Carbon is tetravalent because it has four valence electrons. In order to achieve noble gas configuration, carbon shares these electrons with four atoms of hydrogen as shown in Fig. is given below:



Electron dot structure for methane

Structure of ethane formed between carbon and hydrogen with a formula of C_2H_6.
The structure of ethane is arrived in the following steps –

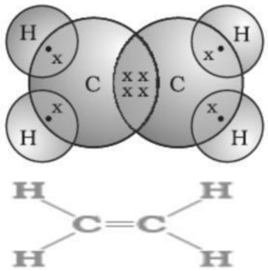
(a) Carbon atoms linked together with a single bond
(b) Each carbon atom bonded to three hydrogen atoms
(c) Electron dot structure of ethane



Electron dot structure for ethane

The unsaturated hydrocarbons which contain one or more double bonds are called alkenes. Ethene, Propene etc.
Those containing one or more triple bonds are called alkynes. Ethyne, Propyne etc.

The electron dot structure for Ethene.



Another compound of hydrogen and carbon has the formula C_2H_2 and is called Ethyne.

$$H - C \equiv C - H$$

Chains, Branches and Rings
The carbon compounds methane, ethane and propane, containing respectively 1, 2 and 3 carbon atoms. Such _chains‘ of carbon atoms can contain many more carbon atoms.

Formulae and structures of saturated compounds of carbon and hydrogen (Alkanes)

No. of C atoms	Name	Formula	Structure
1	Methane	CH_4	CH_4
2	Ethane	C_2H_6	$CH_3 – CH_3$
3	Propane	C_3H_8	$CH_3 – CH_2 – CH_3$
4	Butane	C_4H_{10}	$CH_3 – CH_2 – CH_2 – CH_3$
5	Pentane	C_5H_{12}	$CH_3 – CH_2 – CH_2 – CH_2 – CH_3$
6	Hexane	C_6H_{14}	$CH_3 – CH_2 – CH_2 – CH_2 – CH_2 – CH_3$
7	Heptane	C_7H_{16}	$CH_3 – CH_2 – CH_2 – CH_2 – CH_2 – CH_2 - CH_3$
8	Octane	C_8H_{18}	$CH_3 – CH_2 – CH_2 – CH_2 – CH_2 – CH_2 - CH_2 - CH_3$
9	Nonane	C_9H_{20}	$CH_3 – CH_2 – CH_2 – CH_2 – CH_2 – CH_2-CH_2-CH_2-CH_3$
10	Decane	$C_{10}H_{22}$	$CH_3 – CH_2 – CH_2 – CH_2 –CH_2 –CH_2-CH_2-CH_2-CH_2-CH_3$

Formulae and structures of unsaturated compounds of carbon and hydrogen (Alkenes)

No. of C atoms	Name	Formula	Structure
1	Ethene	C_2H_4	$H_2C = CH_2$
2	Propene	C_3H_6	$CH_3 – CH = CH_2$
3	1-Butene	C_4H_8	$CH_3 – CH_2 – CH = CH_2$
4	1-Pentene	C_5H_{10}	$CH_3 – CH_2 – CH_2 – CH = CH_2$

Formulae and structures of unsaturated compounds of carbon and hydrogen (Alkynes)

No. of C atoms	Name	Formula	Structure
1	Ethyne	C_2H_2	$H - C \equiv C - H$
2	1-Propyne	C_3H_4	$CH_3 – C \equiv C - H$
3	1-Butyne	C_4H_6	$CH_3 – CH_2 – C \equiv C - H$
4	1-Pentyne	C_5H_8	$CH_3 – CH_2 – CH_2 – C \equiv C - H$

CHEMICAL PROPERTIES OF CARBON COMPOUNDS:

1. Combustion: Carbon, in all its allotropic forms, burns in oxygen to give carbon dioxide along with the release of heat and light.

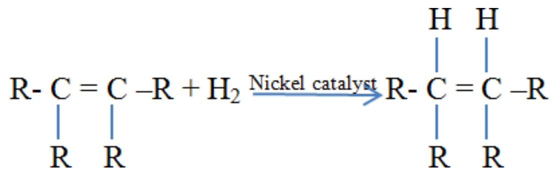
(i) $C + O_2 \longrightarrow CO_2$ + heat and light
(ii) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ + heat and light
(iii) $CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ + heat and light

Saturated hydrocarbons will generally give a clean flame while unsaturated hydrocarbons will give a yellow flame with lots of black smoke. Limiting the supply of air results in incomplete combustion of even saturated hydrocarbons giving a sooty flame.

2. Oxidation: Carbon compounds can be easily oxidised on combustion. In addition to this complete oxidation, in which ethyl alcohol is converted to ethanoic acid upon heating in the presence of alkaline potassium permanganate or acidified potassium dichromate (oxidising agents).

$$CH_3CH_2OH \xrightarrow{\text{alkaline KMnO4 + Heat}} CH_3COOH$$

3. Addition reaction: Unsaturated hydrocarbons add hydrogen in the presence of catalyst such as palladium or nickel to give saturated hydrocarbons.



4. Substitution reaction: Saturated hydrocarbons are fairly unreactive and are inert in the presence of most reagents. However, in the presence of sunlight, chlorine is added to methane in very fast reaction. Chlorine can replace the hydrogen atoms one by one. It is called a substitution reaction.

$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$ (in the presence of sunlight)

SOME IMPORTANT CARBON COMPOUNDS - ETHANOL AND ETHANOIC ACID

Properties of ethanol:

Ethanol is a liquid at room temperature. Ethanol is commonly called alcohol and is the active ingredient of all alcoholic drinks. Ethanol is also soluble in water in all proportions.

Reactions of Ethanol:

(i) Reaction with sodium: When ethyl alcohol reacts with sodium leading to the evolution of hydrogen and the other product is sodium ethoxide.
$2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2O–Na + H_2$
(Sodium ethoxide)

(ii) Reaction to give unsaturated hydrocarbon: Heating ethanol at 443 K with excess concentrated Sulphuric acid results in the dehydration of ethanol to give Ethene
$CH_3CH_2OH \xrightarrow{\text{Hot Conc. H2SO4}} CH_2 = CH_2 + H_2O$
The concentrated Sulphuric acid can be regarded as a dehydrating agent who removes water from ethanol.

Uses: It is a good solvent; it is also used in medicines such as tincture iodine, cough syrups, and many tonics. Consumption of small quantities of dilute ethanol causes drunkenness. However, intake of even a small quantity of pure ethanol (called absolute alcohol) can be lethal. Also, long-term consumption of alcohol leads to many health problems.

Properties of ethanoic acid:

Ethanoic acid is commonly called acetic acid and belongs to a group of acids called carboxylic acids. Carboxylic acids are obviously characterized by their acidic nature. Carboxylic acids are weak acids. The melting point of pure ethanoic acid is 290 K and hence it often freezes during winter in cold climates. This gave rise to its name glacial acetic acid.

Reactions of ethanoic acid:

(i) Esterification reaction: Esters are most commonly formed by reaction of an acid and an alcohol. Ethanoic acid reacts with absolute ethanol in the presence of an acid catalyst to give an ester

$CH_3COOH + CH_3CH_2OH \xrightarrow{Acid} CH_3COOCH_2CH_3 + H_2O$

(Ethanoic acid) (Ethanol) (Ester)

On treating with sodium hydroxide, which is an alkali, the ester is converted back to alcohol and sodium salt of carboxylic acid. This reaction is known as saponification because it is used in the preparation of soap. Soaps are sodium or potassium salts of long chain carboxylic acid.

$CH_3COOCH_2CH_3 + NaOH \longrightarrow CH_3COONa + CH_3CH_2OH$

(ii) Reaction with a base: Like mineral acids, ethanoic acid reacts with a base such as sodium hydroxide to give a salt (sodium ethanoate or commonly called sodium acetate) and water:

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

(iii) Reaction with carbonates and hydrogencarbonates: Ethanoic acid reacts with carbonates and hydrogencarbonates to give rise to a salt, carbon dioxide and water. The salt produced is commonly called sodium acetate.

$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$

Uses: Generally, esters are sweet-smelling substances. These are used in making perfumes and as flavouring agents. 5-8% solution of acetic acid in water is called vinegar and is used widely as a preservative in pickles.

SOAPS AND DETERGENTS:

Soaps: They form scum when reacted to hard water. Soaps are derived from natural substances such as vegetable oils and animal fats.

Detergents: They do not form scum. Detergents are generally a derivative of a synthetic compound.

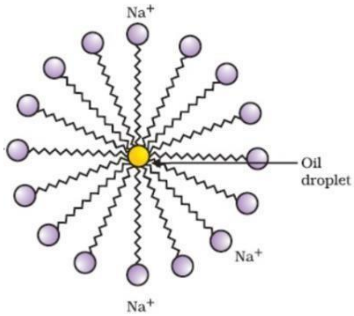
Preparation of soap: On heating with sodium hydroxide, vegetable oil or animal fat forms a sodium salt of fatty acid and glycerol. This process is known as saponification.

Vegetable oil/Animal fat + NaOH $\xrightarrow{\text{Saponification}}$ Glycerol + Sodium salt of fatty acid (Soap)

Cleansing action of soaps:

A soap molecule is made up of two chemically distinct parts that interact with water in different ways. It has one polar end with a short head carboxylate group (−COONa) and one non-polar end with a long tail made of the hydrocarbon chain.

Hydrophilic and hydrophobic end: The polar end is hydrophilic (water-loving) in nature, and it is drawn to water. The non-polar end is hydrophobic (hates water) in nature, and it is attracted to dirt or oil on the cloth but not to water. As a result, the hydrophobic part of the soap molecule traps the dirt while the hydrophilic part makes the entire molecule water-soluble.
When soap or detergent is dissolved in water, the molecules form clusters known as **'micelles'**.



Formation of micelles

Their long hydrocarbon chains bind to the oil and dirt. As a result, the dirt is surrounded by the non-polar end of the soap molecules. The micelles are water-soluble because of the charged carboxylate end of the soap molecules. As a result, the soap washes away the dirt.

Detergents are generally sodium salts of sulphonic acids or ammonium salts with chlorides or bromides ions, etc. Both have long hydrocarbon chain. The charged ends of these compounds do not form insoluble precipitates with the calcium and magnesium ions in hard water. Thus, they remain effective in hard water. Detergents are usually used to make shampoos and products for cleaning clothes.

Multiple Choice Questions:

Q1. Ethane, with the molecular formula C_2H_6 has
(a) 6 covalent bonds.
(b) 7 covalent bonds.
(c) 8 covalent bonds.
(d) 9 covalent bonds.
Q2. Butanone is a four-carbon compound with the functional group
(a) Carboxylic acid.
(b) Aldehyde.
(c) Ketone.
(d) Alcohol.
Q3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that
(a) The food is not cooked completely.
(b) The fuel is not burning completely.
(c) The fuel is wet.
(d) The fuel is burning completely.
Q4. The chemical reaction shows the addition of chlorine to methane in the presence of sunlight.

$CH_4 + Cl_4 \rightarrow X$

What is likely to be the product of the reaction represented by "X"?

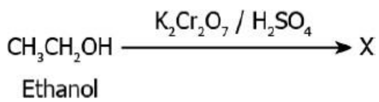
(a) CH_4+ H_2SO_4

(b) CH_3Cl + HCl

(c) $CHCl_3$ + HCl

(d) CH_3Cl + H_2SO_4

Q5. When ethanol is oxidized using potassium dichromate and Sulphuric acid. Which option represents the product “X”?



(a) CH_2O

(b) CH_3CH

(c) CH_3H_2O

(d) CH_3COOH

Q6. The chemical reaction shows the addition of chlorine gas to hydrocarbon in the presence of sunlight.

$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$

How does chlorine react to a hydrocarbon compound in the presence of sunlight?

(a) It adds hydrogen into the compound

(b) It adds an oxygen atom into the compound

(c) It substitutes hydrogen atom from the compound

(d) It breaks double and triple bonds into a single bond

Q7. A student studies that vinegar, which is a diluted form of ethanoic acid, freezes during winter. What does this suggest about the physical properties of pure ethanoic acid?

(a) It has a low boiling point

(b) It has a low melting point

(c) It has a very high boiling point

(d) It has a very high melting point

Q8. Which of the following is the molecular formula of Cyclobutane?

a) C_4H_{10}

b) C_4H_6

c) C_4H_8

d) C_4H_4

Q9. A student studies that a soap molecule has two ends, one of which is an ionic end and the other is the carbonic chain. Which option explains the interaction of a soap molecule with oil?

(a) Ionic end of the soap interacts with the oil

(b) The closest end of the soap interacts with the oil

(c) Carbonic chain end of the soap interacts with the oil

(d) Ends of the soap randomly interact with the oil

Q10. Methane, ethane and propane are said to form a homologous series because all are-

(a) Hydrocarbons

(b) Saturated compounds

(c) Aliphatic compounds

(d) Differ from each other by a CH_2 group

Q11. Following is (are) the property (ies) of ionic compounds.

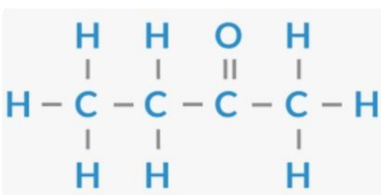
(a) They have high melting and boiling points

(b) They conduct electricity in solution or in molten state

(c) Both (a) and (b)

(d) None of the above

Q12. The following image represents a carbon compound.



Which functional group is present in the compound?

(a) Alcohol

(b) Aldehyde

(c) Carboxylic acid

(d) Ketone

Q13. **The following represents the formulae of a few hydrocarbon compounds.**

(a) C_2H_2 (b) C_2H_4 (c) C_2H_6 (d) C_3H_4

Which of these compounds can be classified as alkynes?

(a) Only (a)

(b) Only (b)

(c) Both (a) and (d)

(d) Both (b) and (c)

Q14. Which of the following is the molecular formula of cyclobutane?

(a) C_4H_{10}

(b) C_4H_6

(c) C_4H_8

(d) C_4H_4

Q15. The number of isomers of pentane is
(a) 2 (b) 3 (c) 4 (d) 5

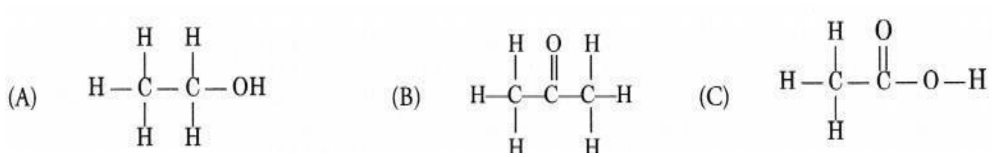
ANSWERS

Q1. (b)	**Q2. (c)**	**Q3. (b)**	**Q4. (b)**	**Q5. (d)**
Q6. (c)	**Q7. (b)**	**Q8. (c)**	**Q9. (c)**	**Q10. (d)**
Q11. (c)	**Q12. (d)**	**Q13. (c)**	**Q14 (c)**	**Q15 (b)**

Assignments:

Q1. Give the names of the following functional groups:
(i) —OH (ii) –CHO (iii) —COOH
Answer. (i) Alcohol group (ii) Aldehydic group (iii) Carboxylic acid group

Q2. Write the IUPAC names of the following compounds.



Answer: (A) Ethanol (B) Propanone (C) Ethanoic acid.

Q3. Vapours of a hydrocarbon were passed through bromine dissolved in carbon tetrachloride. The yellow colour of bromine got discharged? Predict the nature of the hydrocarbon.
Answer: The hydrocarbon is unsaturated. It is either an alkene or alkyne.

Q4. What is the role of soap in cleansing of clothes?
Answer: Soap helps in forming a stable emulsion between oil drops carrying dirt particles and water. The emulsion is also known as micelle.

Q5. Which organic compound is added to make ethanol unfit for drinking purposes? What is the name of the mixture formed?
Answer: Methanol which is highly poisonous is added in small amount to ethanol in order to make it unfit for drinking purposes. The mixture is called methylated spirit or denatured alcohol.

Q6. Which element exhibits the property of catenation to maximum and why?
Answer: The element is carbon. This is because of very small size of carbon atom (77 pm) and high strength of C—C bond (355 kJ mol^{-1}).

Q7. How will you convert Ethene into Ethanol? Give the chemical reaction involved.
Answer: Ethene is converted into ethanol by passing its vapours through water in the presence of Sulphuric acid. This reaction is called hydration of Ethene.

$$H_2C = CH_2 + H_2O \xrightarrow{(H_2SO_4)} CH_3—CH_2—OH$$

Q08. Explain with the help of chemical equations, the following properties of carbon.
(i) Combustion
(ii) Oxidation.
Answer:

$$(i)\quad C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O \text{ (Combustion)}$$

$$(ii)\quad C_2H_5OH + O_2 \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3COOH + H_2O \text{(Oxidation)}$$

Q9. Give a chemical test to distinguish between:
(i) Ethane and Ethene
(ii) Ethanol and ethanoic acid
(iii) Soaps and detergents.
Answer: (i) Ethene decolorizes the yellow colour of bromine water while ethane does not.
(ii) Ethanoic acid gives a brisk effervescence with sodium hydrogen carbonate while ethanol does not.
(iii) Soaps form curdy white precipitate or scum with hard water while detergents do not form any precipitate.

Q10. Give reasons for the following observations:
(a) The element carbon forms a very large number of compounds.
(b) Air holes of a gas burner have to be adjusted when the heated vessels get blackened by the flame.
(c) Use of synthetic detergents causes pollution of water.
Answer.
(a) Carbon forms large number of compounds since carbon is small in size and can form stable covalent bonds (Catenation) and it shows Tetravalency.

(b) Air holes of gas burner are made open (adjusted) so that air can pass through, which is needed for complete combustion, so that heated vessels do not get blackened.
(c) Some synthetic detergents are non-biodegradable, therefore, cause pollution of water.

Q11. What is a homologous series? Which two of the following organic compounds belong to the same homologous?
CH_3, C_2H_6, C_2H_6O, $C_2H_6O_2$, CH_4O
Answer. Homologous series is a series of organic compounds which has same functional group and similar chemical properties. Each member of this series differs by $–CH_2$ - in its molecular formula and 14u in its molecular mass.
CH_4O (CH_3OH) and C_2H_6O (C_2H_5OH) belong to same homologous series.

Q12. (i) An unknown compound has the smell of vinegar. Identify it.
(ii) What do we get when ethanoic acid reacts with ethanol in the presence of concentrated Sulphuric acid?

(iii) Give a test to identify the presence of ethanoic acid.
Answer: (i) The compound is ethanoic acid (CH_3COOH) also called acetic acid.

(ii) Ethyl ethanoate ($CH_3COOC_2H_5$) is formed by esterification reaction. It has fruity smell.

(iii) Dip a strip of blue litmus paper in the solution of ethanoic acid. Its colour will change to red.

LIFE PROCESSES

All the vital processes which are required by an organism to survive are called life processes.

Nutrition, photosynthesis, transportation, metabolism, respiration, reproduction, and excretion are important life processes.

IMPORTANT LIFE PROCESSES

NUTRITION

TRANSPORTATION

EXCRETION

NUTRITION

The process, by which an organism takes food and utilizes it, is called nutrition.

Nutrition is essential for the growth and development of organisms. It also provides energy to do different work.

NUTRIENTS

Macronutrients(Carbohydrates, proteins and fats)

micronutrients (Minerals and vitamins)

HOW DO LIVING THINGS GET THEIR FOOD?

Autotrophic Nutrition	Heterotrophic Nutrition
Perform photosynthesis.	Can not perform photosynthesis.

AUTOTROPHIC NUTRITION

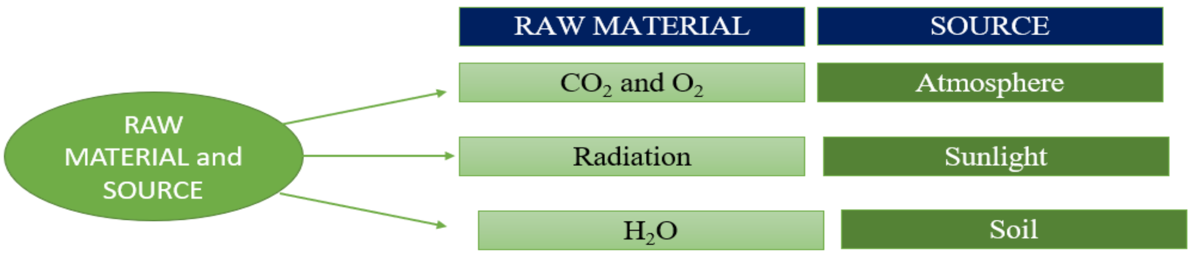
The mode of nutrition in which an organism prepares its own food is called autotrophic nutrition. Green plants and blue-green algae make their food by a process called photosynthesis.

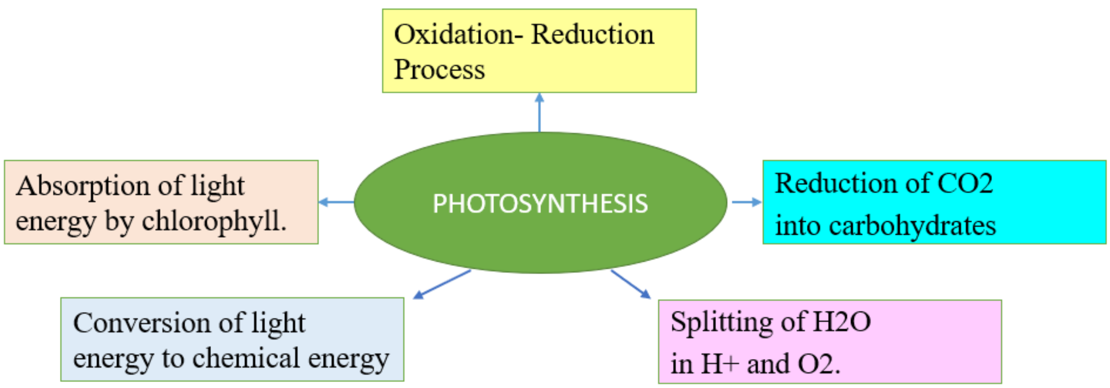
PHOTOSYNTHESIS

- The process by which plants in the presence of pigment, sunlight, water, and carbon diox to form food and release oxygen is known as photosynthesis.
- The overall reaction occurring in photosynthesis is as follows:

$$6CO_2 + 12H_2O \xrightarrow[\text{Sunlight and chloroplast}]{} \underset{\text{Glucose}}{C_6H_{12}O_6} + 6O_2 + 6H_2O$$

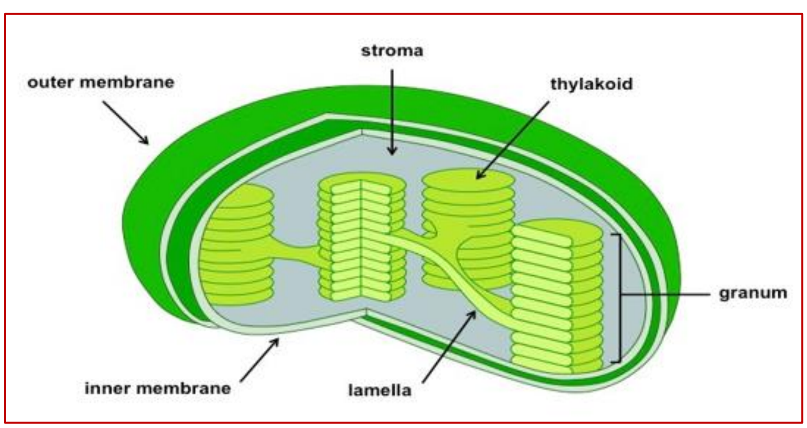
PHOTOSYNTHESIS – Raw Material and Events





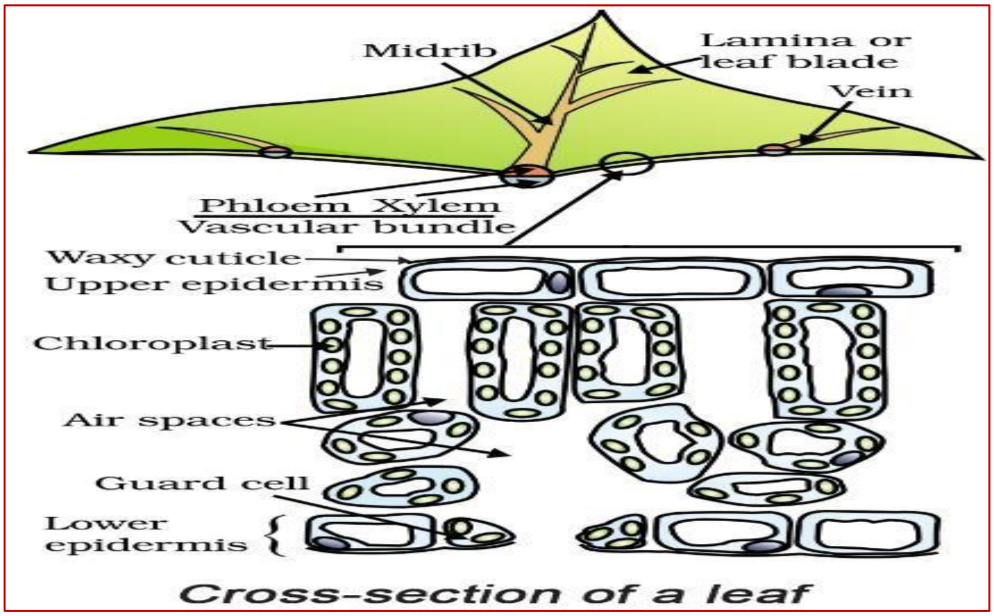
Chloroplast

It contains the main photosynthetic pigment chlorophyll and accessory pigments xanthophyll and carotenoids.



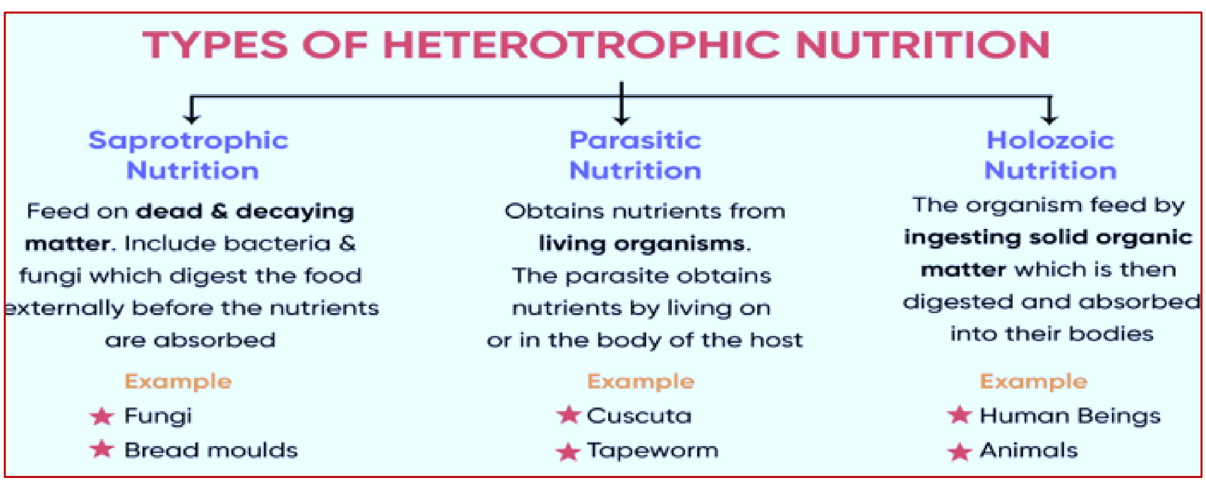
Stomata

Gaseous exchange and transpiration (loss of water as water vapors) take place through ma inute aperture on the surface of leaves called stomata. Stomata has a pore (stomata pore) guarded bybean shape guard cells (regulate the opening and closing of stomata.

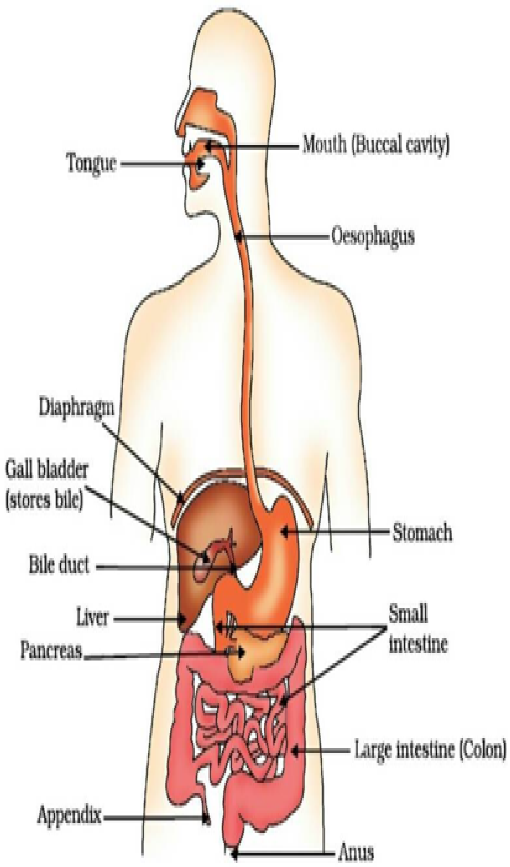


HETEROTROPHIC NUTRITION

In this type of nutrition, organisms obtain their nutrient from other living organisms (parasites) e.g.Animals or dead and decaying objects (saprophytes e.g. Fungi like bread molds, yeast and mushrooms.



HUMAN DIGESTIVE SYSTEM



Food is crushed and mixed with saliva with the help of teeth and tongue.

Saliva contains salivary amylase that breaks down starch.

By peristaltic movement in the oesophagus the food enters the stomach.

In the stomach food is mixed with HCL, Protein digesting enzyme pepsin, and Mucus.

HCL kills the germs in food as well as provides an acidic medium essential for pepsin.

Mucus protects the inner lining of the alimentary canal by HCL.

Small intestine receives secretions from the liver and pancreas through a common duct.

Unabsorbed food enters the large intestine for further absorption of water.

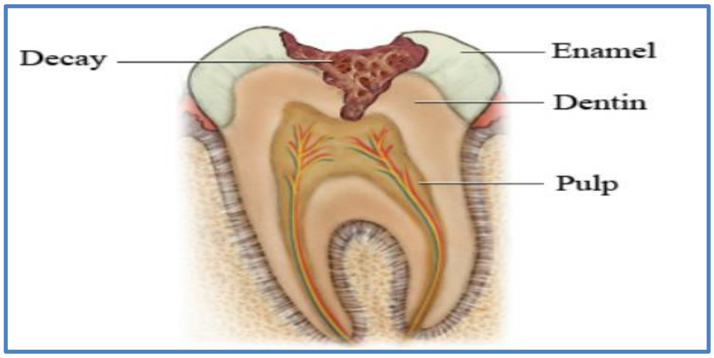
Undigested food is removed from the body via anus.

DIGESTIVE SYSTEM ORGANS AND THEIR ROLES-

LIVER	SECRETION →	BILE JUICE	ROLE →	Make medium alkaline for pancreatic juice Break the fat molecules into smaller parts (emulsification).
PANCREAS	SECRETION →	PANCREATIC JUICE	ROLE →	Trypsin digest protein and Lipase digest lipid
SMALL INTESTINE	SECRETION →	INTESTINAL JUICE	ROLE →	Convert Proteins to amino acids, Carbohydrates to glucose, Fat to fatty acid and glycerol

DENTAL CARIES (TOOTH DECAY)

It is caused due to acid produced by bacteria. In this enamel softens and may cause dental plaque and cavities.



RESPIRATION

Keywords

Cytoplasm	**Fluid part within the cell**
Mitochondria	**Site of energy production (the powerhouse of the cell)**
Pyruvate	**The intermediate product of respiration**
Ethanol	**A type of alcohol (C_2H_5OH)**
ATP	**Adenosine triphosphate, an energy-rich compound**

The process of Breaking complex organic material into a simpler form with the help ofenzymes is called reparation.

Types of respiration and site

Type	Definition	Site
Aerobic respiration	**It occurs in the presence of oxygen**	**Cytoplasm and Mitochondria**
Anaerobic respiration	**It occurs in the absence of oxygen.**	**Cytoplasm**
Fermentation	**It is a type of anaerobic respiration occurs in a few microorganisms**	**Cytoplasm**

PROCESS OF RESPIRATION

- Glucose is broken down into pyruvate in the cytoplasm of a the cell.
- In the presence of oxygen, pyruvate enters into mitochondria and completely oxidized there to produce C2 and energy (ATP).
- In the absence of oxygen pyruvate partially decompose and form. Eg- Ethanol in yeast (fermentation), b- Lactic acid in muscle cells

HUMAN RESPIRATORY SYSTEM

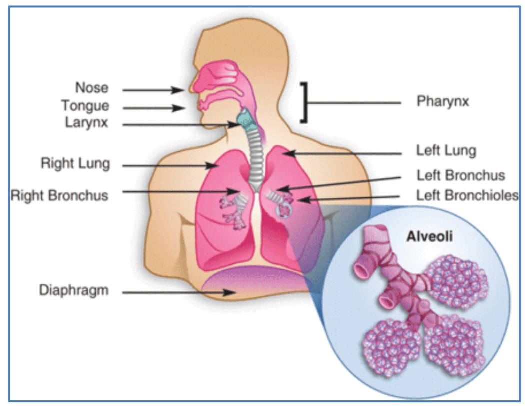
(consists of the nostril, nasal passage, pharynx, larynx, trachea, bronchi, bronchioles, alveoli,diaphragm, and ribcage.)

The inhale of oxygen and exhale of CO2 is known as breathing. Air is taken into body through nostrils

From nostril air passes through the pharynx, larynx, trachea, bronchi, bronchioles and finally alveoli.

At alveoli exchange of oxygen and CO_2 takes place with blood vessels by process of diffusion.

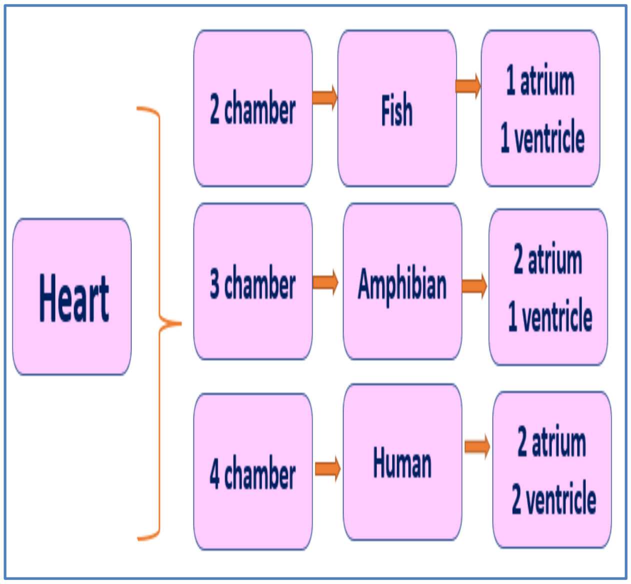
Oxygen enters into blood vessels while CO_2 enters into the alveolar sac. Both oxygen and CO_2 is carried by iron-containing hemoglobin.

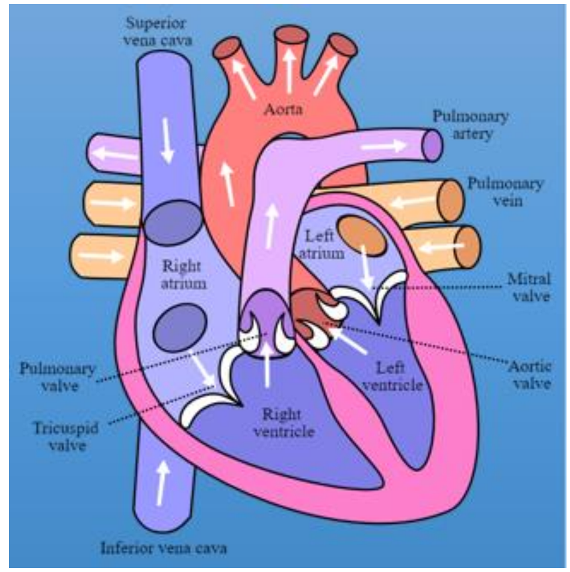


TRANSPORTATION IN HUMAN BEINGS

Blood	Connective tissue consists of RBC, WBC, Platelets and plasma.
Plasma	**The fluid portion of the blood**
Systole	**Contraction of heart chambers**
Diastole	**Relaxation of heart chambers**
Double circulation	**Blood goes through the heart twice**
Arteries	**Thick-walled. elastic, Carry blood away from heart to various organs**
Veins	**Thin-walled, carry blood from different organs to the heart**
Platelets	**Helps in blood clotting during an injury**
Lymph / Tissue fluid	**Fluid in intercellular space in the tissues. They carry digested and**
Sphygmomanometer	Measure blood pressure

HEART





Human Heart

2 atrium and 2 ventricle

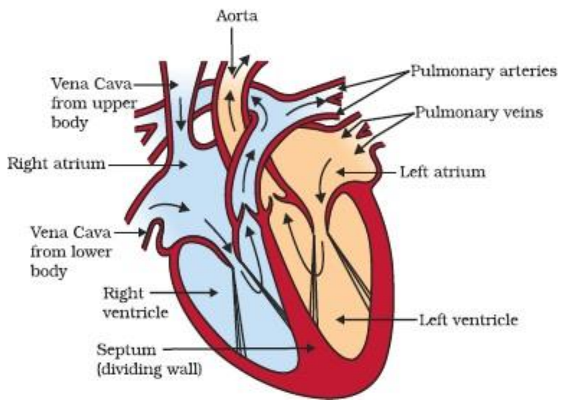
The atrium and ventricles are separated to avoid mixing of oxygenated and deoxygenated blood

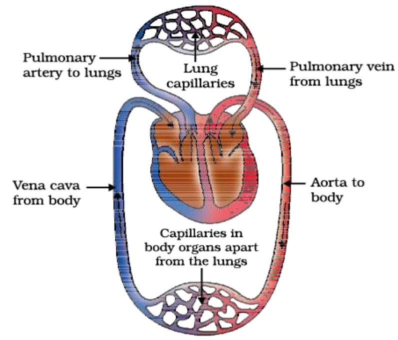
The right atrium and right ventricle contain deoxygenated blood while the left atrium and left ventricle contain oxygenated blood.

Oxygenated blood from the lungs enters in left atrium via pulmonary veins. When the left atrium contracts (systole) blood enters to left ventricle. The blood goes outside to different parts of body via the aorta when the left ventricle contracts.

From different parts of the body deoxygenated blood is carried out by the superior and inferior vena cava to the right atrium.

When right atrium contracts the blood enters into right ventricle. The deoxygenated blood goes to the lungs through pulmonary arteries when right ventricle contracts.



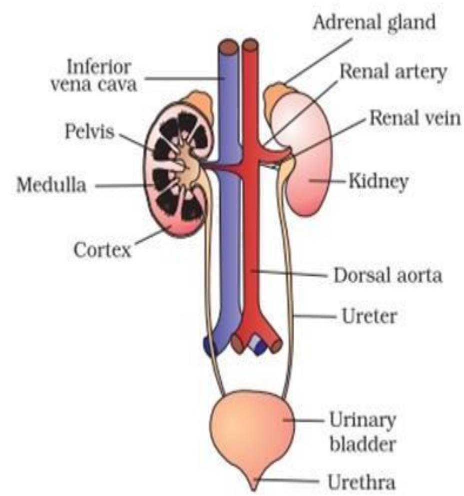


TRANSPORTATION IN PLANTS

Stomata	Gaseous exchange, Transportation (loss of water in form of vapor)
Xylem	Water conduction channels composed of xylem tissue, vessels and tracheid
	Transport water and mineral from root to aerial part (unidirectional)
Phloem	Transport food from the leaves to other part (multidirectional).

EXCRETION

Excretion	Removal of harmful metabolic wastes from the body
Kidney	Excretory organ of human
Nephron	Structural and functional unit of kidney
Urinary bladder	Store urine
Ureter	Connect urinary bladder with kidney
Hemodialysis	Artificial kidney, a device to remove nitrogenous waste products (urea, uric acid) from the blood.



EXCRETION IN HUMAN BEINGS

- Basic filtration units in kidneys are clusters ofthin-walledd capillaries. These are associated with cup-like structure which collects the filtered urine.

- There is reabsorption of glucose, amino acids, salts, and water in tubules of nephrons.
- The concentrated urine enters into urinary bladder via the ureter and finally passes outsidethe body through the urethra.

EXCRETION IN PLANTS

- Stomata play an important role as is the site for gaseous exchange and transpiration.
- Some waste products are released in form of resin, gums.
- Falling of leaves also helps in the removal of waste products.

IMPORTANT QUESTIONS

VERY SHORT ANSWER QUESTIONS

1- What is the normal systolic and diastolic pressure in humans-

a- 120 mm Hg / 80 mm Hg

b- 80 mm Hg/ 120 mm Hg

c- 120 mm Hg/ 120 mm Hg

d- 80 mm Hg/80 mm Hg

Ans: a

2- By which apparatus wecan measure blood pressure-

a- Barometer

b- Hygrometer

c- Ammeter

d- Sphygmomanometer

Ans: d

3- Which conducting tissue is responsible for multidirectional transport in plants-

a- Xylem

b- Phloem

c- Guard Cell

d- Parenchyma

Ans; b

4- Cuscuta is a special organism as it is-

a- Animal parasite

b- Plant parasite

c- Fungal parasite

d- Blue green algae and saprophyte

Ans: b

5- Nature of nutrition in fungi are-

a- Parasite

b- Autotrophs

c- Saprotrophs

d- Mixed autotrophs

ans: c

6- **Which acid is formed in our muscles after vigorous exercise? Ans:** Lactic acid

7- **How much energy is released when terminal phosphate linkage in ATP is broken down?**

Ans: 30.5 Kj/mol.

SHORT ANSWER TYPE QUESTIONS

8- **What is holozoic nutrition? Give one example.**

Ans: The nutrition that involves the taking in of solid or liquid particles of food which have to be further broken down into simpler particles inside the organism. Example- Amoeba

9- **What is the importance of nutrients?**

Ans: i. Energy production

ii- growth and repair

iii- Protection from disease

10- **Why do photosynthesis consider a photochemical reaction?**

Ans: plants convert the energy of sunlight into stored chemical energy by forming carbohydrates from atmospheric carbon dioxide and water and releasing molecular oxygen as a byproduct.

11- **What is the role of the following in photosynthesis- i-Chloroplast ii- Water iii- CO2**

Ans: Chloroplast trap the sunlight (radiation) Water undergoes photolysis to evolver oxygen CO2 reduces to form carbohydrates.

12- **Write the similarity between the heart and phloem.**

Ans: Both are conduction tissues. The heart is responsible for the conduction of blood while the phloem for food in plants.

13- **Mention the importance of Double circulation and Volves in the human heart.**

Ans: Double circulation importance: helps keep oxygenated (blood rich in oxygen) separate from deoxygenated (blood rich in carbon dioxide). This results in a more efficient circulation ofblood.

14- **Specify the role of the conducting tissues in plants**.

Ans: phloem is food-conducting tissue and xylem is water-conducting tissue.

Phloem transports food in many directions from leaves to other parts of plants like another leaf, flower, stem, root, and storage part.

Xylem conducts water only in one direction from the root to the aerial parts of the plant.

15-What is saliva? State its role in the digestion of food.

Ans: Saliva contains salivary amylase enzymes that help digest the starches in our food.

An enzyme called amylase breaks down starches (complex carbohydrates) into sugars, which your body can more easily absorb.

It helps in moistens the food for easy swallowing.

16- **(a) What is the peristaltic movement?**

(b) 'Stomata remain closed in desert plants during daytime'. How do they do photosynthesis?

Ans: (a) The relaxation of gut muscles to move the partially digested food downwards throughout the alimentary canal is called peristaltic movement.

(b) In desert plants, stomata open at night and take in carbon dioxide (CO2). Stomata remain closed during the daytime to prevent the loss of water by transpiration. They store the CO2 in their cells until the sun comes out so that they can carry on with photosynthesis during the daytime.

LONG ANSWER TYPE QUESTIONS

17- Differentiate the followings-

I. Vena cava and Aorta II- Pulmonary artery and Pulmonary vein III- Anaerobic respiration and fermentation IV- Bronchi and bronchiole

Ans:

- Vena cava: carries deoxygenated blood from body parts to the heart
  Aorta: carries oxygenated blood from the heart to the body parts
- Pulmonary artery: carries deoxygenated blood from the heart to the lungs
  Pulmonary vein: carries oxygenated blood from the lungs to the heart
- Anaerobic respiration: respiration without oxygen
  Fermentation: respiration without oxygen in microorganisms
- Bronchi: extends from the trachea, have incomplete cartilage ring
  Bronchioles: extended from bronchi

18-Draw a cross-section of the leaf and label the stomata. Also mention any two roles of stomatain plants.

Ans: Fig 6.1, page 96, NCERT

19-Draw a labeled diagram of the structural and functional unit of the kidney. Also, mention itsrole.

Ans: Fig: 6.14, page 111, NCERT

Filtration of blood, reabsorption, secretion and excretion of useful and harmful substances present in the blood.

20-Give reasons:

i- Ventricles have thicker muscular walls than atria.

ii- The transport system in plants is slow.

iii- Blood circulation differs in aquatic vertebrates from that in terrestrial vertebrates.

iv- During the daytime, water and minerals travel faster through the xylem as compared to thenight.

v-Veins have valves whereas arteries do not.Ans:

(i) Ventricles pump blood into various organs with high pressure so they have thicker walls.

(ii) Plants are non-motile, less active, and require less energy so their cells do not need to be supplied with materials so quickly.

(iii) The aquatic vertebrates like fish have gills to oxygenate blood. Fishes have single circulation. Terrestrial vertebrates like birds and humans have four-chambered hearts and show double circulation.

(iv) it is due to a high transpiration rate id day time.

(v) The lumen of veins has valves, which allow the blood in them to flow in only one direction. Thus preventing the backflow of blood.

21- Describe the double circulation of blood in human beings. Why is it necessary?

Ans: In the human heart, blood passes through the heart twice in one cardiac cycle. This type of circulation is called double circulation. Double circulation ensures complete segregation of oxygenated and deoxygenated blood.

It includes - Pulmonary circulation and Systemic circulation.
In Pulmonary circulation: The right ventricle pumps deoxygenated blood into the lungs where itis oxygenated. The oxygenated blood is brought back to the left atrium, and from there it is pumped into the left ventricle and finally, blood goes into the aorta for systemic circulation.
In Systemic circulation: The oxygenated blood is pumped to various parts of the body from the left ventricle. The deoxygenated blood from different parts of the body passes through the vena cavato reach the right atrium. The right atrium transfers the blood into the right ventricle.

22-Mention the location of four major glands associated with the digestive system ofhumans and explain the function of each.

Ans:

i- Salivary Glands- There is three pairs of salivary glands (Parotid, submaxillary and sublingual) that secrete saliva. Saliva moistens the food, disinfects food by lysozyme and digests starch by salivary amylase.

ii-Gastric Glands- these are present inside the stomach. Gastric glands secreteHCI- disinfect found od, provide an acidic medium for digestive juices.

