केन्द्रीय विद्यालय संगठन

KENDRIYA VIDYALAYASANGATHAN

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**

विषय कोड / SUBJECT CODE - 086

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 **)**

PREPARED BY: 1. ANUPAM S. PRAKASH TA (PHYSICS)

2. TEJINDER SINGH, TA (CHEMISTRY)

3. RAMAKANT UPADHYAYE TA (BIOLOGY)

शिक्षा एवं प्रशिक्षण का आंचलिक संस्थान, चंडीगढ़