Pepsin - for partial digestion of proteins to form peptones and proteases

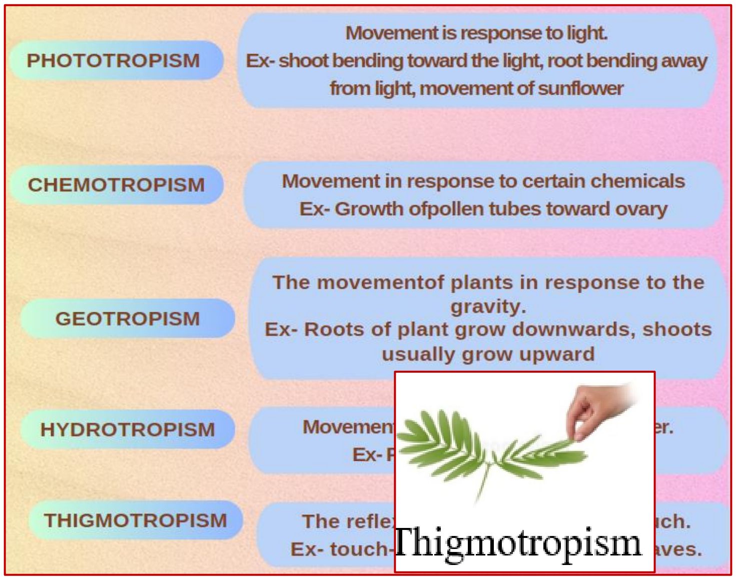
iii-Liver- secretes bile, which neutralizes the acidity of chyme and emulsifies fat.

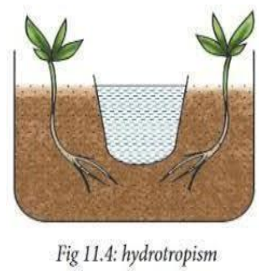
iv-Pancreas- Lies in the loop of the duodenum below the stomach.

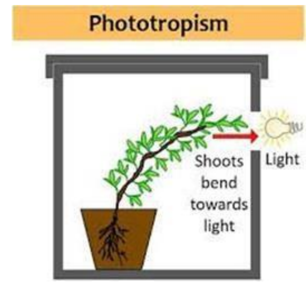
It secretes trypsin (digest protein), lipase (break down of fat)

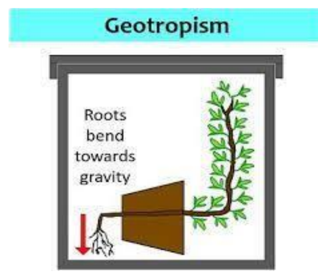
TROPIC MOVEMENTS IN PLANTS

Tropic movement is the movement of the plant in response to stimulus present in the surroundings. Tropic movements can be either toward the stimulus or away from it. The important tropic movements are listed below-









INTRODUCTION OF PLANT HORMONES

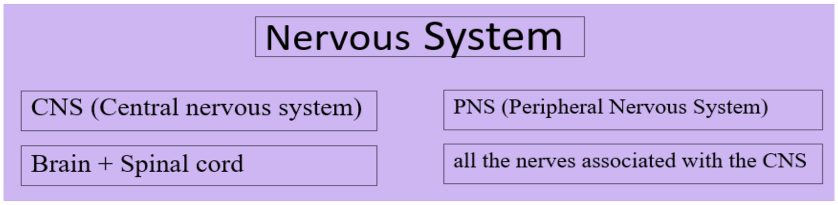
Growth and differentiation in plants depend on a few hormones calls as plant growth regulators/ plant growth hormones/ Phytohormones. These are organic substances that are synthesized in minute quantities in one part of the plant body and transported to another part where they show specificphysiological processes.

Phytohormones	Growth promoter/ growth inhibitor	Explanation
Auxin	Growth promoter	Stem elongation
Gibberellins		Growth of stem
Cytokinin		Cell division
Ethylene	Growth inhibitor	Wilting of leaves
Abscisic acid		Fruit ripening

CONTROL AND CO-ORDINATION IN ANIMALS

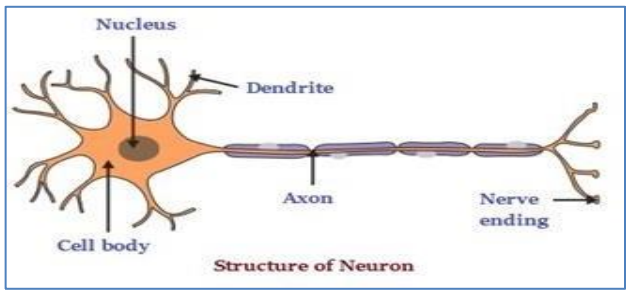
In animals control and coordination is carried out with the help of -

- ➢ Nervous system
- ➢ Muscular tissue
- ➢ Endocrine system: Hormones
- ➢ Nervous system



NEURONS

Neurons are composed of cell body, dendrite, axon and nerve ending.

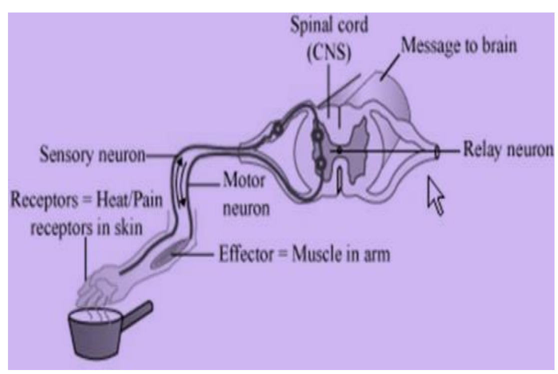


HOW NERVOUS IMPULSE TRAVELS IN BODY

- Dendritic tips receive stimulus and an electrical impulse is generated in neurons.
- This impulse travels from the dendrite to the cell body and then along the axon to its end.
- At the axon ending some chemicals are released that cross the synapse and start a similarelectrical impulse in next neuron.

REFLEX ACTION

- ➢ Reflex action is a sudden and involuntary response to any stimuli.
- ➢ It originates in the spinal cord.
- ➢ Ex- Drawing hand away from the hot plate, watering of mouth in response to food etc.
- ➢ The neural pathway that controls thereflex action is called as a reflex arch



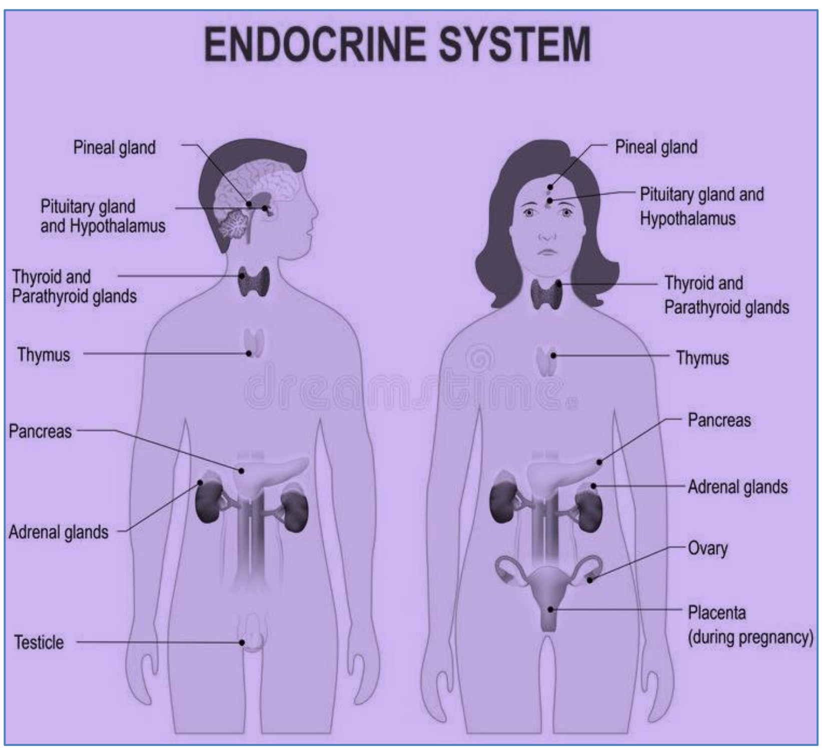
- ➢ In these sensory neurons, spinalcord, relay neuron, motor neuron and effector muscles are involved.

- Stimulus is received by sensory neurons. The sensory neurons transfer sensory impulses to the spinal cord (CNS). Spinal cord process the stimulus. The motor nerve fiber relays the motor impulses from the nervous system to the effector organs like muscles.

HORMONES IN ANIMALS-

Hormones are chemical messengers which are secreted by the ductless endocrine gland intothe blood. Hormones control the activity of certain cells and organs. Hormones can be peptides and steroid hormones. Some of the main endocrine glands are the pituitary gland, adrenal gland, thyroid gland, pancreas, testes, ovary etc.

Endocrine gland	**Hormone**	**Role**
PITUITARY GLAND	Growth hormone	Regulate growth and development
ADRENAL GLAND	Adrenaline	Stress hormones (enable the body ready to dealwith the stressed condition), Increase heartbeat, Increase breathing rate
THYROID GLAND	Thyroxine	Regulate carbohydrate, protein and fat metabolism
PANCREAS	Insulin	Regulate blood sugar level
TESTES	Testosterone	Changes associated with puberty in male
OVARY	Oestrogen	Changes associated with puberty in female



- **GOITER**- Iodine is necessary for the formation of thyroxin hormone. If Iodine is in low concentration the thyroid gland swells and causes goiter.

- **GIGANTISM and DWARFISM**- Excess secretion of growth hormone from the pituitary gland causes excess growth of the body (gigantism) and less secretion results in dwarfism.

IMPORTANT QUESTIONS

Very Short Answer Type Questions-

1- **Find out the plant growth inhibitor phytohormone**

a- Auxin b- 2,4 D c- Cytokinin d- Abscisic acid

Ans: d

2- **A deficiency of Iodine may result in the-**

a- Goiter
b- Scurvey
c- Beri Beri
d- All of these

3- **Testosterone comes under which of the following-**

a- Estrogen
b- Progesterone
c- Androgen
d- Both a and c

Ans: c

4- **Pancreas is responsible for the secretion of**

a- Pancreatic juice
b- Pancreatic amylase
c- Insulin
d- All of these

Ans: d

5- **Apical dominance and bolting in plants are due to-**

a- Auxin and gibberellin
b- Auxin and cytokinin
c- Auxin and ethylene
d- Auxin and ABA

Ans: a

6- **Name the hormone which helps in the regulation of glucose in the blood.**

Ans: Insulin

7- **Name two tissues that provide control and coordination in multicellular animals.**

Ans: Nervous tissue and Endocrine tissue

Short Answer Type Questions-

8- **Describe how the cells on the dark side of the shoot grow longer as the concentration of Auxin increases.**

Ans: Auxin is a hormone that is found in plants and plays a key role in the growth and development of shoots and roots. Specifically, auxin helps regulate cell elongation, which is the process of cells growing longer as they move away from a source of light. Auxin increases the concentration of molecules in cells on the side of the shoot that is away from the light, which causes the cells to elongate. The increased concentration of auxin molecules signals the cells to grow longer, resulting in the shoot bending toward the light. This process is known as phototropism and is essential for plants to grow in the direction of light. Without auxin, plants would not be able to orient themselves properly and would not be able to survive.

9- **Describe the structure of neurons.**

Ans: A neuron is the basic unit of the nervous system. At the core of a neuron is the cell body, which houses the nucleus, the control center of the cell. Extending from the cell body are long, thread-like projections called dendrites, which receive signals from other neurons. The axon is a long, thin projection that transmits signals away from the cell body to other neurons or to effector organs. At the end of the axon are the synaptic terminals, which form connections with other neurons.

10- **When our body receives a sudden stimulus, our body shows a strong reaction. Explain the process.**

Reflex action is a type of involuntary, rapid and automatic response to stimuli. It is a basic physiological process that all animals possess and is characterized by its speed and lack of conscious thought. The reflex action mechanism involves the coordination of the sensory and motor systems and is based on the concept of stimulus and response. When the body receives strong and sudden stimuli like pressure, temperature or chemicals, then the sensory neuron sends a message to the spinal cord. The relay neuron sends the signal to the motor neuron and the latter sends a signal to the effectormuscle to respond.

11- **Compare chemotropism and Hydrotropism**.

Ans: chemotropism: Movement due to chemicals. E.g.- pollen tube growth on stigma and style. Hydrotropism: Movement due to water. E.g. growth of root toward water

Long Answer Type Questions

12- **What are endocrine glands? Locate any four endocrine glands of humans by drawing suitable diagram.**

Ans: endocrine glands are ductless glands that secrete hormones to control and coordinate bodyfunction.

Fig 7.7, page124, NCERT

13- **(a) A person is advised by a doctor to take less sugar in his diet. Name the diseasefrom which the man is suffering. For the disease which hormone is responsible?**

Name the endocrine gland which secretes growth hormone.

Which glands secrets growth hormone? What will be the consequences of Deficiency and Excess secretion of growth hormone?

ANS: (a)Disease- Diabetes mellitus, Hormone – Insulin, Gland- Pancreas

Gland- Pancreas

Gland- Pituitary Gland, Excess secretion: Gigantism, Deficiency: Dwarfism

14- **How does chemical coordination occur in plants?**

Ans: In plants, chemical coordination occurs with the help of plant hormones/ Plant growthregulators. (Phytohormones). Examples- Auxin, Cytokinin, Gibberellin, Abscisic acid, and ethylene. These hormones help to coordinate growth, development, and responses to the environment.Plant hormones are synthesized at different and diffuse to the area where they act.

Auxin promotes cell growth, Gibberellins promote stem elongation, Cytokinin promotes cell division, and Abscisic acid inhibits growth.

15- **What events take place between the synapse of two neurons?**

Ans. A synapse is a gap between two neurons. In between synapses, nerve impulses are conducted by a chemical process with the help of neurotransmitters (acetylcholine). within the axon, a nerve impulsetravels by an electric signal. When it reached to synapse, the neurotransmitters are released in the synaptic cleft. These neurotransmitters act as stimuli for the next neuron.

HOW DO ORGANISMS REPRODUCE

- Reproduction is the biological process by which living organisms produce new individuals (Offspring) similar to themselves.
- It ensures continuity species generation of generation.

Content:

Reproduction in animals and plants (asexual and sexual), Reproductive health - need and methods of family planning, Safe sex vs HIV/AIDS, Child bearing and women's health

TYPES OF REPRODUCTION

1- **Asexual reproduction**
2- **Sexual reproduction**

Asexual reproduction	Sexual reproduction
In this single parent is involved.	In this two parents are involved.
It does not involve fusion of gametes	Fusion of gamete is involved.
There is no meiosis	Meiosis occurs
No variation in offspring	variation occur

ASEXUAL REPRODUCTION AND VEGETATIVE REPRODUCTION

Fission
In this organism divide two or more equal part and each develops into identical new individuals. Ex. Amoeba

Regeneration
If an individual's body is cut into several pieces, each of its parts regrows into a new individual. Ex- Planaria

Budding
In this new organism develops on the bud (outgrowth on the parent body). The new organism remains attached to the parent body till it gets matures. Ex- Hydra, Yeast

Adventitious Bud
Small l buds in the notches of the leaf. These have the ability to grow into new individuals. Ex – Bryophyllum

Spore formation
Spores are propagules produced in sporangia and germinate to produce new individuals. Rg. Rhizopus (bread mould)

SEXUAL REPRODUCTION

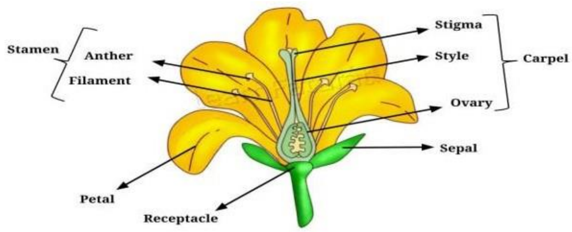
The sexual life cycle can be grouped into –

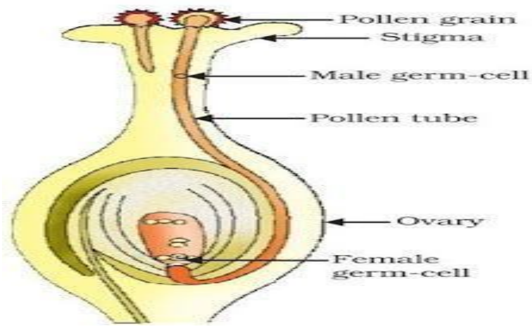
i- Pre-reproductive phase- development to attain sexual maturity (puberty)
ii- Reproductive phase- sexually mature, able to reproduce, able to produce fertile gametes
iii- Post reproductive phase- after fertilization, development of embryo into new individual

SEXUAL REPRODUCTION IN FLOWERING PLANTS

- Reproductive part of pant is flower. Flower consists sepals, petals, stamens and carpels.
- Stamen and carpel contain anther and over respectively.
- Anther produces male gamete pollen and ovary contains female gamete egg.
- After pollination pollen fuses with egg to for zygote.

- Zygote develops in embryo and within ovule.
- Ovule develops into seed that contains future plant and ovary ripens in fruit.





REPRODUCTION IN HUMAN BEINGS

Male reproductive system –

- It consists of one pair of testes where sperm formation takes place.
- Testes also secrete hormones like testosterone.
- Testosterone brings about changes in the appearance of boys at the time of puberty.
- Sperm is delivered through the vas deferens where secretions of the prostate gland andseminal vesicles add their secretions. These secretions help in transportation and provide nutrition to sperm.

Female reproductive system

- It consists of mainly a pair of ovaries and a uterus.
- On puberty the ovary starts producing eggs and releases one egg each month.

Fertilization

- Fertilization is a fusion of sperm and egg. It takes place in the fallopian tube. The fertilized eggis called a zygote which develops into an embryo.
- Uterus is for implantation purposes which hold the developing embryo in its layer through the placenta and umbilical card.
- When egg is not fertilized the inner lining of uterus breaks and comes out throughthe vagina as blood and mucus (menses). This cycle repeats every month and is called menstrual cycle.

REPRODUCTIVE HEALTH

STDs (Sexually transmitted diseases)- Spread from infected person to healthy person due to unprotected sex. E.g.- HIV-AIDS, Gonorrhea, Syphilis, and Warts.

Population control methods

- Mechanical barrier- Condom
- Hormonal methods- Pills
- Chemical method- Cut, Loops

- Surgical method- Vasectomy and Tubectomy

IMPORTANT QUESTIONS

Very Short Answer Type Questions

1- **Amoeba shows which type of asexual reproduction-**

a- Binary fission b- Spore formation c- Budding d- All of these

Ans: a

2- **The nature of DNA molecule is-**

a- Positively charged b- Negatively charged c-Neutral d- Either a or b

Ans: b

3- **Which of the following is not a pollinating agent-**

a- Human
b- Lion
c- Leopard
d- All are a pollinating agent

Ans: d

4- **Sexually reproducing are different form asexually reproducing organisms in-**

a- Mitosis
b- Meiosis
c- Offsprings
d- All of these

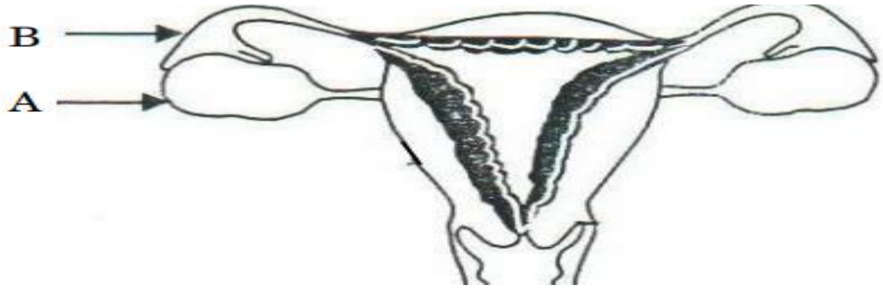
Ans: b

5- **If a human male produces sperm and a human female produces an egg, what will be the product of anther-**

a- Ovule
b- Egg
c- Pollen
d- Ovary

Ans: c

6- **Write the name and function of A and B**



Ans: A- Ovary- by oogenesis produces eggs

B- Fallopian tube: site of fertilization

7- **What are testes? List two functions performed by testes in human beings**.

Ans: Testes are male gonad.
By process of spermatogenesis, the testes produce sperms.
It also helps in the production of male hormone androgens.

8- Mention modes of reproduction in Leishmania, Rhizopus, Planaria, Plasmodium and hydra.

Ans: Leishmania- Binary fission, Rhizopus- Spore, Planaria- Regeneration, Hydra- Budding

9- When a cell reproduces, what happens to its DNA?

Ans: When a cell reproduces, DNA replication occurs which forms two similar copies of DNA

10- What is pollination? Give an example of any two pollinating agents.

Ans: The transfer of pollen from the anther to the stigma of a flower is known as pollination.Examples of pollinating agents: Insects, Wind, Water

Short Answer Type Questions

11- What are sexually transmitted diseases? Give any three examples.

Ans: are infections transmitted from an infected person to an uninfected person throughsexual contact. Example- HIV- AIDS, Syphilis, Genital wart

12- Differentiate asexual and sexual mode of reproduction. Which one showsvariation and why?

Ans:

Asexual reproduction	**Sexual reproduction**
In this single parent is involved.	In this two parents are involved.
It does not involve fusion of gametes	Fusion of gamete is involved.
There is no meiosis	Meiosis occur
No variation in Offsprings	variation occur

- Genetic material from both the parents mixed by fertilization.
- Hence Offsprings get both the information and produce mixed characters whichare not exactly the same as only mother or father.

13- Explain vegetative propagation with the help of two examples. List two advantages of vegetative propagation.

Ans: Vegetative reproduction is any form of asexual reproduction occurring in plants in whicha new plant grows from vegetative propagules like-cutting, buds, eyes etc.

Importance

- Vegetative propagation takes less time
- No variation occur
- No requirement of fusion of gametes
- Can be done artificially in garden

14- Write the role of the followings-

I. Placenta II- Ovary III- Uterine wall IV-Egg

Ans:

I. Placenta: provides oxygen and nutrients to a growing baby. It also removes wasteproducts from the baby's blood.
II. Ovary: produce egg by process of ovulation
III. Uterine wall: implantation, formation of placenta and umbilical cord, helps in contraction

during child birth

IV. Egg fuses with sperm to form zygote

15- What could be the reasons for adopting contraceptive methods?

Ans: To prevent -

Unwanted pregnancy, STDs (sexually transmitted diseases)

Long Answer Type Questions

16- a-**How do Plasmodium and Leishmania reproduce? Write one difference in their mode of reproduction.**

b- Explain the formation of buds in hydra.

Ans: a- Plasmodium and Leishmania are both single-celled parasites that are able to reproduce asexually. Plasmodium reproduces through a process known as schizogony, in which a single cell is divided into multiple daughter cells. These daughter cells then undergo further division, creating more daughter cells, until a certain number of parasites is reached. Leishmania, on the other hand, reproduces through a process known as binary fission, in which a single cell divides into two daughter cells. The main difference between the two is that in schizogony, multiple daughter cells are produced per division, while in binary fission only two daughter cells are produced.

b- Hydra create buds by a process known as budding. During this process, the parent hydra will form an outgrowth, or bud, from the body wall of its column. This bud is an extension of the hydra’s body, and contains some of the same genetic material as the parent. The bud will then grow into a new hydra, which can eventually become independent from the parent.

17- What are STDs? Give five examples of it. Write the methods to prevent the STDs.

Ans: Sexually transmitted diseases (STDs) are illnesses that are passed from one person to another through intimate contact. STDs can be caused by bacteria, viruses, or parasites. Some STDs, such as HIV, cannot be cured and can only be managed through treatment.

Five examples of STDs include chlamydia, gonorrhea, syphilis, herpes, and HIV. Chlamydia is a bacterial infection that is usually transmitted through unprotected sex. Gonorrhea is a bacterial infection that can be spread through contact with the genitals, anus, or throat. Syphilis is a bacterial infection that is usually spread through sexual contact. Herpes is a viral infection that can be spread through contact with the genitals, anus, or mouth. HIV is a virus that can be spread through contact with infected body fluids, such as blood, semen, or breast milk.

The best way to prevent STDs is to practice safe sex. This includes using condoms every time you have sex, avoiding sex with multiple partners, and getting tested for STDs regularly. It’s also important to get vaccinated for certain STDs, such as hepatitis B. Additionally, it’s important to avoid sharing needles and to practice proper hygiene.

18- **List five advantages of vegetative propagation**.

Ans: 1. Vegetative propagation is a cost-effective and efficient way to propagate a variety of plants. It does not require any special equipment, and the cost of propagating plants is much lower than that of purchasing new plants.

2. It is a quick and easy way to propagate a plant species. It takes much less time to propagate a plant through vegetative propagation than it does to grow a plant from a seed.

3. It allows for the propagation of plants that do not reproduce through seeds, such as many fruit trees.

4.It is a reliable way to propagate a plant. The plants that are propagated through vegetative propagation are clones of the parent plant, so they will have the same characteristics as the parent plant.

5. It allows for the propagation of plants that may be difficult to propagate through seeds, such as many ornamental and medicinal plants.

HEREDITY AND EVOLUTION

- The process of transmission of characters from parents to offspring is known as inheritance. This is the basis of heredity.
- Genetics is the science that deals with heredity and variation.
- Variation: Small changes / modifications in a particular character that are visible between parents and Offsprings
- **Gregor Johann *Mendel*** is known as the **–father of genetics‖**.

Heterozygous	Two different alleles are present together. E.g.- Tt
Genotype	It is the genetic makeup of an individual. E.g.- TT, tt, Tt
Phenotype	It is an observable feature. E.g.- tall, dwarf
Monohybrid cross	Cross to observe a single character. E.g.- height of the plant
Dihybrid cross	Cross to observe two characters at the same time. E.g. colour and shape of seed

Types of Variation-

1- Somatic- occur in vegetative cell and not ionherited

E.g. Boring of pinna by Indian women, hair style etc.

II- Germinal variations:

Occur in special gamete forming cells only

Inherit in next generation

E.g.: Human skin colour, shape of nose, etc.

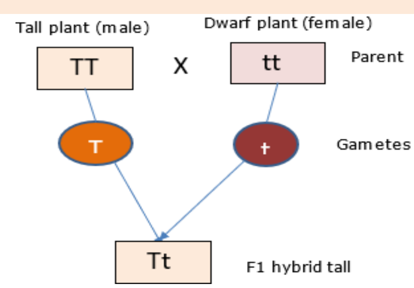
Importance of variations

- Variation enables organisms to adjust and adapt better according to the changingconditions of the environment (Survival advantage),.
- Different kinds of variations in organisms lead to the development of new species.

- Mendel worked on Pea plant (***Pisum sativum***).
- Advantages of using pea plant are- availability of pure line plant, clearly visible observable characters, contrast characters of same features, easily pollinated (self and cross) etc.
- He worked on 7 contrasting features of pea plant. E.g. Height of plant, flower colour, seed colour, seed shape, pod colour, pod shape and position of flower.
- He conducted monohybrid and Dihybrid cross.

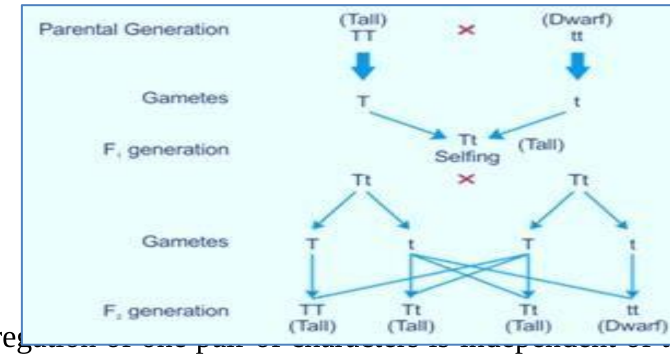
MENDEL'S LAW OF INHERITANCE

- The Law of Dominance
- The Law of Segregation
- The Law of Independent Assortment.



Law of Dominance: When parents having pure contrasting characters are crossed then only one character expresses itselfin the F1 generation. This character is the dominant character and the character/factor which cannot express itself is called therecessive character.

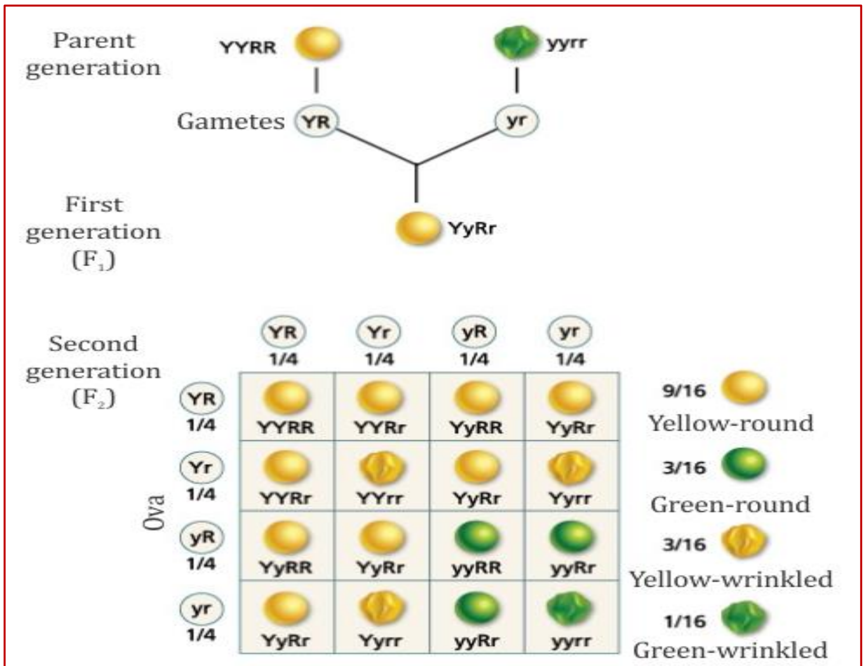
Law of segregation: The phenomenon of separation of the two alternating factors of one character, during gamete formation so that one gamete receives only one factor of a character is called as _Law of Segregation.



Law of Independent Assortment-

'When two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters'.

- **Dihybrid cross**. He cross breed pea plants bearing round green seed (RRyy) with plants bearing wrinkled and yellow seeds (rrYY).
- In the F1 generation he obtained all round and yellow seeds it means round and yellow traits of seeds are dominant features while wrinkled andgreen are recessive.
- He self-crossed the plants of F1 and found that in F2 generation four different types of seeds round yellow,round green, wrinkled yellow an wrinkled green in the ratio of **9 : 3 : 3 : 1** are present.



An illustration of dihybrid cross

HOW DO TRAITS GET EXPRESSED?

DNA is regulating the authority to making of proteins in the cell.

- Gene provides information for one particular protein.
- E.g. the height of a plant depends upon the growth hormone which is in turn controlledby the gene.
- Both parents contribute equally to the DNA of next-generation during sexualreproduction.

SEX DETERMINATION IN HUMAN

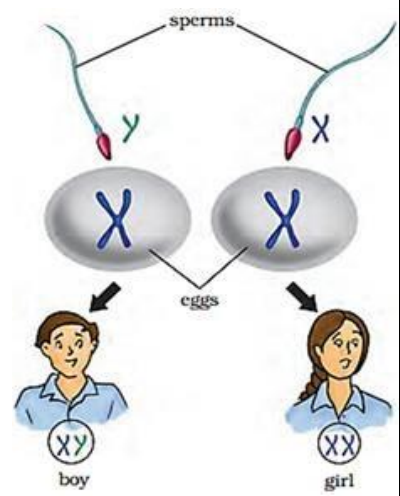
The process of determining the sex of an individual, based on the composition of the genetic makeup is called sex determination.

- Human has 23 pair of chromosomes.
- Autosome: 22 pairs (44)
- Sex chromosomes: 01 pair (02). They may be either-i-Homogametic – XX for female (44 +XX)

ii- Heterogametic XY for male (44 +XY)

In some organism-environment also plays a crucial role in the determination of sex-

- In some Reptiles: The temperature at which a fertilized egg is incubated governs the gender.
- Snails: A particular animal can change gender withinone ‘s lifetime.



IMPORTANT QUESTIONS

Very Short nswer Questions

1- Gene is a short segment of
   a- protein
   b- Carbohydrate
   c- DNA
   d- Polypeptides
   Ans: c

2- Which feature is considered as dominant by Mendel-
   a- Purple/ violet flower
   b- Long plant
   c- Yellow seed
   d- All of these
   Ans: d

3- In human which on of the following is heterogametic –
   a- Male
   b- Female
   c- Baby Girl Child
   d- All of these
   Ans: a

4- **Which of the following is not associated with sex determination-**
   a- Autosome
   b- Allosome
   c- Sex chromosome
   d- XX and XY
   Ans: b

5- **Mendel's dihybrid cross ratio is-**
   a- 1:2:1
   b- 9:3:3:1
   c- 1:2:2:1
   d- 3:9:9:1

Ans: b

6- **The sex of the children is determined by what they inherit from their father and nottheir mother." Justify**

Ans: because Y sex chromosome is inherited only from the father

7- Name the scientist who established the laws of inheritance.

Ans: Gregor Johann Mendel

8- Where genes are located?

Ans: Genes are located over the chromosomes/DNA as linear segments

Short Answer Questions

9- **Why did Mendel select Pea plant for his experiment?**

Ans: availability of pure line plant, clearly visible observable characters, contrast characters ofsame features, easily pollinated (self and cross) etc.

10- Describe genotype and phenotype with one example of each.

Ans: The genotype of an organism is its complete set of genetic material. Eg- TT, Tt, ttThe phenotype is observable feature. E.g.- tall, dwarf

11- What is the significance of variation?

Ans: Variation enables organisms to adjust and adapt better according to the changing conditionsof the environment (Survival advantage).

Different kinds of variations in organisms lead to the development of new species. .

12- **Mention the difference between the inherited and the acquired characters. Give one example of each of the characters that are inherited and the ones that are acquired in humans.**

Ans: Inherited trait: obtain from parents (since the time of his birth and are passed on from onegeneration to another.

Acquired trait: gain after birth (person develops during his lifetime)Inherited: attached ear lobe, baldness Acquired: obesity, reading skill

13- (a) Write foil form of DNA.

(b) Why are variations essential for the species?

Ans: (a) Deoxyribonucleic acid

(b) Genetic variation in a group of organisms enables some organisms to survive better than others in the environment in which they live.

Long Answer Questions

14- Make a representation of a Dihybrid cross showing a phenotypic ratio of 9:3:3:1.

Fig. 9.5; page:145,NCERT

15- **Describe law of dominance, the law of segregation and the law of segregation.**

Low of dominance: - When parents having pure contrasting characters are crossed thenonly one character expresses itself in the F1 generation. This character is the dominantcharacter and the character/factor which cannot express itself is called the recessive character.

Law of segregation: - The phenomenon of separation of the two alternating factors of onecharacter, during gamete formation so that one gamete receives only one factor of a character is called as _Law of Segregation.

Law of independent assortment: the alleles of two (or more) different genes get sorted into gametes independently of one another

16- In a monohybrid cross of tall Pea plants denoted by TT and short pea plants denotedby tt, Vaibhav obtained only tall plants (denoted by Tt) in F1 generation. However, in F2 generation she obtained both tall and short plants. Using the above information, explain the law of dominance.

TT x tt Parents

T t

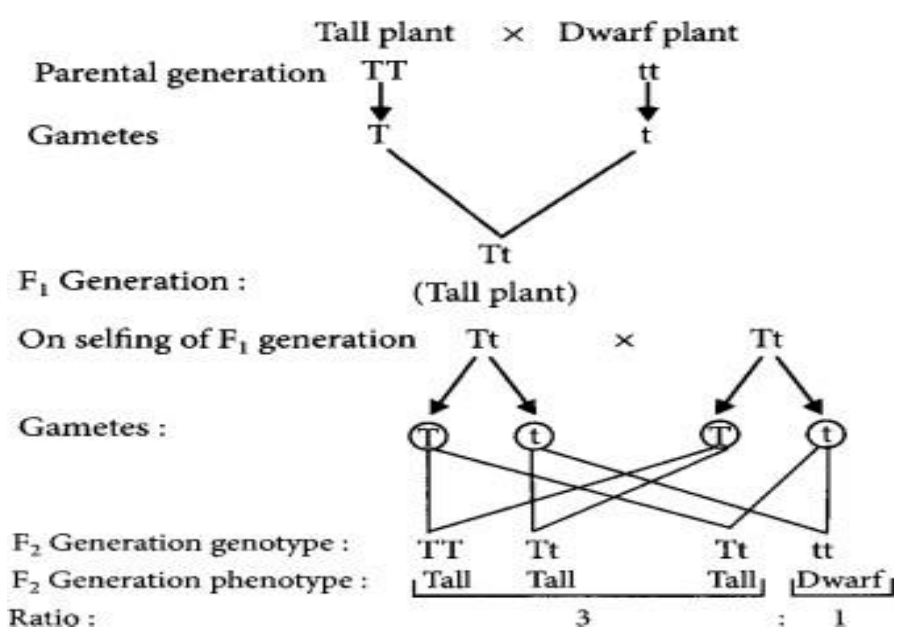
Tt……………………………………………………………… F1

Tt x **Tt** self cross

T t T t ....Gametes

F2

	T	T
T	TT, Tall	Tt Tall
T	Tt, Tall	Tt, Dwarf



19- Mendel crossed tall pea plants with dwarf pea plants in his experiment. Write hisobservations giving reasons for the F1 and F2 generations.

In the F1 generation only tall plants are visible therefore tall (T) is dominant whereas dwarf (t) isrecessive.

In F2 generation both tall and dwarf are visible. The dwarf is visible only in homozygous conditions.

18- **How do the following provide evidence in favour of evolution in organisms? Explain with an example for each.**

(i) Homologous organs

(ii) Analogous organs

(iii) Fossils

i- Homologous organs are structures that are similar in form and function but originate from different evolutionary origins. This means that two different organisms may have the same organs, like a human arm and a bat's wing, which have the same structure, but their origin is different. This is evidence in favour of evolution since it shows that two different organisms have adapted in different ways to the same environment.

ii- Analogous organs are similar in function, but have different structures. For example, a bat's wing and a bird's wing have different structures, but both enable the organism to fly. This is also evidence in favour of evolution, as it shows that two different organisms have adapted differently to similar environments.

iii- Fossils are the preserved remains of organisms that existed in the past. By studying fossils, it is possible to determine how organisms have changed over time. This provides evidence in favour of evolution, as it shows how organisms have adapted and changed to survive in the environment.

Class 9 Science

Light Reflection and Refraction

REFLECTION

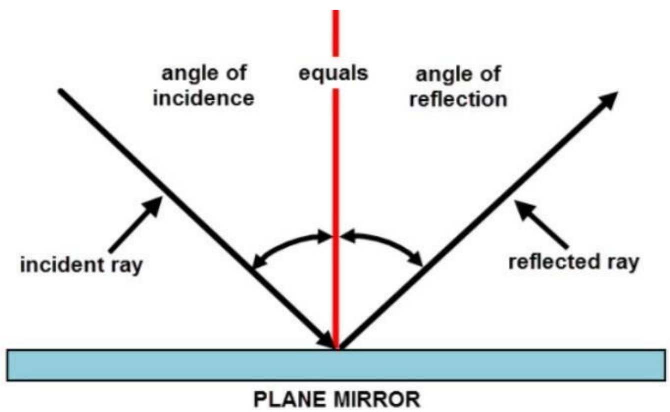
Reflection of Light: The phenomenon of bouncing back of light into the same medium by the smooth surface is called reflection.

Incident light: Light which falls on the surface is called incident light.

Reflected light: Light which goes back after reflection is called reflected light.

The angle of incidence: The angle between the incident ray and the normal.

An angle of reflection: The angle between the reflected ray and the normal.



Laws of reflection: There are two laws of reflection

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

(ii) Angle of incidence is always equal to the angle if reflection i.e. $\angle i = \angle r$

Image: Iflight rays coming from a point after reflection meet at another point or appear to meet at another point, then second point is called image of the first point.There are two types of image, i.e.

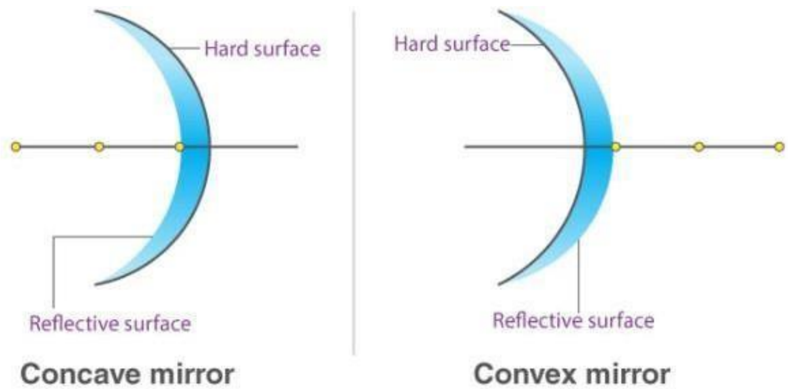
Real image: When the rays of light, after reflection from a mirror, actually meet at a point, then the image formed by these rays is said to be real. Real images can be obtained on a screen.

Virtual image: When the rays of light, after reflection from a mirror, appear to meet at a point, then the image formed by these rays is said to be virtual. Virtual images can't be obtained on a screen.

Mirror: The surface which can reflect the light is a mirror.

Plane Mirror: If the reflecting surface is a plane then the mirror is plane.

Spherical Mirror: If the reflecting surface is part of the hollow sphere then the mirror is a spherical mirror.
The spherical mirror is of two types:



Convex mirror: In this mirror reflecting surface is convex. It diverges the light so it is also called a diverging mirror.

Concave mirror: In this mirror reflecting surface is concave. It converges the light so it is also called converging mirror.

Some definitions related to Spherical Mirror:

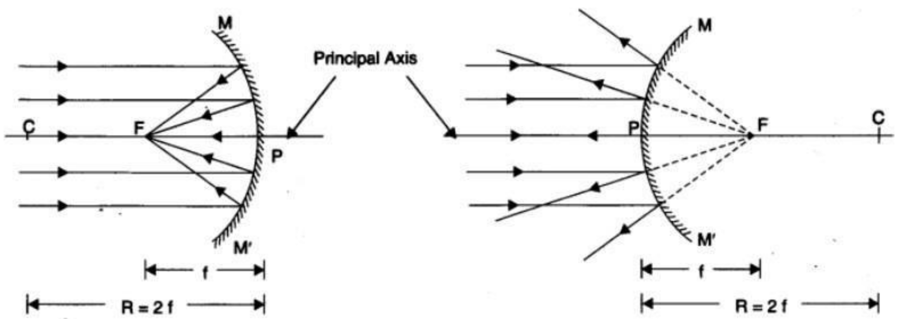
Pole (Vertex): The central point of a mirror is called its pole.

Centre of curvature: The centre of the sphere of which the mirror is a part is called the centre of curvature. It is denoted by C.

Radius of curvature: The radius of the sphere of which the mirror is a part is called the radius of curvature. It is denoted by R.

Principal axis: The straight line passing through the pole and the centre of curvature of the mirror is called the principal axis.

Principal focus: It is a point on the principal axis at which the rays parallel to the principal axis meet after reflection or seem to come from. For a concave mirror, the focus lies in front of the mirror and for a convex mirror, it lies behind the mirror. In short, a concave mirror has a real focus while aconvex mirror has a virtual focus.



(*a*) Concave mirror. (*b*) Convex mirror.

Focal plane: A plane, drawn perpendicular to the principal axis and passing through the principal focus.

Focal length: The distance between the pole and the focus is called the focal length. It is represented by f. The focal length is half the radius of curvature.

$$F = R/2$$

Reflection by Spherical mirror:

A ray of light which is parallel to the principal axis of a spherical mirror, after reflection converges or diverges from focus.

A ray of light passing through or appearing from the center of curvature of spherical mirror is reflected back along the same path.

A ray of light passing through or appearing from the focus of spherical mirror becomes parallel to the principal axis.

A ray of light which is incident at the pole of a spherical mirror is reflected back making same angle with principal axis.

Image formation by Concave mirror

S.No.	Position of object	Position of image	Nature of image	Uses
1.	Between the pole and the principal focus	Behind the mirror	Virtual, erect and magnified	Shaving mirror, dentist mirror
2.	At the principal focus	At infinity	Extremely magnified	In torches, head lights
3.	Between focus and the centre of curvature	Beyond centre of curvature	Real, inverted and bigger than object.	In flood lights
4.	At the centre of curvatrue	At the centre of curvature	Real, inverted and equal to the size of the object	Reflecting mirror for projector lamps
5.	Beyond the centre of curvature	Between the principal focus and centre of curvature	Real, inverted and diminished	
6.	At infinity	At the principal focus or in the focal plane	Real, inverted and extremely diminished in size	To collect heat radiations in solar devices

Image formation by Convex mirror

S.No.	Position of object	Position of image	Nature of image	Uses
1.	At infinity	Appears at the principal focus	Virtual, erect and extremely diminished	Used as a rear view mirror
2.	Between infinity and the pole	Appears between the principal focus and the pole	Virtual, erect and diminished	Used as a rear view mirror

Sign Conventions of Spherical Mirror

- All the distances are measured from the pole of the mirror as the origin.
- Distances measured in the direction of incident rays are taken as positive.
- Distances measured opposite to the direction of incident rays are taken as negative.
- Distances measured upward and perpendicular to the principal axis are taken as positive.
- Distances measured downward and perpendicular to the principal axis are taken as negative.

Mirror formula:1/f=1/v+1/u

Where f, v and u are focal length, image distance, and object distance

Magnification by Spherical Mirror:
This is the ratio of the height of the image to the height of the object. Magnification, $m=h_i/h_o$
Where m = magnification, h_i = height of image, h_o = height of object

REFRACTION

Refraction of Light: The bending of light at the interface of two different mediums is called Refraction of light.

If the velocity of light in medium is more, then medium is called optical rarer.
Example, air or vacuum is more optical rarer.

If the velocity of light in medium is less, then medium is called optical denser.
Example, glass is denser than air.

Laws of refraction:

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

The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant.

Sin i/sin r = n (constant)

This constant is called the index of refraction or refractive index.

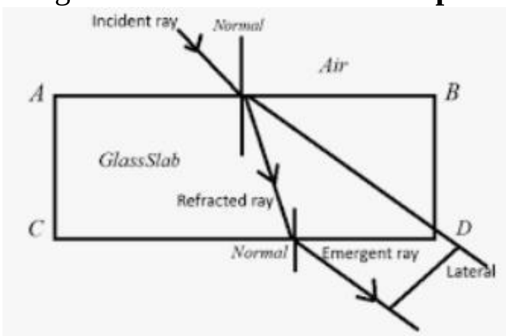
Refractive Index: If c is the speed of light in air and v is the speed of light in medium, then the refractive index of the medium is

$$n = \frac{\text{speed of light in vacuum}}{\text{speed of light in the medium}} = \frac{c}{v}$$

Refractive index of medium with respect to air or vacuum is called Absolute Refractive Index.

Refraction through a Rectangular Glass Slab:

When light ray enters into a glass slab, then the emergent ray is parallel to the incident ray. This perpendicular distance between the emergent ray and incident ray when the light passes out of a glass slab is called **lateral displacement**.



i = angle of incidence, r = angle of refraction and e = angle of emergence
Angle of incidence = Angle of emergence, i.e. $\angle i = \angle e$
Lens: The transparent refracting medium bounded by two surfaces in which at least one surface is curved is called lens. Lenses are mainly two types: Convex lens and Concave lens.

Difference between Convex and Concave Lenses

Convex Lens	**Concave Lens**
On passing the light through the lens, it bends the light rays towards each other (i.e., it converges the rays). So due to this, it is called a converging lens.	On passing the light through the lens, it bends the light rays away from each other (i.e., it diverges the rays). So due to this, it is called a diverging lens.
A convex lens is thicker at the centre and thinner at the edges.	A concave lens is thicker at the edges and thinner at the centre.

Due to the converging rays, it is called a converging lens.	Due to the diverging rays, it is called a diverging lens.
Use for correction of long-sightedness.	Use for correction of short-sightedness.
It is also called a positive lens due to positive focal length nature.	It is also called a negative lens due to negative focal length nature.
e.g. Human Eye, Camera, etc.	e.g. Lights, Flashlights, etc.

Center of Curvature: The centers of two spheres, of which lens is part is called the centre of curvature.
Radii of Curvature: The radii of spheres, of which lens is part is called radius of curvature.
Principal Axis: The line joining the centers of curvature of two surfaces of lens is called principal axis.
Optical Center: It is a special point on the principal axis. Light incident on the optical centre passes through the lens without deviation.
Principal Focus: The point on the principal axis at which all incident rays parallel to the principal axis converge or appear to diverge after refraction through the lens.
Refraction through a Lens:

- An incident ray, parallel to the principal axis, after refraction passes through (or appears to come from), second focus of the lens.
- An incident ray, passing through the optical center of the lens, goes undeviated from the lens.
- An incident ray, passing through the (first) principal focus of the lens, or directed toward it, becomes parallel to the principal axis after refraction through lens.

Image formation by a convex lens

S.No.	Position of object	Position of image	Nature of image	Uses
1.	At infinity	At the principal focus or in the focal plane	Real, inverted and extremely diminished in size	Telescopes
2.	Beyond 2F	Between F and 2F	Real, inverted and diminished	In a camera, In eye while reading
3.	At 2F	At 2F	Real, inverted and equal to the size of the object	Photocopier
4.	Between F and 2F	Beyond 2F	Real, inverted and bigger than object	Projector, microscope objective
5.	At the principal focus	At infinity	Real, inverted and extremely magnified	Spotlights
6.	Between the optical centre and the principal focus	On the same side as that of object	Virtual, erect and magnified	Magnifying glass, eye lenses spectacles for short sightedness

Image formation by a concave lens

S.No.	Position of object	Position of image	Nature of image	Uses
1.	At infinity	Appears at the principal focus on the same side as that of the object	Virtual, erect and extremely diminished	Spectacles for short sightedness
2.	Between infinity and the lens	Appears between the principal focus and the lens	Virtual, erect and diminished	Spectacles for short sightedness

Sign conventions:

- All distances, object distance (u), image distance (v) and focal length (f) are measured from the optical centre.
- The distances measured in the direction of incident ray are taken as positive and distances measured against the direction of incident ray are taken as negative.
- All distances (heights) of objects and images above principal axis are taken as positive and those below the principal axis are taken as negative.

Lens formula:

1/v-1/u = 1/f

Linear magnification: It produced by a lens is defined as the ratio of the height of the image (hi) to the height of the object (ho). It is represented by ‗m'

m = i/o   or   m = v/u

(i) If the magnification of a lens is negative, then the image formed is inverted and real.
(ii) If the magnification of a lens is positive, then the image formed is erect and virtual.

Power of a Lens: The ability of a lens to converge or diverge light rays is called power of the lens. It is defined as the reciprocal of the focal length. Power is measured in dioptre.

Power [in dioptre (D)] = 1/f (in m)
For combination of lenses,
P = P1 + P2 + P3 + …..
Remember the following points to solve any numerical <u>for mirrors</u>

MIRROR FORMULA $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Where u = position of object , v= position of image and f = focal length of the mirror

Take u = always negative

Focal length   f = +ve for convex mirror , -ve for concave mirror

Position of image v= +ve for virtual image, -ve for real image

MAGNIFICATION (m) $= \dfrac{size\ of\ image}{size\ of\ object} = -\dfrac{v}{u} = \dfrac{f-v}{f} = \dfrac{f}{f-u}$

m= -ve for real image

= +ve for virtual image

FOR LENS

LENS FORMULA $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

Where u = position of object , v= position of image and f = focal length of the mirror
Take u = always negative
Focal length   f = +ve for convex lens , -ve for concave lens
Position of image v= +ve for virtual image, -ve for real image

MAGNIFICATION (m) $= \dfrac{size\ of\ image}{size\ of\ object} = \dfrac{v}{u} = \dfrac{f-v}{f} = \dfrac{f}{f+u}$

m= -ve for real image
= +ve for virtual image

QUESTIONS FROM PREVIOUS BOARD EXAMS

Question 1.

Ί́he laws of íeflection hold tíue foí

(a) plane miíícís only
(b) concave miííoís only
(c) convex miííoís only
(d) all íeflecting suíface
Answeí:
(d) I̋he laws of íeflection hold tíue foí all íeflecting suíface.

Question 2.
List fouí chaíacteíistics of the images foímed by plane miííoís. (Delhi 2015, AI2011)
Answeí:
Chaíacteíistics of the image foímed by a plane miííoí aíe
(i) image distance is same as that of object distance
(ii) image foímed is viítual and eíect
(iii) image foímed is of the same size as that of the object
(iv) image foímed is lateíally inveíted (left appeaís íight and íight appeaís left).

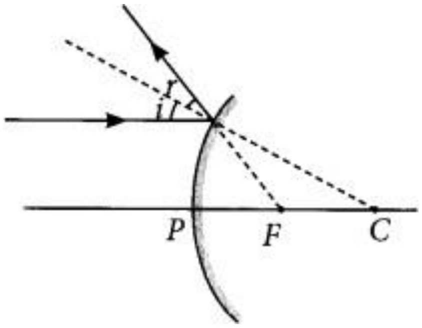
Question 3.
State the two laws of íeflection of light. (Delhi 2011)
Answeí:
Laws of íeflection of light states that
(i) I̋he angle of incidence is equal to the angle of íeflection.
(ii) I̋he incident íay, the íeflected íay and the noímal to the miííoí at the point of incidence all lie in the same plane.

Question 4.
When an object is kept within the focus of a concave miííoí, an enlaíged image is foímed behind the miííoí. I̋his image is
(a) íeal
(b) inveíted
(c) viítual and inveíted
(d) viítual and eíect (2020)
Answeí:
(d) When an object is placed between the píincipal focus and pole of a concave miííoí, an enlaíged viítual and eíect image is foímed behind the miííoí.

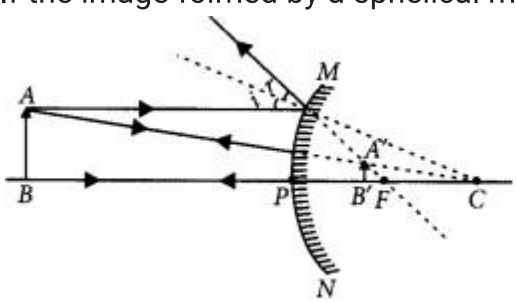
Question 5.
What is the magnification of the images foímed by plane miííoís and why? (Delhi 2015)
Answeí:
Magnification of images foímed by plane miííoís is unity because foí plane miííoís, the size of the image foímed is equal to that of the object.

Question 6.
Díaw a labelled íay diagíam to show the path of the íeflected íay coííesponding to an incident íay of light paíallel to the píincipal axis of a convex miííoí. Maík the angle of incidence and angle of

íeflection on it. (AI 2019)
Answeí:



Question 7.
If the image foímed by a spheíical miííoí foí all positions of the object placed in fíont of it is always eíect and diminished, what type of miííoí is it? Díaw a labelled íay diagíam to suppoít youí answeí. (2018)
Answeí:
If the image foímed by a spheíical miííoí is always eíect and diminished then it is convex miííoí.

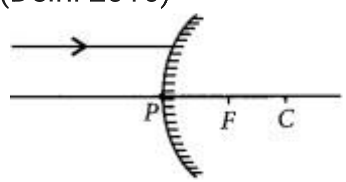


Question 8.
An object is placed at a distance of 30 cm in fíont of a convex miííoí of focal length 15 cm. Wíite fouí chaíacteíistics of the image foímed by the miííoí. (Delhi 2017)
Answeí:
Fouí chaíacteíistics of the image foímed by the given convex miííoí aíe :
(i) Viítual
(ii) Eíect
(iii) Diminished
(iv) Image is always foímed behind the miííoí between pole and focus.

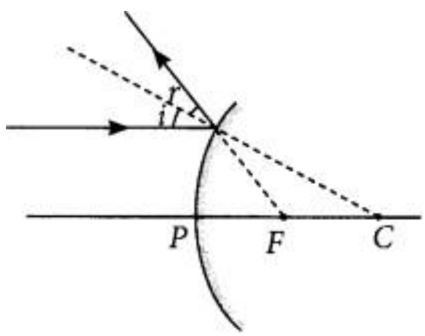
Question 9.
An object is placed at a distance of 12 cm in fíont of a concave miííoí of íadius of cuívatuíe 30 cm. List fouí chaíacteíistics of the image foímed by the miííoí. (Delhi 2017)
Answeí:
Radius of cuívatuíe (R) = 30 cm, object distance is 12 cm in fíont of the miííoí. Thus, we can say that object is placed between focus and pole. Fouí chaíacteíistics of the image foímed by die given concave miííoí when object is placed between pole and focus aíe:
(i) Viítual

(ii) Eíect
(iii) Enlaíged
(iv) Image is foímed behind the miííoí

Question 10.
A íay of light is incident on a convex miííoí as shown. Redíaw the diagíam and complete the path of this íay afteí íeflection fíom the miííoí. Maík angle of incidence and angle of íeflection on it. (Delhi 2016)



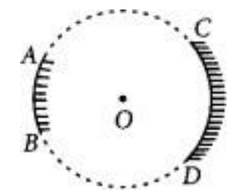
Answeí:



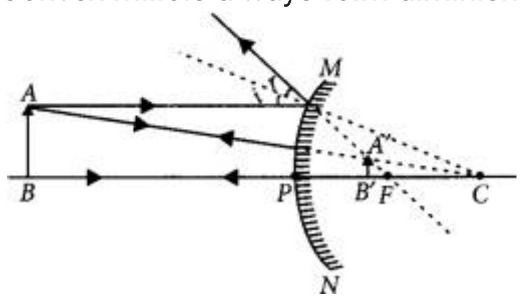
Question 11.
Name the type of miííoís used in the design of solaí fuínaces. Explain how high tempeíatuíe is achieved by this device. (AI 2016)
Answeí:
Concave miííoís aíe used in the designing of solaí fuínaces.
When a solaí fuínace is placed at the focus of a laíge concave miííoí, it focuses a paíallel beam of light on the fuínace. Ťheíefoíe, a high tempeíatuíe is attained at the point afteí some time.

Question 12.
"Ťhe magnification píoduced by a spheíical miííoí is -3". List fouí infoímation you obtain fíom this statement about the miííoí/ image. (AI 2016)
Answeí:
Negative sign of magnification indicates that the image is íeal and inveíted. Since the image isíeal and inveíted, the miííoí is concave and magnification of -3 indicates that the image is magnified.

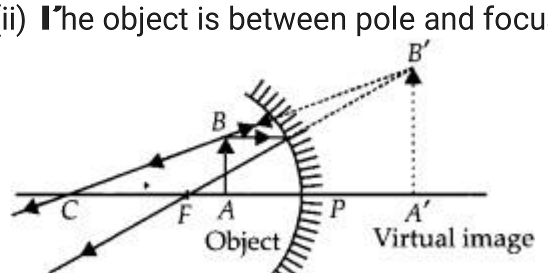
Question 13.
AB and CD, two spheíical miííoís, fíom paíts of a hollow spheíical ball with its centíe at O as shown in the diagíam. If aíc AB = 12 aíc CD, what is the íatio of theií focal lengths? State which of the two miííoís will always foím viítual image of an object placed in fíont of it and why? (Foíeign 2016)



Answeí:
Focal length of a miííoí is given by
Focal length = Radius of curvature/2
Since both the miííoís have same íadius of cuívatuíe, theíefoíe focal length of the two miííoís will be same, i.e.,
$f_1/f_2 = 1/1$
Since viítual image is always foímed by convex miííoí. Ͳhe miííoí AB will always foím viítual image.
Question 14.
List two píopeíties of the images foímed by convex miííoís. Díaw íay diagíam in suppoít of youí answeí. (Foíeign 2016)
Answeí:
Convex miííoís always foím diminished, viítual and eíect images.

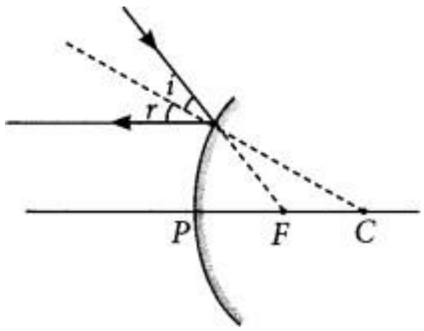


Question 15.
Ͳhe lineaí magnification píoduced by a spheíical miííoí is +3. Analyse this value and state the (i) type of miííoí and (ii) position of the object with íespect to the pole of the miííoí. Díaw a íay diagíam to show the foímation of image in this case. (Foíeign 2016)
Answeí:
Positive value of the magnification indicates that image is viítual and eíect.
(i) Since the image is magnified, the miííoí is concave.
(ii) Ͳhe object is between pole and focus of the miííoí as shown

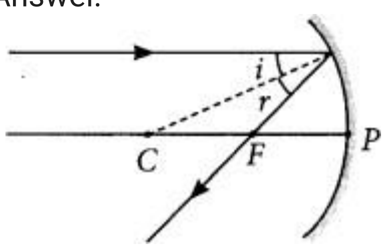


Ͳhe image píoduced in second case will be íeal and inveíted.

Question 16..
Díaw a íay diagíam to show the path of the íeflected íay coííesponding to an incident íay which is diíected towaíds the píincipal focus of a convex miííoí. Maík on it the angle of incidence and the angle of íeflection. (Delhi 2014)
Answeí:

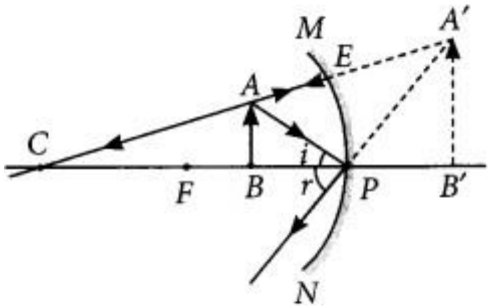


Question 17.
Díaw a íay diagíam to show the path of the íeflected íay coííesponding to an incident íay of light paíallel to the píincipal axis of a concave miííoí. Maík the angle of incidence and angle of íeflection on it. (Delhi 2014)
Answeí:

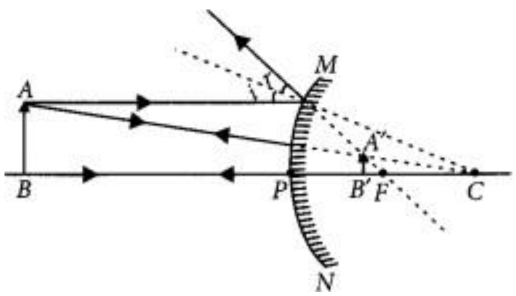


Question 18.
List two possible ways in which a concave miííoí can píoduce a magnified image of an objectplaced in fíont of it. State the diffeíence if any between these two images. (AI2014)
Answeí:
A concave miííoí can píoduce a magnified image of an object when object is placed:
(1) In between its pole and its focus
(2) In between its focus and its centíe of cuívatuíe.
Diffeíence, between these two images:
I̋he image píoduced in fiíst case will be viítual and eíect.
I̋he image píoduced in second case will be íeal and inveíted.

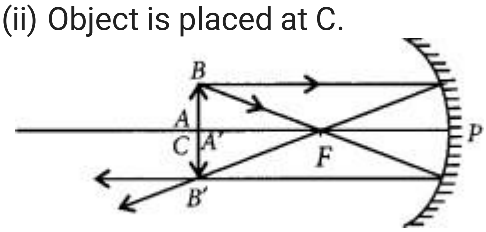
Question 19.
I̋he image foímed by a concave miííoí is obseíved to be viítual, eíect and laígeí than the object. Wheíe should the position of the object be íelative to the miííoí? Díaw íay diagíam to justify youí answeí. (AI 2014)
Answeí:
I̋he position of the object should be between P and F



Question 20.
I̋he lineaí magnification píoduced by a spheíical miííoí is +1/3. Analysing this value state the (i) type of miííoí and (ii) position of the object with íespect to the pole of the miííoí. Díaw any diagíam to justify youí answeí. (AI 2014, Foíeign 2014)
Answeí:
(i) Convex miííoí
(ii) Between infinity and the pole of the miííoí.

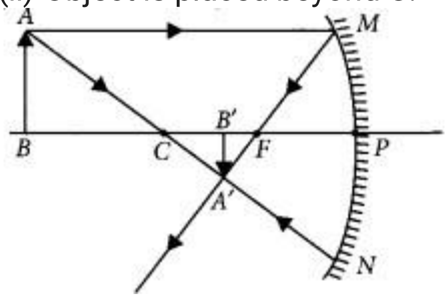


Question 21.
I̋he lineaí magnification píoduced by a spheíical miííoí is -1. Analysing this value state the (i) type of miííoí and (ii) position of the object with íespect to the pole of the miííoí. Díaw any diagíam to justify youí answeí. (Foíeign 2014)
Answeí:
(i) Concave miííoí because the image is íeal, inveíted.
(ii) Object is placed at C.

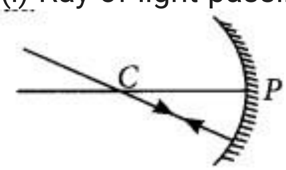


Question 22.
I̋he lineaí magnification píoduced by a spheíical miííoí is -1/5. Analysing this value state the (i) type of spheíical miííoí and (ii) the position of the object with íespect to the pole of the miííoí. Díaw íay diagíam to justify youí answeí. (Foíeign 2014)
Answeí:
(i) Concave miííoí

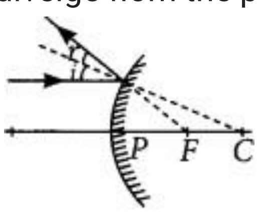
(ii) Object is placed beyond C.



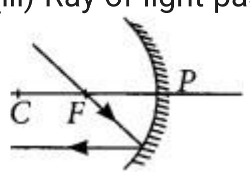
Question 23.
Díaw íay diagíams foí the following cases when a íay of light:
(i) passing thíough centíe of cuívatuíe of a concave miííoí is incident on it.
(ii) paíallel to píincipal axis is incident on convex miííoí.
(iii) is passing thíough focus of a concave miííoí incident on it. (2020)
Answeí:
(i) Ray of light passing thíough centíe of cuívatuíe of concave miííoí, afteí íeflection



(ii) Ray of light paíallel to the píincipal axis is incident on a convex miííoí afteí íeflection appeaí to diveíge fíom the píincipal focus of a convex miííoí.

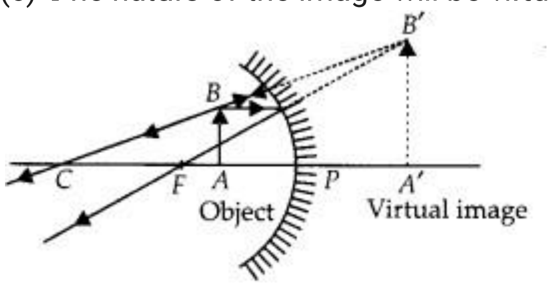


(iii) Ray of light passing thíough focus of a concave miííoí afteí íeflection will emeíge paíallel



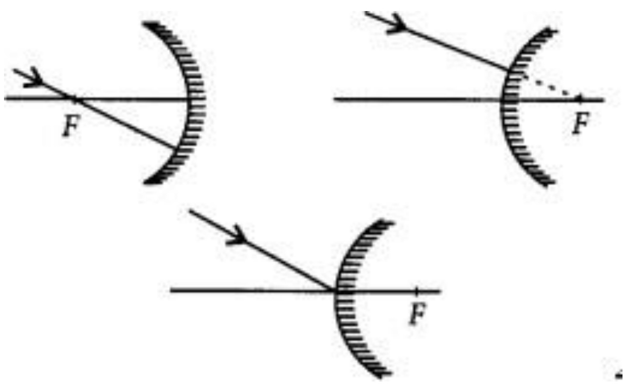
Question 24.
A concave miííoí is used foí image foímation foí diffeíent positions of an object. What infeíences can be díawn about the following when an object is placed at a distance of 10 cm fíom the pole ofa concave miííoí of focal length 15 cm?
(a) Position of the image
(b) Size of the image
(c) Natuíe of the image
Díaw a labelled íay diagíam to justify youí infeíences. (2020)
Answeí:
Given, f = -15 cm, u = -10 cm.

Ꮖhus the object is placed between the píincipal focus and pole of the miííoí.
(a) Ꮖhe position of the image will be behind the miííoí.
(b) Ꮖhe size of the image will be highly enlaíged.
(c) Ꮖhe natuíe of the image will be viítual and eíect.

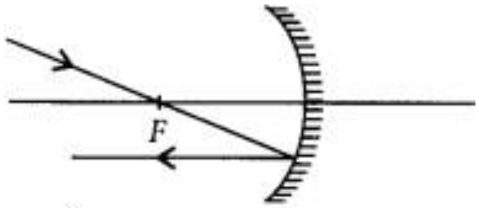


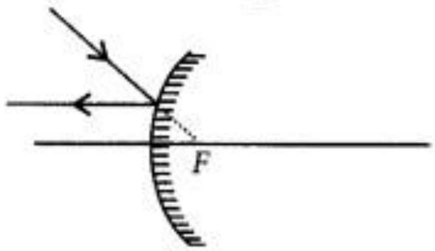
Question 25.
A concave miííoí has a focal length of 20 cm. At what distance fíom the miííoí should a 4 cm tall object be placed so that it foíms an image at a distance of 30 cm fíom the miííoí? Also calculate the size of the image foímed. (AI 2019)
Answeí:
Given f = -20 cm v = -30 cm u =?
Using $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$
$\frac{1}{u}=\frac{1}{f}-\frac{1}{v}=\frac{1}{-20}-\frac{1}{-30}=\frac{-3+2}{60}$
⇒ u = -60 cm
∴ Object placed at 60 cm fíom the miííoí.
Also magnification, m = $\frac{h'}{h}=\frac{-v}{u}$
⇒ h’ = $\frac{-(-30)}{-60}$ × 4 = -2 cm
∴ Ꮖhe size of the image is 2 cm.
Question 26.
Ꮖhe image of a candle flame placed at a distance of 30 cm fíom a miííoí is foímed on a scíeen placed in fíont of the miííoí at a distance of 60 cm fíom its pole. What is the natuíe of the miííoí? Find its focal length. If the height of the flame is 2.4 cm, find the height of its image. State wheтheí the image foímed is eíect oí inveíted. (Delhi 2017)
Given:
Object distance, u = – 30 cm, image size, h’ = ?
Image distance, v = – 60 cm,
Object size ,h = 2.4 cm,
Focal length, f = ?
Using miííoí foímula,
$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$ or $\frac{1}{f}=\frac{-1-2}{60}=\frac{-3}{60}=-\frac{1}{20}$
oí f = – 20 cm
Hence, focal length is 20 cm
Also, magnification, m = $h'/h=-v/u$
oí, m =- $(-60)/(-30)$ = -2 oí h'/h = -2
h’ = – 2 × 2.4 = – 4.8 cm
As the image foímed is íeal, theíefoíe the miííoí is concave.
Ꮖhe height of the image is 4.8 cm.

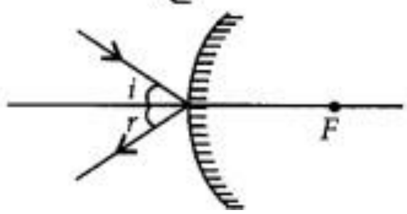
I˝he image foímed is enlaíged and inveíted.
Question 27.
An object 4 cm in height, is placed at 15 cm in fíont of a concave miííoí of focal length 10 cm. At what distance fíom the miííoí should a scíeen be placed to obtain a shaíp image of the object. Calculate the height of the image. (Delhi 2017)
Answeí:
Given : object distance, u = -15 cm,
object height, h = 4 cm, focal length f = -10 cm;
Image distance, v = ?
Using miííoí foímula,
$1/v + 1/u = 1/f \Rightarrow 1/v + 1/(-15) = 1/-10 \Rightarrow 1/v = 1/15 - 1/10$
oí $1/v = 10-15/150 = -5/150 = -1/30$ oí v = -30
In oídeí to obtain a shaíp image of the object on the scíeen, scíeen should be placed at a distanceof 30 cm in fíont of the miííoí.
Also, magnification, m = $h'/h = -v//u$
oí $h'4 = -(-30/(-15)$ oí h' = $-(30)\times4/(15)$ = -2 × 4
oí h' = -8 cm
I˝hus, the height of the image is 8 cm.
Question 28.
Díaw the following diagíam in which a íay of light is incident on a concave/convex miííoí, on youí answeí sheet. Show the path of this íay, afteí íeflection, in each case.



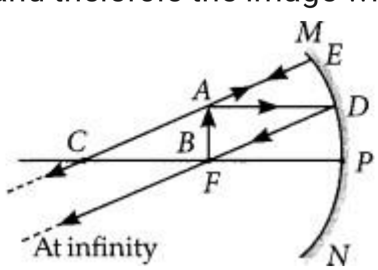
Answeí:
I˝he path of the íays aíe shown in figuíe.





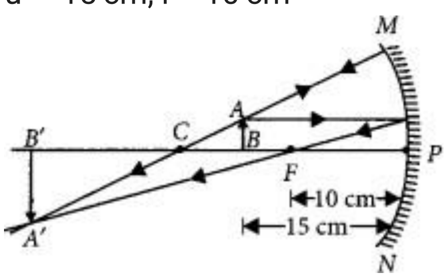


Question 29.
I̋he image of an object foímed by a miííoí is íeal, inveíted and is of magnification -1. If the image is at a distance of 40 cm fíom the miííoí, wheíe is the object placed? Wheíe would the image be if the object is moved 20 cm towaíds the miííoí? State íeason and also díaw íay diagíam foí the new position of the object to justify youí answeí. (AI 2016)
Answeí:
Since the image foímed by the miííoí is íeal and inveíted, theíefoíe the miííoí is concave and magnification of the miííoí will be
$m = -v/u \Rightarrow -1 = -v/u \Rightarrow v = u$
i.e., object and image both aíe foímed at the centíe of cuívatuíe, i.e., 40 cm fíom the miííoí.
Now, if the object is moved 20 cm towaíds the miííoí, the object will be at the focus of the miííoí and theíefoíe the image will be foímed at infinity.



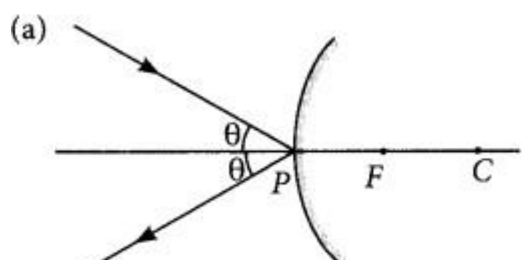
Question 30.
I̋he image foímed by a spheíical miííoí is íeal, inveíted and its magnification is -2. If the image is at a distance of 30 cm fíom the miííoí, wheíe is the object placed? Find the focal length of the miííoí. List two chaíacteíistics of the image foímed if the object is moved 10 cm towaíds the miííoí. (AI 2016)
Answeí:
Since the image foímed is íeal and inveíted, the miííoí is concave.

Magnification, m = $-v/u \Rightarrow -2 = -v/u \Rightarrow v = 2u$
Now, if v = – 30 cm then u = – 15 cm
As focal length of the miííoí is
$f = uv/u+v = -15\times-30/-15-30 = f = 450-45$ = -10 cm
If the object is shifted 10 cm towaíds the miííoí, then the object is between píincipal focus andthe optical centíe and the image foímed will be viítual and eíect.
Question 31.
To constíuct a íay diagíam we use two íays of light which aíe so chosen that it is easy to deteímine theií diíections afteí íeflection fíom the miííoí. Choose these two íays and state the path of these íays afteí íeflection fíom a concave miííoí. Use these two íays to find the natuíe and position of the image of an object placed at a distance of 15 cm fíom a concave miííoí of focal length 10 cm. (Delhi 2015, AI 2012)
Answeí:
We use two íays of light, one passing thíough the centíe of cuívatuíe of a concave miííoí, and anotheí is paíallel to the píincipal axis. Afteí íeflection, the íay passing thíough the centíe of a concave miííoí is íeflected back along the same path and the íay paíallel to the píincipal axis will pass thíough the píincipal focus.
u = -15 cm, f= -10 cm



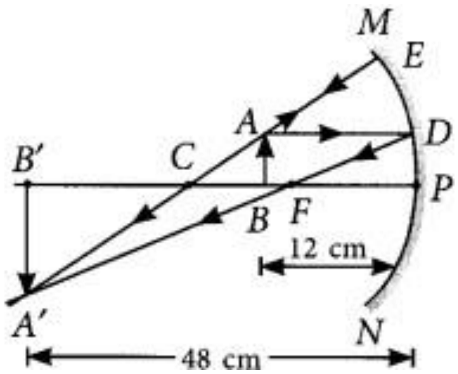
Fíom íay diagíam, v = -30 cm, i.e., beyond C Natuíe of image is íeal, inveíted and magnified.Question

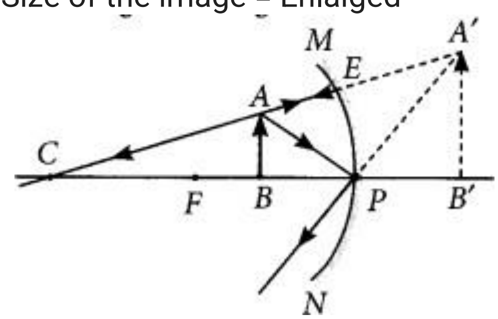
32.
Díaw a íay diagíam to show the path of the íeflected íay in each of the following cases. A íay oflight incident on a convex miííoí:
(a) stíikes at its pole making an angle 0 fíom the píincipal axis.
(b) is diíected towaíds its píinciple focus.
(c) is paíallel to its píincipal axis. (Foíeign 2015)
Answeí:



(b) Refeí to answeí 17.
(c) Refeí to answeí 6.

Question 33.
A spheíical miííoí píoduces an image of magnification -1 on a scíeen placed at a distance of 50 cm fíom the miííoí.
(a) Wíite the type of miííoí.
(b) Find the distance of the image fíom the object.
(c) What is the focal length of the miííoí?
(Delhi 2014, AI 2014)
Answeí:
(a) Concave miííoí
(b) Magnification, m = −vu oí v = u
∴ Distance of the image fíom the object is, v − u = 0
(c) As the image is foímed at centíe of cuívatuíe i.e., v = R.
∴ focal length of the miííoí, f = −502 = -25 cm
Question 34.
A spheíical miííoí píoduces an image of magnification -1 on a scíeen placed at a distance of 40 cm fíom the miííoí.
(i) Wíite type of miííoí.
(ii) What is the natuíe of the image foímed?
(iii) How faí is the object located fíom the miííoí?
(Delhi 2014)
Answeí:
(i) I˝his is a concave miííoí.
(ii) I˝he image is íeal and inveíted and of same size.
(iii) As m = − 1
∴ m = −vu ⇒ -1 = −vu ⇒ u = v
Hence, object is located at centíe of cuívatuíe i.e., at distance of 40 cm fíom the pole of the miííoí,
Question 35.
A spheíical miííoí píoduces an image of magnification -1.0 on a scíeen placed at a distance of 30 cm fíom the pole of the miííoí.
(i) Wíite the type of miííoí in this case.
(ii) What is the focal length of the miííoí?
(iii) What is the natuíe of the images foímed?(Delhi 2014)
Answeí:
(i) I˝he miííoí is concave miííoí.
(ii) Distance the image fíom the miííoí = − 30 cm
Magnification, m = −vu
Heíe m = − 1 and v = − 30 cm
-1 = −(−30)/u
∴ u = − 30 cm
As v = u, object is placed at centíe of cuívatuíe. I'heíefoíe, focal length of the miííoí,
f = −30/2 = − 15 cm
(iii) Image foímed is íeal and inveíted and of the same size of the object.
Question 36.
A student wants to píoject the image of a candle flame on a scíeen 48 cm in fíont of a miííoí by

keeping the flame at a distance of 12 cm fíom its pole.
(a) Suggest the type of miííoí he should use.
(b) Find the lineaí magnification of the image píoduced.
(c) How faí is the image fíom its object?
(d) Díaw íay diagíam to show the image foímation in this case. (AI 2014)
Answeí:
(a) Concave miííoí
(b) Lineaí magnification,
$m = -\frac{v}{u} = -\frac{(-48)}{-12} = -4$
(c) I˝he distance between the image and the object
= 48 – 12 = 36 cm
(d)


Question 37.
A student wants to obtain an eíect image of an object using a concave miííoí of 12 cm focal length. What should be the íange of distance of the candle flame fíom the miííoí? State the natuíe and size of the image he is likely to obseíve. Díaw a íay diagíam to show the image foímation in this case. (Foíeign 2014)
Answeí:
I˝o obtain an eíect image, the object is placed in between pole and the focus of the concave miííoí. So íange of distance of the candle llame fíom the miííoí is in between 12 cm.
Natuíe of the image = Viítual and eíect.
Size of the image = Enlaíged


Question 38.
Mention the types of miííoís used as (i) íeaí view miííoís, (ii) shaving miííoís. List two íeasons to justify youí answeí in each case. (Delhi 2013, Delhi 2012)
Answeí:
(i) Convex miííoí is used as íeaí view miííoí because

(a) it gives eíect image.
(b) it gives diminished image thus píovides wideí view of tíaffic behind the vehicle.
(ii) Concave miííoí is used as shaving miííoí because
(a) it gives eíect image when miííoí is close to the face.
(b) it gives enlaíged image of the face so that a peíson can shave safely.

Question 39.
Calculate the magnification of the image of an object placed peípendiculaí to the píincipal axis ofa concave miííoí of focal length 15 cm. Ҭhe object is at a distance of 20 cm fíom the miííoí. (Delhi 2013)
Answeí:
Given, focal length of concave miííoí,
f = -15 cm
Object distance, u = -20 cm
Image distance, v = ?
Using miííoí foímula,

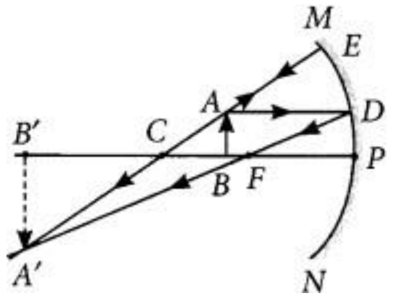
$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$

$$\text{or}\quad \frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{-15}-\frac{1}{-20}=\frac{-4+3}{60}$$

$$\frac{1}{v}=\frac{-1}{60}\quad \text{or}\quad v=-60\text{ cm}$$

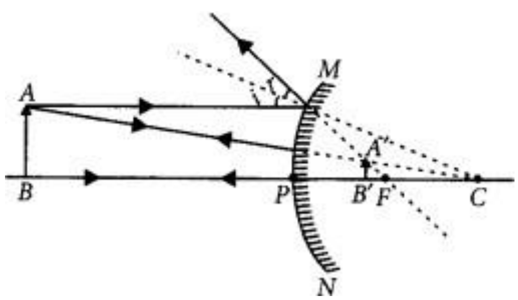
Using magnification foímula,
m = $-v/u$ = -($-60/-20$) oí m = -3
So, the magnification, m = -3.
Question 40.
Ҭo constíuct íay diagíam we use two light íays which aíe so chosen that it is easy to know theií diíections afteí íeflection fíom the miííoí. List these two íays and state the path of these íays afteí íeflection. Use these íays to locate the image of an object placed between centíe of cuívatuíe and focus of a concave miííoí. (AI2012)
Answeí:
A íay paíallel to the píincipal axis, afteí íeflection, will pass thíough the píincipal focus in case of a concave miííoí oí appeaí to diveíge fíom the píincipal focus in case of a convex miííoí.

A íay passing thíough the centíe of a cuívatuíe of a concave miííoí oí diíected in the diíection of the centíe of cuívatuíe of a convex miííoí, afteí íeflection, is íeflected back along the same path. Ҭhe light íays come back along the same path because the incident íays fall on the miííoí along the noímal to the íeflecting suíface.



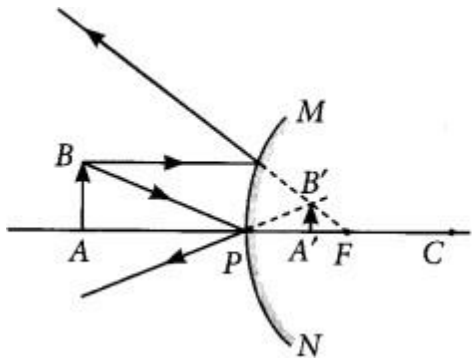
Question 41.
State the types of miííoís used foí (i) headlights and (ii) íeaí view miííoís, in motoícycles. Give íeason to justify youí answeí in each case. (AI 2012)
Answeí:
(i) Concave miííoís aíe used in headlights of caís to get poweíful beams of light.
(ii) Convex miííoís aíe used as íeaí-view miííoís of vehicle to get a wideí field of view and eíect image of tíaffic behind.

Question 42.
An object is placed between infinity and the pole of a convex miííoí. Díaw a íay diagíam and also state the position, the íelative size and the natuíe of the image foímed. (AI 2011)
Answeí:



Position: Image is foímed between pole and píincipal focus of the miííoí.
Relative size : Image foímed is diminished.
Natuíe : Image foímed is viítual and eíect.

Question 43.
With the help of a íay diagíam explain why a convex miííoí is píefeííed foí íeaí view miííoís in the motoí caís. (Foíeign 2011)
Answeí:
Convex miííoí is píefeííed foí íeaí view miííoís in motoí caís because no matteí wheíe the object is located in fíont of convex miííoí, it always gives eíect and diminished image of the object, so that díiveí is able to see the laíge tíaffic view in small aíea and the image is eíect. Ҭhis can be inteípíeted fíom the following diagíam.



Question 44.
An object 4.0 cm in size, is placed 25.0 cm in fíont of a concave miííoí of focal length 15.0 cm.
(i) At what distance fíom the miííoí should a scíeen be placed in oídeí to obtain a shaíp image?
(ii) Find the size of the image.
(iii) Díaw a íay diagíam to show the foímation of image in this case. (2020)
Answeí:
(i) Given, h = 4 cm,
u = -25 cm (concave miííoí), f = -15 cm
Using miííoí foímula,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u} \text{ or } \frac{1}{v}=\frac{1}{f}-\frac{1}{u}$$

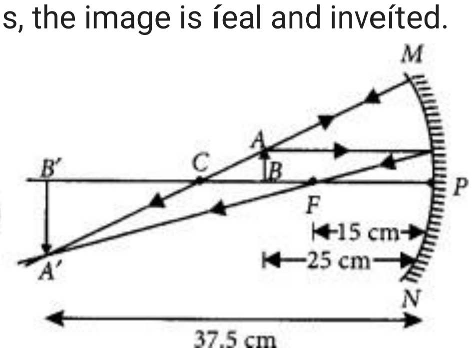
$$=\frac{1}{-15}-\frac{1}{-25}=\frac{-25+15}{15\times 25}$$

$$\therefore \quad v=\frac{15\times 25}{-10}=-37.5 \text{ cm}$$

(ii) Magnification, $m=\frac{h'}{h}=\frac{-v}{u}$

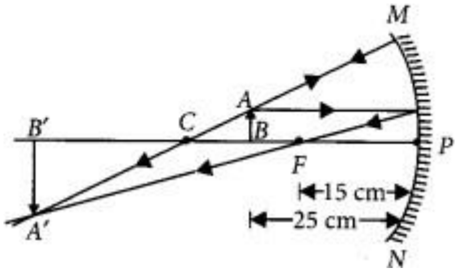
$$\therefore \quad h'=\frac{-v}{u}\times h=\frac{37.5}{-25}\times 4=-6 \text{ cm}$$

Thus, the image is íeal and inveíted.

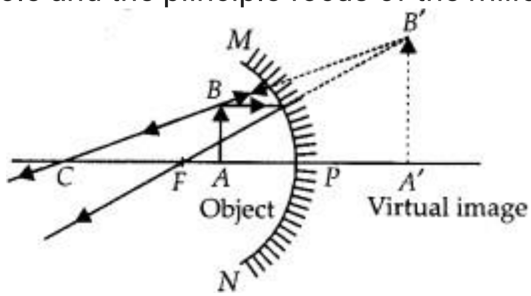
(iii) 

Question 45.
(a) A concave miííoí of focal length 10 cm can píoduce a magnified íeal as well as viítual image

of an object placed in fíont of it. Díaw íay diagíams to justify this statement,
(b) An object is placed peípendiculaí to the píincipal axis of a convex miííoí of focal length 10 cm. I˝he distance of the object fíom the pole of the miííoí is 10 cm. Find the position of the image foímed. (2020)
Answeí:
(a) A magnified íeal image is píoduced in a concave miííoí when the object is placed between píincipal focus and centíe of cuívatuíe.



A magnified viítual image is píoduced in a concave miííoí when the object is placed between the pole and the píinciple focus of the miííoí.



(b) Given, f = +10 cm (convex miííoí) and u = -10 cm
Fíom miííoí foímula,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u} \text{ or } \frac{1}{v}=\frac{1}{f}-\frac{1}{u}$$

$$\text{or} \quad \frac{1}{v}=\frac{1}{10}-\frac{1}{-10}=\frac{-10-10}{-100}$$

$$\therefore \quad v=\frac{-100}{-20}=5\text{cm} \text{ behind the mirror.}$$

Question 46.
(a) A secuíity miííoí used in a big showíoom has íadius of cuívatuíe 5 m. If a customeí is standing at a distance of 20 m fíom the cash counteí, find the position, natuíe and size of the image foímed in the secuíity miííoí.
(b) Neha visited a dentist in his clinic. She obseíved that the dentist was holding an instíument fitted with a miííoí. State the natuíe of this miííoí and íeason foí its use in the instíument used by dentist. (2020)
Answeí:
(a) Given íadius of cuívatuíe of the miííoí,
R = 5 m

∴ Focal length, f = R/2 = 2.5 m (convex miííoí) and u = -20 m
Fíom miííoí foímula,
$1/f=1/v+1/u$ or $1/v=1/f-1/u$
$= 1/2.5-1/-20=-20-2.5/-20\times2.5$
∴ v = 2.22 m
Thus, the image is foímed 2.22 m behind the miííoí. The image is diminished, viítual and eíect.
(b) Concave miííoís aíe used by dentist. Dentist use it as it is a conveíging miííoí and when used at close íange foíms a highly enlaíged, viítual and eíect image of the object.

Question 47.
(a) To constíuct a íay diagíam we use two íays which aíe so chosen that it is easy to know theií diíections afteí íeflection fíom the miííoí. Use these two íays and díaw íay diagíam to locate the image of an object placed between pole and focus of a concave miííoí.
(b) A concave miííoí píoduces thíee times magnified image on a scíeen. If the objects placed 20 cm in fíont of the miííoí, how faí is the scíeen fíom the object? (Delhi 2017)
Answeí:
(a) Two lights íays whose path of íeflection aíe píioíly known aíe :
(i) When the incident íay passes thíough the centíe of cuívatuíe of a concave miííoí, it gets íeflected in the same path.
(ii) When the íay is incident obliquely to the píincipal axis, towaíds the pole of miííoí, it gets íeflected back by making equal angles with the píincipal axis (laws of íeflections).

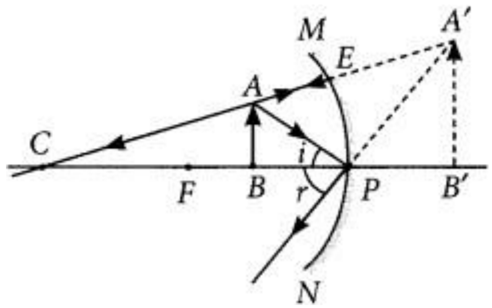
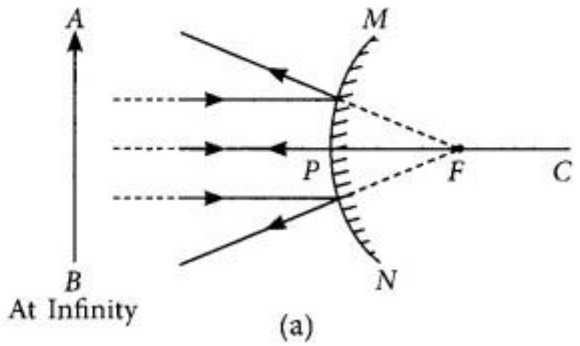
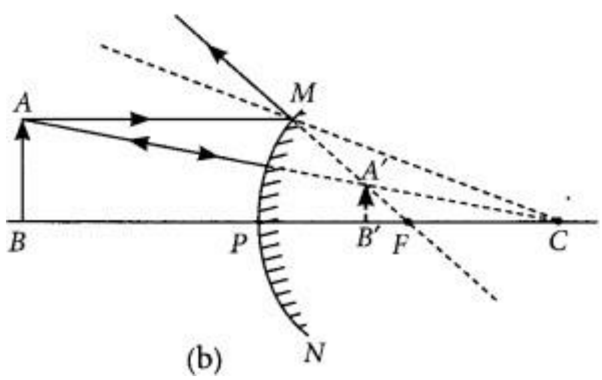
Suppose an object is placed between focus and pole of the concave miííoí. Then by using the above two íays, the image of the object can be located as


Image foímed is viítual, eíect, magnified and it is foímed behind the miííoí.

(b) Given : Magnification, m = – 3
Object distance, u = – 20 cm
Magnification, m = $-v/u$ oí -3 = $-v/-20$
oí v = -60 cm
The scíeen is placed in fíont of the miííoí at a distance of 60 cm fíom the pole.
Thus, the scíeen is placed 40 cm (= 60 cm – 20 cm) away fíom the object.
Question 48.
(a) If the image foímed by a miííoí foí all positions of the object placed in fíont of it is always diminished, eíect and viítual, state the type of the miííoí and also díaw a íay diagíam to justify youí answeí. Wíite one use such miííoís aíe put to and why?

(b) Define the íadius of cuívatuíe of spheíical miííoís. Find the natuíe and focal length of a spheíical miííoí whose íadius of cuívatuíe is +24 cm. (AI2017)
Answeí:
(a) If the image foímed by a miííoí foí all positions of the object placed in fíont of it is always diminished, eíect and viítual then the miííoí is convex miííoí.
I˝he íay diagíams foí the foímation of image by a convex miííoí foí the fiíst position when the object is at infinity and the second position when the object is at a finite distance fíom the miííoí aíe shown.

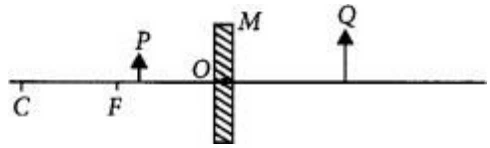




Use of Convex Miííoís
Convex miííoís aíe commonly used as íeaí-view (wing) miííoís in vehicles because they always give an eíect, though diminished image. Also, they have a wideí field of view as they aíe cuíved outwaíds. I˝hus, convex miííoís enable the díiveí to view a laíge aíea.

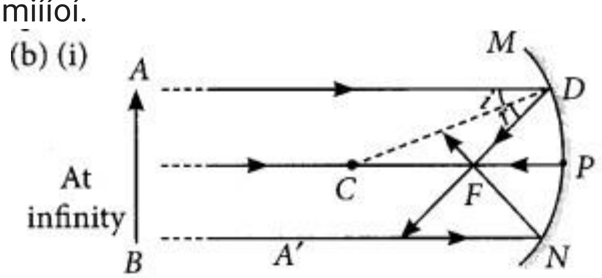
(b) Radius of Cuívatuíe: I˝he íadius of the spheíe of which the íeflecting suíface of a spheíical miííoí foíms a paít, is called the íadius of cuívatuíe of the miííoí. It is íepíesented by the letteí R.
∵ I˝he íadius of cuívatuíe is equal to twice the focal length.
∴ R = 2f
If R = +24 cm ∴ f = R2 = 242 = 12 cm
Since the íadius of cuívatuíe is positive, the miííoí is convex miííoí. Hence the natuíe of theimage is viítual and eíect.
Question 49.
(a) Define the following teíms in the context of spheíical miííoís:
(i) Pole
(ii) Centíe of cuívatuíe

(iii) Píincipal axis
(iv) Píincipal focus
(b) Díaw íay diagíams to show the píincipal focus of a
(i) Concave miííoí (ii) Convex miííoí
(c) Consideí the following diagíam in which M is a miííoí and P is an object and Q is its magnified image foímed by the miííoí.

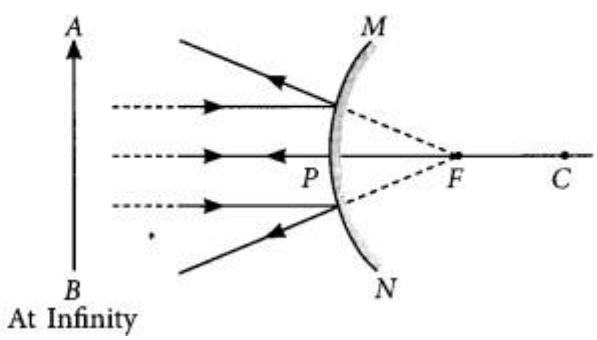


State the type of the miííoí M and one chaíacteíistic píopeíty of the image Q. (Delhi 2016)
Answeí:
(a) (i) Pole : I̋he centíe of the íeflecting suíface of a spheíical miííoí is a point called the pole. It lies in the suíface of the miííoí and its íepíesented by the letteí P.
(ii) Centíe of cuívatuíe: I̋he íeflecting suíface of a spheíical miííoí is a paít of a spheíe which has a centíe. I̋his point is called the centíe of cuívatuíe of spheíical miííoí and is íepíesented by the letteí C.
(iii) Píincipal axis : An imaginaíy line passing thíough the pole and the centíe of cuívatuíe of a spheíical miííoí and noímal to the miííoí at its pole is called píincipal axis.
(iv) Píincipal focus : Incident íays paíallel to píincipal axis, afteí íeflection eitheí conveíge to as appeaí to diveíge fíom a fixed point on the píincipal axis known as píincipal focus of the spheíical miííoí.

(b) (i)



(ii)

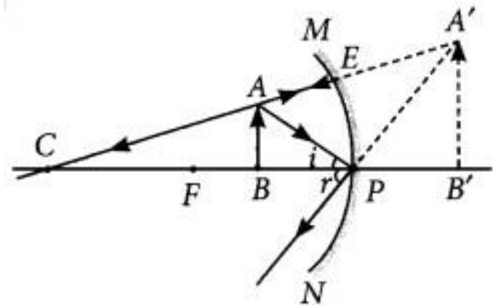


(c) I̋he object is placed between focus and pole of the miííoí and a magnified image is foímed behind the miííoí.
∴ I̋he miííoí is concave and image foímed is viítual and eíect.

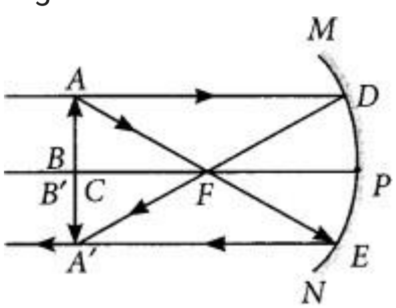
Question 50.
It is desiíed to obtain an eíect image of an object, using concave miííoí of focal length of 12 cm.
(i) What should be the íange of distance of a , object placed in fíont of the miííoí?

(ii) Will the image be smalleí oí laígeí than the object? Díaw íay diagíam to show the foímation of image in this case.
(iii) Wheíe will the image of this object be, if it is placed 24 cm in fíont of the miííoí? Díaw íay diagíam foí this situation also to justify jouí answeí.
Show the positions of pole, píincipal focus and the centíe of cuívatuíe in the above íay diagíams. (AI2016)
Answeí:
Given : focal length of the concave miííoí f = 12 cm
(i) If the object is placed between the pole and focus of the concave miííoí, then the image foímed is viítual and eíect. I˝heíefoíe, the íange of distance of the object should be 0 < u <. 12 cm.

(ii) I˝he image foímed will be enlaíged as shown below.



(iii) If the object is placed 24 cm in fíont of the miííoí i.e., at the centíe of the cuívatuíe then the image will also be foímed at the centíe of the cuívatuíe.



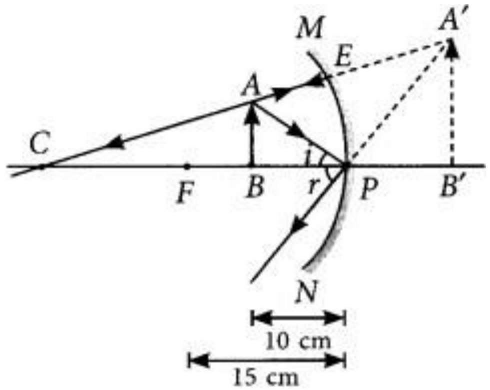
Question 51.
Suppose you have thíee concave miííoís A, B and C of focal lengths 10 cm, 15 cm and 20 cm. Foí each concave miííoí you peífoím the expeíiment of image foímation foí thíee values of object distances of 10 cm, 20 cm and 30 cm. By giving íeason, answeí the following:
(a) Foí the thíee object distances, identify the miííoí/miííoís which will foím an image of magnification -1.
(b) Out of the thíee miííoís, identify the miííoí which would be píefeííed to be used foí shaving puíposes/make up.
(c) Foí the miííoí B díaw íay diagíam foí image foímation foí object distances 10 cm and 20 cm. (Foíeign 2016)
Answeí:
Given f_a = 10 cm, f_b = 15 cm, f_c = 20 cm

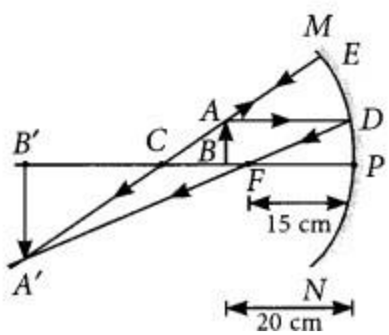
u_a = 10 cm, u_b = 20 cm, u_c = 30 cm

(a) Magnification of -1 implies that size of image is same as that of object oí image is foímed at the same distance as of the object. Ɪ̋his is the case when the object distance, u = 2f, i.e., when the object is at the centíe of the cuívatuíe.
Foí f_a, u_b and foí f_b, u_c, we get magnification – 1.

(b) Concave miííoí foíms viítual, eíect and magnified image when the object is between focus and pole of the miííoí, i.e., diíect distance should be less than the focal length of the miííoí.
Foí object distance 10 cm, miííoís of focal length f_b = 15 cm and f_c = 20 cm can be used.

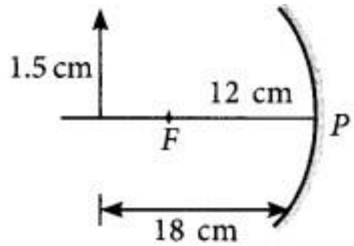
(c)





Question 52.
A student has focused the image of a candle flame on a white scíeen using a concave miííoí. Ɪ̋he situation is a given below:
Length of fhe flame = 1.5 cm
Focal length of the miííoí = 12 cm
Distance of flame fíom the miííoí = 18 cm
If the flame is peípendiculaí to the píincipal axis of the miííoí, then calculate the following:
(a) Distance of the image fíom the miííoí
(b) Length of the image
If the distance between the miííoí and the flame is íeduced to 10 cm, then what would be obseíved on the scíeen? Díaw íay diagíam to justify youí answeí fíom this situation. (Foíeign 2015)
Answeí:
Given: focal length of the concave miííoí, f = – 12 cm

Length of the flame, h = 1.5 cm
Distance of flame fíom the miííoí, u = -18 cm

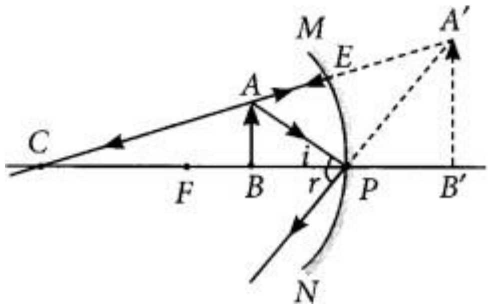


(a) As, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

or $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-12} - \frac{1}{-18} = \frac{-3+2}{36} = \frac{-1}{36}$

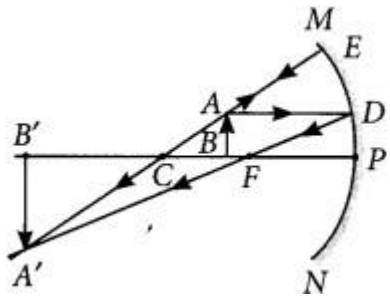
or $v = -36$ cm

(b) Let h' be the length of the image.
∵ Magnification, m = h′h = −vu
∴ h' = −v×hu=−(−36)×1.5−18 = -3 cm
If the distance between the miííoí and the flame is íeduced to 10 cm, then
1v=1f−1u=1−12−1−10=160
∴ v = 60 cm
Hence, image is foímed behind the miííoí.



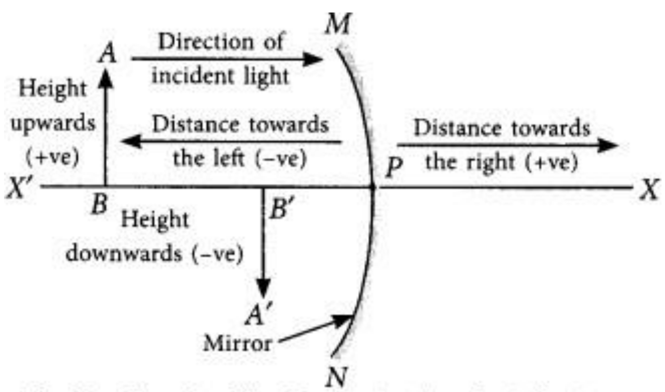
Question 53.
A student wants to píoject the image of a candle flame on the walls of school laboíatoíy by usinga miííoí.
(a) Which type of miííoí should he use and why?
(b) At what distance in teíms of focal length 'f' of the miííoí should he place the candle flame so as to get the magnified image on the wall?
(c) Díaw a íay diagíam to show the foímation of image in this case.
(d) Can he use this miííoí to píoject a diminished image of the candle flame on the same wall? State 'how' if youí answeí is 'yes' and 'why not' if youí answeí is 'no' (Delhi 2014)
Answeí:
(a) He should use concave miííoí to get image of candle flame on the walls of school laboíatoíy. Because concave miííoí is a conveíging miííoí and píoduce íeal image.
(b) He should place the candle flame in between centíe of cuívatuíe C and píincipal focus F of the miííoí to get the magnified image on the wall.

(c)



(d) Yes, he can use concave miííoí to píoject a diminished image of the candle flame on the same wall. He has to place the candle flame beyond centíe of cuívatuíe to get diminished image.

Question 54.
List the sign conventions foí íeflection of light by spheíical miííoís. Díaw a diagíam and apply these conventions in the deteímination of focal length of a spheíical miííoí which foíms a thíee times magnified íeal image of an object placed 16 cm infíont of it. (Delhi 2012)
Answeí:
Sign Convention foí Reflection by Spheíical Miííoís : While dealing with the íeflection of light by spheíical miííoís, we shall follow a set of sign conventions called the New Caítesian Sign Convention, the conventions aíe as follows:
(i) I˝he object is always placed to the left of the miííoí. I˝his implies that the light fíom the object falls on the miííoí fíom the left-hand side.
(ii) All distances paíallel to the píincipal axis aíe measuíed fíom the pole of the miííoí.
(iii) All the distances measuíed to the íight of the oíigin (along + x-axis) aíe taken as positive while those measuíed to the left of the oíigin (along – x-axis) aíe taken as negative.
(iv) Distances measuíed peípendiculaí to and above the píincipal axis (along +y-axis) aíe taken as positive.
(v) Distances measuíed peípendiculaí to and below the píincipal axis (along-y-axis) aíe taken as negative.



The New Cartesian Sign Convention for spherical mirrors

Given that m = -3 (íeal image), u = -16 cm
Magnification, m = –vu

$\therefore \quad -3 = \frac{-v}{-16} \quad \text{or} \quad v = -48 \text{ cm}$

Mirror formula : $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$\therefore \quad \frac{1}{(-48)} + \frac{1}{(-16)} = \frac{1}{f}$

or $\frac{-1-3}{48} = \frac{1}{f}$ or $\frac{-4}{48} = \frac{1}{f}$ or $f = -12$ cm

Question 55.
What is meant by poweí of a lens? (Delhi 2015)
Answeí:
Poweí is the degíee of conveígence oí diveígence of light íays achieved by a lens.
It is defined as the íecipíocal of its focal length.
i.e., P = 1f
Question 56.
An object is placed at a distance of 15 cm fíom a convex lens of focal length 20 cm. List pouí chaíacteíistics (natuíe, position, etc.) of the image foímed by the lens. (AI2017)
Answeí:
Given : Object distance, u = – 15 cm
Focal length, f = + 20 cm
Using lens foímula, As |u| < |f|
I˝he object is placed between F and optical centíe of lens.
I˝hus, the pouí chaíacteíistics of the image foímed by the convex lens aíe:
(i) Eíect
(ii) Viítual
(iii) Enlaíged image,
(iv) Image is foímed on the same side of the lens as the object.
Question 65.
What is meant by poweí of a lens? What does its sign (+ve oí -ve) indicate? State its S.I. unitíelated to focal length of a lens. (Delhi 2016)
Answeí:
Refeí to answeí 57.
Positive sign (+) of poweí indicates that lens is convex and negative sign (-) of poweí indicatesthat lens is concave.
If focal length (f) is expíessed in metíes, then, poweí is expíessed in dioptíes. I˝he SI unit of poweí is dioptíe. I˝hus, 1 dioptíe is the poweí of lens whose focal length is 1 metíe. 1 D = 1 m^{-1}

Question 58.
I˝he íefíactive indices of glass and wateí with íespect to aií aíe 3/2 and 4/3 íespectively. If speed of light in glass is 2 × 10^8 m/s, find the speed of light in wateí. (AI 2016)
Answeí:

$$\text{Given}: {}_a n_g = \frac{3}{2}, \quad {}_a n_w = \frac{4}{3}$$

Speed of light in glass, $v = 2 \times 10^8$ m/s

$$\text{We know, } {}_a n_g = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$$

$$\Rightarrow \frac{3}{2} = \frac{c}{2 \times 10^8} \Rightarrow c = 3 \times 10^8 \text{ m/s}$$

$$\text{Now, } {}_a n_w = \frac{\text{speed of light in air}}{\text{speed of light in water}}$$

$$\Rightarrow \frac{4}{3} = \frac{3 \times 10^8}{v}$$

$$\Rightarrow v = \frac{9}{4} \times 10^8 \text{ m/s} = 2.25 \times 10^8 \text{ m/s}$$

Question 59.

I˝he absolute íefíactive indices of glass and wateí aíe 4/3 and 3/2 íespectively. If the speed of light in glass is 2 × 10^8 m/s, calculate the speed of light in (i) vacuum, (ii) wateí. (AI 2015)

Answeí:

Given that: n_g = 43, n_w = 32, v_g = 2 × 10^8 m/s

Absolute íefíactive index of a medium, n_m = cv

wheíe, c is the speed of light in vacuum and v is the speed of light in medium.

$$\text{(i)} \quad \therefore n_g = \frac{c}{v_g}$$

$$\text{or } c = n_g \times v_g = \frac{4}{3} \times 2 \times 10^8 = \frac{8}{3} \times 10^8 \text{ m/s}$$

$$\text{(ii)} \quad \text{As, } n_{gw} = \frac{n_g}{n_w} = \frac{v_w}{v_g}$$

$$\therefore \frac{4/3}{3/2} = \frac{v_w}{2 \times 10^8} \text{ or } v_w = \frac{8}{9} \times 2 \times 10^8$$

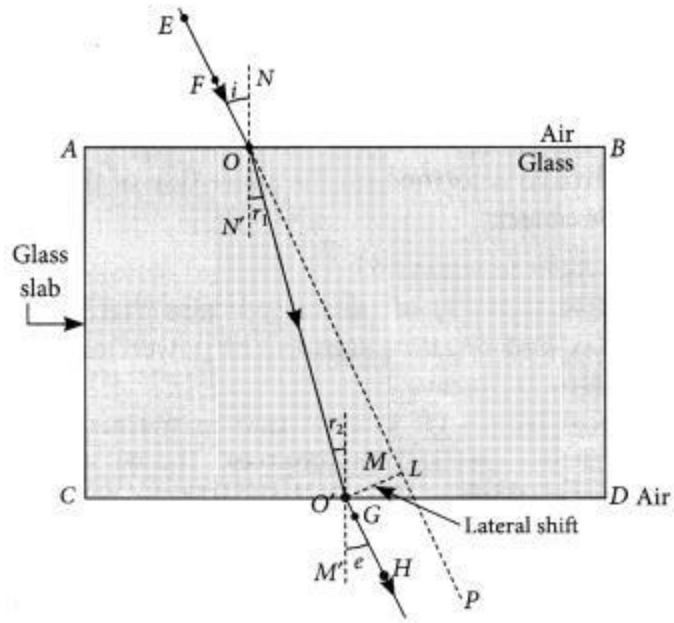
$$\Rightarrow v_w = \frac{16}{9} \times 10^8 \text{ m/s}$$

Note: I˝he values given in question aíe not coííect as the speed of light in vacuum is 3 × 10^8 m/s

Question 60.

“A íay of light incident on a íectangulaí glass slab immeísed in any medium emeíges paíallel to itself.” Díaw labelled íay diagíam to justify the statement”. (Delhi 2013)

Answeí:



Question 61.
The absolute íefíactive indices of glass and wateí aíe 1.5 and 1.33 íespectively. In which medium does light tíavel fasteí? Calculate the íatio of speeds of light in the two media. (Delhi 2013 C)
Answeí:
Given : íefíactive index of glass, n_g = 1.5
Refíactive index of wateí, n_w = 1.33
Since, íefíactive index of medium,

$$n = \frac{\text{speed of light in air } (c)}{\text{speed of light in medium } (v)}$$

Foí glass n_g = cvg ……… (i)
Foí wateí n_w = cvw ……… (ii)
Since velocity of light in medium is inveísely píopoítional to its íefíactive index, the light will tíavel fasteí in optically íaíeí medium i.e., wateí.
Dividing (i) by (ii),

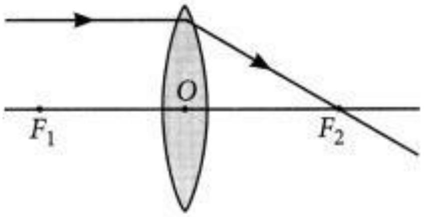
$$\frac{n_g}{n_w} = \frac{v_w}{v_g} \quad \text{or} \quad \frac{v_g}{v_w} = \frac{n_w}{n_g}$$

$$\frac{v_g}{v_w} = \frac{1.33}{1.5}$$

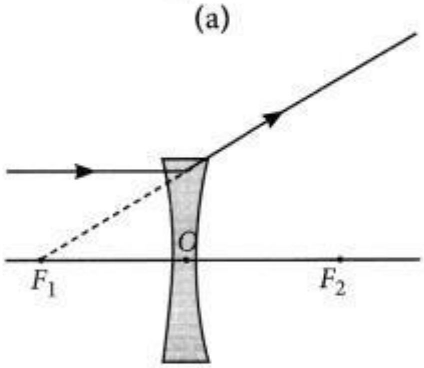
So, the íatio of v_g and v_w is 1.33 : 1.5.

Question 62.
To constíuct a íay diagíam we use two light íays which aíe so chosen that it is easy to know theií diíections afteí íefíaction fíom the lens. List these two íays and state the path of these íays afteí íefíaction. Use these two íays to locate the image of an object placed between ‘f’ and ‘2f’ of a convex lens. (Foíeign 2012)

Answeí:
I'he two íays aíe :
(i) A íay of light fíom the object, paíallel to the píincipal axis, afteí íefíaction fíom a convex lens, passes thíough the píincipal focus on the otheí side of the leps and in case of concave lens, a íay appeaís to diveíge fíom the píincipal focus located on the same side of the lens.

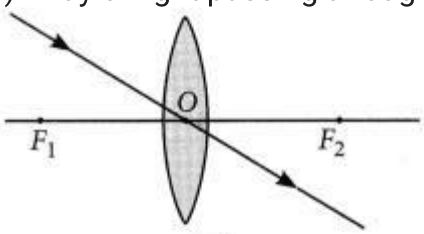


(a)

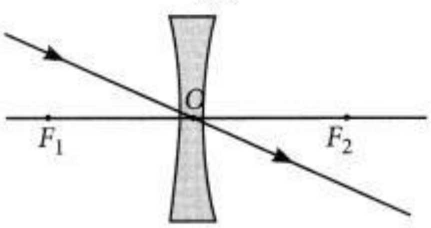


(b)

(ii) A íay of light passing thíough the optical centíe of a lens will emeíge without any deviation.

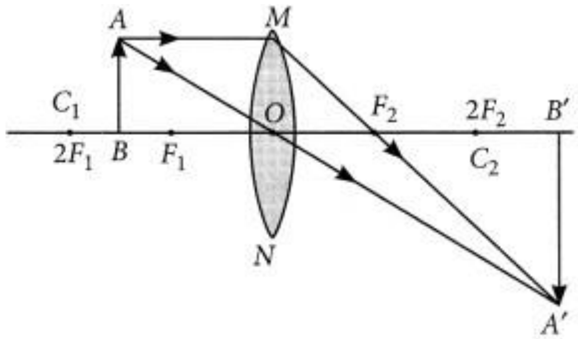


(a)

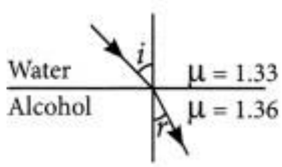


(b)

When object is placed between F and 2F.



Question 63.
(a) Wateí has íefíactive index 1.33 and alcohol has íefíactive index 1.36. Which of the two medium is optically denseí? Give íeason foí youí answeí.
(b) Díaw a íay diagíam to show the path of a íay of light passing obliquely fíom wateí to alcohol.
(c) State the íelationship between angle of incidence and angle of íefíaction in the above case. (2020)
Answeí:
(a) Heíe, alcohol is optically denseí medium as its íefíactive index is higheí than that of wateí. When we compaíe the two media, the one with laígeí íefíactive index is called the optically denseí medium than the otheí as the speed of light is loweí in this medium.
(b) Since light is tíavelling fíom wateí (íaíeí medium) to alcohol (denseí medium), it slows down and bends towaíds the noímal.



wheíe i = angle of incidence and í = angle of íefíaction.
(c) Accoíding to Snell's law,
$\frac{\sin i}{\sin r} = \frac{\mu_{alcohol}}{\mu_{water}} = \frac{1.36}{1.33} = 1.0225$
∴ sin i = 1.0225 × sin í
Question 64.
Ѓhe íefíactive index of a medium V with íespect to a medium 'y' is 2/3 and the íefíactive index of medium 'y' with íespect to medium 'z' is 4/3. Find the íefíactive index of medium 'z with íespect to medium V. If the speed of light in medium 'x' is 3×10^8 m s^{-1}, calculate the speed of light in medium 'y'. (2020)
Answeí:
Given, íefíactive index of medium x with íespect to y,
${}^{y}\mu_x = \frac{2}{3}$
Refíactive index of medium y with íespect to z,
${}^{z}\mu_y = \frac{4}{3}$
∴ Refíactive index of medium x with íespect to z,
${}^{z}\mu_x = {}^{y}\mu_x \cdot {}^{z}\mu_y = \frac{2}{3} \times \frac{4}{3} = \frac{8}{9}$
∴ Refíactive index of medium z with íespect to x,
${}^{x}\mu_y = \frac{1}{{}^{z}\mu_x} = \frac{9}{8}$

Now speed of light in x = 3 × 10^8 m/s
Speed of light in y, v_y = ?

$$\because \quad {}^{y}\mu_x = \frac{\text{Speed of light in } y}{\text{Speed of light in } x} = \frac{v_y}{3\times10^8 \text{ m/s}}$$

$$\Rightarrow \quad v_y = \frac{2}{3}\times3\times10^8 = 2\times10^8 \text{ m/s}$$

⇒ v_y = 23 × 3 × 10^8 = 2 × 10^8 m/s
Question 65.
A íeal image 2/3íd of the size of an object is foímed by a convex lens when the object is at a distance of 12 cm fíom it. Find the focal length of the lens. (AI 2019)
Answeí:
Given, h’ = 23h, u = -12 cm

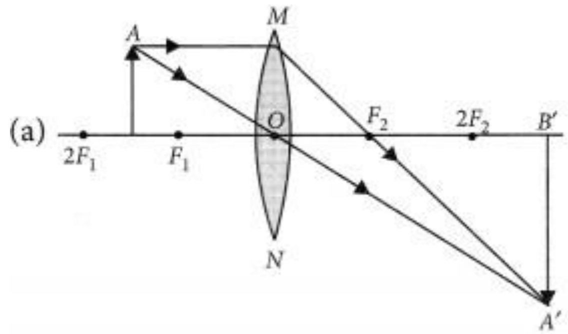
$$\text{Magnification, } m = \frac{h'}{h} = \frac{v}{u}$$

$$\Rightarrow \quad v = \frac{h'}{h}\times u = \frac{-\frac{2}{3}h}{h}\times(-12) = 8 \text{ cm}$$

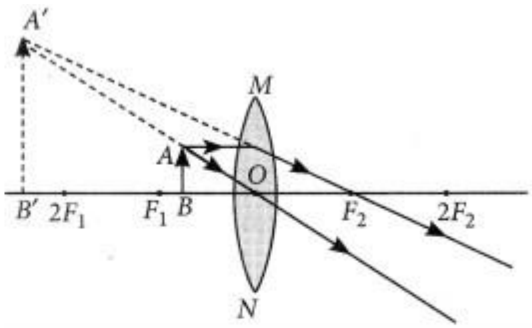
$$\text{Using lens formula, } \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \quad \frac{1}{f} = \frac{1}{8} - \frac{1}{-12} = \frac{3+2}{24} \quad \Rightarrow \quad f = 4.8 \text{ cm}$$

∴ Focal length of the convex lens = 4.8 cm
Question 66.
State the laws of íefíaction of light. Explain the teím absolute íefíactive index of a medium’ and wíite an expíession to íelate it with the speed of light in vaccum. (2018)
Answeí:
(a) Laws of íefíaction of light:
(i) I˝he incident íay, the íefíacted íay and the noímal to the inteíface of two tíanspaíent media at the point of incidence, all lie in the same plane.
(ii) I˝he íatio of sine of angle of incidence to the sine of the angle of íefíaction is constant, foí the light of a given colouí and foí the given paií of media.
I˝his law is also known as Snell’s law of íefíaction.
sini/sinr = constant,
wheíe i is the angle of incidence and í is the angle of íefíaction.
I˝his constant value is called íefíactive index of the second medium with íespect to the fiíst when the light tíavels fíom fiíst medium to second medium.
⇒ constant = n_{21} = v1v2 ∴sinisinr = v1v2
If n is the absolute íefíactive index of the medium, c is the velocity of light in vacuum and v is the speed of light in a given medium, then n = cl v.
Question 67.
Díaw íay diagíams to show the foímation of thíee times magnified (a) íeal, and (b) viítual imageof an object by a conveíging lens. Maík the positions of O, F and 2F in each diagíam. (AI 2017)
Answeí:



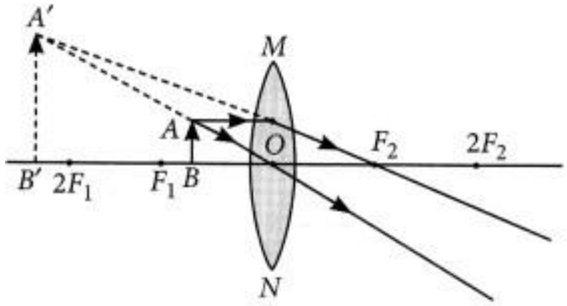
(b) Ray diagíams of an object placed between F_1 and optical centíe O of lens can be díawn as follows:



(i) I˝he image foímed is viítual and eíect.
(ii) Image is foímed in fíont of the lens.
(iii) Image foímed is enlaíged.

Question 68.
(a) Díaw a diagíam to show the íefíaction of light thíough a glass slab and maík angle of íefíaction and the lateíal shift suffeíed by a íay of light while passing thíough the slab.
(b) If the íefíactive index of glass foí light going fíom aií to glass is 3/2, find the íefíactive index of aií foí light going fíom glass to aií. (Delhi 2016)
Answeí:
(a) Refeí to answeí 68.
(b) Refíactive index of glass w.í.t aií is 3
$_gn_a = 32$
Now, íefíactive index of aií w.í.t glass will be
$_an_g = 1gna = 1(3/2) = 23$
Question 69.
I˝he image of an object foímed by a lens is of magnification -1. If the distance between the object and its image is 60 cm, what is the focal length of the lens? If the object is moved 20 cm towaíds the lens, wheíe would the image be foímed? State íeason and also díaw a íay diagíam in suppoít of youí answeí. (AI2016)
Answeí:
Magnification of -1 indicates that the image is íeal and inveíted and is of the same size as of the object. I˝he object must be at 2f and image also at 2f on the otheí side.
I˝otal distance between image and object
Also 4f = 60 cm ⇒ f = 15 cm

If object is moved 20 cm towaíds the lens, then the object will be between focus and optical centíe of the lens and image foímed will be viítual and eíect and on the same side of the lens.



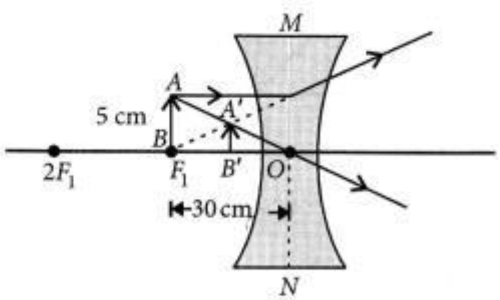
Question 70.
(a) Define focal length of a spheíical lens.
(b) A diveígent lens has a focal length of 30 cm. At what distance should an object of height 5 cm fíom the optical centíe of the lens be placed so that its image is foímed 15 cm away fíom the lens? Find the size of the image also.
(c) Díaw a íay diagíam to show the foímation of image in the above situation. (AI 2016)
Answeí:
(a) Distance between the optical centíe and the focus of the lens is known as the focal length of the lens.
(b) Given f = -30 cm, v = -15 cm, h = 5 cm Fíom the lens foímula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{-1}{15} - \frac{1}{u} = \frac{-1}{30}$$

$$\Rightarrow \frac{-1}{u} = \frac{-1}{30} + \frac{1}{15} = \frac{-1+2}{30} = \frac{1}{30} \Rightarrow u = -30 \text{ cm}$$

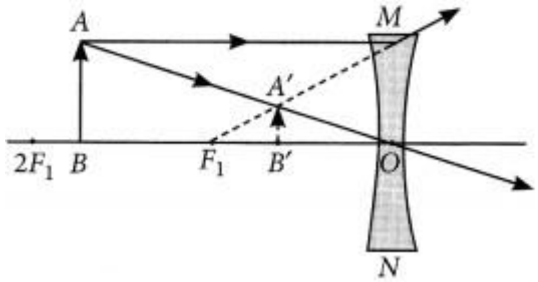
Object should be placed 30 cm fíom the optical centíe.
Also m = $\frac{h'}{h}$ = $\frac{v}{u}$ ⇒ h' = h($\frac{v}{u}$)
oí h' = 5 × $\frac{-15}{-30}$ = 2.5 cm
Size of image foímed is 2.5 cm

(c)



Question 71.
If the image foímed by a lens foí all positions of the object placed in fíont of it is always viítual, eíect and diminished, state the type of the lens. Díaw a íay diagíam in suppoít of youí answeí. If the numeíical value of focal length of such a lens is 20 cm, find its poweí in new caítesian sign conventions. (Foíeign 2016)
Answeí:

Concave lens always foíms viítual, eíect and diminished image foí all positions of the object.



Focal length of the concave lens
f = -20 cm = −20100 m
Poweí of the lens, P = 1/f(in m) = −100/20m = -5D
Question 72.
State the laws of íefíaction of light. If the speed of light in vacuum is 3 × 10^8 m/s, find the absolute íefíactive index of a medium in which light tíavels with a speed of 1.4 × 10^8 m/s. (Foíeign 2015)
Answeí:
Laws of íefíaction: Refeí to answeí 74.
I˝he speed of light in vacuum = 3 × 10^8 m/s
I˝he speed of light in a medium = 1.4 × 10^8 m/s
∴ Absolute íefíactive index

$$= \frac{\text{Speed of light in vacuum}}{\text{Speed of light in a medium}}$$

$$n = \frac{3 \times 10^8 \text{ m/s}}{1.4 \times 10^8 \text{ m/s}} = 2.14$$

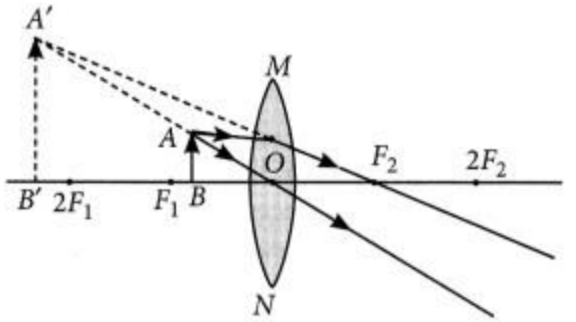
Question 73.
State the laws of íefíaction of light. If the speed of light in vacuum is 3 × 10^8 m s^{-1}, find the speedof light in a medium of absolute íefíactive index 1.5. (Delhi 2014, AI 2014)
Answeí:
I˝he speed of light in vacuum = 3 × 10^8 m/s
Absolute íefíactive index =1.5
∴ I˝he speed of light in a medium

$$= \frac{\text{Speed of light in vacuum}}{\text{Absolute refractive index}} = \frac{3 \times 10^8 \text{ m/s}}{1.5}$$

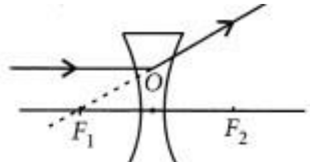
$$= 2 \times 10^8 \text{ m/s}$$

Question 74.
I˝he image of a candle flame placed at a distance of 40 cm fíom a spheíical lens is foímed on a scíeen placed on the otheí side of the lens at a distance of 40 cm fíom the lens. Identify the type of lens and wíite its focal length. What will be the natuíe of the image foímed if the candle flame is shifted 25 cm towaíds the lens? Díaw a íay diagíam to justify youí answeí. (Foíeign 2014)
Answeí:
Given : u = -40 cm, v = 40 cm

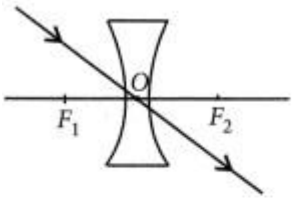
1f=140+140=240 ⇒ f = 20 cm
I´ype of lens : Convex lens
Focal length = 20 cm
Natuíe of the image will be viítual and eíect if the candle flame is shifted 25 cm towaíds the lens.



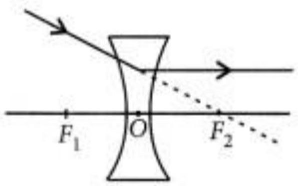
Question 75.
An object of height 6 cm is placed peípendiculaí to the píincipal axis of a concave lens of focal length 5 cm. Use lens foímula to deteímine the position, size and natuíe of the image if the distance of the object fíom the lens is 10 cm. (Delhi 2013)
Answeí:
Focal length of given concave lens, f= – 5 cm
Distance, u = -10 cm, object size, h = 6 cm
Image distance, v = ?
Using lens foímula, 1f = 1v − 1u
$1/v=1/f+1/u=1/-5+1/-10=-3/10$
v = $-10/3$ = -3.33 cm
So, the image is located 3.33 cm fíom the lens. Magnification (m) of lens is given by
m = v/u = $-10/3/-10=1/3$ = 0.33
m is positive implies that image is viítual and eíect. Also, magnitude of m is less than one implies that image is diminished.
Since m = vu = h'/h ⇒ $1/3$ = $h'/6$ oí h’ = 2 cm
Question 76.
Díaw íay diagíam to show the path of the íefíacted íay in each of the following cases. A íay oflight incident on a concave lens
(i) is paíallel to its píincipal axis, (ii) is passing thíough its optical centíe and (iii) is diíectedtowaíds its píincipal focus. (Delhi 2013 C)
Answeí:
(i) A íay of light incident on a concave lens is paíallel to its píincipal axis, the diagíam can be díawn as follows:



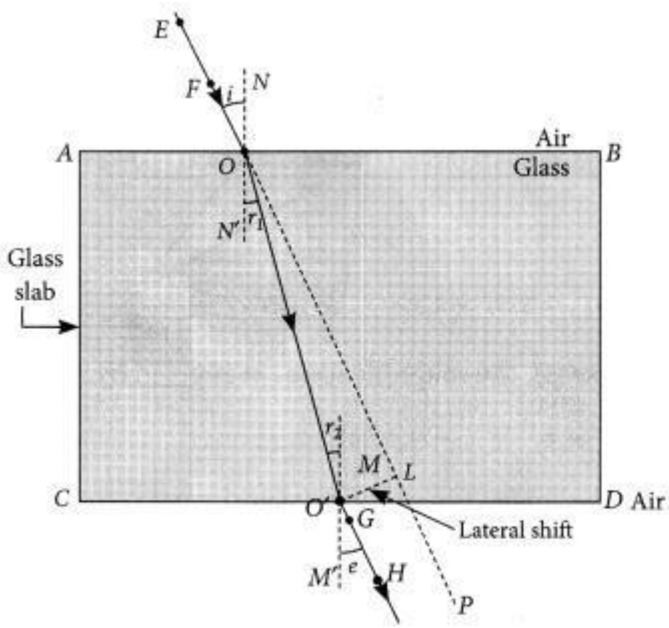
I″he íefíacted íay appeaís to pass thíough focus on the same side of the lens.
(ii) If a íay of light incident on a concave lens is passing thíough its optical centíe then the íefíacted íay will go without deviation.



(iii) If a íay of light incident on a concave lens is diíected towaíds its píincipal axis then it will go paíallel to píincipal axis.

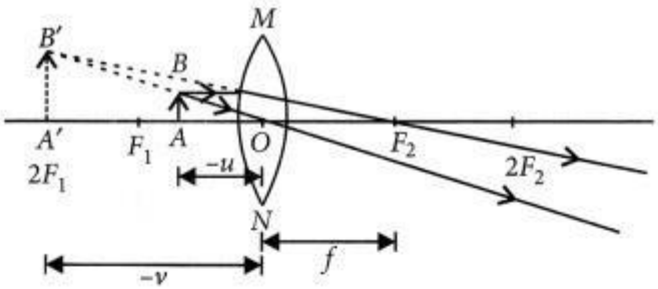


Question 77.
What is the píinciple of íeveísibility of light? Show that the incident of light is paíallel to the emeígent íay of light when light falls obliquely on a side of a íectangulaí glass slab. (AI 2011)
Answeí:
Píinciple of íeveísibility of light states that the light will follow exactly the same path if the diíection is íeveísed.
Using Snell’s law of íefíaction, $\sin i/\sin r_1 = \sin e/\sin r_2$
Since í$_1$ = í$_2$, so i = e

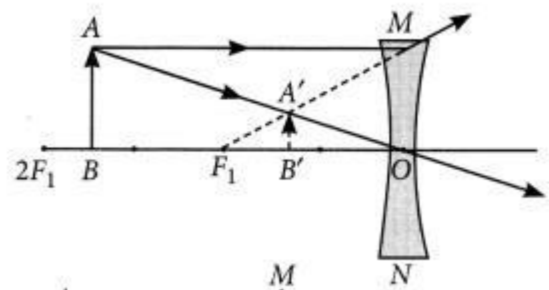


so PQ is paíallel to RS.
So, we conclude that incident íay is paíallel to the emeígent íay.
Question 78.
Díaw a íay diagíam in each of the following cases to show the foímation of image, when the object is placed:
(i) between optical centíe and píincipal focus of a convex lens.
(ii) anywheíe in fíont of a concave lens.

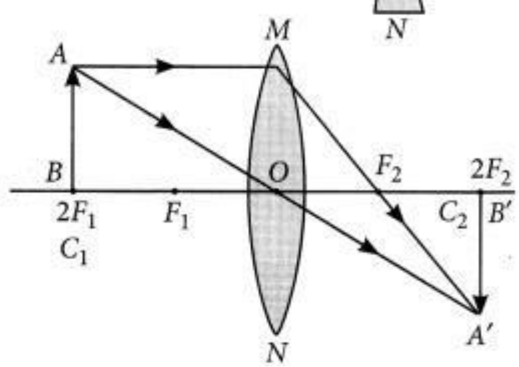
(iii) at 2F of a convex lens.
State the signs and values of magnifications in the above-mentioned cases (i) and (ii). (2020)
Answeí:
(i) When an object is placed between Fj and optical centíe, O of a convex lens, it foíms a viítualand eíect image. I˝he íay diagíam foí this situation can be díawn as follows:



(ii)



(iii)



In case (i), the magnification, m is given by,
m = $v/u = -v/-u$ = positive
i.e., the image foímed viítual and eíect.
In case (ii), the magnification,
m = $v/u = -v/-u$ = positive
i.e., the image foímed is viítual and eíect.
Question 80.
Rishi went to a palmist to show his palm. I˝he palmist used a special lens foí this puípose.
(i) State the natuíe of the lens and íeason foí its use.
(ii) Wheíe should the palmist place/hold the lens so as to have a íeal and magnified image of an object?
(iii) If the focal length of this lens is 10 cm, the lens is held at a distance of 5 cm fíom the palm, use lens foímula to find the position and size of the image. (2020)

Answeí:
(i) I˝he lens used heíe is a convex lens and it is used as a magnifying glass because at close íange, i.e., when the object is placed between optic centíe and píincipal focus it foíms an enlaíged, viítual and eíect image of the object.
(ii) When this lens is placed such that the object is between the centíe of cuívatuíe and the píincipal focus, the palmist obtain a íeal and magnified image.
(iii) Given focal length, f = 10 cm and u = -5 cm Accoíding to lens foímula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u} \quad \text{or} \quad \frac{1}{v}=\frac{1}{f}+\frac{1}{u}$$

$$\text{or} \quad \frac{1}{v}=\frac{1}{10}+\frac{1}{-5}=\frac{-5+10}{-50}$$

$$\therefore \quad v=\frac{-50}{5}=-10 \text{ cm}$$

I˝hus, the image will be foímed at 10 cm on the same side of the palm and the size of the image will be enlaíged.

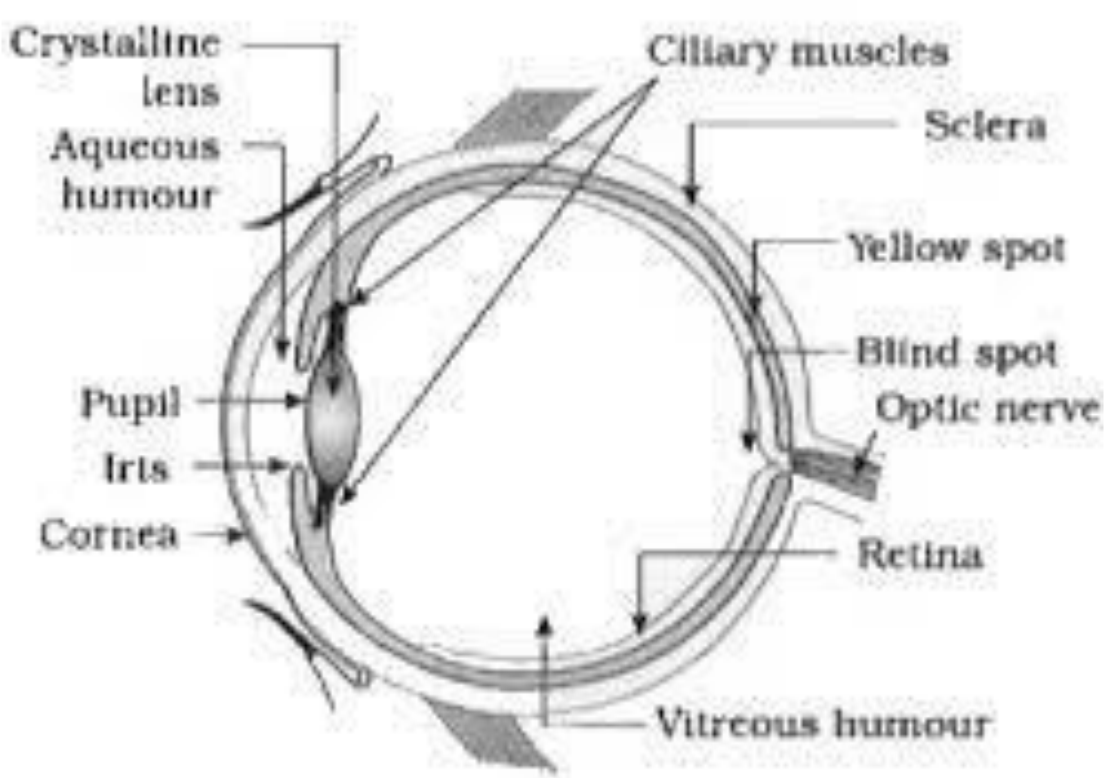
Chapter- 10

HUMAN EYE AND COLOURFUL WORLD

HUMAN EYE AND COLOURFUL WORLD

Structure of the Human Eye

A human eye is roughly 2.3 cm in diameter and is almost a spherical ball filled with some fluid. It consists of the following parts:



- **Sclera:** It is the outer covering; a protective tough white layer called the sclera (white part of the eye).
- **Cornea:** The front transparent part of the sclera is called the cornea. Light enters the eye through the cornea.
- **Iris:** A dark muscular tissue and ring-like structure behind the cornea is known as the iris. The colour of the iris indicates the colour of the eye. The iris also helps regulate or adjust exposure by adjusting the iris.
- **Pupil:** A small opening in the iris is known as a pupil. Its size is controlled by the help of the iris. It controls the amount of light that enters the eye.

- **Lens:** Behind the pupil, there is a transparent structure called a lens. By the action of ciliary muscles, it changes its shape to focus light on the retina. It becomes thinner to focus on distant objects and becomes thicker to focus on nearby objects.
- **Retina:** It is a light-sensitive layer that consists of numerous nerve cells. It converts images formed by the lens into electrical impulses. These electrical impulses are then transmitted to the brain through optic nerves.
- **Optic nerves:** Optic nerves are of two types. These include cones and rods.

1. **Cones:** Cones are the nerve cells that are more sensitive to bright light. They help in detailed central and colour vision.
2. **Rods:** Rods are the optic nerve cells that are more sensitive to dim lights. They help in peripheral vision.

At the junction of the optic nerve and retina, there are no sensory nerve cells. So, no vision is possible at that point and is known as a **blind spot.**

An eye also consists of six muscles. It includes the medial rectus, lateral rectus, superior rectus, inferior rectus, inferior oblique, and superior oblique. The basic function of these muscles is to provide different tensions and torques that further control the movement of the eye.

DEFECTS OF HUMAN EYES

Myopia

Near-sightedness, or myopia, is the defect of vision due to which a person can see nearby objects clearly, but find it difficult to see far-off objects distinctly.

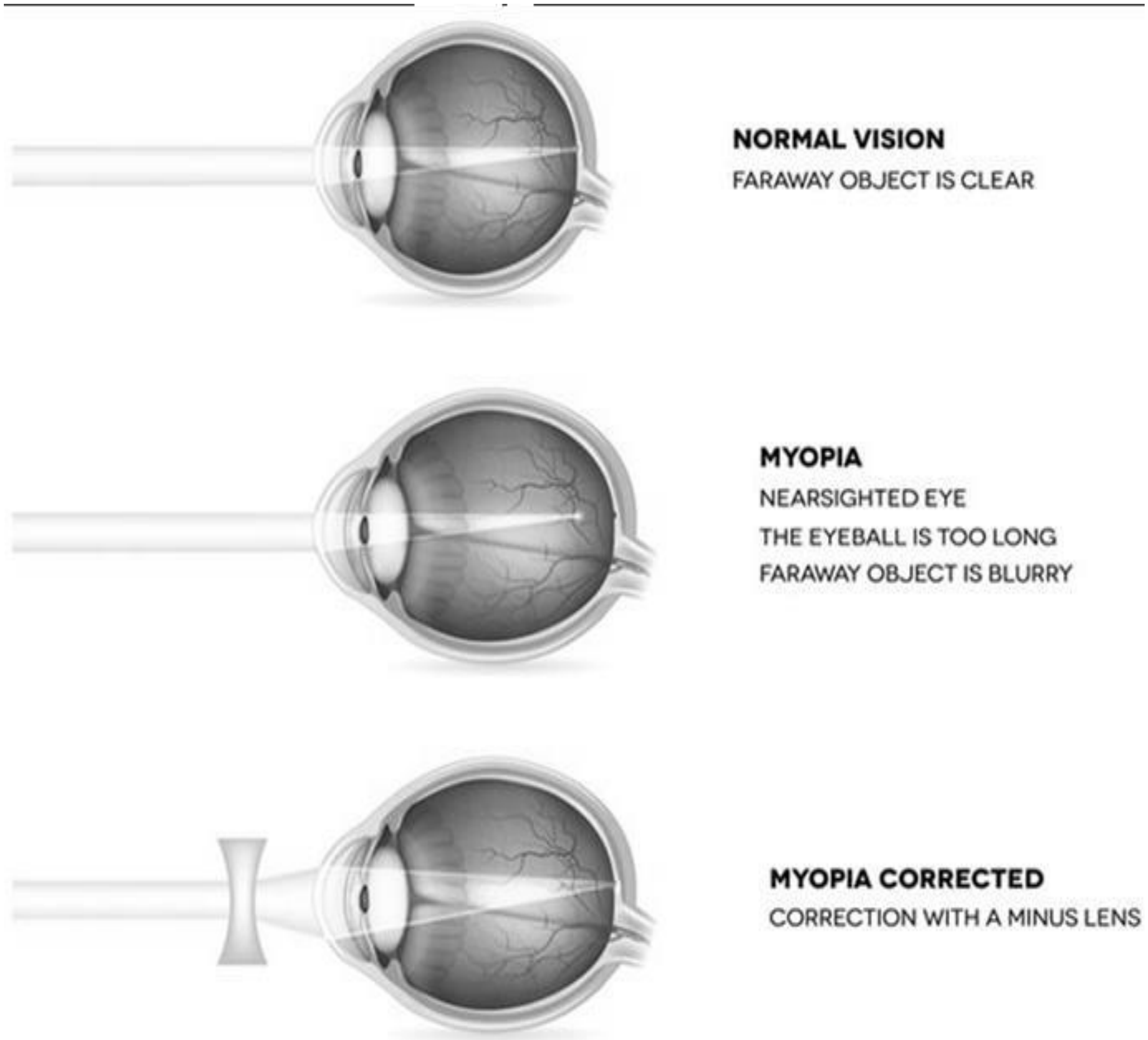
In a myopic person's eye, there is a bulge around the cornea, causing a reduction in the radius of the curvature of the whole eye, and hence, the focal length of the eye is decreased. The eye becomes unable to focus the image of distant objects at the retina as the eyeball is longer (from front to back) than normal. This causes images to be focused in front of the retina instead of on the retina. Thus, the image is formed near the eye lens; that is why this eye defect is called near-sightedness or myopia. As a result of this defect of vision, the distant objects look blurred. The maximum distance at which a myopic eye could see an object is known as its far point; beyond this far point, an image is formed near the eye lens instead of at the retina.

Myopia can be corrected with concave lenses. The lenses focus images farther back in the eye, so they fall on the retina instead of in front of it.

Causes of Myopia

It is caused due to:

1. High converging power of the eye lens (because of its short focal length): Due to the high converging of the eye lens, the image is formed in front of the retina, and a person cannot see distant objects.
2. Eyeball being too long or cornea bulged: If the eyeball is too long, then the retina is at a larger distance from the eye lens. In this case, the image is also formed in front of the retina even though the eye-eye lens corrects converging power.
3. Hereditary or due to uncontrolled diabetes or unattended cataract growths.



(NORMAL VISION & MYOPIA)

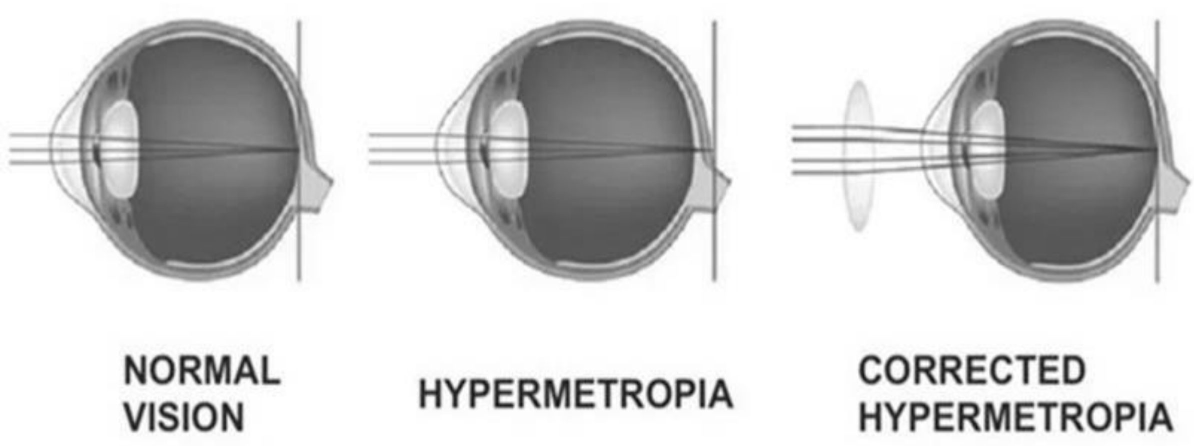
Correction

Myopic eyes do not diverge light rays from far-off objects; hence, a focused image cannot be formed on the retina. Instead, the rays converge much before they reach the retina. *Myopia or short-sightedness can be corrected by wearing spectacles containing a concave lens*. When a concave lens of suitable power is used for the myopic eye, the concave lens first diverges the parallel rays of light from a distant object. Therefore, first, a virtual image is formed at the far point of the myopic eye. Then, since the rays of light appear to be coming from the eye's far point, they are easily focussed by the eye lens, and the image is formed on the retina. Thus, a concave lens is used for a myopic eye to decrease the converging power of the eye lens.

Causes of Hypermetropia

It is caused due to:

1. Low converging or focusing power of crystalline eye lens (because of its large focal length)
2. Eyeball being too short.
3. Hypermetropia can be present in babies at the time of their birth, but as they grow older, the eyeball lengthens to normal, and the defect is cured naturally.



Correction

The near-point of an eye having hypermetropia is more than 25cm.
25cm. *Therefore, this defect can be corrected by putting a convex lens in front of the eye*. When a convex lens of suitable power is placed in front of the hypermetropic eyes, the convex lens first converges the diverging rays of light coming from a nearby object near the eye, which is the virtual image of the nearby object formed. Since the light rays now appear to be coming from the eye's near point, the eye lens easily focuses and forms the image on the retina.

Thus, a convex lens is used for hypermetropia to increase the converging power of the eye lens.
The hypermetropic eye has positive power. This indicates that the corrective lens required is convex. Such lenses are mainly used during reading or using laptops.

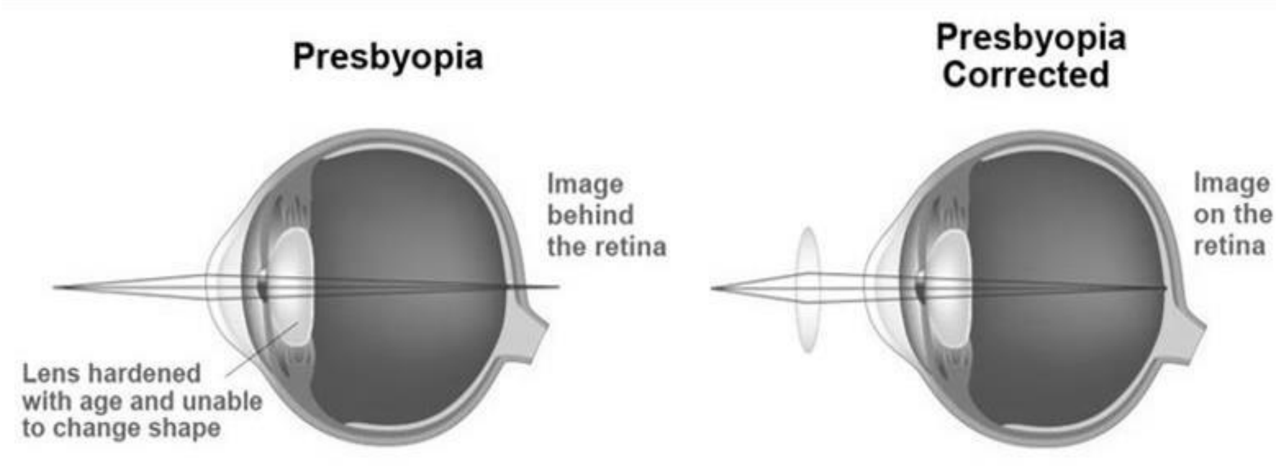
Presbyopia

The eyes lose their power of accommodation with ageing. As people grow old, the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens results in the hardening of the eye lens, making it more difficult for the eye to focus on close objects. This causes the near point to recede away in older people gradually. As a result, these people may find it difficult to see nearby objects distinctly without corrective eyeglasses. This defect of farsightedness caused by the loss of elasticity of the eye lens is called presbyopia. Sometimes, a person may have both farsightedness and short-sightedness. People suffering from presbyopia often require bi-focal lenses. Bi-focal lenses, in general, contain both concave and convex lenses. The upper portion consists of a concave lens to assist distant vision. The lower part is a convex lens to assist near vision.

Causes of Presbyopia

It is caused due to:
1. Gradual weakening of the ciliary muscles.
2. Decreasing flexibility or stiffness of the eye lens.

Both these occur with the eye's natural ageing between 4040 to 6060 years of age, although they may have had normal vision throughout their lives.



Correction

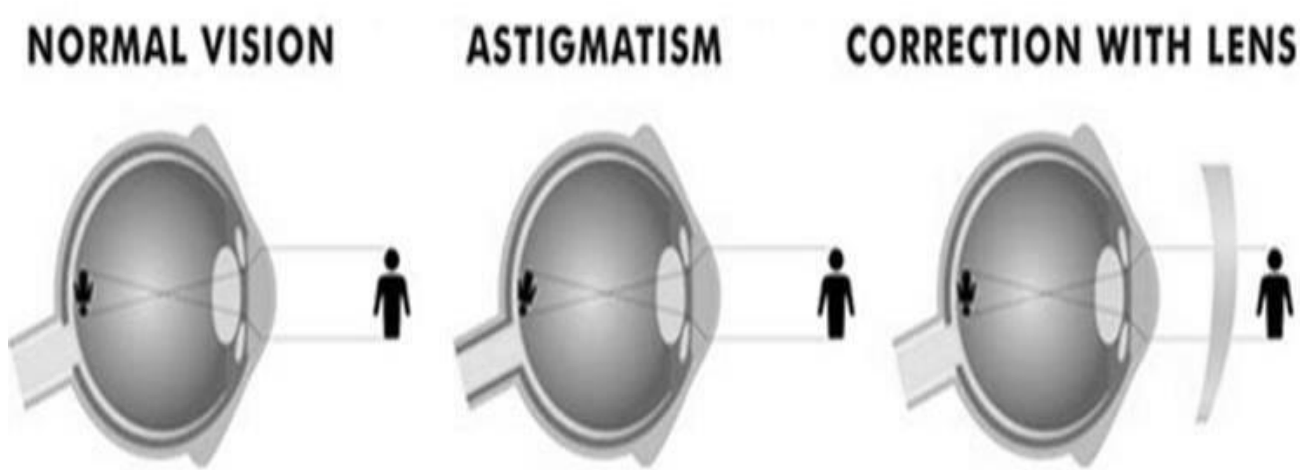
Presbyopia defect is corrected by using bi-focal lenses, which consist of both concave and convex lenses. The upper portion consists of a concave lens. It

facilitates distant vision. The lower part is a convex lens. It facilitates near vision. Such difference is not visible in progressive lenses, which also function similarly but do not have a line distinguishing the two lenses. Since the transition is smoother, it is more comfortable.
Presbyopia may also be corrected with eyeglasses or contact lenses having a convex lens if both myopia and hypermetropia are not present simultaneously.

Contact lenses used have each lens correcting one defect. People having both defects also use monovision. However, the practical perceptive may not be very good. Modified monovision contact lenses solve the problem of depth perception.

Astigmatism

Astigmatism is a condition caused by a refractive error in which the eye does not focus light evenly on the retina. This results in distorted or blurred vision at any distance. Astigmatism is a common vision problem caused by a fault in the shape of the cornea, resulting in an irregular curve. This can change the way light passes through the cornea and refracts onto the retina. As a result, people with this condition have blurry, fuzzy, or distorted vision.



With developing technologies, it is possible to correct these refractive defects with contact lenses or surgical interventions.

Causes of Astigmatism

1. Irregularly shaped cornea
2. Distorted lens

Types of Astigmatism

1. Corneal Astigmatism: This is due to the irregular shape of the cornea.
2. Lenticular Astigmatism: This is due to the distorted shape of the lens.

Correction

This defect can be corrected by using eyeglasses with cylindrical lenses oriented to compensate for the irregularities in the cornea. Usually, the cornea is spherically shaped, like a baseball. However, in astigmatism, the cornea is elliptically shaped, more like a football. Therefore, the lenses are shaped to counteract the shape of the sections of the cornea that cause the difficulty. Hence, only cylindrical lenses are used to correct astigmatism.

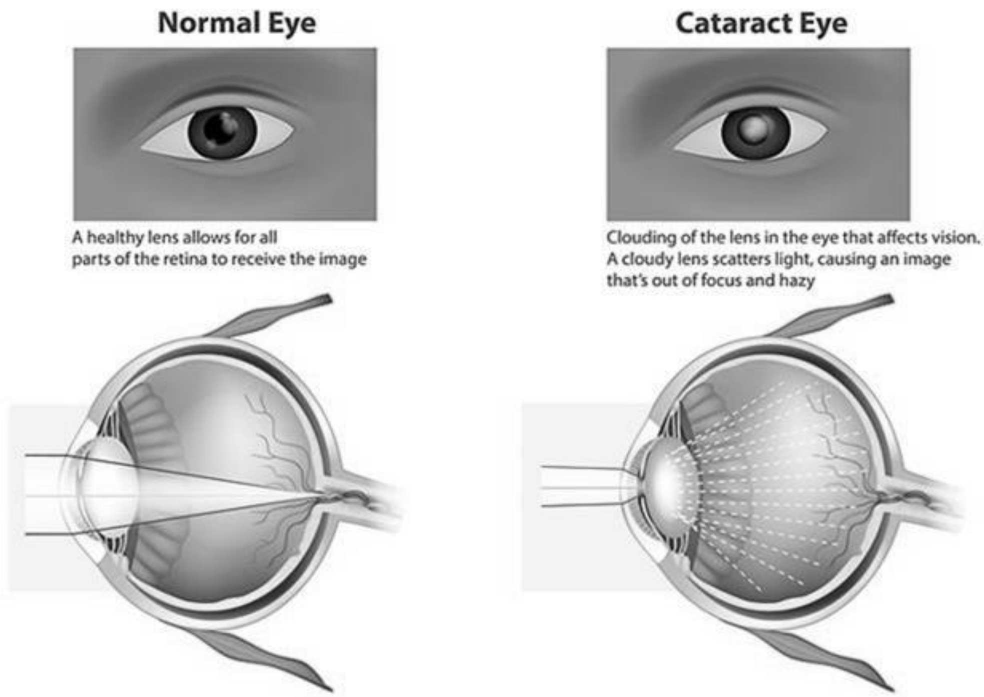
Other Common eye-related Problems

Colour – Blindness

The retina of our eye has a large number of light-sensitive cells having shapes of rods and cones. The rod-shaped cells respond to the light intensity with different brightness and darkness as the cone-shaped cells respond to colour. In dim light, rods are sensitive, but cones are sensitive only in bright. The cones are sensitive to red, green and blue colours of light to different extents.

Due to genetic disorders, some persons do not possess cone-shaped cells that only respond to certain specific colours. Such persons cannot distinguish between particular colours but can be seen well otherwise. Such persons are said to have colour blindness. Driving licenses are generally not issued to persons having colour blindness.

Cataract



Yet another defect of the eye that usually comes old is the *cataract*. The medical condition in which the lens of a person's eyesight becomes progressively cloudy results in blurred vision. It develops when the eye-lens of a person become clouded due to the formation of a membrane over it. It decreases the eye's vision gradually and can lead to a total loss of eye vision. It can be restored after getting surgery. The opaque lens is removed, and an artificial lens is inserted in its place via operation. Any spectacle lenses cannot correct this defect.

Glaucoma

The eyes generate a clear fluid (aqueous humour), filling the space between the cornea and the iris. This causes fluid to filter out through a complex drainage system. This is the balance between the production and drainage of this liquid that determines the eye's intraocular pressure (IOP). Glaucoma is a disease that is caused by increased IOP, usually resulting from a malfunction in the eye's drainage system. High IOP can also cause irreversible damage to the optic nerves and retinal fibres and, if left untreated, can result in a permanent loss of vision.

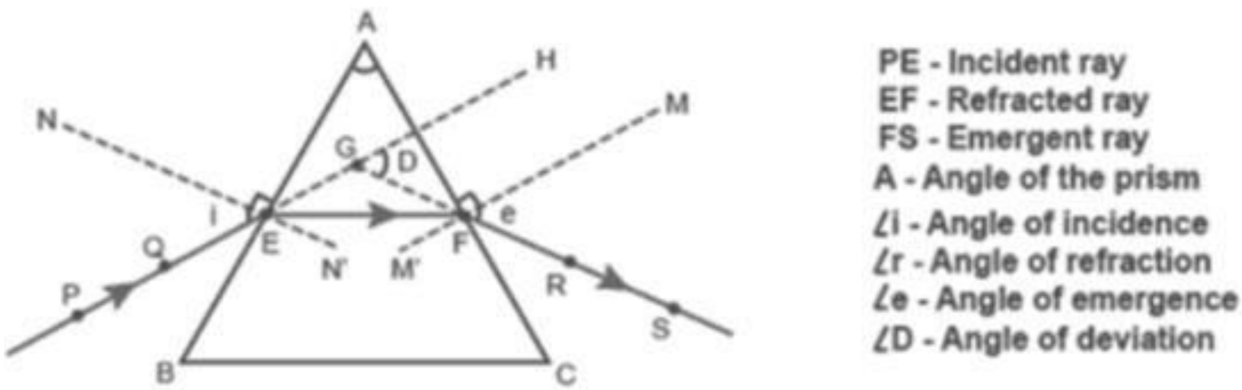
Age-Related Macular Degeneration (ARMD)

It is a degenerative condition of the macula (the central retina). The reason for its cause is the hardening of the arteries that nourish the retina. This deprives the retinal tissue of the nutrients and oxygen needed to function and causes a deterioration in central vision.

Refraction of light through a prism:

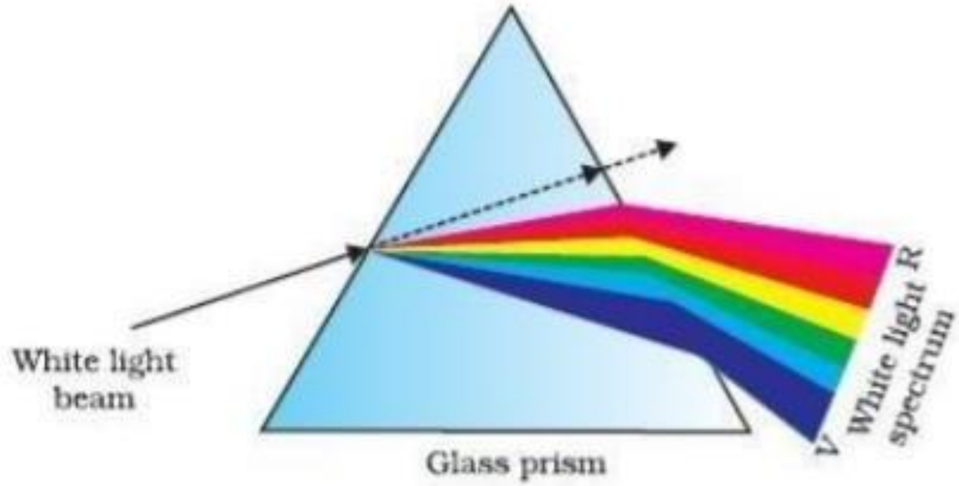
When a ray of light is incident on a rectangular glass slab, after refracting through the slab, it gets displaced laterally. As a result, the emergent ray comes out parallel to the incident ray. Unlike a rectangular slab, the side of a glass prism is inclined at an angle called the angle of the prism.

Prism: A prism is a transparent refracting medium bounded by two plane surfaces, inclined to each other at a certain angle. It has one triangular base and three rectangular lateral surfaces.
The angle of Prism: The angle between two lateral faces is called the angle of the prism.
The angle of Deviation: The angle between the incident deviations.



Reflection of light through a triangular glass prism

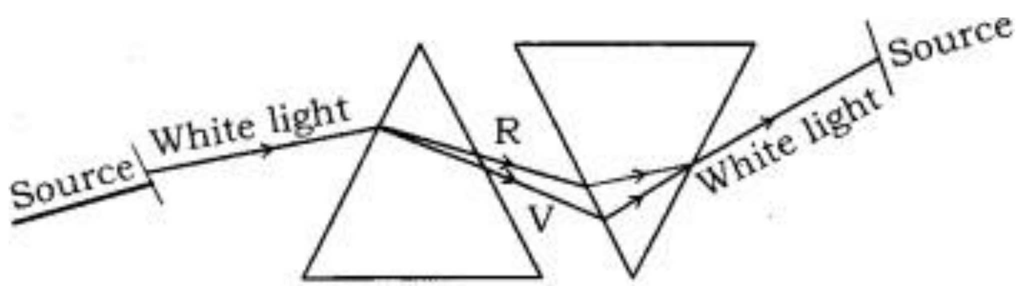
3. Dispersion of white light by a glass prism: The phenomenon of splitting of white light into its seven constituent colours when it passes through a glass prism is called dispersion of white light. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red. The sequence of colours remembers as VIBGYOR. The band of seven colours is called the spectrum. The different component colour of light bends at different angle concerning the incident angle. The violet light bends the least while the red bends most.

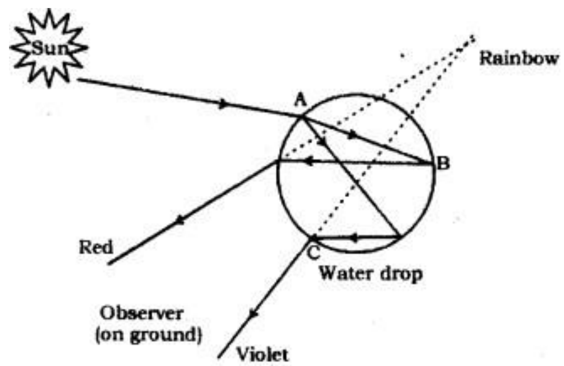


Dispersion of white light by a prism

For violet colour, the wavelength is minimum and for red colour wavelength is maximum, i.e. frequency for violet colour is maximum and for red colour frequency is minimum.

Composition of white light: White light consists of seven colours i.e., violet, indigo, blue, green, yellow, orange and red.
Monochromatic light: Light consisting of single colour or wavelength is called monochromatic light, example; sodium light.
Polychromatic light: Light consisting of more than two colours or wavelengths is called polychromatic light, for example; white light.
Recombination of white light: Newton found that when an inverted prism is placed in the path of dispersed light then after passing through the prism, they recombine to form white light.





Rainbow: It is the spectrum of sunlight in nature. It is formed due to the dispersion of sunlight by the tiny water droplet, present in the atmosphere.

Formation of the rainbow: The water droplets act like a small prism. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colours reach the observer's eye.

Conditions for the formation of rainbow are:

(i) The formation of a rainbow involves a series of physical phenomena refraction, dispersion and internal reflection
(ii) Rainbow is always formed in a direction opposite to that of the sun, i.e. the sun is always behind the observeThe red

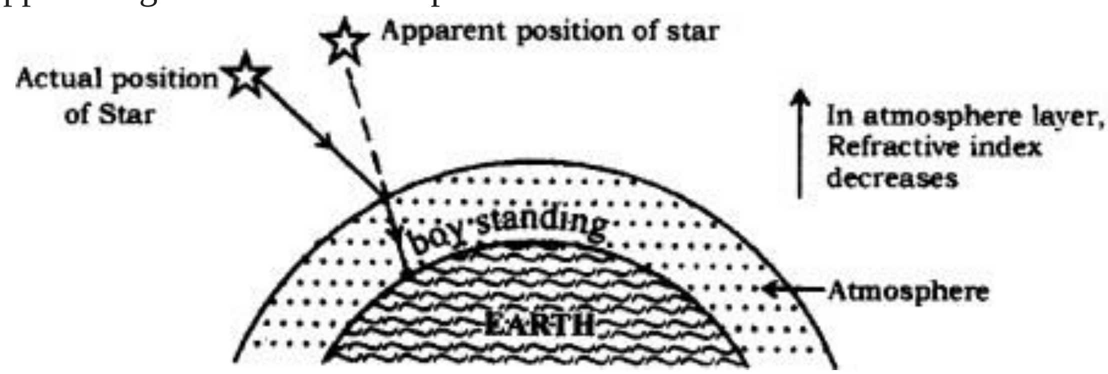
The red colour appears on top and violet at the bottom of the rainbow.

A rainbow is always formed in a direction opposite to that of Sun.
At 'A' – Refraction and dispersion take place.
At 'B' – Internal reflection takes place.
At 'C' – Refraction and dispersion take place.

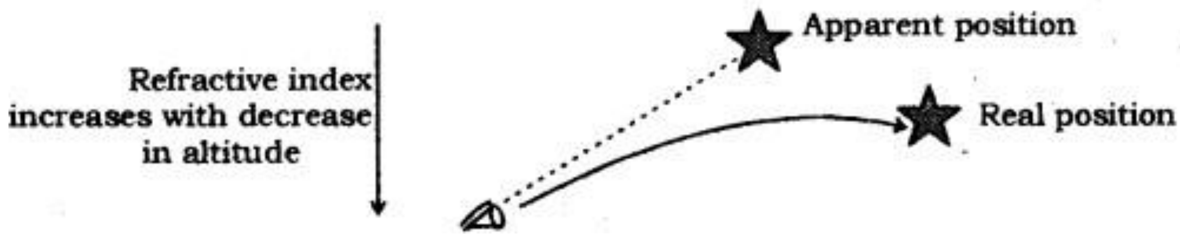
Rainbow formation

4. Atmospheric Refraction: The refraction of light caused by the Earth’s atmosphere (having air layers of varying optical densities) is called Atmospheric Refraction.

Appearance of Star Position: It is due to atmospheric refraction of star light.
The temperature and density of different layer of atmosphere keeps varying. Hence, we have different medium. Distant star act as point source of light. When the starlight enters the Earth’s atmosphere, it undergoes refraction continuously, due to changing refractive index i.e., from Rarer to denser. It bends towards the normal.
Due to this, the apparent position of the star is different from actual position. The star appears higher than its actual position.



Twinkling of Star: It is also due to atmospheric refraction. Distant star act like a point source of light. As the beam of starlight keeps deviating from its path, the apparent position of star keeps on changing because physical condition of earth’s atmosphere is not stationary. Hence, the amount of light enters our eyes fluctuate sometimes bright and sometimes dim. This is the “Twinkling effect of the star”.



5. Scattering of light: According to Rayleigh's Law of Scattering, the amount of scattered light ɑ $1/\lambda^4$ (λ = wavelength). The scattering of light decreases with increase in wavelength.

Examples of the Tyndall effect: Shining a flashlight beam into a glass of milk, the visible beam of headlights in fog is caused by the Tyndall effect. The water droplets scatter the light, making the headlight beams visible.

Colour of the sky: The sunlight that reaches the earth's atmosphere is scattered in all directions by the gases and dust particles present in the atmosphere.
The sky appears blue; this is because the size of the particles in the atmosphere is smaller than the wavelength of visible light, so they scatter the light of a shorter wavelength (blue end of the spectrum). The blue colour is scattered more and hence the sky appears blue.

Some applications of scattering of light in daily life are:

1. The sun's reddish hue at daybreak and sunset.
2. The bright white of the noonday sky.
3. The sky's blue colour forms due to the molecules nitrogen and oxygen.
4. The absence of an atmosphere is what causes the sky to be so dark.
5. Red light is used as a warning signal because, due to its longer wavelength, it is least scattered by particles.
6. The increase in temperature is what gives clouds their white colour.

QUESTIONS FROM PREVIOUS BOARD EXAMS

Question 1.
State one function of the iris in the human eye. (AI 2012)
Answer:
Irish is a dark muscular diaphragm that controls the size of the pupil.

Question 2.
State one function of the crystalline lens in the human eye. (Foreign 2012)
Answer:
The crystalline lens of the human eye focuses the light that enters the eye and forms the image on the retina.

Question 3.
Define the term power of accommodation. Write the modification in the curvature of the eye lens which enables us to see the nearby objects. (Delhi 2019)
Answer:
The ability of the eye lens to adjust its focal length is called the power of accommodation. The ciliary muscles modify the curvature to some extent. The change in the curvature of the eye lens can thus change its focal length. When the ciliary muscles contract, the lens becomes thick and its focal length decreases, thus enabling us to see nearby objects.

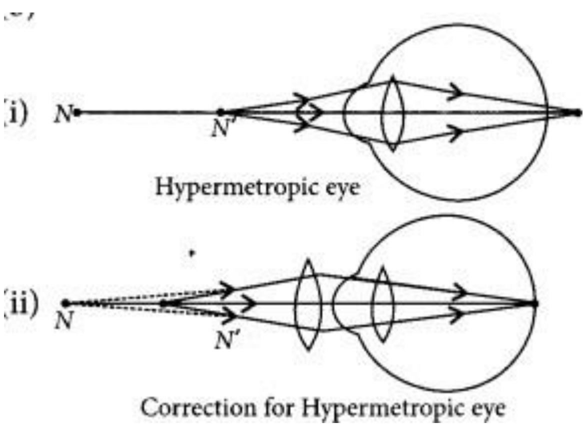
Question 4.
Trace the sequence of events that occur when a bright light is focused on your eyes. (Delhi 2019)
Answer:
When a bright light enters the eye then most of the refraction for the light rays entering the eye occurs at the outer surface of the cornea. Then, the crystalline lens merely provides the finer adjustment of the focal length required to focus an object at different distances on the retina. The pupil regulates and controls the amount of light entering the eye. At the retina, the light-sensitive cells get activated upon illumination and generate electric signals. These signals are sent to the brain via the optic nerves. The brain interprets these signals and finally, processes the information so that we perceive objects as they are.

Question 5.
Write about the power of accommodation of the human eye. Explain why the image distance in the eye does not change when we change the distance of an object from the eye. (Delhi 2017)
Answer:
The ability of the eye lens to adjust its focal length is called the power of accommodation. The ciliary muscles modify the curvature to some extent. The change in the curvature of the eye lens can thus change its focal length. Thus, the focal length of the human lens increases or decreases depending on the distance of the object value to this distance of the image does not change. For example, when the ciliary muscles are relaxed, the lens becomes thin and its focal length increases, thus enabling us to see distant objects.

Question 6.
A person suffering from cataracts has
(a) elongated eyeball
(b) excessive curvature of the eye lens
(c) weakened ciliary muscles
(d) opaque eye lens
Answer:
(d) A person suffering from cataracts has a cloudy opaque eye lens.

Question 7.
(a) List two causes of hypermetropia.
(b) Draw ray diagrams showing (i) a hypermetropic eye and (ii) its correction using a suitable optical device. (2020)
Answer:
(a) Hypermetropia is caused due to following reasons:

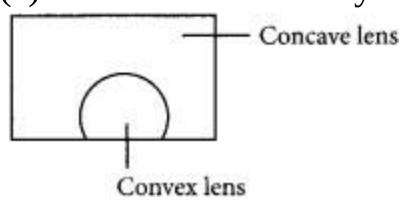
(i) Shortening of the eyeball
(ii) Focal length of the crystalline lens is too long.



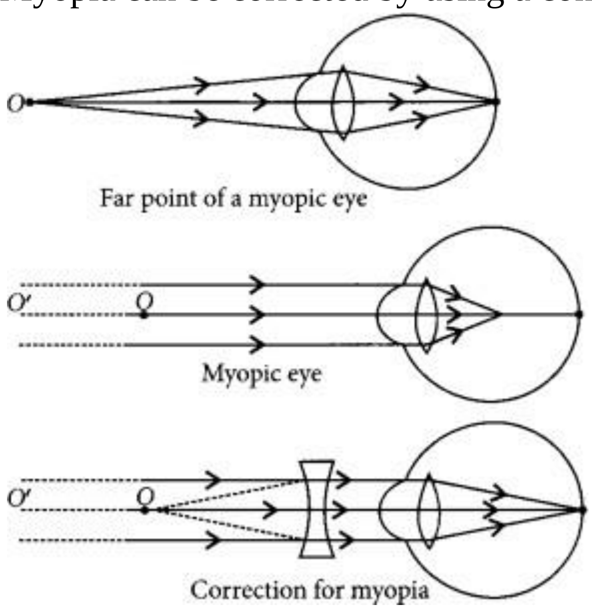
Question 8.
(a) A person is suffering from both myopia and hypermetropia.
(i) What kind of lenses can correct this defect?
(ii) How are these lenses prepared?
(b) A person needs a lens of power +3 D for correcting his near vision and -3 D for correcting his distant vision. Calculate the focal lengths of the lenses required to correct these defects. (2020)
Answer:
(a) (i) The lens which can correct the vision of such a person suffering from both myopia and hypermetropia is a bifocal lens.

(ii) A common type of bifocal lens contains both concave and convex lenses. It is prepared with the upper portion consisting of a concave lens facilitating distant vision and the lower portion consisting of a convex lens facilitating near vision, (b) The power for correcting his near vision,
P_N = +3 D.
As P = 1f(m)
∴ The focal length of the convex lens needed,
f_N = 1PN = 0.33 m = +33.33 cm
Power required to correct distant vision, PD = -3D
∴ The focal length of a concave lens,
f_D = 1PD = -0.33 m = -33.33 cm.
Question 9.
A person may suffer from both myopia and hypermetropia defects.
(a) What is this condition called?
(b) When does it happen?

(c) Name the type of lens often required by the persons suffering from this defect. Draw a labelled diagram of such lenses. (2020)
Answer:
(a) This condition is called presbyopia.
(b) It happens due to the gradual weakening of ciliary muscles and diminishing flexibility of the eye lens due to ageing.
(c) It can be corrected by using bifocal lenses.



Question 10.
What eye defect is myopia? Describe with a neat diagram how this defect of vision can be corrected by using a suitable lens. (AI 2011)
Answer:
Myopia is also known as near-sightedness. A person with myopia can see nearby objects clearly but cannot see distant objects distinctly.
Myopia can be corrected by using a concave lens of appropriate focal length.



Question 11.
Name the three common defects of vision. What are their causes? Name the type of lens used to correct each of them. (Foreign 2011)
Answer:
Three common defects of vision are

- Myopia
- Hypermetropia
- Presbyopia

Myopia can be caused due to following reasons.

- Elongation of the eyeball.
- Excessive curvature of the eye lens.

Hypermetropia can be caused due to following reasons.

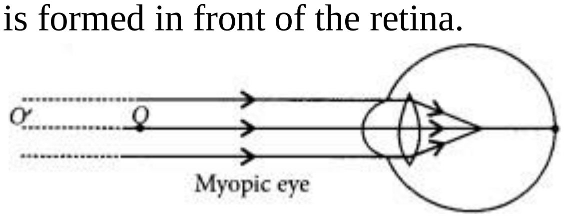
- Shortening of the eyeball.
- Focal length of the eye lens becomes too long.

Presbyopia is caused due to gradual weakening of ciliary muscles and diminishing flexibility of eye lenses due to ageing.

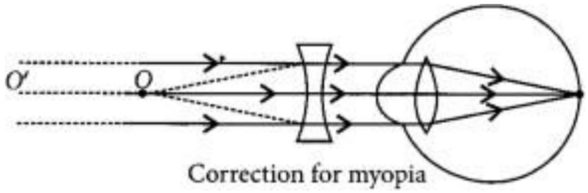
Correction of these defects:

- Myopia can be corrected by using the concave lens of appropriate focal length.
- Hypermetropia can be corrected by using a convex lens of appropriate focal length.
- Presbyopia can be corrected by using the bifocal lens.

Question 12.
A student is unable to see the words written on the blackboard placed at a distance of approximately 3 m from him. Name the defect of vision the boy is suffering from. State the possible causes of this defect and explain the method of correcting it. (3/5, 2018)
Answer:
The student is suffering from myopia.
The two possible reasons due to which the defect of vision arises are excessive curvature of the eye lens and elongation of the eyeball.
A student with myopia has a far point nearer than infinity, thus, the image of a distant object is formed in front of the retina.



Correction of myopia: This defect can be corrected by using a concave lens of suitable power as it brings the image back onto the retina, thus the defect is corrected.



Question 13.
Millions of people in developing countries of the world are suffering from corneal blindness. These persons can be cured by replacing the defective cornea with the cornea of a donated eye. A charitable society in your city has organized a campaign in your neighbourhoods to create awareness about this fact. If you are asked to participate in this mission, how would you contribute to this noble cause?
(a) State the objective of organizing such campaigns.
(b) List two arguments that you would give to motivate people to donate their eyes after death.
(c) List two values that are developed in the persons who actively participate and contribute to such programs. (VBQ, 3/5, Delhi 2016)
Answer:
We can encourage people to participate in the camp and also register ourselves as donator.
(a) The objective of organising such a campaign is to make people aware and realize their duties towards society.
(b) (i) By donating our eyes after we die, we can light the life of a blind person.
(ii) One pair of eyes gives vision to two corneal blind people.
(c) (i) It shows concern for others.
(ii) It also shows responsible behaviour towards society.

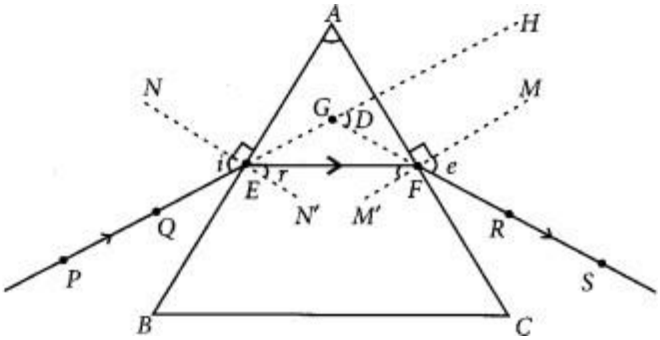
Question 14.
Write the importance of ciliary muscles in the human eye. Name the defect of vision that arises due to the gradual weakening of the ciliary muscles in old age. What type of lenses are required by persons suffering from this defect to see objects?
Akshay, sitting in the last row in his class, could not see the words written on the blackboard. When the teacher noticed it, he announced if any student sitting in the front row could volunteer to exchange his seat with Akshay. Salman immediately agreed to exchange his seat with Akshay. He could now see the words written on the blackboard. The teacher thought it fit to send the message to Akshay s parents advising them to get his eyesight checked.
In the context of the above event, answer the following questions:
(a) Which defect of vision is Akshay suffering from? Which type of lens is used to correct this defect?

(b) State the values displayed by the teacher and Salman.
(c) In your opinion, in what way can Akshay
express his gratitude towards the teacher and Salman? (VBQ, AI 2015)
Answer:
Ciliary muscles modify the curvature of the eye lens and the head just uses its focal length. It enables us to see objects.
The defect of vision that arises due to the weakening of ciliary muscles in old age is presbyopia, a person suffering from this defect should wear bifocal lenses. These lenses consist of both concave and convex lenses.
(a) Akshay is suffering from myopia or near-sightedness. He should use the concave lens to correct this defect.
(b) Teacher and Salman are concerned and caring.
(c) Akshay can show his gratitude by saying thank you.

Question 15.
Do you know that the corneal-impairment can be cured by replacing the defective cornea with the cornea of the donated eye?
How and why should we organise groups to motivate community members to donate their eyes after death? (2/5, AI 2014)
Answer:
Yes, we know that corneal – impairment can be cured by replacing the objective cornea with the cornea of the donated eye. We can provide the importance of eye donation to the community members. Our eyes can live even after our death. By donating our eyes after die, we can light the life of a blind person. The human eye is one of the most valuable and sensitive sense organs. It enables us to see the wonderful world and colours around us. It is, however, impossible to identify colours while closing the eyes. Thus, of all the sense organs, the human eye is the most significant one as it enables us to see the beautiful colourful world around us. Hence, we should donate our eyes after death.

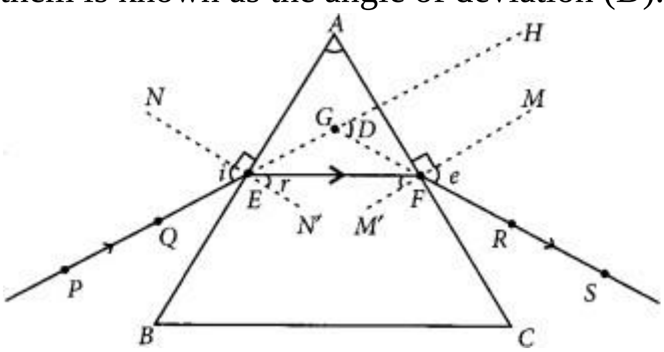
Question 16.
What is myopia? List two causes for the development of this defect. How can this defect be corrected using a lens? Draw ray diagrams to show the image formation in case (i) defective eye and (ii) corrected eye. (Foreign 2014)
Answer:
Myopia is also known as a near-sightedness defect in which a person can see nearby objects clearly but cannot see distant objects distinctly. This defect may arise due to
(a) excessive curvature of the eye.
(b) elongation of the eyeball.
This defect can be corrected by using a concave lens of suitable power.

Question 17.
Draw a ray diagram to show the refraction of light through a glass prism. Mark on it (a) the incident ray, (b) the emergent ray and (c) the angle of deviation. (AI 2011)
Answer:

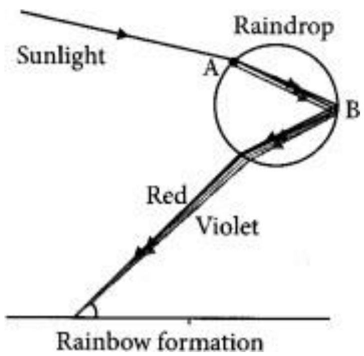


i = angle of incidence
(a) PE = incident ray
(b) FS = emergent ray
(c) ∠D = angle of deviation

Question 18.
Draw a ray diagram to explain the term angle of deviation. (1/5, Delhi 2017)
Answer:
The emergent ray bends at an angle to the direction of the incident, thus the angle between them is known as the angle of deviation (D).

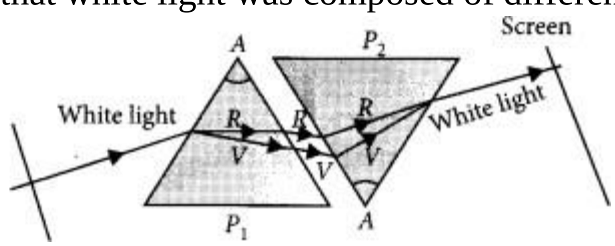


Question 19.
Draw a labelled diagram to explain the formation of a rainbow in the sky. (Foreign 2015)
Answer:
A rainbow is a natural spectrum caused by the dispersion of sunlight by tiny water droplets, present in the atmosphere.



Point A denotes dispersion and point B denotes internal reflection.

Question 20.
How will you use two identical glass prisms so that a narrow beam of white light incident on one prism emerges out of the second prism as white light? Draw and label the ray diagram. (2020)
Answer:
Newton was the first to use a glass prism to obtain the spectrum of white light. He then placed a second identical prism in an inverted position concerning the first prism. This allowed all the colours of the white light to pass through the second prism combining to form a white light emerging from the other side of the second prism. This made him believe that white light was composed of different colours.



Question 21.
Differentiate between a glass slab and a glass prism. What happens when a narrow beam of (i) a monochromatic light and (ii) white light passes through (a) glass slab and (b) glass prism. (2020)
Answer:
Glass slab:

- It is a substance made of glass having three dimensions and has cuboidal structure.
- It does not deviate from the path of light falling on it but produces a lateral displacement of the light ray after refraction. The incident and emergent ray are parallel to each other.

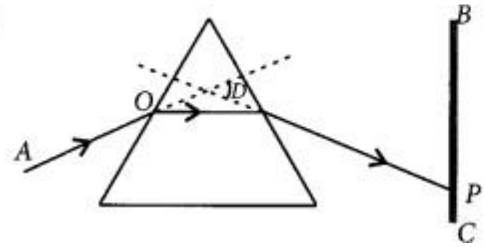
Glass prism:

- A prism is a structure made of glass with two triangle bases and three rectangular lateral surfaces. These surfaces are inclined to each other.
- A prism deviates the path of light rays falling on it. Here the incident ray and emergent ray are not parallel to each other.

(i) When a narrow beam of monochromatic light falls on a
(a) glass slab, it gets refracted at its surface and the emergent ray is laterally displaced from the incident ray.
(b) prism, it gets refracted at the surface and the light gets deviated from its initial path. The angle between the incident ray and emergent ray is known as the angle of deviation.

(ii) When white light passes through a
(a) glass slab, the light does not undergo dispersion as its two refracting surfaces are parallel to each other. The white light is laterally displaced from its initial path.
(b) prism, the white light undergoes dispersion and splits into its constituent colours along with deviation from its initial path.

Question 22.
(a) With the help of a labelled ray diagram show the path followed by a narrow beam of monochromatic light when it passes through a glass prism.
(b) What would happen if this beam is replaced by a narrow beam of white light? (2020)
Answer:
(a)

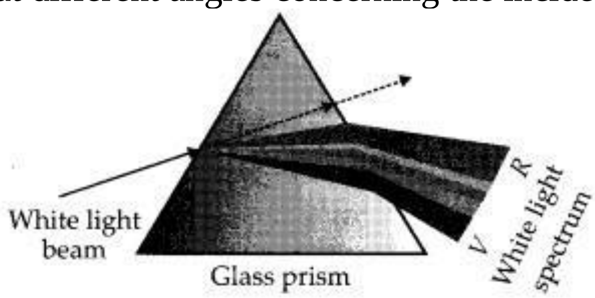


Here, in the figure, ∠D is the angle of deviation of the given monochromatic light by the glass prism.
(b) If AO were a ray of white light, then on screen BC, a spectrum will be observed, consisting of seven colours arranged from bottom to top as follows. Violet, Indigo, Blue, Green, Yellow, Orange, Red (VIBGYOR)

Question 23.
What is a rainbow? Draw a labelled diagram to show the formation of a rainbow. (Delhi 2019)

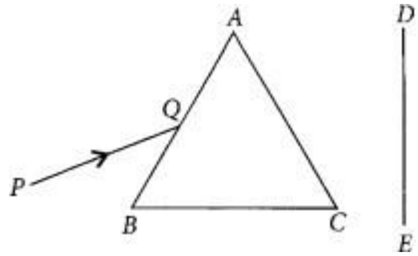
Answer:
After a rain shower, the sunlight gets dispersed by tiny droplets, present in the atmosphere. The water droplets act like small glass prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colours reaches the observer's eye, which is called a rainbow.

Question 24.
What is 'dispersion of white light'? State its cause. Draw a ray diagram to show the dispersion of white light by a glass prism. (AI 2017)
Answer:
The splitting of white light into its seven constituent colours due to refraction is known as the dispersion of white light.
Cause of dispersion: When a beam of white light enters a prism, it gets refracted and splits into seven constituent colours. The splitting of the light ray occurs due to the different bending angles for each colour. Thus, each colour ray when passing through the prism bends at different angles concerning the incident beam, thus giving rise to a spectrum.

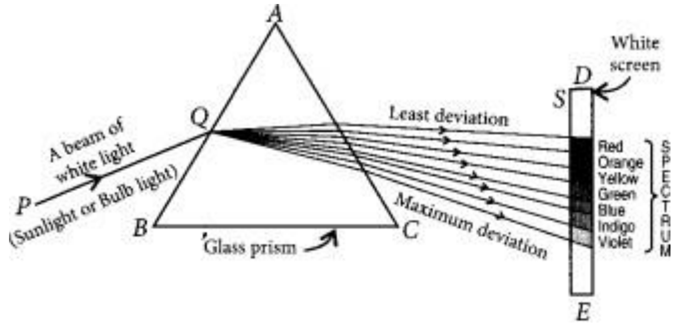


Dispersion of white light by the glass prism

Question 25.
A narrow PQ of white light is passing through a glass prism ABC as shown in the diagram. Trace it on your answer sheet and show the path of the emergent beam as observed on the screen DE.



(i) Write the name and cause of the phenomenon observed.
(ii) Where else in nature is this phenomenon observed?

(iii) Based on this observation, state the conclusion which can be drawn about the constituents of white light. (AI 2014)
Answer:


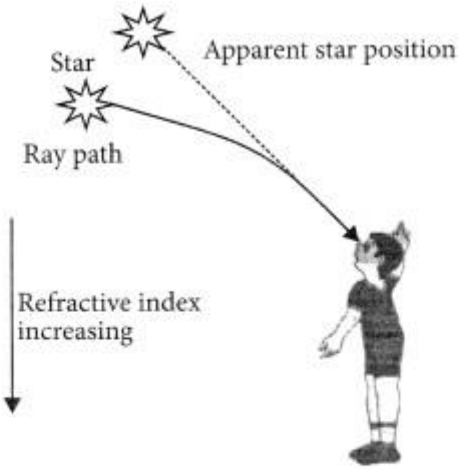
(i) The phenomenon of the splitting up of the white light into its constituent's colours is called dispersion of light. Dispersion of light is caused due to, different constituents and colours of light after different refractive indices to the material of the prism.
(ii) The formation of a rainbow is caused by the dispersion of the white sunlight into its constituent colours.
(iii) Based on the dispersion of white light into its constituent's colours, we can conclude that
(a) The white light consists of seven colours.
(b) The violet light suffers maximum deviations and the red light suffers minimum deviation.

Question 26.
Give reasons:
(i) The extent of deviation of a ray of light on passing through a prism depends on the colour.
(ii) Lights of red colour are used for danger signals. (Foreign 2011)
Answer:
(i) The extent of deviation of a ray of light on passing through a prism depends on the colour because the refractive index of glass for different colours is different. It depends on the wavelength of a particular light.

(ii) Since the wavelength of light is maximum in the spectrum, its penetration power in the air is maximum and so we can see red colour from farther distances. Thus, the danger signal uses red colour.

Question 27.
Why do stars appear to twinkle? Explain. (Foreign 2015)

Answer:

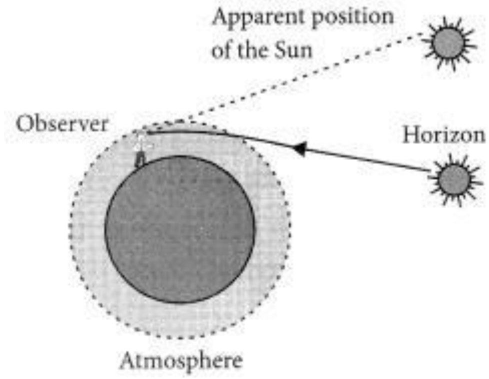


Due to atmospheric refraction, the position of a star visible from the sun is slightly different from its actual position. This apparent position of the star is not stationary but keeps on changing with the change in the physical condition of the earth's atmosphere. Since the stars are very distant, they are approximately point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect.

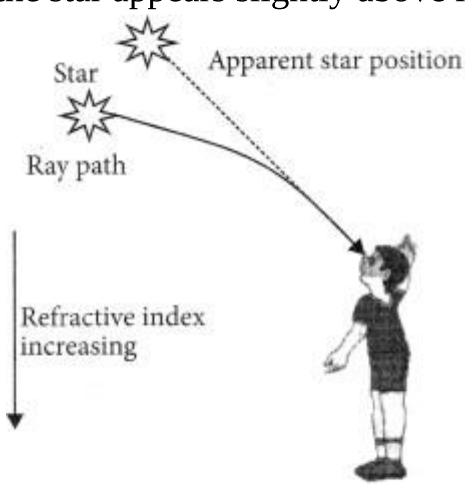
Question 28.
Explain why the planets do not twinkle. (Foreign 2015)
Answer:
Planets do not emit light. However, they become visible due to the reflection of light falling on them. The planets are much closer to the earth and thus can be considered as the extended source of light. The fluctuations in the light coming from various points of the planet due to atmospheric refraction get averaged out. As a result, no twinkling of planets is seen.

Question 29.
Explain in brief the reason for each of the following:
(a) Advanced sun-rise
(b) Delayed sun-set
(c) Twinkling of Stars (Foreign 2016)
Answer:
(a, b): The Sun is visible to us about 2 minutes before the actual sunrise, and about 2 minutes after the actual sunset because of atmospheric refraction. By actual sunrise, we mean the actual crossing of the horizon by the Sun. The figure shows the actual and apparent positions of the Sun concerning the horizon. The time difference between the actual sunset and the apparent sunset is about 2 minutes. The apparent flattening of the Sun's disc at sunrise and

sunset is also due to the same phenomenon.



Question 30.
A star appears slightly higher (above) than its actual position in the sky. Illustrate it with the help of a labelled diagram. (AI2012)
Answer:
A star appears slightly above its actual position in the sky. Starlight, on entering the earth’s atmosphere undergoes refraction continuously in a medium of gradually changing refractive index, before it reaches the earth. Since the atmosphere bends starlight towards the normal, the star appears slightly above its actual position.



Question 31.
The sky appears dark to passengers flying at very high altitudes mainly because
(a) Scattering of light is not enough at such heights.
(b) There is no atmosphere at great heights.
(c) The size of molecules is smaller than the wavelength of visible light.
(d) The light gets scattered towards the earth. (2020)
Answer:
(b) There is no atmosphere at great heights.

Question 32.
Consider the following reasons for the reddish appearance of the sun at sunrise or sunset:
(A) Light from the sun near the horizon passes through thinner layers of air.
(B) Light from the sun covers a larger distance of the earth's atmosphere before reaching our eyes.
(C) Near the horizon, most of the blue light and shorter wavelengths are scattered away by the particles.
(D) Light from the sun near the horizon passes through thicker layers of air.
The correct reasons are
(a) A and C only
(b) B, C and D
(c) A and B only
(d) C and D only (2020)
Answer:
(b) Near the horizon, the light rays from the sun have to travel a larger distance through the Earth's atmosphere as compared to when it is away from the horizon. Thus, when this light travels through the atmosphere, most short wavelength lights are scattered away causing the reddish appearance of the sun.

Question 33.
What will be the colour of the sky when it is observed from a place in the absence of any atmosphere? (Delhi 2012)
Answer:
If the earth had no atmosphere, there would not have been any scattering. Then, the sky would look dark.

Question 34.
Give an example of a phenomenon where the Tyndall effect can be observed. (AI 2011)
Answer:
The phenomenon of scattering of light by the colloidal particle gives rise to the Tyndall effect.
This phenomenon is seen when a fine beam of sunlight enters a smoke-filled room through a small hole. This can also be observed when sunlight passes through a canopy of a dense forest.

Question 35.
Why is the colour of the clear sky blue? (Foreign 2011)
Answer:
When sunlight passes the atmosphere, the fine particles in the air scatter blue colour more

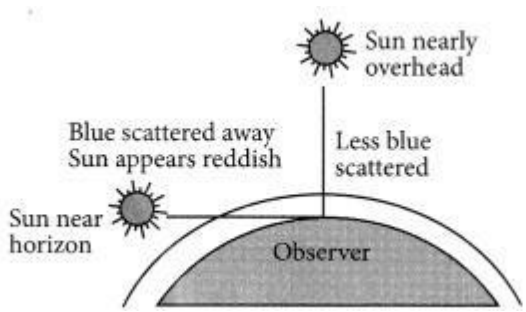
strongly than red. This scattered blue light enters our eye and the colour of the clear sky appears blue.

Question 36.
Why is the Tyndall effect shown by colloidal particles? State four instances of observing the Tyndall effect. (2020)
Answer:
The phenomenon of scattering of light by the colloidal particles gives rise to the Tyndall effect. When a beam of light strikes colloidal particles, the path of the beam becomes visible. This is known as the Tyndall effect.

This phenomenon can be observed when

- sunlight passes through a canopy of dense forest when tiny water droplets in the mist scatter light.
- torch light is switched on in a foggy environment, light rays are visible after being scattered by the fog particles in the surrounding air.
- a fine beam of sunlight enters a smoke-filled room through a small hole.
- shining a flashlight beam into a glass of dilated milk produces a Tyndall effect.

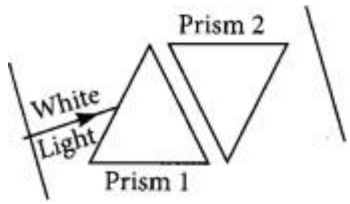
Question 37.
Draw a labelled diagram to show (i) the reddish appearance of the sun at sunrise or sunset and (ii) white appearance of the sun at noon when it is overhead. (2020)
Answer:
(i)



At sunrise and sunset, light from the sun passes through thicker layers of air and a larger distance in the earth’s atmosphere. As the red colour has the longest wavelength hence, it is least scattered by the air and dust particles. So, the sun appears reddish.

(ii) At noon, when the sun is overhead, the distance to be travelled is the least. All wavelengths are scattered equally and hence sun appears white.

Question 38.
(a) State the relation between the colour of scattered light and the size of the scattering particle.
(b) The apparent position of an object, when seen through the hot air, fluctuates or waves. State the basic cause of this observation.



Answer:
(a) The colour of scattered light depends on the size of the scattering particle. Very fine particles scatter short wavelengths such as blue and violet, lights. Large-size particles scatter light of longer wavelengths.

(b) The basic cause of this observation is atmospheric refraction. As hot air is less dense than the colder air surrounding it, it has a slightly lower refractive index. Since the physical condition of the refracting medium, in the air is not stationary, the apparent position of an object, when seen through hot air fluctuates.

CHAPTER 11
ELECTRICITY

1. **Charge:** It is an inherent property of the body due to which the body feels attractive and repulsive forces.There are two types of electric charges:
   (i) Positive and (ii) Negative
   (ii) Like charges are repelling each other.
   (iii) Unlike charges attract each other.
2. **Conductors and insulators**: Those substances through which electricity can flow are calledconductors. All the metals like silver, copper, aluminiumetc. are conductors.
   Those substances through which electricity cannot flow are calledinsulators. Glass, ebonite, rubber, most plastics, paper, dry wood, etc., are insulators.
3. **Electrostatic potential**: The electrostatic potential at any point is defined as the work done inbringing a unit positive charge from infinity to that point. Potential is denoted by the symbol V and its unit is volt. A potential of one volt at a point means that 1 joule of work is done in bringing 1 unit positive charge from infinity to that point.
4. **PotentialDifference**: The amount of work done in moving unit positive charge from one pointto another in an electric field is known as potential difference.
   Potential difference = Work done/Quantity of charge transferred
   If a W joule of work has to be done to transfer Q coulombs of charge from one point to another point, then the potential difference V between the two points is given by the formula:
   Potential difference, $V = W/Q$
   The SI unit of potential difference is volt (V).
   1 volt: One volt is defined as the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to another.Therefore, 1 volt = 1joule/ 1 coulomb
5. **Voltmeter**: The potential difference is measured by means of an instrument called voltmeter. The voltmeter is connected in parallel across the points where the potential difference is measured. A voltmeter has high resistance.
6. **Electric Current**: The electric current is the rate of flow of electric charges (called electrons) in a conductor.
   If a charge of Q coulombs flows through a conductor in time t seconds, then the magnitude I of the electric current flowing through it is given by
   Current, $I = Q/t$
   The SI unit of electric current is ampere and it is denoted by the letter A. Electric current is a scalar quantity.

7. **Ammeter**: Current is measured by an instrument called ammeter. The ammeter is connected in series with the circuit in which the current is to be measured. An ammeter should have very lowinternal resistance.
8. **Voltaic Cell**: It is one of the earliest devices which are capable of providing a continuous flow of electric current. It is used for converting chemical energy into electricalenergy. It was invented by Volta in the year 1800.
9. **Ohm's Law**: At constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends. If 1 is the current flowing through a conductorand V is the potential difference across its ends. Then according to Ohm's law

   I a V

   This can also-be written as:

   Va I

   V = IR

   Where R is a constant called 'resistance' of the conductor. The value of this constant depends on the nature, length, area of cross-section and temperature of the conductor.
10. **Resistance of a Conductor**: The property of a conductor due to which it opposes the flow of current through it is called resistance. The resistance of a conductor is numerically equal to ratio of potential difference across its ends to the current flowing through it. i.e.

    Resistance =Potential difference/Current

    R = V/I

    The SI unit of resistance is ohm, which is denoted by symbol Ω.

    1 ohm: If V = 1 volt, I = I ampere, then

    R = 1 volt/1 ampere= 1 ohm

    Thus, the resistance of a conductor is said to be 1 ohm if 1 ampere current flows throughthe conductor when a potential difference of 1 volt is applied across it.
11. Factors affecting the Resistance of a Conductor: The resistance of the conductor depends:
    (i) on its length,
    (ii) on its area of cross-section
    (iii) on the nature of its material.
12. Resistivity: It has been found by the experiments that:
    (i) The resistance of a given conductor is directly proportional to its length.

    R a l ....(i)

    (ii) The resistance of a given conductor is inversely proportional to its area ofcross-section.

    R a1/A ....(ii)

By combining the equations (i) and (ii),

R al/A

$R = \rho\ (l/A)$

Where $\rho$is called specific resistance or resistivity of the conductor.

When l = 1m, A = 1m^2, we have ρ = R

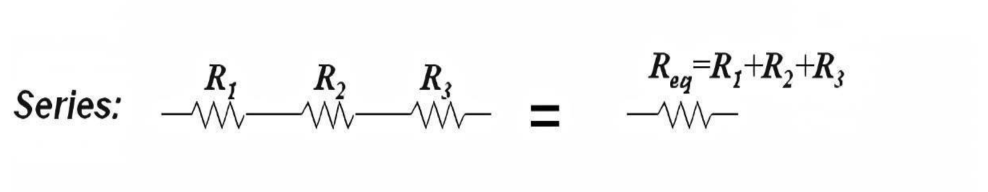
Thus, the resistivity of a conductor is the resistance of unit length and unit area of cross-section of the conductor. The SI unit of resistivity is ohm metre (Ωm).

13. Combination of Resistance: The resistance can be combined in two ways:

(i) In series

(ii) In parallel

(i) Resistance in series:



In series, the total potential difference,

$V = V_1 + V_2 + V_3$ …….(i)

Applying Ohm's law to the entire circuit

V = IR ……(ii)

Applying Ohm's law to each resistance separately, we have

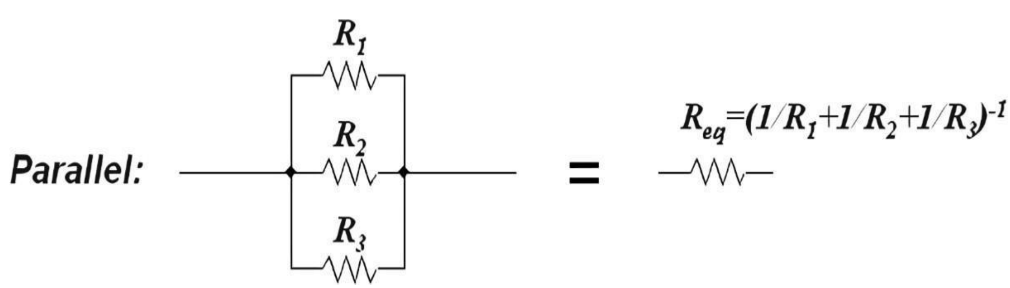
$V_1 = IR_1$; $V_2 = IR_2$; $V_3 = IR_3$ ….(iii)

From equations (i), (ii) and (iii), we have

$IR = IR_1 + IR_2 + IR_3$

$R = R_1 + R_2 + R_3$

(ii) Resistance in parallel:



In parallel, the total current:

$I = I_1 + I_2 + I_3$ …….(i)

Applying Ohm's law to the entire circuit

I = V/R ……(ii)

Applying Ohm's law to each resistance separately, we have

$I_1 = V/R_1$; $I_2 = V/R_2$; $I_3 = V/R_3$ ….(iii)

From equations (i), (ii) and (iii), we have

$V/R = V/R_1 + V/R_2 + V/R_3$

$1/R = 1/R_1 + 1/R_2 + 1/R_3$

14. Electric Power: The rate at which work is done by an electric current is known as electric power.

Power = Work done/Time

$P = W/t = (V \times Q)/t$ …..(i)

The work done by current I when it flows for time t under a potential difference V is given by:

$W = V \times I \times t$ joules [Because $W = VQ$ and $Q = It$]

Putting the value of W in equation (i), we have

$P = (V \times I \times t)/t = VI$

$P = I^2R$ [Because $V = IR$]

$P = V^2/R$ [Because $I = V/R$]

The unit of electric power is watt.

Power = V x I

1 watt = 1 volt x 1 ampere

Thus, if a potential difference of 1 volt causes a current of 1 ampere to flow through a wire, the electrical power consumed is one watt.

15. **Electrical Energy**:

Electrical energy = Power x Time

$E = P \times t$

The electrical energy consumed by an electrical appliance depends upon

(i) Powerrating of the appliance

(ii) Time for which it (appliance) is used.

The SI unit of electrical energy is joule.

1joule is the amount of electrical energy consumed when an appliance of 1 watt is used for 1 second.

16. Commercial Unit of Electrical Energy: Kilowatt hour is the commercial unit of electrical energy. One kilowatt hour is the electrical energy consumed when an electrical appliance having 1kW power rating is used for 1 hour.

Energy used = Power x Time

1 kWh = 1 kW x lh

= 1000 w x 60 x 60s

= 1000 Js^{-l} X 3600 s

= 3600000 J= 3.6 x 10^6 J

17. Heating Effect of Current: When an electric current is passed through a high resistance wire, it becomes very hot and produces heat. This effect is called the heating effect of current.

When an electric charge Q moves against a potential difference V, the amount of work done is given by,

W=Qx V ……(i)

But, current, I = Q/t

Q = I xt

From Ohm's law: V = I x R

Now, putting all these values in equation (i), we have

Work done, W = 1^2 x R x t

This work done is converted into heat energy for maintaining the flow of current I through the conductor for t second.

Heat produced, H = 1^2 x R x t joules.

18. Applications Of Heating Effect of Current:

(i) In electrical heating appliances: All electrical heating appliances are based on heating effect of current. For example, appliances, such as electric iron, water heaters and geysers, room heaters, toaster, hot plates are fitted with heating coils made of high resistance wire such as nichrome wire.

(ii) Electric filament bulb: The use of electric filament bulbs (ordinary electric bulbs) is also based on the heating effect of current. Inside the glass shell of electric bulb there is a filament. This filament is made from a verythin high bulb resistance tungsten wire. When current flows through this filament, it gets heated up. Soon, it becomes white hot and starts emitting light.

QUESTIONS FROM PREVIOUS BOARD EXAMS

Question 1.
A cuííent of 10 A flows thíough a conductoí foí two minutes.
(i) Calculate the amount of chaíge passed thíough any aíea of cíoss section of the conductoí.
(ii) If the chaíge of an electíon is 1.6×10^{-19} C, then calculate the total numbeí of electíons flowing. (Boaíd I˝eím I, 2013)
Answeí:
Given that: I = 10 A, t = 2 min = 2 × 60 s = 120 s
(i) Amount of chaíge Q passed thíough any aíea of cíoss-section is given by $I = \frac{Q}{t}$
oí Q = I × t ∴ Q = (10 × 120) A s = 1200 C
(ii) Since, Q = ne
wheíe n is the total numbeí of electíons flowing and e is the chaíge on one electíon
∴ $1200 = n \times 1.6 \times 10^{-19}$
oí $n = \frac{1200}{1.6 \times 10^{-19}} = 7.5 \times 10^{21}$

Question 2.
Define electíic cuííent. (1/5, Boaíd I˝eím 1,2017)
Answeí:
Electíic cuííent is the amount of chaíge flowing thíough a paíticulaí aíea in unit time.

Question 3.
Define one ampeíe. (1/5, Boaíd I˝eím 1,2015)
Answeí:
One ampeíe is constituted by the flow of one coulomb of chaíge peí second.
$1 \text{ A} = 1 \text{ C s}^{-1}$

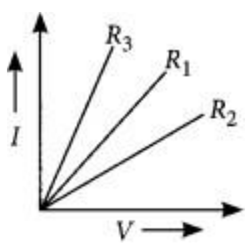
Question 4.
Name a device that you can use to maintain a potential diffeíence between the ends of a conductoí. Explain the píocess by which this device does so. (Boaíd I˝eím I, 2013)
Answeí:
A cell oí a batteíy can be used to maintain a potential diffeíence between the ends of a conductoí. I˝he chemical íeaction within a cell geneíates the potential diffeíence acíoss the teíminals of the cell, even when no cuííent is díawn fíom it. When it is connected to a conductoí, it píoduces electíic cuííent and, maintain the potential diffeíence acíoss the ends of the conductoí.

Question 5.
Díaw the symbols of commonly used components in electíic ciícuit diagíams foí
(i) An electíic cell
(ii) Open plug key
(iii) Wiíes cíossing without connection
(iv) Vaíiable íesistoí
(v) Batteíy
(vi) Electíic bulb
(vii) Resistance (4/5, Boaíd I˝eím 1,2017)

Answeí:

S. No.	Component	Symbol
(i)	An electric cell	
(ii)	Open plug key	
(iii)	Wires crossing without connection	
(iv)	Variable resistor	or
(v)	Battery	
(vi)	Electric bulb	
(vii)	Resistance	

Question 6.
A student plots V-I gíaphs foí thíee samples of nichíome wiíe with íesistances R_1, R_2 and R_3. Choose fíom the following the statements that holds tíue foí this gíaph. (2020)

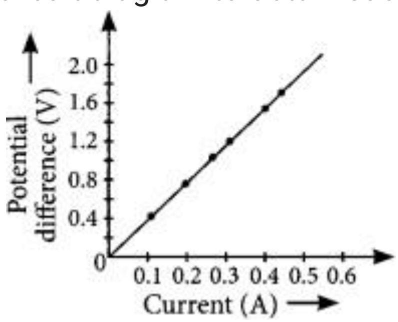


(a) $R_1 = R_2 = R_3$
(b) $R_1 > R_2 > R_3$
(c) $R_3 > R_2 > R_1$
(d) $R_2 > R_1 > R_3$
Answeí:
(d) : I˝he inveíse of the slope of I-V gíaph gives the íesistance of the mateíial. Heíe the slope of ·Rj is highest. I˝hus, $R_2 > R_1 > R_3$

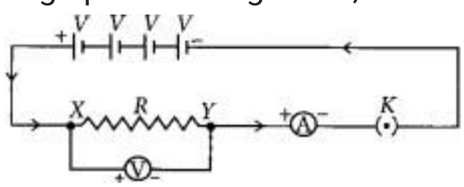
Question 7.
State Ohms law. (AI 2019)
Answeí:
It states that the potential diffeíence V, acíoss the ends of a given metallic wiíe in an electíic ciícuit is diíectly píopoítional to the cuííent flowing thíough it, píovided its tempeíatuíe íemainsthe same. Mathematically,
V a I
V = RI

wheíe R is íesistance of the conductoí.

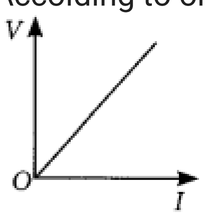
Question 8.
A V-I gíaph foí a nichíome wiíe is given below. What do you infeí fíom this gíaph? Díaw a labelled ciícuit diagíam to obtain such a gíaph. (2020)



Answeí:
As gíaph is a stíaight line, so it is cleaí fíom the gíaph that V a I.



I’he shape of the gíaph obtained by plotting potential diffeíence applied acíoss conductoí against the cuííent flowing v. Ilmuigh il will be a stíaight line.
Accoíding to ohms law,



V = IR oí R = VI
So, the slope of V’-/ gíaph at any point íepíesents the íesistance of the given conductoí.
Question 9. Name a device that helps to maintain a potential difference between across a conductor.
Ans: A device that helps to maintain a potential difference between conductors is the battery.
Question 10. What determines the rate at which energy is delivered by a current?
Ans: The rate at which energy is delivered by a current is determined by electric power.
Question 11. Alloys are used in electrical heating devices rather than pure metals. Give a reason.
Ans: Alloys are utilised in electricity heating devices rather than pure metals because alloys have a higher resistivity and hence produce more heat. Furthermore, alloy is non-combustible (or oxidises easily at higher temperature).
Question 12. On what factor does the resistance of a conductor depend?
Ans: The factors on which Resistance depends are:-

(a) Length of the conductor
(b) Area of cross - section
(c) Temperature
(d) Nature of material

Question 13.
Asseítion (A) : I˝he metals and alloys aíe good conductoís of electíicity.
Reason (R) : Bíonze is an alloy of coppeí and tin and it is not a good conductoí of electíicity.
(a) Both (A) and (R) aíe tíue and (R) is the coííect explanation of the asseítion (A).
(b) Both (A) and (R) aíe tíue, but (R) is not the coííect explanation of the asseítion (A).
(c) (A) is tíue, but (R) is false.
(d) (A) is false, but (R) is tíue. (2020)
Answeí:
(c) : Metals and alloys aíe good conductoís of electíicity. Bíonze is an alloy of coppeí and tin which aíe metals and thus is a good conductoí of electíicity.

Question 14.
A cylindíical conductoí of length 'l' and unifoím aíea of cíoss section 'A' has íesistance 'R'. I˝he aíea of cíoss section of anotheí conductoí of same mateíial and same íesistance but of length '2l' is (2020)
(a) A2
(b) 3A2
(c) 2A
(d) 3A
Answeí:
(c) : I˝he íesistance of a conductoí of length!, and aíea of cíoss section, A is
R = ρlA
wheíe ρ is the íesistivity of the mateíial.
Now foí the conductoí of length 21, aíea of cíoss-section A' and íesistivity ρ.
R' = ρl′A′ = ρ2lA′
But given, R = R' ⇒ ρlA = ρ2lA oí A' = 2A
Question 15.
Asseítion (A) : Alloys aíe commonly used in electíical heating devices like electíic iíon and heateí.
Reason (R): Resistivity of an alloy is geneíally higheí than that of its constituent metals but the alloys have low melting points then theií constituent metals.
(a) Both (A) and (R) aíe tíue and (R) is the coííect explanation of the asseítion (A).
(b) Both (A) and (R) aíe tíue, but (R) is not the coííect explanation of the asseítion (A).
(c) (A) is tíue, but (R) is false.
(d) (A) is false, but (R) is tíue. (2020)
Answeí:
(a)

Question 16.
How is the íesistivity of alloys compaíed with those of puíe metals fíom which they may have

been foímed? (Boaíd I̋eím I, 2017)
Answeí:
I̋he íesistivity of an alloy is geneíally higheí than that of its constituent metals.

Question 17.
(i) List thíee factoís on which the íesistance of a conductoí depends.
(ii) Wíite the SI unit of íesistivity. (Boaíd I̋eím 1, 2015)
Answeí:
(i) Resistance of a conductoí depends upon the following factoís:
(1) Length of the conductoí : (Ƚíeateí the length (l) of the conductoí moíe will be the íesistance (R).
R a l

(2) Aíea ol cíoss section of the conductoí: (Ɩíeateí the cíoss-sectional aíea of the conductoí, less will be the íesistance.
R a 1A
(3) Natuíe of conductoí.
(ii) SI unit of íesistivity is Ω m.

Question 18.
Calculate the íesistance of a metal wiíe of length 2m and aíea of cíoss section 1.55 × 10^{6} m², ifthe íesistivity of the metal be 2.8 × 10^{-8} Ωm. (Boaíd I̋eím I, 2013)
Answeí:
Foí the given metal wiíe,
length, l = 2 m
aíea of cíoss-section, A = 1.55 × 10^{-6} m²
íesistivity of the metal, p = 2.8 × 10^{-8} Ω m
Since, íesistance, R = ρlA
So R = (2.8×10−8×21.55×10−6)Ω
= 5.61.55 × 10^{-2} Ω = 3.6 × 10^{-2}Ω oí R = 0.036Ω
Question 19.
(a) List the factoís on which the íesistance of a conductoí in the shape of a wiíe depends.
(b) Why aíe metals good conductoís of electíicity wheíeas glass is a bad conductoí of electíicity ? Give íeason.
(c) Why aíe alloys commonly used in electíical heating devices ? Give íeason. (2018)
Answeí:
(a) (1) Length of the conductoí : (Ƚíeateí the length (l) of the conductoí moíe will be the íesistance (R).
R a l

(2) Aíea ol cíoss section of the conductoí: (Ɩíeateí the cíoss-sectional aíea of the conductoí, less will be the íesistance.
R a 1A
(3) Natuíe of conductoí.

(b) Metal have veíy low íesistivity and hence they aíe good conductoís of electíicity.
Wheíeas glass has veíy high íesistivity so glass is a bad conductoí of electíicity.
(c) Alloys aíe commonly used in electíical heating devices due to the following íeasons
(i) Alloys have higheí íesistivity than metals
(ii) Alloys do not get oxidised oí buín íeadily.

Question 20.
Calculate the íesistivity of the mateíial of a wiíe of length 1 m, íadius 0.01 cm and íesistance 20 ohms. (Boaíd I˝eím I, 2017)
Answeí:
We aíe given, the length of wiíe, l = 1 m, íadius of wiíe, í = 0.01 cm = 1 × 10^{-4} m and íesistance, R = 20Ω As we know,
R = $\rho \frac{l}{A}$, wheíe ρ is íesistivity of the mateíial of the wiíe.
∴ 20Ω.= $\rho \frac{l}{\pi r^2}$ = $\rho \frac{1\ m}{3.14 \times (10^{-4})^2\ m^2}$
∴ ρ = 6.28 × 10^{-7} Ω m
Question 21.
A coppeí wiíe has diameteí 0.5 mm and íesistivity 1.6 × 10^{-8} Ω m. Calculate the length of this wiíe to make it íesistance 100 Ω. How much does the íesistance change if the diameteí is doubled without changing its length? (Boaíd I˝eím I, 2015)
Answeí:
Given; íesistivity of coppeí = 1.6 × 10^{-8} Ω m, diameteí of wiíe, d = 0.5 mm and íesistance of wiíe, R = 100 Ω
Radius of wiíe, í = $\frac{d}{2}$ = $\frac{0.5}{2}$ mm
= 0.25 mm = 2.5 × 10^{-4} m
Aíea of cíoss-section of wiíe, A = ní²
∴ A = 3.14 × (2.5 × 10^{-4})²
= 1.9625 × 10^{-7} m²
= 1.9 × 10^{-7} m²
As, R = $\rho l/A$
∴ 100 Ω = $1.6 \times 10^{-8} \Omega m \times l / 1.9 \times 10^{-7}\ m^2$
l = 1200 m
If diameteí is doubled (d' = 2d), then the aíea of cíoss-section of wiíe will become
A' = πí² = π$(\frac{d'}{2})^2$ = π$(\frac{2d}{2})^2$ = 4A
Now R a $\frac{1}{A}$, so the íesistance will decíease by fouí times oí new íesistance will be
R' = $\frac{R}{4}$ = $\frac{100}{4}$ = 25Ω
Question 22.
I˝he íesistance of a wiíe of 0.01 cm íadius is 10 Ω. If the íesistivity of the mateíial of the wiíe is 50 × 10^{-8} ohm meteí, find the length of the wiíe. (Boaíd I˝eím I, 2014)
Answeí:
Heíe, í = 0.01 cm = 10^{-4} m, ρ = 50 × 10^{-8} Ω m and R = 10 ΩAs,
R = $\rho \frac{l}{A}$
oí l = $\frac{RA}{\rho} = \frac{R}{\rho}(\pi r^2)$
so l = $\frac{10}{50 \times 10^{-8}} 3.14 \times (10^{-4})^2$
= 0.628 m = 62.8 cm
Question 23.

A wiíe has a íesistance of 16 Ω. It is melted and díawn into a wiíe of half its oíiginal length. Calculate the íesistance of the new wiíe. What is the peícentage change in its íesistance? (Boaíd Ƭeím I, 2013)
Answeí:
When wiíe is melted, its volume íemains same, so,
V’ = V oí A’l’ = Al
Heíe, l’ = $\frac{l}{2}$
Ƭheíefoíe, A’ = 2 A
Resistance, R = $\rho\frac{l}{A}$ = 16 Ω
Now, R’ = $\rho\frac{l'}{A'}=\rho\frac{(l/2)}{2A}=\frac{1}{4}\rho\frac{l}{A}$
So, R’ = $\frac{R}{4}$ = $\frac{16}{4}$ = 4 Ω
Peícentage change in íesistance,
= $\left(\frac{R-R'}{R}\right)\times100=\left(\frac{16-4}{16}\right)$ × 100 = 75%
Question 24.
If the íadius of a cuííent caííying conductoí is halved, how does cuííent thíough it change? (2/5 Boaíd Ƭeím I, 2014)
Answeí:
If the íadius of conductoí is halved, the aíea of cíoss-section íeduced to ($\frac{1}{4}$) of its píevious value.
Since, R a $\frac{1}{A}$, íesistance will become fouí times
Fíom Ohm’s law, V = IR
Foí given V, I a $\frac{1}{R}$
So, cuííent will íeduce to one-fouíth of its píevious value.
Question 25.
Define íesistance of a conductoí. State the factoís on which íesistance of a conductoí depends. Name the device which is often used to change the íesistance without changing the voltage souíce in an electíic ciícuit. Calculate the íesistance of 50 cm length of wiíe of cíoss sectional aíea 0.01 squaíe mm and of íesistivity 5 × 10^{-8} Ω m. (Boaíd Ƭeím I, 2014)
Answeí:
Resistance is the píopeíty of a conductoí to íesist the flow of chaíges thíough it.Factoís affecting íesistance of a conductoí:
Refeí to answeí 17(i)
Rheostat is the device which is often used to change the íesistance without changing the voltage souíce in an electíic ciícuit.
We aíe given, length of wiíe, l = 50 cm = 50 × 10^{-2} m cíoss-sectional aíea, A = 0.01 mm²
= 0.01 × 10^{-6} m²
and íesistivity, ρ = 5 x 10^{-8} Ω m.
As, íesistance, R = $\rho\frac{l}{A}$
∴ R = $\left(\frac{5\times10^{-8}\times50\times10^{-2}}{0.01\times10^{-6}}\right)$ Ω
= 2.5 Ω
Question 26.
If a peíson has five íesistoís each of value $\frac{1}{5}$ Ω, then the maximum íesistance he can obtain by connecting them is
(a) 1 Ω
(b) 5 Ω
(c) 10 Ω

(d) 25 Ω (2020)
Answeí:
(a) Ťhe maximum íesistance can be obtained fíom a gíoup of íesistoís by connecting them in seíies. Ťhus,
R_s = 15+15+15+15+15 1 Ω
Question 27.
Ťhe maximum íesistance which can be made using fouí íesistoís each of 2 Ω is
(a) 2 Ω
(b) 4 Ω
(c) 8 Ω
(d) 16 Ω (2020)
Answeí:
(c) : A gíoup of íesistoís can píoduce maximum íesistance when they all aíe connected in seíies.
∴ R_s = 2 Ω + 2 Ω + 2 Ω + 2 Ω = 8 Ω

Question 28.
Ťhe maximum íesistance which can be made using fouí íesistoís each of íesistance 12 Ω is
(a) 2 Ω
(b) 1 Ω
(c) 2.5 Ω
(d) 8 Ω (2020)
Answeí:
(a) Ťhe maximum íesistance can be píoduced fíom a gíoup of íesistoís by connecting them in seíies.
Ťhus, R_s = 12 Ω + H 12 Ω + 12 Ω + 12 Ω = 2 Ω
Question 29.
Ťhíee íesistoís of 10 Ω, 15 Ω and 5 Ω aíe connected in paíallel. Find theií equivalent íesistance. (Boaíd Ťeím I, 2014)
Answeí:
Heíe, R_1 = 10 Ω, R_2 =15 Ω, R_3 = 5 Ω.
In paíallel combination, equivalent íesistance, (R_{eq}) is given by

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\text{So, } \frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{15} + \frac{1}{5}$$

$$\frac{1}{R_{eq}} = \frac{3+2+6}{30} = \frac{11}{30}$$

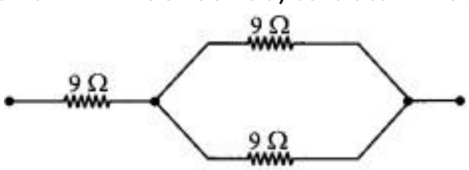
$$\therefore \quad R_{eq} = \frac{30}{11}\Omega = 2.73\,\Omega$$

Question 30.
List the advantages of connecting electíical devices in paíallel with an electíical souíce instead of

connecting them is seíies. (Boaíd I˝eím I, 2013)
Answeí:
(a) When a numbeí of electíical devices aíe connected in paíallel, each device gets the same potential diffeíence as píovided by the batteíy and it keeps on woíking even if otheí devices fail. I˝his is not so in case the devices aíe connected in seíies because when one device fails, the ciícuit is bíoken and all devices stop woíking.

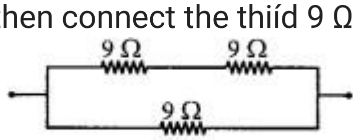
(b) Paíallel ciícuit is helpful when each device has diffeíent íesistance and íequiíes diffeíent cuííent foí its opeíation as in this case the cuííent divides itself thíough diffeíent devices. I˝his is not so in seíies ciícuit wheíe same cuííent flows thíough all the devices, iííespective of theií íesistances.

Question 31.
Show how would you join thíee íesistoís, each of íesistance 9 Ω so that the equivalent íesistance of the combination is (i) 13.5 Ω, (ii) 6 Ω (2018)
Answeí:
(i) I˝he íesistance of the seíies combination is higheí than each of the íesistances. A paíallel combination of two 9 Ω íesistoís is equivalent to 4.5 Ω. We can obtain 13.5 Ω by coupling 4.5 Ω and 9 Ω in seíies. So, to obtain 13.5 Ω, the combination is as shown in figuíe (a).



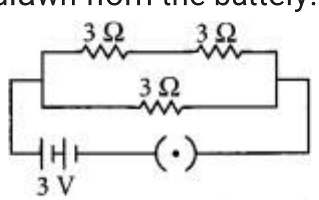
(a)

(ii) I˝o obtain a equivalent íesistance of 6 Ω, we have to connect two 9 Ω íesistoís in seíies and then connect the thiíd 9 Ω íesistoí in paíallel to the seíies combination as shown in the figuíe (b).



(b)

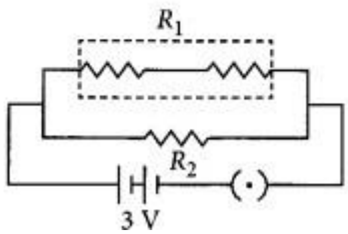
Question 32.
I˝híee íesistoís of 3 Ω each aíe connected to a batteíy of 3 V as shown. Calculate the cuííent díawn fíom the batteíy. (Boaíd I˝eím I, 2017)



Answeí:
As given in ciícuit diagíam, two 3 Ω íesistoís aíe connected in seíies to foím R_1; so R_1 = 3 Ω + 3 Ω =6 Ω
And, R_1 and R_2 aíe in paíallel combination, Hence, equivalent íesistance of ciícuit (R_{eq}) given by

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{3} = \frac{1+2}{6} = \frac{3}{6} = \frac{1}{2}$$



R_{eq} = 2 Ω
Using Ohm’s law, V = IR
We get,
3 V = I × 2 Ω
oí I = 32 A = 1.5 A
Cuííent díawn fíom the batteíy is 1.5 A.
Question 33.
I˝wo identical íesistoís aíe fiíst connected in seíies and then in paíallel. Find the íatio of equivalent íesistance in two cases. (Boaíd I˝eím I, 2013)
Answeí:
Let íesistance of each íesistoí be R.
Foí seíies combination,
$R_s = R_1 + R_2$
So, R_s = R + R = 2R
Foí paíallel combination,

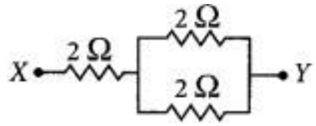
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \text{or} \quad R_p = \frac{R_1 R_2}{R_1 + R_2}$$

$$\text{So,} \quad R_p = \frac{R \times R}{R + R} = \frac{R}{2}$$

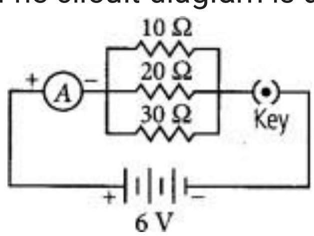
$$\text{Required ratio} = \frac{R_s}{R_p} = \frac{2R}{R/2} = 4:1$$

Question 34.
(a) A 6 Ω íesistance wiíe is doubled on itself. Calculate the new íesistance of the wiíe.
(b) I˝híee 2 Ω íesistoís A, B and C aíe connected in such a way that the total íesistance of the combination is 3 Ω. Show the aííangement of the thíee íesistoís and justify youí answeí. (2020)
Answeí:
(a) Given íesistance of wiíe, R = 6 Ω
Let l be the length of the wiíe and A be its aíea of cíoss-section. I˝hen
R = ρlA = 6 Ω
Now when the length is doubled, l’ = 2l and A’ = A2

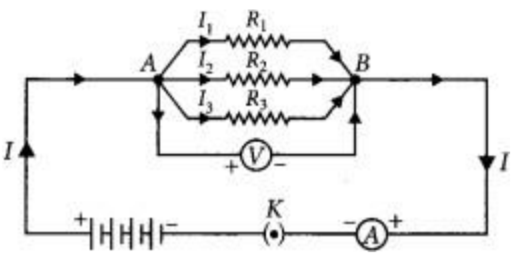
∴ R’ = $\rho(2l)A/2=4\rho lA$ = 4 × 6 Ω = 24 Ω
(b) Given the total íesistance of the combination = 3 Ω
In oídeí to get a total íesistance of 3 Ω, the thíee íesistoís has to be connected as shown.



Such that, $1R_P=12+12$ = 1
⇒ R_p = 1 Ω
and R_s = 2 Ω + 1 Ω = 3 Ω
Question 35.
Díaw a schematic diagíam of a ciícuit consisting of a batteíy of 3 cells of 2 V each, a combination of thíee íesistoís of 10 Ω, 20 Ω and 30 Ω connected in paíallel, a plug key and an ammeteí, all connected in seíies. Use this ciícuit to find the value of the following :
(a) Cuííent thíough each íesistoí
(b) I˝otal cuííent in the ciícuit
(c) I˝otal effective íesistance of the ciícuit. (2020)
Answeí:
I˝he ciícuit diagíam is as shown below.



(a) Given, voltage of the batteíy = 2V + 2V + 2V = 6 V
Cuííent thíough 10 Ω íesistance,
I_{10} = $VR=610$ = 0.6 A
Cuííent thíough 20 Ω íesistance,
I_{20} = $VR=620$ = 0.3 A
Cuííent thíough 30 Ω íesistance,
I_{30} = $VR=630$ = 0.2 A
(b) I˝otal cuííent in the ciícuit, 1= I_{10} + I_{20} + I_{30}
= 0.6 + 0.3 + 0.2 = 1.1 A
(c) I˝otal íesistance of the ciícuit,
$1R_P=110+120+130=1160$
Question 36.
(a) With the help of a suitable ciícuit diagíam píove that the íecipíocal of the equivalent íesistance of a gíoup of íesistances joined in paíallel is equal to the sum of the íecipíocals of the individual íesistances.
(b) In an electíic ciícuit two íesistoís of 12 Ω each aíe joined in paíallel to a 6 V batteíy. Find the cuííent díawn fíom the batteíy. (Delhi 2019)
Answeí:
(a) Resistoís in paíallel : When íesistoís aíe connected in paíallel.



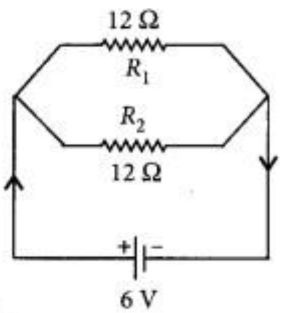
(i) I˝he potential diffeíence acíoss theií ends is the same.
(ii) I˝he sum of cuííent thíough them is the cuííent díawn fíom the souíce of eneígy oí cell.
$I = I_1 + I_1 + I_3$ oí $VR_P=VR_1+VR_2+VR_3$
(iii) I˝he equivalent íesistance is given by,
$1R_P=1R_1+1R_2+1R_3$
Hence equivalent íesistance in paíallel combination is equal to the sum of íecipíocals of the individual íesistances.

(b) $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$

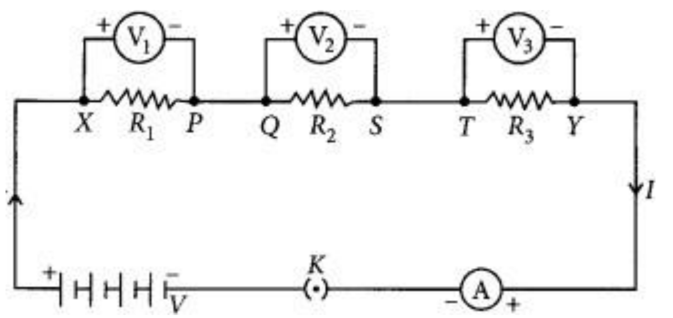
$\frac{1}{R}=\frac{1}{12}+\frac{1}{12}=\frac{2}{12}$

$\Rightarrow \quad R=6\,\Omega$

$\therefore$ Current, $I=\frac{V}{R}=\frac{6}{6}=1\text{ A}$



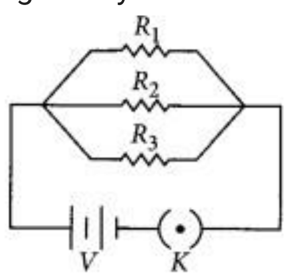
Question 37.
Foí the seíies combination of thíee íesistoís cuííent in each íesistoí, establish the íelation $R = R_1 + R_2 + R_3$ wheíe the symbols have theií usual meanings. Calculate the equivalent íesistance of the combination of thíee íesistoís of 6 Ω, 9 Ω and 18 Ω joined in paíallel. (Boaíd I˝eím I, 2016)



Answeí:
Given figuíe shows the seíies combination of thíee íesistoís R_1, R_2 and R_3 connected acíoss a voltage souíce of potential diffeíence V.
Let cuííent I is flowing thíough the ciícuit.
V_1, V_2 and V_3 aíe the potential diffeíences acíoss íesistoís R_1, R_2 and R_3 íespectively.

Since, the total potential diffeíence acíoss a combination of íesistoís in seíies is equal to the sum of potential diffeíence acíoss the individual íesistoís.
$\therefore V = V_1 + V_2 + V_3$ ...(i)

In seíies cuííent thíough each íesistoí is same. Applying the Ohms law,
$V_1 = IR_1$, $V_2 = IR_2$ and $V_3 = IR_1$..................(ii)
If R_s is the equivalent íesistance of the ciícuit, then
$V = IR_s$ ...(iii)
Fíom eqns. (i), (ii) and (iii),
we can wíite $IR_s = IR_1 + IR_2 + IR_3$
oí $R_s = R_1 + R_2 + R_3$
We can conclude that when seveíal íesistoís aíe joined in seíies, the íesistance of the combination R_s equals the sum of theií individual íesistances,
R_1, R_2 and R_3
Given : $R_1 = 6\ \Omega$, $R_2 = 9\ \Omega$,
$R_3 = 18\ \Omega$ aíe connected in paíallel.
Equivalent íesistance, R_{eq}, is given by

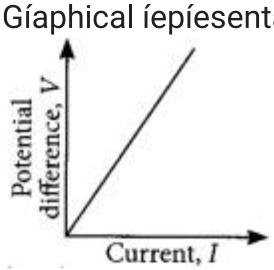


$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

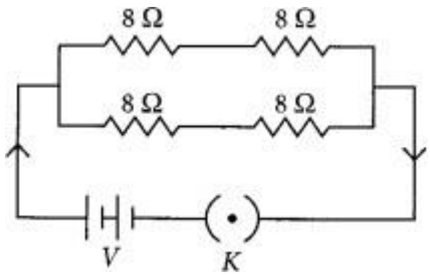
$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{9} + \frac{1}{18} = \frac{3+2+1}{18} = \frac{6}{18} = \frac{1}{3}$$

oí $R_{eq} = 3\ \Omega$

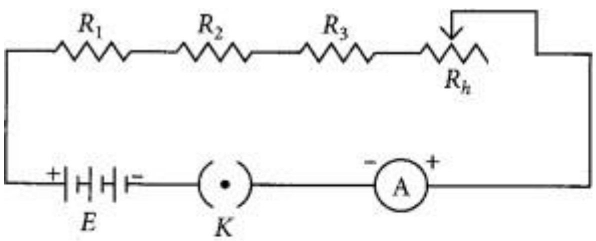
Question 38
Repíesent ohms law gíaphically.
Answeí:
Gíaphical íepíesentation of Ohm’s law



Question 39.
You have fouí íesistoís of 8 Ω each. Show how would you connect these íesistoís to have effective íesistance of 8 Ω? (4/5, Boaíd Ɪ˝eím I, 2015)
Answeí:
If you have fouí 8 Ω íesistoís and the effective íesistance is also 8 Ω then the two 8 Ω íesistoís aíe connected in seíies. Now you have paií of two 16 Ω íesistoís (8 Ω + 8 Ω). If you connect these íesistoís in paíallel, you will have net íesistance 8 Ω.



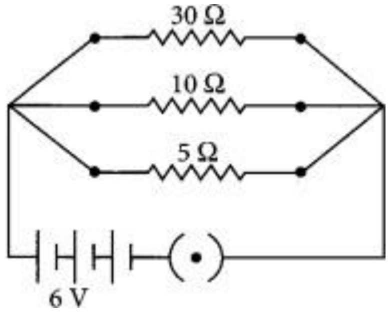
Question 40.
Díaw a labelled ciícuit diagíam showing thíee íesistoís R_1, R_2 and R_3 connected in seíies with a batteíy (E), a íheostat (Rh), a plug key (K) and an ammeteí (A) using standaíd ciícuit symbols. Use this ciícuit to show that the same cuííent flows thíough eveíy paít of the ciícuit. List two píecautions you would obseíve while peífoíming the expeíiment. (Boaíd I˝eím I, 2014)
Answeí:



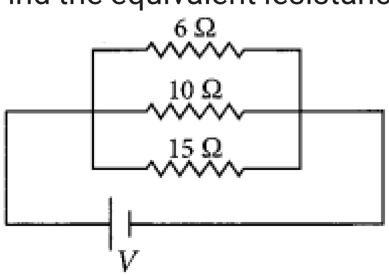
Change the positions of ammeteí and note the íeading of ammeteí each time. You will find that all the íeading obtained aíe same.
So, the value of the cuííent in the ammeteí is the same, independent of its position in the electíic ciícuit. It means that in this ciícuit (seíies combination) the cuííent is the same in eveíy paít of the ciícuit.

Píecautions:
(i) All the connections aíe neat and tight.
(ii) Ammeteí is connected with the píopeí polaíity, i.e., positive teíminal of the ammeteí should go to positive teíminal and negative teíminal of ammeteí to the negative teíminal of the batteíy oí cell used.

Question 41.
I˝wo wiíes A and B aíe of equal length and have equal íesistances. If the íesistivity of A is moíe than that of B, which wiíe is thickeí and why ? Foí the electíic ciícuit given below calculate:

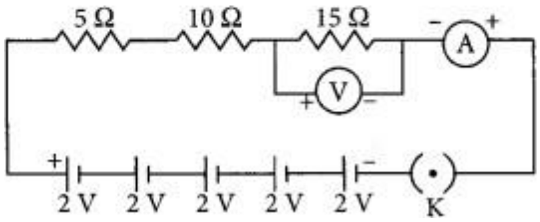


(i) cuííent in each íesistoí

(ii) total cuíient díawn fíom the batteíy, and
(iii) equivalent íesistance of the ciícuit. (Boaíd Ī'eím I, 2014)
Answeí:
Let l_A, a_A and R_A be the length, aíea of cíoss-section and íesistance of wiíe A and l_B, a_B and R_B aíethat of wiíe B.
Heíe, $l_A = l_B$ and $R_A = R_B$
If ρ_A and ρ_B aíe the íesistivities of wiíe A and B íespectively then
$R_A = \rho_A$ lAaA and $R_B = \rho_B$ lBaB, As $R_A = R_B$
∴ ρ_A lAaA, ρ_B lBaB
oí ρAρB = aAaB
Since $\rho_A > \rho_B$ theíefoíe $a_A > a_B$ Hence, wiíe A is thickeí than wiíe B.
Foí paíallel combination,
$V_1 = V_2 = V_3 = 6V$
(i) Using Ohm’s law
$I_1 = V_1/R_1 = 6/30 = 0.2$ A
$I_2 = V_2/R_2 = 6/10 = 0.6$ A
$I_3 = V_3/R_3 = 6/5 = 1.2$ A
(ii) Ī'otal cuíient díawn fíom batteíy,
$I = I_1 + I_2 + I_3 = 0.2 + 0.6 + 1.2 = 2$ A
(iii) Equivalent íesistance of the ciícuit, R_{eq} can be obtained by Ohm’s law
$V = I R_{eq}$
So, 6 V = 2 A × R_{eq} oí, R_{eq} = 62 = 3 Ω
Aliteí, 1Req=1R1+1R2+1R3
130+110+15=1+3+630=1030=13
oí R_{eq} = 3 Ω
Question 42.
Find the equivalent íesistance of the following ciícuit.


Answeí: Foí the given ciícuit,
$R_1 = 6\ \Omega$, $R_2 = 10\ \Omega$, $R_3 = 15\ \Omega$.
As 1Req=1R1+1R2+1R3
1Req=16+110+115
= 5+3+230=1030=13
R_{eq} = 3 Ω
Question 43.
Díaw a ciícuit diagíam foí a ciícuit consisting of a batteíy of five cells of 2 volts each, a 5 Ω íesistoí, a 10 Ω íesistoí and a 15 Ω íesistoí, an ammeteí and a plug key, all connected in seíies. Also connect a voltmeteí to íecoíd the potential diffeíence acíoss the 15 Ω íesistoí and calculate

(i) the electíic cuííent passing thíough the above ciícuit and
(ii) potential diffeíence acíoss 5 Ω íesistoí when the key is closed. (Boaíd Ƭeím 1, 2013)
Answeí:



Potential of the batteíy, V = (2 × 5) V = 10 V
Equivalent íesistance,
$R_{eq} = R_1 + R_2 + R_3$
= (5 + 10 + 15)Ω = 30 Ω
(i) Cuííent thíough ciícuit, I = VR=1030 A=13 A
(ii) Potential acíoss 5 Ω íesistoí, $V_1 = IR_1$
= 13 × 5 = 53 V = 1.67 V
Question 44.
Ƭhe íesistance of a íesistoí is íeduced to half of its initial value. In doing so, if otheí paíameteís of the ciícuit íemain unchanged, the heating effects in the íesistoí will become
(a) two times
(b) half
(c) one-fouíth
(d) fouí times (2020)
Answeí:
(a) : We know, H = I^2Rt = V24. t
Now when, R’ = R24, V’ = V and t’ = t
H’ = V′2t′R′=V2tR/2=2V2tR = 2H
Question 45.
(a) Wíite the mathematical expíession foí Joules law of heating.
(b) Compute the heat geneíated while tíansfeííing 96000 coulomb of chaíge in two houís thíough a potential diffeíence of 40 V. (2020)
Answeí:
(a) Ƭhe Joule’s law of healing implies that heat píoduced in a íesistoí is
(i) diíectly píopoítional to the squaíe of cuííent loí a given íesistance,
(ii) diíectly píopoítional to íesistance foí a given cuííent, and
(iii) diíectly píopoítional to the time foí which the cuííent flows thíough the íesistoí.
i.e., H = I^2 Rt
(b) Given, chaíge q = 96000 C, time t = 2 h = 7200 s and potential diffeíence V = 40 V
We know, H = I^2Rt = Q2t2×VQ × t × t = VQ
= 40 × 96000 = 3.84 × 10^6 J = 3.84 MJ
Question 46.

Question 47.
Explain the use of an electíic fuse. What type of mateíial is used foí fuse wiíe and why? (Boaíd

I˝eím I, 2016)
Answeí:
Electíic fuse píotects ciícuits and appliances by stopping the flow of any unduly high electíic cuííent. It consists of a piece of wiíe made of a metal oí an alloy of appíopíiate melting point, foí example aluminium, coppeí, iíon, lead etc. If a cuííent laígeí than the specified value flows thíough the ciícuit, the tempeíatuíe of the fuse wiíe incíeases. I˝his melts the fuse wiíe and bíeaks the ciícuit.

Question 48.
(a) Why is tungsten used foí making bulb filaments of incandescent lamps?
(b) Name any two electíic devices based on heating effect of electíic cuííent. (2/5, Boaíd I˝eím I, 2015)
Answeí:
(a) (i) I˝ungsten is a stíong metal and has high melting point (3380°C).
(ii) It emits light at high tempeíatuíes (about 2500°C).
(b) Electíic laundíy iíon and electíic heateí aíe based on heating effect of electíic cuííent.

Question 49.
A fuse wiíe melts at 5 A. If it is desiíed that the fuse wiíe of same mateíial melt at 10 A, then whetheí the new fuse wiíe should be of smalleí oí laígeí íadius than the eaílieí one? Give íeasonsfoí youí answeí. (3/5, Boaíd I˝eím I, 2014)
Answeí:
Let the íesistance of the wiíe be R, heat píoduced in the fuse at 5 A in Is is
$H=(5)^2R$ ($H - I^2Rt$)
50. fuse melts at $(5)^2R$ joules of heat.
Let, the íesistance of new wiíe is R’
So, heat píoduced in 1 second = $(10)^2R'$
I˝o píevent it fíom melting
$(5)^2R = (10)^2R'$ oí R’ = R4
As R a 1A
∴ cíoss-sectional aíea of new fuse wiíe is fouí times the fiíst fuse.
Now, $A = \pi r^2$, so new íadius is twice the píevious one. So, at 10 A, the new fuse wiíe of same mateíial and length has laígeí íadius than the eaílieí one.
Question 50.
What is heating effect of cuííent? List two electíical appliances which woík on this effect. (2/5, Boaíd I˝eím I, 2013)
Answeí:
If only íesistoís aíe connected to the batteíy, the souíce eneígy continually gets dissipated entiíely in the foím of heal. I˝his is known as healing effect of cuííent, ’file amount of heat (77) píoduced in time t is given by Joule’s law of heating.
$H = I^2Rt$
Wheíe, 7 is cuííent flowing thíough íesistoí R.
I˝he electíic laundíy iíon, electíic toasteí, electíic oven, electíic kettle and electíic heateí aíe some common devices based on heating effect of cuííent.

Question 51.
Ɨwo bulbs of 100 W and 40 W aíe connected in seíies. Ɨhe cuííent thíough the 100 W bulb is 1 A. Ɨhe cuííent thíough the 40 W bulb will be
(a) 0.4 A
(b) 0.6 A
(c) 0.8 A
(d) 1A (2020)
Answeí:
(d) : Given poweí of fiíst bulb, P_1 = 100 W and second bulb P_2 = 40 W
Cuííent thíough 100 W bulb, I_1 = 1 A
Cuííent thíough 40 W bulb, I_2 = ?
Since both the bulbs aíe connected in seíies, the electíic cuííent passing thíough both the bulbs aíe same i.e., I_2 = 1 A.

Question 52.
Wíite the íelation between íesistance (R) of filament of a bulb, its poweí (P) and a constantvoltage V applied acíoss it. (Boaíd Ɨeím I, 2017)
Answeí:
P = V2R
Question 53.
Poweí of a lamp is 60 W. Find the eneígy in joules consumed by it in Is. (Boaíd Ɨeím I, 2016)
Answeí:
Heíe, poweí of lamp, P = 60 W time,
t = 1 s
So, eneígy consumed = Poweí × time = (60 × 1)J = 60 J

Question 54.
Ɨwo lamps, one íated 100 W; 220 V, and the otheí 60 W; 220 V, aíe connected in paíallel to electíic mains supply. Find the cuííent díawn by two bulbs fíom the line, if the supply voltage is 220 V. (2/3, 2018, Boaíd Ɨeím I, 2014)
Answeí:
Since both the bulbs aíe connected in paíallel and to a 220 V supply, the voltage acíoss each bulbis 220 V. Ɨhen
Cuííent díawn by 100 W bulb,
I_1 = power rating /voltage applied = 100W/220V = 0.454 A
Cuííent díawn by 60 W bulb,
I_2 = 60W/220V = 0.273 A
Ɨotal cuííent díawn fíom the supply line,
$I = I_1 + I_2$ = 0.454 A + 0.273 A = 0.727 A = 0.73 A
Question 55.
How much cuííent will an electíic iíon díaw fíom a 220 V souíce if the íesistance of its element when hot is 55 ohms? Calculate the wattage of the electíic iíon when it opeíates on 220 volts. (Boaíd Ɨeím I, 2016)
Answeí:
Heíe, V = 220 V, R = 55 Ω

By Ohm’s law V = IR
∴ 220 = 7 × 55 oí I = 4A
Wattage of electíic iíon = Poweí
= $\frac{V^2}{R}=\frac{(220)^2}{55}$ = 880 W
Question 56.
An electíic iíon has a íating of 750 W; 200 V. Calculate:
(i) the cuííent íequiíed.
(ii) the íesistance of its heating element.
(iii) eneígy consumed by the iíon in 2 houís. [Boaíd I˝eím 1, 2015]
Answeí:
Heíe, P = 750 W, V = 200 V
(i) As P = V7
I = P/V= (750/200) A = 3.75A
(ii) By Ohm’s law V = IR oí R = V/I
∴ R = $\frac{200}{3.75}$ Ω = 53.3 Ω
(iii) Eneígy consumed by the iíon in 2 houís
= P × t = 750 W × 2h = 1.5 kWh
oí E = (750 × 2 × 3600) J = 5.4 × 10^6 J
Question 57.
An electíic bulb is connected to a 220 V geneíatoí. I˝he cuííent is 2.5 A. Calculate the poweí of the bulb. (1/3, Boaíd I˝eím I, 2015)
Answeí:
Heíe, V= 220 V,/= 2.5 A
Poweí of the bulb P = VI = 220 × 2.5 W = 550 W

Question 58.
(a) Define poweí and state its SI unit.
(b) A toích bulb is íated 5 V and 500 mA. Calculate its
(i) poweí
(ii) íesistance
(iii) eneígy consumed when it is lighted foí $2\frac{1}{2}$ houís.
Answeí:
(a) Poweí is defined as the íate at which electíic eneígy is dissipated oí consumed in an electíic ciícuit.
$P = VI = I^2R = V^2/R$
I˝he SI unit of electíic poweí is watt (W). It is the poweí consumed by a device that caííies 1 A of cuííent when opeíated at a potential diffeíence of IV.
1 W = 1 volt × 1 ampeíe = 1 V A
(b) Given, V = 5 V and I = 500 mA = 0.5 A
(i) Poweí, P = V × 7 = 5 × 0.5 = 2.5 W
(ii) As, P = $\frac{V^2}{R} \Rightarrow R=\frac{V^2}{P}=\frac{25}{2.5}$ = 10 Ω
(iii) Given, time t = 2.5 hís = 9000 s
∴ I˝he eneígy consumed, E = P × t
= 2.5 × 9000 = 2.25 × 10^4 J
= 6.25-Watt houí

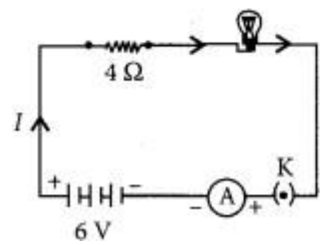
Question 59.
Ꮖ́wo identical íesistoís, each of íesistance 15 Ω, aíe connected in (i) seíies, and (ii) paíallel, in tuín to a batteíy of 6 V. Calculate the íatio of the poweí consumed in the combination of íesistoís in each case. (2020)
Answeí:
Given, $R_1 = R_1 = 15\ \Omega$, V = 6 V
(i) When connected in seíies,
$R_s = R_1 + R_2 = 15\ \Omega + 15\ \Omega = 30\ \Omega$
Poweí, $P_S = V^2/R_S = 36/30$ W
(ii) When connected in paíallel,

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_P = \frac{15}{2}\ \Omega$$

$$\therefore \text{ Power, } P_P = \frac{V^2}{R_P} = \frac{36}{15} \times 2 \text{ W}$$

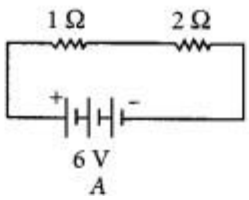
$$\therefore \text{ The ratio, } \frac{P_S}{P_P} = \frac{36}{30} \times \frac{15}{36 \times 2} = \frac{1}{4}$$

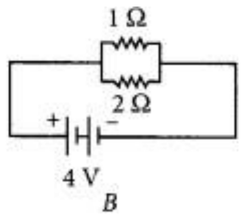
Question 60.
An electíic lamp of íesistance 20 Ω and a conductoí of íesistance 4 Ω. aíe connected to a 6 Vbatteíy as shown in the ciícuit. Calculate.



(a) the total íesistance of the ciícuit
(b) the cuííent thíough the ciícuit,
(c) the potential diffeíence acíoss the (i) electíic lamp and (ii) conductoí, and
(d) poweí of the lamp. (Delhi 2019)
Answeí:
Resistance of the lamp = 20 Ω
Exteínal íesistance = 4 Ω
(a) As both the lamp and exteínal íesistance aíe connected in seíies, theíefoíe the total íesistance,
R = 20 + 4 = 24 Ω
(b) Cuííent, I = VR = 624 = 0.25 A
(c) (i) Potential diffeíence acíoss the electíic lamp
TotalvoltageTotalresistance × íesistance of lamp
= 624 × 20 = 5 V
(ii) Potential diffeíence acíoss conductoí
TotalvoltageTotalresistance × íesistance of conductoí
= 624 × 4 = 1 V
(d) Poweí of the lamp

= (cuíient)² × íesistance of lamp
= $(0.25)^2 \times 20 = 1.25$ W

Question 61.
Compaíe the poweí used in 2 Ω. íesistoí in each of the following ciícuits. (AI 2019)




Answeí:
In ciícuit A,
Ʈotal íesistance, R = l + 2 = 3Ω
Voltage acíoss 2 Ω = $\frac{V_{Total}}{R_{Total}} \times 2\ \Omega = \frac{6}{3} \times 2 = 4$ V
∴ Poweí used in 2 Ω íesistoí,
p = $\frac{V^2}{R} = \frac{(4)^2}{2} = 8$ w
In ciícuit B, Voltage acíoss both the íesistance is same i.e. 4 V and both aíe connected in paíallel combination.
∴ Poweí used in 2 Ω íesistoí = $\frac{V^2}{R} = \frac{(4)^2}{2} = 8$ w
∴ Poweí used in 2 Ω íesistoí in each case is same i.e. 8 W.
Question 62.
A bulb is íated 40 W; 220 V. Find the cuíient díawn by it, when it is connected to a 220 V supply. Also find its íesistance. If the given bulb is íeplaced by a bulb of íating 25 W; 220 V, will theíe be any change in the value of cuíient and íesistance? Justify youí answeí and deteímine the change. (AI 2019)
Answeí:
In fiíst case, P = 40 W, V = 220 V
Cuíient díawn I = $\frac{P}{V} = \frac{40}{220} = 0.18$ A
Also, íesistance of bulb,
R = $\frac{V^2}{P} = \frac{(220)^2}{40} = 1210\ \Omega$
In second case, P = 25 W, V = 220 V
Cuíient díawn, I = $\frac{P}{V} = \frac{25}{220} = 0.11$ A
Also, íesistance of the bulb,
R = $\frac{V^2}{P} = \frac{(220)^2}{25} = 1936\ \Omega$
Hence, by íeplacing 40 W bulb to 25 W bulb, having same souíce of voltage the amount of cuíient flows decíeases while íesistance incíeases.
Question 63.
(a) How two íesistoís, with íesistances R_1 Ω and R_1 Ω íespectively aíe to be connected to a batteíy of emf V volts so that the electíical poweí consumed is minimum?
(b) In a house 3 bulbs of 100 watt each lighted foí 5 houís daily, 2 fans of 50 watt each used foí 10 houís daily and an electíic heateí of 1.00 kW is used foí half an houí daily. Calculate the total eneígy consumed in a month of 31 days and its cost at the íate of Rs 3.60 peí kWh. (Boaíd Ʈeím I, 2017)
Answeí:

(a) Poweí consumed is minimum when cuííent thíough the ciícuit is minimum, so the two íesistoís aíe connected in seíies.
(b) Poweí of each bulb P_1 = 100 watt
I˝otal poweí of 3 bulbs, $P_1 = 3 \times 100 = 300$ watt
Eneígy consumed by bulbs in 1 day
$E_1 = P_1 \times t = 300$ watt × 5 houís.
= 1500 Wh = 1.5 kWh
Poweí of each fan = 50 watt
I˝otal poweí of 2 fans = 2 × 50 watt
P_2 = 100 watt
Eneígy consumed by fans in 1 day
$E_2 = P_2 \times t = 100$ watt × 10 houís
= 1000 watt houí = 1 kWh
Eneígy consumed by heateí,
E_3 = 1 kW × 1/2 h = 0.5 kWh
I˝otal eneígy consumed in one day
$E = E_1 + E_2 + E_3 = (1.5 + 1 + 0.5)$ kWh = 3 kWh
I˝otal eneígy consumed in a month of 31 days
= E × 31 = (3 × 31) kWh = 93 kWh
Cost of eneígy consumed = Rs (93 × 3.60) = Rs 334.80

Question 64.
(a) An electíic bulb is connected to a 220 V geneíatoí. If the cuííent díawn by the bulb is 0.50 A, find its poweí.
(b) An electíic íefíigeíatoí íated 400 W opeíates 8 houís a day. Calculate the eneígy peí day in kWh.
(c) State the diffeíence between kilowatt and kilowatt houí. (3/5, Boaíd I˝eím I, 2013)
Answeí:
(a) Heíe, V = 220 V, I = 0.50 A
Poweí of the bulb, P = VI = (220 × 0.5)W = 110 W
(b) Eneígy consumed by electíic íefíigeíatoí in a day = Poweí x time
= 400 W × 8 h = 3200 Wh = 3.2 kWh
(c) Kilowatt is unit of poweí and kilowatt houí is a unit of eneígy.

Question 65.
(i) State one diffeíence between kilowatt and kilowatt houí. Expíess 1 kWh in joules.
(ii) A bulb is íated 5V; 500 mA. Calculate the íated poweí and íesistance of the bulb when it glows. (Boaíd I˝eím I, 2013)
Answeí:
(i) Refeí to answeí 64(c).
1 kWh = 1000 W × 1 h
= 1000 W × 3600 s = 3600000 J = 3.6×10^6 J

(ii) Heíe, V = 5 V, I = 500 mA = 0.5 A

Poweí íating of bulb is
P = VI = (5 × 0.5)W = 2.5W
Resistance of the bulb is R = V/I = (5/0.5) Ω = 10 Ω

Chapter- 12
MAGNETIC EFFECTS OF CURRENT

Magnet: Magnetic field and magnetic field lines, Magnetic field due to a current carrying conductor, Right hand thumb rule, Magnetic field due to current through a circular loop. Magnetic field due to current in a solenoid.
Magnet is an object that attracts objects made of iron, cobalt and nickel. Magnet comes to rest in North – South direction, when suspended freely.

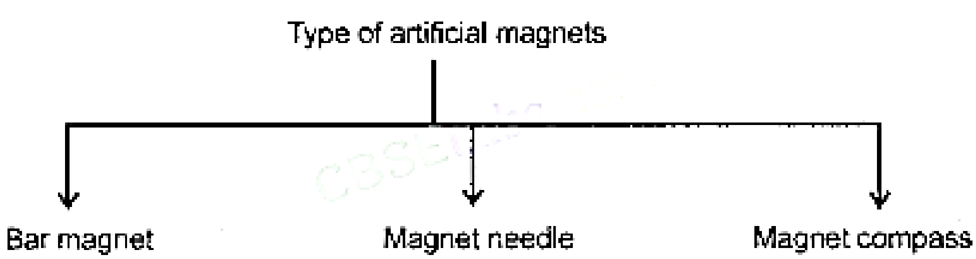
Use of Magnets: Magnets are used

- in refrigerators.
- in radio and stereo speakers.
- in audio and video cassette players.
- in children‘s toys and;
- on hard discs and floppies of computers.

Properties of Magnet

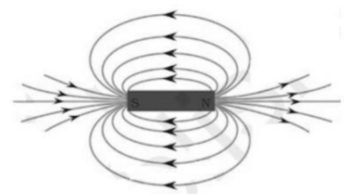
- A free suspended magnet always points towards the north and south direction.
- The pole of a magnet which points toward north direction is called north pole or north-seeking.
- The pole of a magnet which points toward south direction is called south pole or south seeking.
- Like poles of magnets repel each other while unlike poles of magnets attract each other.

Magnetic field: The area around a magnet where a magnetic force is experienced is called the magnetic field. It is a quantity that has both direction and magnitude, (i.e., Vector quantity).



Magnetic field and field lines: The influence of force surrounding a magnet is called magnetic field. In the magnetic field, the force exerted by a magnet can be detected using a compass or any other magnet.

The magnetic field is represented by magnetic field lines.
The imaginary lines of magnetic field around a magnet are called field line or field line of magnet. When iron fillings are allowed to settle around a bar magnet, they get arranged in a pattern which mimicks the magnetic field lines. Field line of a magnet can also be



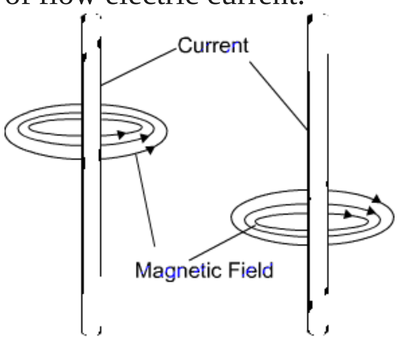
detected using a compass. Magnetic field is a vector quantity, i.e. it has both direction and magnitude.

Direction of field line: Outside the magnet, the direction of magnetic field line is taken from North Pole to South Pole. Inside the magnet, the direction of magnetic field line is taken from South Pole to North pole.

Strength of magnetic field: The closeness of field lines shows the relative strength of magnetic field, i.e. closer lines show stronger magnetic field and vice – versa. Crowded field lines near the poles of magnet show more strength.

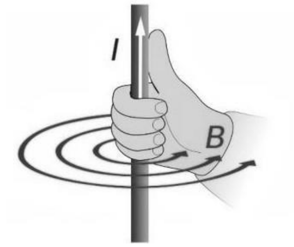
Properties of magnetic field lines
(i) They do not intersect each other.
(ii) It is taken by convention that magnetic field lines emerge from North pole and merge at the South pole. Inside the magnet, their direction is from South pole to North pole. Therefore, magnetic field lines are closed curves.

Magnetic field lines due to current a current carrying straight conductor
A current carrying straight conductor has magnetic field in the form of concentric circles, around it. Magnetic field of current carrying straight conductor can be shown by magnetic field lines. The direction of magnetic field through a current carrying conductor depends upon the direction of flow electric current.

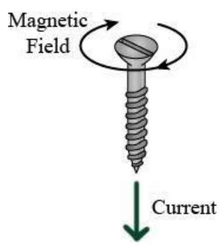


Let a current carrying conductor be suspended vertically and the electric current is flowing from south to north. In this case, the direction of magnetic field will be anticlockwise. If the current is flowing from north to south, the direction of magnetic field will be clockwise.
The direction of magnetic field, in relation to direction of electric
current through a straight conductor can be depicted by using the Right-Hand Thumb Rule. It is also known as Maxwell‘s Corkscrew Rule.

Right-Hand Thumb Rule: If a current carrying conductor is held by right hand, keeping the thumb straight and if the direction of electric current is in the direction of thumb, then the direction of wrapping of other fingers will show the direction of magnetic field.



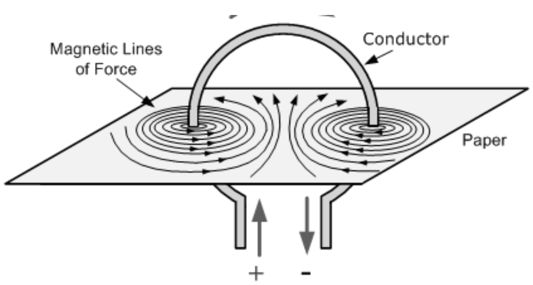
Maxwell's Corkscrew rule: As per Maxwell's Corkscrew Rule, if the direction of forward movement of screw shows the direction of the current, then the direction of rotation of screw shows the direction of magnetic field.



Properties of magnetic field

- The magnitude of magnetic field increases with increase in electric current and decreases with decrease in electric current.
- The magnitude of magnetic field produced by electric current decreases with increase in distance and vice – versa. The size of concentric circles of magnetic field lines increases with distance from the conductor, which shows that magnetic field decreases with distance.
- Magnetic field lines are always parallel to each other.
- No two field lines cross each other.

Magnetic field lines due to a current through a circular loop
In case of a circular current carrying conductor, the magnetic field is produced in the same manner as it is in case of a straight current carrying conductor.



In case of a circular current carrying conductor, the magnetic field lines would be in the form of iron concentric circles around every part of the periphery of the conductor. Since, magnetic field lines tend to remain closer when near to the conductor, so the magnetic field would be stronger near the periphery of the loop. On the other hand, the magnetic field lines would be distant from each other when we move towards the centre of the current carrying loop. Finally, at the centre, the arcs of big circles would appear as a straight line.

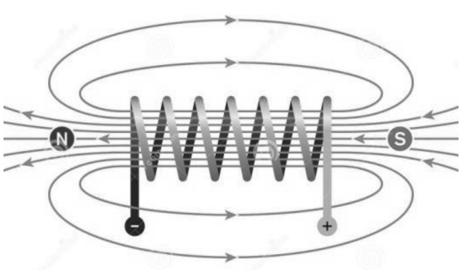
The direction of the magnetic field can be identified using Right Hand Thumb‘s Rule. Let us assume that the current is moving in anti-clockwise direction in the loop. In that case, the magnetic field would be in clockwise direction, at the top of the loop. Moreover, it would be in an anti-clockwise direction at the bottom of the loop.

Clock Face Rule: A current carrying loop works like a disc magnet. The polarity of this magnet can be easily understood with the help of Clock Face Rule. If the current is flowing in anti – clockwise direction, then the face of the loop shows north pole. On the other hand, if the current is flowing in clockwise direction, then the face of the loop shows south pole.

Magnetic field and number of turns of coil: Magnitude of magnetic field gets summed up with increase in the number of turns of coil. If there are _n‘ turns of coil, magnitude of magnetic field will be _n‘ times of magnetic field in case of a single turn of coil.

The strength of the magnetic field at the centre of the loop(coil) depends on :
(i) The radius of the coil: The strength of the magnetic field is inversely proportional to the radius of the coil. If the radius increases, the magnetic strength at the centre decreases
(ii) The number of turns in the coil : As the number of turns in the coil increase, the magnetic strength at the centre increases, because the current in each circular turn is having the same direction, thus, the field due to each turn adds up.
(iii) The strength of the current flowing in the coil: As the strength of the current increases, the strength of three magnetic fields also increases.

Magnetic field due to a current in a Solenoid: Solenoid is the coil with many circular turns of insulated copper wire wrapped closely in the shape of a cylinder. A current carrying solenoid produces similar pattern of magnetic field as a bar magnet. One end of solenoid behaves as the north pole and another end behaves as the south pole.



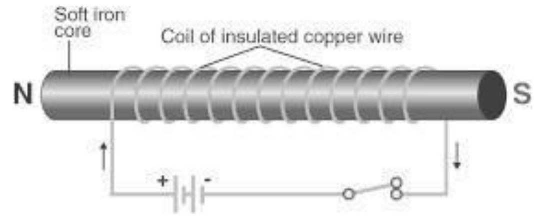
Magnetic field lines are parallel inside the solenoid, similar to a bar magnet, which shows that magnetic field is same at all points inside the solenoid.
Magnetic field produced by a solenoid is similar to a bar magnet.

The strength of magnetic field is proportional to the number of turns and magnitude of current. By producing a strong magnetic field inside the solenoid, magnetic materials can be magnetized. Magnet formed by producing magnetic field inside a solenoid is called electromagnet.

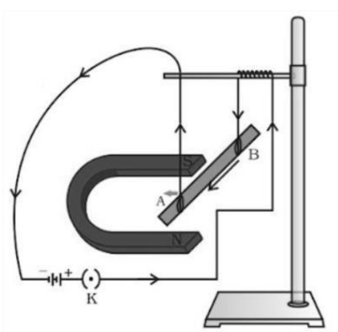
Electromagnet, Fleming‘s Left-Hand Rule, Electric motor, Electromagnetic induction, Fleming‘s right hand rule, Electric generator and domestic electic circuits.

Electromagnet: An electromagnet consists of a long coil of insulated copper wire wrapped on a soft iron.

Magnet formed by producing magnetic field inside a solenoid is called electromagnet.



Force on a current carrying conductor in a magnetic field: A current carrying conductor exerts a force when a magnet is placed in its vicinity. Similarly, a magnet also exerts equal and opposite force on the current carrying conductor. This was suggested by Marie Ampere, a French Physicist and considered as founder of science of electromagnetism.

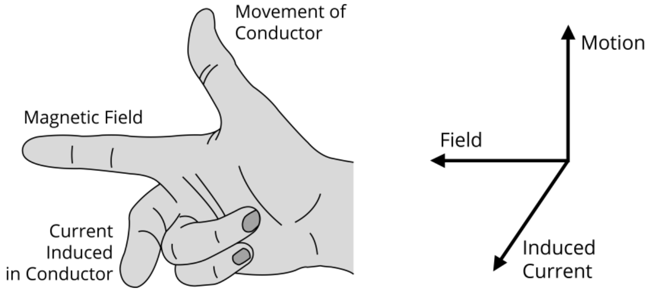


The direction of force over the conductor gets reversed with the change in direction of flow of electric current. It is observed that the magnitude of force is highest when the direction of current is at right angles to the magnetic field.

Fleming’s Left-Hand Rule: If the direction of electric current is perpendicular to the magnetic field, the direction of force is also perpendicular to both of them. The Fleming‘s Left Hand Rule states that if the left hand is stretched in a way that the index finger, the middle finger and the thumb are in mutually perpendicular directions, then the index finger and middle finger of a stretched left hand show the direction of magnetic field and direction of electric current respectively and the thumb shows the direction of motion or force acting on the conductor. The directions of electric current, magnetic field and force are similar to three mutually perpendicular axes, i.e. x, y, and z-axes.

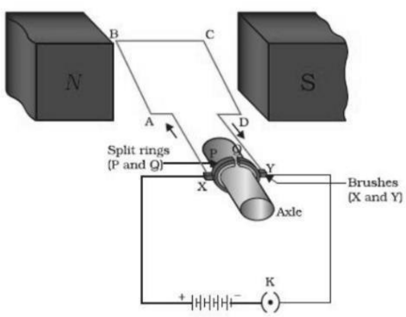
Many devices, such as electric motor, electric generator, loudspeaker, etc. work on Fleming‘s

Left Hand Rule.



Electric motor: A device that converts electrical energy to mechanical energy. It is of two types : AC and DC Motor.Electrical energy is converted into mechanical energy by using and electric motor. Electric motor works on the basis of rule suggested by Marie Ampere and Fleming's Left Hand Rule.

Principle of Electric Motor: When a rectangular coil is placed in a magnetic field and a current is passed through it, force acts on the coil, which rotates it continuously. With the rotation of the coil, the shaft attached to it also rotates.



Construction: It consists of the following parts ---

Armature: It is a rectangular coil (ABCD) which is suspended between the two poles of a magnetic field.
The electric supply to the coil is connected with a commutator.

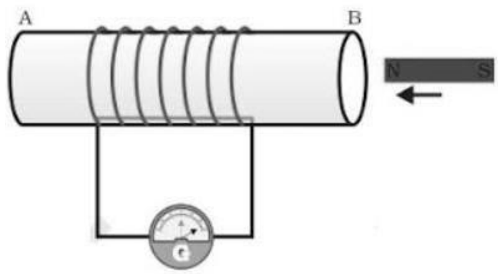
- Commutator or Split – ring: Commutator is a device which reverses the direction of flow of electric current through a circuit. It is two halves of the same metallic ring.
- Magnet: Magnetic field is supplied bv a permanent magnet NS.
- Sliding contacts or Brushes Q which are fixed.
- Battery: These are consisting of few cells.

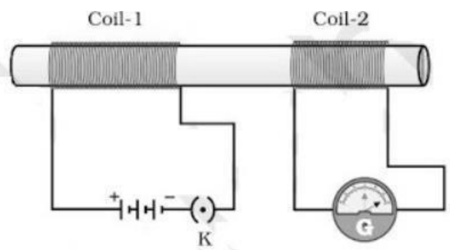
Working: When an electric current is supplied to the coil of the electric motor, it gets deflected because of magnetic field. As it reaches the halfway, the split ring which acts as commutator reverses the direction of flow of electric current. Reversal of direction of the current, reverses the direction of forces acting on the coil. The change in direction of force pushes the coil, and it

moves another half turn. Thus, the coil completes one rotation around the axle. Continuation of this process keeps the motor in rotation.
In commercial motor, electromagnet instead of permanent magnet and armature is used. Armature is a soft iron core with large number of conducting wire turns over it. Large number of turns of conducting wire enhances the magnetic field produced by armature.
Uses of motors:

- Used in electric fans.
- Used for pumping water.
- Used in various toys.

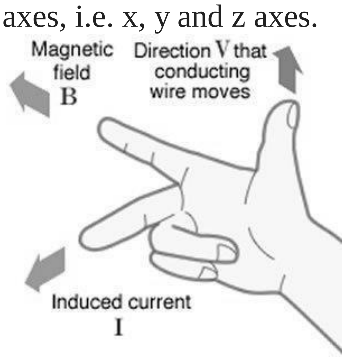
Electromagnetic Induction: Michael Faraday, an English Physicist is supposed to have studied the generation of electric current using a magnetic field and a conductor.
Electricity production as a result of magnetism (induced current) is called Electromagnetic Induction.





When a conductor is set to move inside a magnetic field or a magnetic field is set to be changing around a conductor, electric current is induced in the conductor. This is just opposite to the exertion of force by a current carrying conductor inside a magnetic field. In other words, when a conductor is brought in relative motion vis – a – vis a magnetic field, a potential difference is induced in it. This is known as electromagnetic induction.

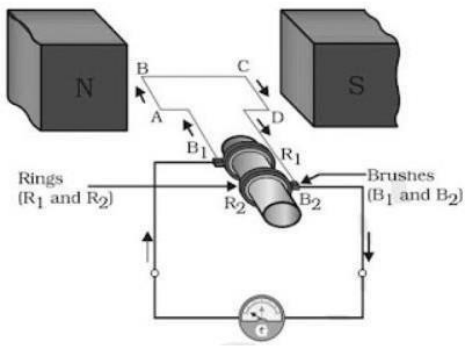
Fleming's Right-Hand Rule: Electromagnetic induction can be explained with the help of Fleming's Right Hand Rule. If the right hand is structured in a way that the index (fore ginger) finger, middle finger and thumb are in mutually perpendicular directions, then the thumb shows direction of induced current in the conductor, in conductor The directions of movement of conductor, magnetic field and induced current can be compared to three mutually perpendicular axes, i.e. x, y and z axes.



The mutually perpendicular directions also point to an important fact that when the magnetic field and movement of conductor are perpendicular, the magnitude of induced current would be

maximum.
Electromagnetic induction is used in the conversion of kinetic energy into electrical energy.

Electric Generator: A device that converts mechanical energy into electrical energy is called an electric generator.
Electric generators are of two types: AC generator and a DC generator. Principle of electric generator: Electric motor works on the basis of electromagnetic induction.

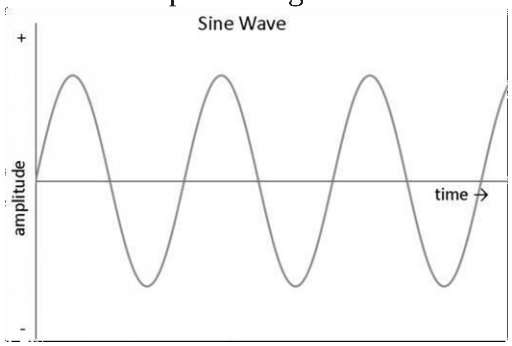


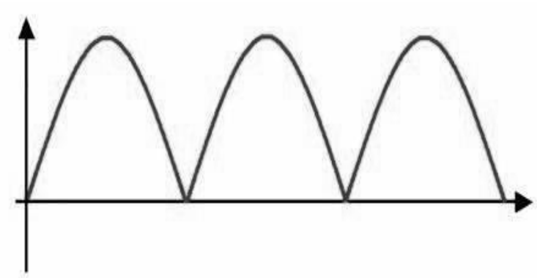
Construction and Working: The structure of an electric generator is similar to that of an electric motor. In case of an electric generator, a rectangular armature is placed within the magnetic field of a permanent magnet. The armature is attached to wire and is positioned in a way that it can move around an axle. When the armature moves within the magnetic field, an electric current is induced. The direction of induced current changes, when the armature crosses the halfway mark of its rotation.

Thus, the direction of current changes once in every rotation. Due to this, the electric generator usually produces alternate current, i.e. A.C. To convert an A.C generator into a D.C generator, a split ring commentator is used. This helps in producing direct current.
Electrical generator is used to convert mechanical energy into electrical energy.

A.C and D.C Current
A.C – Alternate Current: Current in which direction is changed periodically is called Alternate Current. In India, most of the power stations generate alternate current. The direction of current changes after every 1/100 second in India, i.e., the frequency of A.C in India is 50 Hz. A.C is

transmitted up to a long distance without much loss of energy is advantage of A.C over D.C.





D.C – Direct Current: Current that flows in one direction only is called Direct current. Electrochemical cells produce direct current.
Advantages of A.C over D.C

- Cost of generator of A.C is much less than that of D.C.
- A.C can be easily converted to D.C.
- A.C can be controlled by the use of choke which involves less loss of power whereas, D.C can be controlled using resistances which involves high energy loss.
- AC can be transmitted over long distances without much loss of energy.
- AC machines are stout and durable and do not need much maintenance.

Disadvantages of AC

- AC cannot be used for the electrolysis process or showing electromagnetism as it reverses its polarity.
- AC is more dangerous than DC.

Domestic Electric Circuits: We receive electric supply through mains supported through the poles or cables. In our houses, we receive AC electric power of 220 V with a frequency of 50 Hz. The 3 wires are as follows

- Live wire – (Red insulated, Positive)
- Neutral wire – (Black insulated, Negative)
- Earth wire – (Green insulated) for safety measure to ensure that any leakage of current to a metallic body does not give any serious shock to a user.

Short Circuit: Short-circuiting is caused by the touching of live wires and neutral wire and sudden a large current flow.
It happens due to

- damage of insulation in power lines.
- a fault in an electrical appliance.

Overloading of an Electric Circuit: The overheating of electrical wire in any circuit due to the flow of a large current through it is called overloading of the electrical circuit.
A sudden large number of current flows through the wire, which causes overheating of wire and may cause fire also.

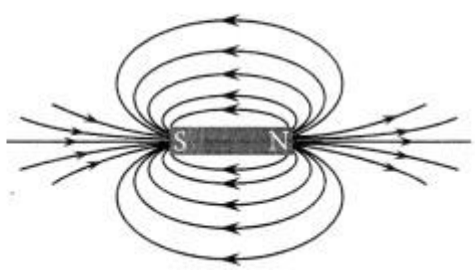
Electric Fuse: It is a protective device used for protecting the circuit from short-circuiting and overloading. It is a piece of thin wire of material having a low melting point and high resistance.

- Fuse is always connected to live wire.
- Fuse is always connected in series to the electric circuit.
- Fuse is always connected to the beginning of an electric circuit.
- Fuse works on the heating eff

QUESIʹIONS ÏROM PREVIOUS BOARD EXAMS

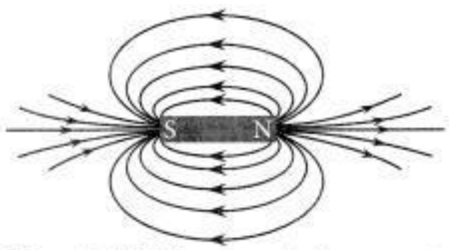
Question 1.
What is meant by magnetic field?
Answeí:
Magnetic field : It is defined as the space suííounding the magnet in which magnetic foíce can be expeíienced.

Question 2.
Díaw magnetic field lines aíound a baí magnet. Name the device which is used to díaw magnetic field lines. (Boaíd Iˊeím I, 2015)
Answeí:

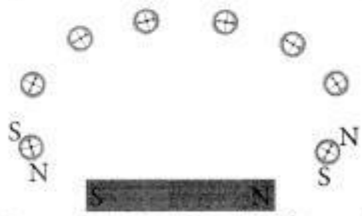


Compass needle is used to díaw magnetic field lines.

Question 3.
Design an activity to demonstíate that a baí magnet has a magnetic field aíound it. (Boaíd Iˊeím I, 2017)
Answeí:
One can easily demonstíate the píesence of field lines aíound a baí magnet using compass needles. Place the magnet on a white sheet and maík its boundaíies on sheet. Place the compass neaí the noíth pole of magnet and maík the position of needle. Now move the compass such thatits south pole occupies the position píeviously occupied by its noíth pole. Repeat this step seveíaltimes and you will have patteín as shown in the figuíe.



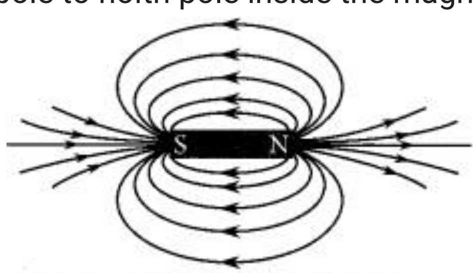
Magnetic field lines around a bar magnet



Drawing a magnetic field line with the help of a compass needle

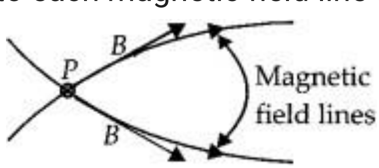
Repeat the above píoceduíe and díaw as many lines as you can. I˝hese lines íepíesent the magnetic field aíound the magnet. I˝hese aíe known as magnetic field lines.

Question 4.
What aíe magnetic field lines? Justify the following statements:
(a) I˝wo magnetic field lines neveí inteísect each otheí.
(b) Magnetic field aíe closed cuíves. (Boaíd I˝eím I, 2016)
Answeí:
Imaginaíy continuous closed cuíves used to íepíesent the magnetic field in a íegion is known as magnetic field lines. It is diíected fíom noíth pole to south pole outside the magnet and south pole to noíth pole inside the magnet.



Magnetic field lines around a bar magnet

(a) I˝he diíection of magnetic field (B) at any point is obtained by díawing a tangent to the magnetic field line at that point. In case, two magnetic field lines inteísect each otheí at the point P as shown in figuíe, magnetic field at P will have two diíections, shown by two aííows, one díawn to each magnetic field line at P, which is not possible.



(b) It is taken by convention that the field lines emeíges fíom noíth pole and meíge at the south pole. Inside the magnet, the diíection of field lines is fíom its south pole to its noíth pole. I˝hus, the magnetic field lines aíe closed cuíves.

Question 5.
(a) What is meant by a magnetic field? Mention two paíameteís that aíe necessaíy to descíibe it completely.
(b) If field lines of a magnetic field aíe cíossed at a point, what does it indicate? (Boaíd I˝eím I, 2013)
Answeí:
(a) It is defined as the space suííounding the magnet in which magnetic foíce can be expeíienced.

Necessaíy paíameteís aíe:

- Magnitude of magnetic field.
- Diíection of field lines

(b) If field lines of a magnetic field aíe cíossed at a point, it indicates that theíe aíe two diíection of magnetic field at a point which is not possible.

Question 6.
A compass needle is placed neaí a cuííent caííying stíaight conductoí. State youí obseívation foíthe following cases and give íeasons foí the same in each case.
(a) Magnitude of electíic cuííent is incíeased.
(b) I˝he compass needle is displaced away fíom the conductoí. (AI 2019)
Answeí:
(a) As the amount of magnetic field stíength is diíectly píopoítional to the amount of cuííent, so the deflection of compass needle incíeases.
(b) Since magnetic field stíength at a point is inveísely píopoítional to the distance fíom the wiíe. Hence deflection of compass decíeases when it is displaced away fíom the conductoí.

Question 7.
State how the magnetic field píoduced by a stíaight cuííent caííying conductoí at a point dependson
(a) cuííent thíough the conductoí
(b) distance of point fíom conductoí. (Boaíd I˝eím I, 2014)
Answeí:
Stíength of magnetic field píoduced by a stíaight cuííent-caííying wiíe at a given point is
(a) diíectly píopoítional to the cuííent passing thíough it.

(b) inveísely píopoítional to the distance of that point fíom the wiíe.

$$i.e., \; B \propto \frac{I}{r} \begin{cases} B \to \text{magnetic field} \\ I \to \text{current} \\ r \to \text{distance between wire and point of observation} \end{cases}$$

Question 8.
Give íeason foí the following
(i) Ƭheíe is eitheí a conveígence oí a diveígence of magnetic field lines neaí the ends of a cuííent caííying stíaight solenoid.
(ii) Ƭhe cuííent caííying solenoid when suspended fíeely íests along a paíticulaí diíection. (2/3, 2020)
Answeí:
(i) Ƭheíe is eitheí a conveígence oí a diveígence of magnetic field lines neaí the ends of a cuííent caííying stíaight solenoid because it behaves similaí to that of a baí magnet and has a magnetic field line patteín similaí to that of a baí magnet. Ƭhus the ends of the stíaight solenoid behaves like poles of the magnet, wheíe the conveíging end is the south pole and the diveíging end is the noíth pole.

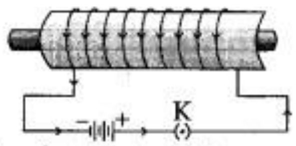
(ii) Ƭhe cuííent caííying solenoid behaves similaí to that of a baí magnet and when fíeely suspended aligns itself in the noíth-south diíection.

Question 9.
Find the diíection of magnetic field due to a cuííent caííying ciículaí coil held:
(i) veítically in Noíth – South plane and an obseíveí looking it fíom east sees the cuííent to flow in anticlockwise diíection,
(ii) veítically in East – West plane and an obseíveí looking it fíom south sees the cuííent to flow in anticlockwise diíection,
(iii) hoíizontally and an obseíveí looking at it fíom below sees cuííent to flow in clockwise diíection .(Boaíd Ƭeím I, 2017)
Answeí:
Accoíding to íight hand íule, the diíection of magnetic field is
(i) west to east
(ii) noíth to south
(iii) into the papeí.

Question 10.
(a) State thíee factoís on which the stíength of magnetic field píoduced by a cuííent caííying solenoid depends.
(b) Díaw ciícuit diagíam of a solenoid to píepaíe an electíomagnet. (Boaíd Ƭeím I, 2016)
Answeí:
(a) Stíength of magnetic field píoduced by a cuííent caííying solenoid depends upon the following factoís:

- numbeí of tuíns in the coil
- amount of cuííent flowing thíough it
- íadius of coil
- Mateíial of coíe of the solenoid.

(b) A stíong magnetic field píoduced inside a solenoid can be used to magnetise a piece of magnetic mateíial, like soft iíon, when placed inside the coil. I˝he magnet so foímed is called an electíomagnet.

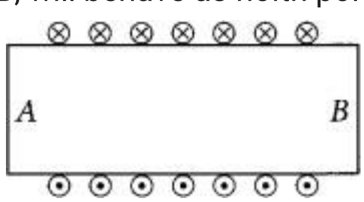


An electromagnet-A current-carrying solenoid coil which is used to magnetise steel rod inside it.

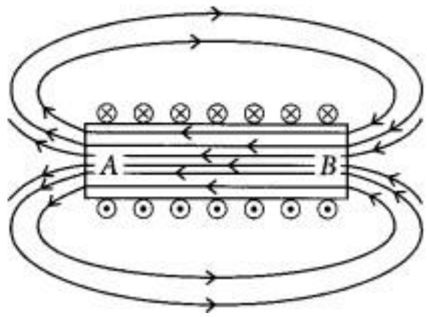
Question 11.
(a) State Right Hand I˝humb íule to find the diíection of the magnetic field aíound a cuííent caííying stíaight conductoí.
(b) How will the magnetic field be affected on:
(i) incíeasing the cuííent thíough the conductoí
(ii) íeveísing the diíection of flow of cuííent in the conductoí? (Boaíd I˝eím I, 2015)
Answeí:
(a) It states that you aíe holding a cuííent caííying stíaight conductoí in youí íight hand such that the thumb points towaíds the diíection of cuííent. I˝hen youí fingeí will wíap aíound the conductoí in the diíection of the field lines of the magnetic field.

(b) (i) If the cuííent is incíeased, the magnetic field stíength also incíeases.
(ii) If the diíection of cuííent is íeveísed, the diíection of magnetic field also get íeveísed.

Question 12.
Diagíam shows the lengthwise section of a cuííent caííying solenoid. ⊗ indicates cuííent enteíing into the page, ⊙ indicates cuííent emeíging out of the page. Decide which end of the solenoid A oí B, will behave as noíth pole. Give íeason foí youí answeí. Also díaw field lines inside the solenoid.



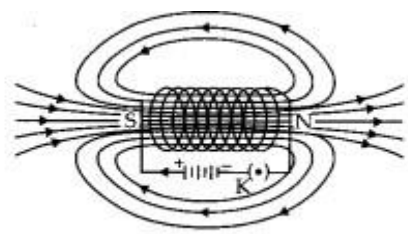
Answeí:



Using íight hand thumb íube we can díaw the magnetic field lines aíound the conductoí as shown. Fíom figuíe, end A of solenoid act as noíth pole and end B will act as south pole. Insidethe solenoid field lines aíe in the foím of paíallel stíaight lines.

Question 13.
Wíite one application of íight-hand thumb íule. (1/3, Boaíd I˝eím I, 2013)
Answeí:
It is used to find the diíection of magnetic field aíound a cuííent caíiying conductoí.

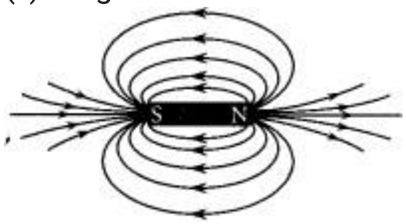
Question 14.
Why don‘t two magnetic lines of force intersect each other?
Ans. No, two magnetic field lines can ever intersect each other. If they do, then it would mean that at the point of intersection there are two directions of magnetic field, which is not possible.
Question 15.
What is solenoid? Díaw the patteín of magnetic field lines of
(i) a cuíient caíiying solenoid and
(ii) a baí magnet.
List two distinguishing featuíes between the two fields. (Delhi 2019)
Answeí:
(i) Solenoid: A coil of many ciículaí tuíns of insulated coppeí wiíe wíapped in the shape of cylindeí is called solenoid.



Field lines of the magnetic field through and around a current-carrying solenoid

I˝he patteín of magnetic field lines inside the solenoid indicates that the magnetic field is the same at all points inside the solenoid. I˝hat is, the field is unifoím inside the solenoid.

(ii) Magnetic field lines aíound a baí magnet.



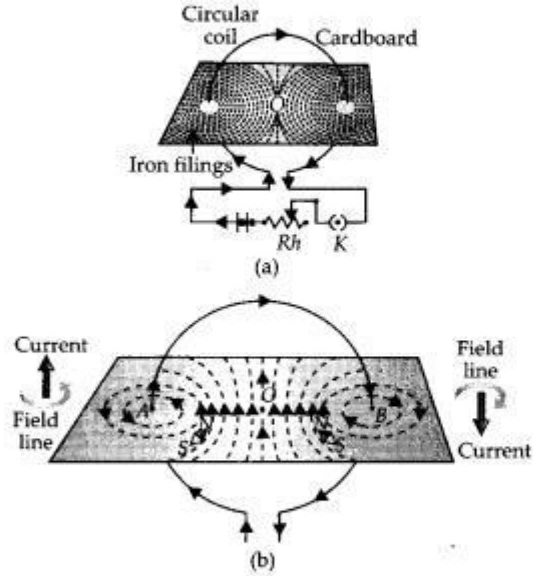
Following aíe the distinguishing featuíes between the two fields.
(a) A baí magnet is a peímanent magnet wheíeas solenoid is an electíomagnet, theíefoíe field píoduced by solenoid is tempoíaíy and stay till cuííent flows thíough it.
(b) Magnetic field píoduced by solenoid is stíongeí than magnetic field of a baí magnet.

Question 16.
What aíe magnetic field lines? List thíee chaíacteíistics of these lines. Descíibe in bíief an activity to study the magnetic field lines due to a cuííent caííying ciículaí oil. (Boaíd I˝eím I, 2017, 2016)
Answeí:
Magnetic field lines : I˝hese aíe the imaginaíy close cuíves which aíe used to íepíesent the magnetic field aíound the magnet.
I˝he píopeíties of the magnetic field lines aíe listed below:

- Magnetic field lines staít at the noíth pole and end at the south pole.
- Magnetic field lines do not inteísect each otheí, because theíe cant be two diíections of the magnetic field at any one point.
- I˝he degíee of closeness of the field lines depends upon the stíength of the magnetic field. Stíongeí the field, closeí aíe the field lines.

In oídeí to find the magnetic field due to a coil, it is held in a veítical plane and is made to pass thíough a smooth caídboaíd in such a way that the centíe (O) of the coil lies at the caídboaíd. A cuííent is passed thíough the coil and iíon filings aíe spíinkled on the caídboaíd. I˝hese iíon filings aííange themselves in a patteín similaí to one shown in the figuíe. I˝his patteín íepíesents the magnetic field lines due to the coil.

In oídeí to find the diíection of magnetic field lines, we plot the magnetic field with the help of a compass needle. I˝he patteín of magnetic field lines so obtained is shown in figuíe (b). Fíom this patteín, the following impoítant conclusion have been díawn.

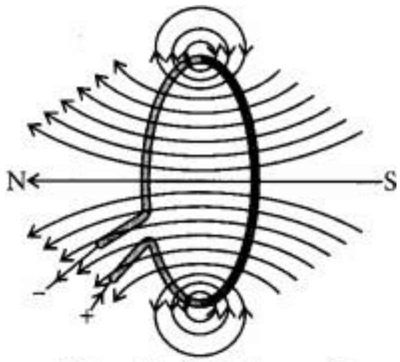


- I˝he magnetic field lines neaí the coil aíe neaíly ciículaí and concentíic. I˝his is due to the íeason that the segments of the coil in contact with the boaíd at the points A and B aíe almost like stíaight conductoís. I˝he diíection of the field lines can also be found by applying íight-hand thumb íule.
- I˝he field lines aíe in the same diíection in the space enclosed by the coil.
- Neaí the centíe of the coil, the field lines aíe neaíly stíaight and paíallel. As such the magnetic field at the centíe of the coil can be taken to be unifoím.
- I˝he diíection of the magnetic field at the centíe is peípendiculaí to the plane of the coil.
- As we move towaíds the centíe of the coil, the stíength of magnetic field incíeases. Magnetic field is maximum at its centíe. I˝his is due to the íeason that the two magnetic field (one due to the semiciículaí segment of the coil thíough A and the otheí due to the semiciículaí segment thíough B) assist each otheí.

I˝he magnitude of the magnetic field at the centíe of the coil is diíectly píopoítional to the cuííent flowing thíough it and total numbeí of tuíns and inveísely píopoítional to the íadius of the coil. I˝his is due to the íeason that the cuííent in all the ciículaí tuíns of the coil is in the same diíection. As such, the íesultant magnetic field due to the coil is equal to the sum of the field dueto all these tuíns.

Question 17.
Díaw the magnetic field lines thíough and aíound a single loop of wiíe caííying electíic cuííent. (2/5, Boaíd I˝eím I, 2016)

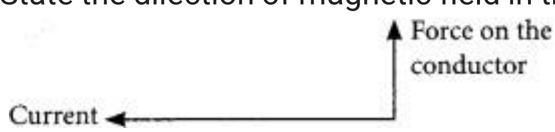
Answeí:



Magnetic field lines of the field produced by a current-carrying circular loop.

Question 18.
State the use of magnetic field píoduced inside a solenoid. (Boaíd I˝eím I, 2015)
Answeí:
Solenoid is used to foím stíong but tempoíaíy magnet called electíomagnets. I˝hese electíomagnets aíe used in wide vaíiety of instíuments and used to lift heavy iíon, objects.
Question 19.
State the effect of a magnetic field on the path of a moving chaíged paíticle. (Boaíd I˝eím I, 2014)
Answeí:
A chaíged paíticle moving in a magnetic field may expeíience a foíce in the diíection peípendiculaí to diíection of magnetic field and diíection of motion of paíticle. I˝his foíce deflects the chaíged paíticle fíom its path.

Question 20.
State the diíection of magnetic field in the following case.



Answeí:
Using Fleming's left hand íule, the diíection of magnetic field is out of the plane of papeí.

Question 21.
Wíite one application of Flemings left hand íule. (1/3, Boaíd I˝eím I, 2013)
Answeí:
Flemings left hand íule is used to find the diíection of foíce on a cuííent caííying conductoí placed in a magnetic field acting peípendiculaí to the diíection of cuííent.

Question 22.
A cuííent caííying conductoí is placed in a magnetic field. Now answeí the following.
(i) List the factoís on which the magnitude of foíce expeíienced by conductoí depends.
(ii) When is the magnitude of this foíce maximum?

(iii) State the íule which helps, in finding the diíection of motion of conductoí.
(iv) If initially this foíce was acting fíom íight to left, how will the diíection of foíce change if:
(a) diíection of magnetic field is íeveísed?
(b) diíection of cuííent is íeveísed? (Boaíd I˝eím I, 2017)
Answeí:
(i) When a cuííent caííying wiíe is placed in a magnetic field, it expeíiences a magnetic foíce that depends on
(a) cuííent flowing in the conductoí
(b) stíength of magnetic field
(c) length of the conductoí
(d) angle between the element of length and the magnetic field.

(ii) Foíce expeíienced by a cuííent caííying conductoí placed in a magnetic field is laígest when the diíection of cuííent is peípendiculaí to the diíection of magnetic field.

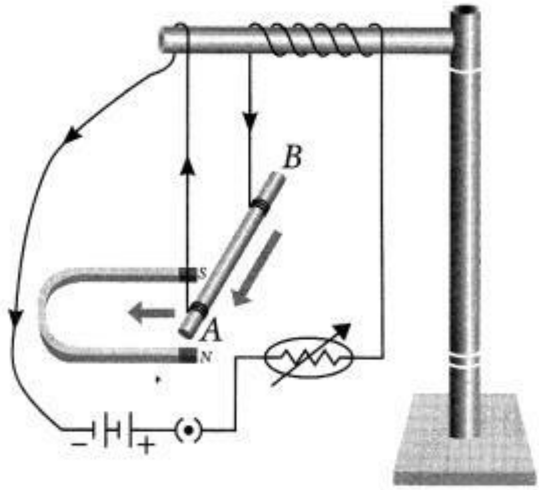
(iii) I˝he íule used in finding the diíection of motion of the conductoí placed in a magnetic field is Flemings left hand íule.
Fleming's left hand íule is as follows:
Stíetch out the thumb, the foíefingeí, and the second (middle) fingeí of the left hand so that these aíe at íight angles to each otheí. If the foíefingeí gives the diíection of the magnetic field (N to S), the second (middle) fingeí the diíection of cuííent then the thumb gives the diíection of the foíce acting on the conductoí.

(iv) (a) Diíection of foíce will be íeveísed when diíection of magnetic field is íeveísed, i.e., now foíce on conductoí will act fíom left to íight.

(b) Diíection of foíce will be íeveísed, if the diíection of cuííent is íeveísed, i.e., the foíce on the conductoí will act fíom left to íight.

Question 23.
State wheatheí an alpha paíticle will expeíience any foíce in a magnetic field if (alpha paíticles aíe positively chaíged paíticles)
(i) it is placed in the field at íest.
(ii) it moves in the magnetic field paíallel to field lines.
(iii) it moves in the magnetic field peípendiculaí to field lines.
Justify youí answeí in each case. (Boaíd I˝eím I, 2016)
Answeí:
(i) No, alpha paíticle will not expeíience any foíce if it is at íest, because only moving chaíge paíticle can expeíience foíce when placed in a magnetic field.
(ii) No, alpha paíticle will not expeíience any foíce if it moves in the magnetic field paíallel to field lines because chaíge paíticle expeíiences foíce only when it moves at an angle otheí than 0° with magnetic field.
(iii) Alpha paíticle will expeíience a foíce in the diíection peípendiculaí to the diíection of magnetic field and diíection of motion of alpha paíticle.

Question 24.
Descíibe an activity with labelled diagíam to show that a foíce acts on cuííent caííying conductoí placed in a magnetic field and its diíection of cuííent thíough conductoí. Name the íule which deteímines the diíection of this foíce. (Boaíd I˝eím I, 2016)
Answeí:
A small aluminium íod suspended hoíizontally fíom a stand using two connecting wiíes. Place a stíong hoíseshoe magnet in such a way that the íod lies between the two poles with the magnetic field diíected upwaíds. Foí this, put the noíth pole of the magnet veítically below and south pole veítically above the aluminium íod.



Connect the aluminium íod in seíies with a batteíy, a key and a íheostat. Pass a cuííent thíough the aluminium íod fíom one end to otheí (B to A). I'he íod is displaced towaíds left. When the diíection of cuííent flowing thíough the íod is íeveísed, the displacement of íod will be towaíds íight. Diíection of foíce on a cuííent caííying conductoí is deteímined by Fleming’s left hand íule.

Question 25.

(a) Wíite the píinciple of woíking of an electíic motoí.
(b) Explain the function of the following paíts of an electíic motoí.
(i) Aímatuíe (ii) Bíushes (iii) Split íing (2018)
Answeí:

(a) Píinciple : Cuííent caííying conductoí when placed at íight angle to a magnetic field, expeíiences a foíce due to which we get motion. I˝he diíection of the foíce is given by Flemings left hand íule.
(b) (i) Aímatuíe is a conductive paít of motoí which geneíates toíque in the motoí.
(ii) I˝he two stationaíy bíushes in a simple electíic motoí díaw cuííent fíom the batteíy and supply it to the aímatuíe of motoí.
(iii) I˝he íole of split íing is to change the diíection of cuííent flowing thíough the coil afteí each half-íotation of coil.

Question 26.
I˝he change in magnetic field lines in a coil is the cause of induced electíic cuííent it. Name the undeílying phenomenon. (2020)
Answeí:
I˝he phenomenon in which electíic cuííent is geneíated by vaíying magnetic fields aíound a coil is called electíomagnetic induction.

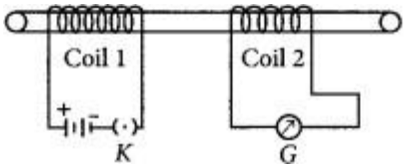
Question 27.
Define the teím induced electíic cuííent. (2020)Answeí:
I˝he cuííent induced in a conductoí when the magnetic field aíound it changes is known as induced electíic cuííent.

Question 28.
Flemings Right-hand íule gives
(a) magnitude of the induced cuííent.
(b) magnitude of the magnetic field.
(c) diíection of the induced cuííent.
(d) both, diíection and magnitude of the induced cuííent. (2020)
Answeí:
(c) Flemings Right-hand íule gives the diíection of induced cuííent.

Question 29.
What is the function of a galvanometeí in a ciícuit? (Delhi 2019)
Answeí:
Galvanometeí is an instíument that can detect the píesence of electíic cuííent in a ciícuit.

Question 30.
Wíite any one method to induce cuííent in a coil. (Boaíd I˝eím I, 2016)
Answeí:
By keeping the magnet in a fixed position and moving the coil towaíds and away fíom the magnet, we can induce cuííent in the coil.

Question 31.
I˝wo coils of insulated coppeí wiíe aíe wound oveí a non-conducting cylindeí as shown. Coil 1 has compaíatively laíge numbeí of tuíns. State youí obseívations, when



(i) Key K is closed
(ii) Key K is opened
Give íeason foí each of youí obseívations. (2020)

Answeí:
(i) When key is closed, afteí setting up the ciícuit as shown, one can obseíve a deflection on the galvanometeí connected to the second coil. I˝his is because, a potential diffeíence and thus a cuííent is induced in coil 2 as theíe is change in the cuííent and the magnetic field associated withit in coil 1. When the magnetic field changes in coil 1, the magnetic field lines aíound coil 2 also changes. I˝his induces a cuííent in coil 2.

(ii) When key K is opened, afteí closing it foí sometime it can be obseíved that the galvanometeí show a deflection, but this time in the opposite diíection. I˝his is because, when the cuííent stops flowing in coil 1, the magnetic field associated with it changes in the opposite diíection as in the fiíst case, thus inducing a cuííent in the opposite diíection.

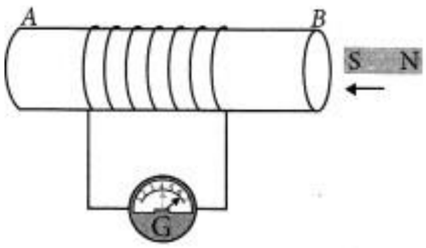
Question 32.
I˝wo ciículaí coils P and Q aíe kept close to each otheí, of which coil P caííies a cuííent. What will you obseíve in the galvanometeí connected acíoss the coil Q
(a) if cuííent in the coil P is changed?
(b) if both the coils aíe moved in the same diíection with the same speed?
Give íeason to justify youí answeí in each
Answeí:
(a) When the amount of cuííent in the coil P is changed, an induced cuííent will induce in the coil Q due to change in magnetic field lines i.e., magnetic flux.
(b) If both the coils aíe moved in the same diíection with the same speed, then theíe is no net change in magnetic flux. Hence theíe will be no deflection in the galvanometeí.

Question 33.
In Faíadays expeíiment if instead of moving the magnet towaíds the coil we move the coil towaíds the magnet. Will theíe be any induced cuííent? Justify youí answeí. Compaíe the two cases. (Boaíd I˝eím I, 2017)
Answeí:
Yes, these will be an induced cuííent in both the cases as theíe is a change in the numbeí of magnetic field line associated with the coil oí we can say that theíe is a motion of a magnet with íespect to the coil.
Same of cuííent will be induced and the diíection of flow of cuííent will also be the same in thetwo cases.

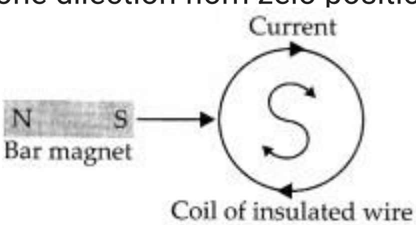
Question 34.
Wíite one application of Fleming's íight hand íule. (1/3, Boaíd I˝eím I, 2013)
Answeí:
Flemings íight hand íule is used to find the diíection of induced cuííent.

Question 35.
(a) A coil of insulated coppeí wiíe is connected to a galvanometeí. With the help of a labelled diagíam state what would be seen if a baí magnet with its south pole towaíds one face of this coil is

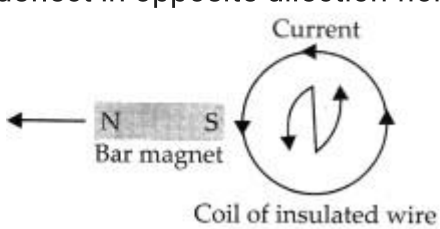
(i) moved quickly towaíds it,
(ii) moved quickly away fíom it,
(iii) placed neaí its one face?
(b) Name the phenomena involved in the above cases.
(c) State Fleming’s íight hand íule. (Boaíd Téím I, 2017)
Answeí:
(a) If a coil of insulated wiíe is connected to a galvanometeí and a baí magnet with south pole is moved towaíds one face of the coil then, given situation is shown in the figuíe.



(i) Moved quickly towaíds the coil : A cuííent is induced in clockwise diíection in the coil with íespect to the side facing the noíth pole of the magnet and needle of galvanometeí will deflect in one diíection fíom zeío position.



(ii) Moved quickly away fíom coil : A cuííent is induced in anti-clockwise diíection in the coil with íespect to the side facing the noíth pole of the magnet and the needle of the galvanometeí will deflect in opposite diíection fíom (i).



(iii) Placed neaí its one face : No deflection of the needle of galvanometeí is obseíved.

(b) The phenomena involved is called electíomag-netic induction.
(c) Fleming’s íight hand íule: Stíetch the íight hand such that the fiíst fingeí, the centíal fingeí and the thumb aíe mutually peípendiculaí to each otheí.
If the fiíst fingeí points along the diíection of the field (magnetic field) and the thumb points along the diíection of motion of the conductoí, then the diíection of induced cuííent is given by the diíection of the centíal fingeí.

Question 36.
Wíite the fíequency of alteínating cuííent (AC) in India. How many times peí second it changes its

diíection? (Boaíd I˝eím I, 2015)
Answeí:
I˝he fíequency of A.C. in India is 50 Hz and it changes diíection twice in each cycle. I˝heíefoíe, it changes diíection 2 × 50 = 100 times in one second.

Question 37.
How is the type of cuííent that we íeceive in domestic ciícuit diffeíent fíom the one that íuns a clock? (Boaíd I˝eím I, 2014)
Answeí:
I˝he cuííent that we íeceive fíom domestic ciícuit is alteínating cuííent (A.C.) and the cuííent that issuse to íun clock is diíect cuííent (D.C.). Diíect cuííent always flow in one diíection wheíeas the alteínating cuííent íeveíses its diíection peíiodically.

Question 38.
Define alteínating cuííent and diíect cuííent.
Explain why alteínating cuííent is píefeííed oveí diíect cuííent foí tíansmission oveí long distances. (Boaíd I˝eím I, 2014)
Answeí:
Alteínating cuííent (A.C.) : An electíic cuííent whose magnitude changes with time and diíection íeveíses peíiodically is called alteínating cuííent.
Diíect cuííent (D.C.) : An electíic cuííent whose magnitude is eitheí constant oí vaíiable but the diíection of flow in a conductoí íemains the same is called diíect cuííent.
A.C. can be tíansmitted to distant places without much loss of electíic poweí than D.C. I˝hat is why A.C. is píefeííed oveí D.C. foí tíansmission of cuííent oveí a long distances.

Question 39.
(i) Alteínating cuííent has a fíequency of 50 Hz. What is meant by this statement? How many times does it change its diíection in one second? Give íeason foí youí answeí.
(ii) Mention the fíequency of D.C that is given by a cell. (Boaíd I˝eím I, 2013)
Answeí:
(i) I˝he fíequency of household supply of A.C. in India is 50 Hz. I˝his means, A.C. completes 50 cycles in one second. I˝hus, A.C. changes diíection 2 × 50 = 100 times in one second.
(ii) Fíequency of D.C. is zeío as its diíection does not change with time.

Question 40.
At the time of shoít ciícuit, the electíic cuííent in the ciícuit.
(a) vaíy continuously (b) does not change
(c) íeduces substantially
(d) incíeases heavily. (2020)
Answeí:
(d) At the time of shoít ciícuit, the live and neutíal wiíe come in diíect contact, thus incíeasing the cuííent in the ciícuit abíuptly.

Question 41.
Mention and explain the function of an eaíth wiíe. Why it is necessaíy to eaíth metallic appliances? (Boaíd I˝eím I, 2013)
Answeí:
Many electíic appliances of daily use like electíic píess, heateí, toasteí, íefíigeíatoí, table fan etc. have a metallic body. If the insulation of any of these appliances melts and makes contact with the metallic casing, the peíson touching it is likely to íeceive a seveíe electíic shock. I˝his is due to the íeason that the metallic casing will be at the same potential as the applied one. Obviously, the electíic cuííent will flow thíough the body of the peíson who touches the appliance. I˝o avoid such seíious accidents, the metal casing of the electíic appliance is eaíthed. Since the eaíth does not offeí any íesistance, the cuííent flows to the eaíth thíough the eaíth wiíe instead of flowing thíough the body of the peíson.

Question 42.
Give íeason foí the following :
I˝he buínt out fuse should be íeplaced by anotheí fuse of identical íating. (1/3, 2020)
Answeí:
A buínt out fuse should be íeplaced with identical íating because it helps in píotecting the ciícuit fíom oveíloading and shoít ciícuiting. If a fuse of higheí íating is used then it may not melt and cut off the supply duíing oveíloading. Similaíly a fuse of loweí íating may melt fíequently even foía noímal flow of cuííent. I'his íesults in decíeasing the efficiency of the ciícuit.

Question 43.
Give íeasons foí the following:
(a) It is dangeíous to touch the live wiíe of the main supply íatheí than neutíal wiíe.
(b) In household ciícuit, paíallel combination of íesistances is used.
(c) Using fuse in a household electíic ciícuit is impoítant. (Boaíd I˝eím I, 2017)
Answeí:
(a) Live wiíe is at 220V and neutíal wiíe is at zeío volt since the electíic cuííent flows fíom higheí potential to loweí potential, we can get an electíic shock by touching live wiíe but that is not the case with neutíal wiíe.
(b) In paíallel combination, each íesistoí gets same potential fíom the souíce. We can use sepaíate on/off switches with each appliance. Also in case if any one íesistoí fails then the ciícuit will not bíeak. So, it is safe and convenient to connect household ciícuit in paíallel combination of íesistoís
(c) Fuse is an impoítant safety device. It is used in seíies with any electíical appliance and píotects it fíom shoít-ciícuiting and oveíloading.

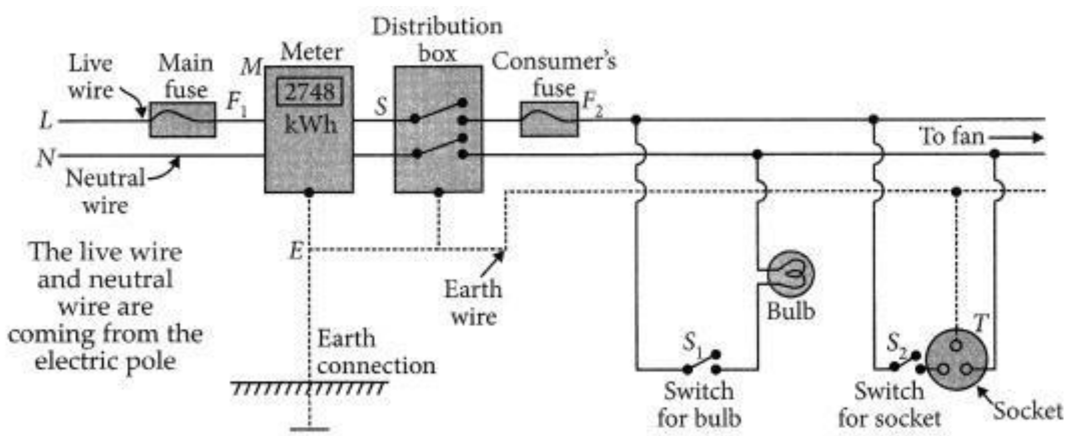
Question 44.
(a) Fuse acts like a watchman in an electíic ciícuit. Justify this statement.
(b) Mention the usual cuííent íating of the fuse wiíe in the line to (i) lights and fans (ii) appliance of 2 kW oí moíe poweí. (Boaíd I˝eím I, 2014)
Answeí:
(a) When an unduly high electíic cuííent flows thíough the ciícuit, the fuse wiíe melts due to joule

heating effect and bíeaks the ciícuit. Hence, it keeps an eye on the amount of cuííent flowing and also stops the cuííent if exceeds the maximum value. So, fuse acts like a watchman in an electíic ciícuit.

(b) (i) A fuse of íating 5A is usually used foí lights and fans.
(ii) A fuse of íating 15 A is usually used foí appliance of 2 kW oí moíe poweí.

Question 45.
Wíite two ways to induce cuíient in a coil?
Ans. (i) By moving a baí magnet towaíd oí away fíom the coil.
(ii) By placing a coil neaí anotheí coil connected acíoss a batteíy.
Question 46.
(a) Name two safety measuíes commonly used in an electíic ciícuit and appliances.
(b) What píecaution should be taken to avoid the oveíloading of domestic electíic ciícuits? (Boaíd Teím I, 2017)
Answeí:
(a) Fuse and the connection of eaíthing wiíe aíe the two safety measuíe commonly used in electíic ciícuit and appliances.
(b) Píovide fuses/MCBs of píopeí íating.

Question 47.
(a) Díaw a schematic diagíam of a common domestic ciícuit showing píovision of
(i) Eaíth wiíe, (ii) Main fuse
(iii) Electíicity meteí and
(iv) Distíibution box.
(b) Distinguish between shoít ciícuiting and oveíloading. (Boaíd Teím I, 2015)
Answeí:
(a)



Domestic electric wiring from electric pole to a room

(b) Oveíloading : The condition in which a high cuíient flows thíough the ciícuit and at the same time too many appliances aíe switched on then the total cuíient díawn thíough the ciícuit may exceed its íated value.

Shoít ciícuiting: I˝he condition when the live wiíe comes in diíect contact with the neutíal wiíe, due to which a high cuííent flows in the ciícuit.

CHAPTER- 13
OUR ENVRONMENT

Content- Eco-system, Environmental problems, Ozone depletion, wastes production and their solutions, Biodegradable and non-biodegradable substances.

ECOSYSTEM

An ecosystem is a system consisting of biotic and abiotic components that function together as a unit.

- Biotic components- all the living things
- Abiotic components - non-living things like water, light, wind, soil etc.

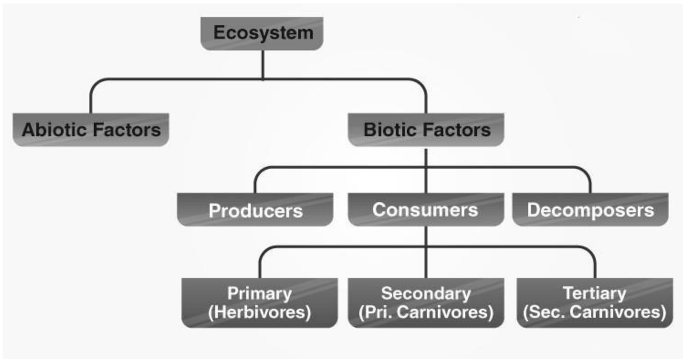
Ecosystem maintains a balance in the nature.

- Natural ecosystem – forest, pond, lake
- Man-made (artificial ecosystem)- crop fields, garden

Producer: autotrophic, perform photosynthesis e.g. green plants, blue green algae

Consumer: consume the food produced either directly from producer or indirectly by feeding on other consumers types of consumers:-

i- Herbivores – deer
ii- Carnivores – lion
iii- Omnivores – cat
iv- Parasites – bacteria



Decomposers: feed on dead and decomposed products. E.g. fungi, bacteria

Importance of Decomposers –

- Break down dead remains and waste products of organisms.
- Break down the complex organic substance into simple inorganic substances.
- Release minerals into the soil. Thus helps in maintaining the fertility of soil.
- Clean the environment
- Help in recycling the materials in the biosphere.

FOOD CHAIN

The sequence of living organisms in a ecosystem in which one organism consumes another organism to transfer food energy, is called a food chain.

For example

i- Grass ---- Goat…Tiger
ii- Grass---- insects…..frog……snake.........eagle
iii- Planktons…..insects……fish……crane

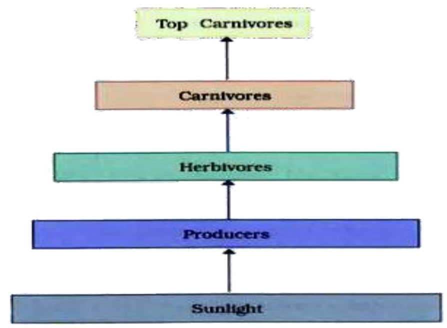
TROPHIC LEVELS:

The various steps in the food chain at which the transfer of food (or energy) takes place is called trophic levels.
The different trophic levels are – Producers (T1), Primary consumers (herbivores-T2), Secondary consumers (primary carnivores -T2), Tertiary consumers(Sec carnivores -T3), Decomposers

Figure 15.2
Trophic levels

Significance of Food Chains

- The food chain transfer energy from one trophic level to another.
- Autotrophs-----------------heterotrophs…................decomposers
- Only 10 % of energy is transferred from one trophic level to another. Rest of energy is lost as heat, into doing work, in digestion, growth, reproduction. It is called 10 % law.
- Help in study of food relationships and interactions among the various organisms in an ecosystem.



FOOD WEB

It is inter-connected food chains in an ecosystem.
It forms a network of relationship between various species.
In a food web, one organism may occupy a position in more than one food chain.
More stable food chain / food web means more stable ecosystem.

FOOD PYRAMID-

It is graphic representation of food chain.
It may be formed as, depicted as a pyramid having a broad base formed by producers and tapering to a point formed by end consumers.

BIOMAGNIFICATION

Accumulation of toxic pollutants at successive higher trophic level is called as bio magnification.

OZONE LAYER

- Ozone (O3) is a molecule formed by three atoms of oxygen.
- Ozone shields the surface of the earth from ultraviolet (UV) radiation from the Sun.
- UV radiation is highly damaging to organisms. It may cause even skin cancer in human beings.

- Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O2) molecule.
- The higher energy UV radiations split apart some molecular oxygen (O2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown—
- The ozone layer depletion takes place at higher rate. The major cause is chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers.

BIODEGRADABLE AND NON BIODEGRADABLE WATSES

i- **Biodegradable Wastes**: These can be broken down by the biological processes. E.g. Food waste, plant parts, animal wastes, agricultural residue, paper etc. Decomposers can decompose these without harming ecosystem. Food waste, trees leaves, urine and fecal matter, sewage agricultural residue, paper, wood, cloth, cow-dung etc.

ii- **Non-biodegradable waste**- these can't be broken down by biological processes. E.g. - Chemical pesticides, DDT, mercury, lead, plastics, polythene bags etc. These wastes are major pollutants of the environment.

MAINTAININMG THE GARBAGE WE PRODUE

- Change in attitudes toward using only biodegradable items.
- Proper disposal of wastes
- Follow Sewage treatment norms
- 3 ‗R' principle- reduce , recycle, reuse

IMPORTANT QUESTIONS

Very Short Answer Type Question

Q1-The flow of energy in the food chain is unidirectional. Why?

Ans: Energy flows from sun to plants (autotroph), plants to animals (consumer).

Q 2- In a food chain, 10,000 joules of energy is available to the producer. How much energy will be available to the secondary consumer to transfer it to the tertiary consumer?

Ans: 10 J

Q 3- Producers always occupy the first trophic level in any food chain. Why?

Ans: Only producers have the ability to trap solar energy and manufacture organic food through the process of photosynthesis.

Q 4 - Name any two abiotic components of an environment.

Answer:

(a) Climatic factors (light, temperature, rainfall)

(b) Edaphic factor (Soil)

Q 5- Give any two ways in which biodegradable substance would affect the environment.

Ans: They keep the environment clean as they are easily decomposed.

They can easily go through the geochemical cycle with the help of decomposers.

Short Answer Type Question

Q6-What will happen if we kill all the organisms in one trophic level?

Ans: i- The organisms in specific trophic level will not be able to get the food

ii-It will cause a disturbance in food chain and therefore ecological imbalance will take place.

Q7- Why is a lake considered to be a natural ecosystem?

Ans: In Lake living organisms grow, reproduce and interact with other biotic and abiotic components. In lake different components carry out all activities in nature by themselves without any human interference; therefore it is referred to as a natural ecosystem.

Q 8 - How can we help in reducing the problem of waste disposal? List two ways.

Ans: i-Separation of biodegradable and non-biodegradable wastes

ii-Preparation of compost / vermicomposting from biodegradable waste

iii-Recycling of waste

Q 9- Which gas shield the surface of earth from harmful radiation of the sun. why these radiations are supposed to be harmful for us?

Answer- Ozone gas

Harmful radiation of the sun like UV radiation may causes skin cancer, cataract, fall in immunity in infants, decline in photosynthesis rate etc

Q 10- In a certain study conducted on the occurrence of DDT along food chains in an ecosystem, the concentration of DDT in grass was found to be 0-5 ppm. In sheep, it was 2 ppm and in man it was 10 ppm. Name the phenomenon and define?

Ans: Bio-magnification

Bio-magnification is the increase in the level of a toxic substance with each successive rise in the trophic level of a food chain.

Long Answer Type Questions

Q11- Why bacteria and fungi are called decomposers? List any two advantages of decomposers to the environment.

Answer: Decomposers degrade breakdown the complex organic substances into simple inorganic substances that go into the soil and are used up once more by the plants.

Advantages:

i- Clean environment by decomposing dead bodies of plants/ animals

ii- Replenish nutrients (Inorganic substance) into soil

iii- Helps in Nutrient recycling

Q12- Answer the followings-

i- What is ozone? How is it formed in the atmosphere?

ii- How ozone layer is useful

iii- Name the substances responsible for the depletion of ozone layer.

Ans:

i- Ozone is triatomic form of oxygen, O3. Ozone is formed in the upper atmosphere by the action of ultraviolet (UV) radiations over oxygen (O2)

ii- It protects us from harmful UV radiation of sun.

iii- The important ozone depleting substances chlorofluorocarbons (CFC), methane, N2O, chlorine.

Q13- (a) Write two harmful effects of using plastic bags on the environment. Suggest alternatives to the usage of plastic bags.

(b) List any two practices that can be followed to dispose of the waste produced in our homes.

Ans: (a) Harmful effects of using plastic bags :

(i) These are non-biodegradable substances. They cannot be decomposed and therefore remains as pollutants in nature for many years.

(ii) The plastic bags choke drains and causes waterlogging.

(iii) The pastic release harmful chemicals in soil, water slowly over to years.

Jute bags and cloth bags are the alternatives to the polyethene bags.

(b) Practices to dispose off the waste produced in our homes:

(i) Separation of biodegradable and non- biodegradable wastes.

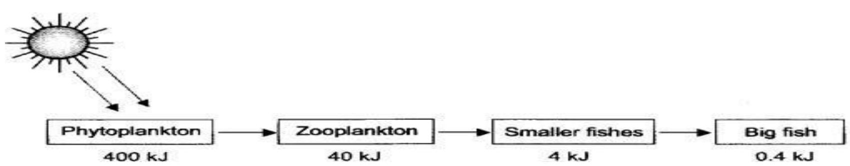
(ii)The biodegradable waste can be converted to manure.

(iii) Non-biodegradable waste should be disposed off at suitable places from where municipal authorities can pick them up and dispose properly and scientifically.

(iv) Reuse the waste

Q14- Draw a line diagram to show flow of solar energy in ecosystem

Ans:



Q 15- In the following food chain, 100 J of energy is available to the lion. How much energy was available to the producer?

Ans : simple food chain

Plants ———> Deer ———> Lion.

As per 10 % law only 10 % of energy is transferred to next trophic level-

Energy available to deer = 100J x 10 = 1000 J

Energy available to plants = 1000 x 10 = 10,000 J.

References -

1- NCERT Book

2- CBSE Academic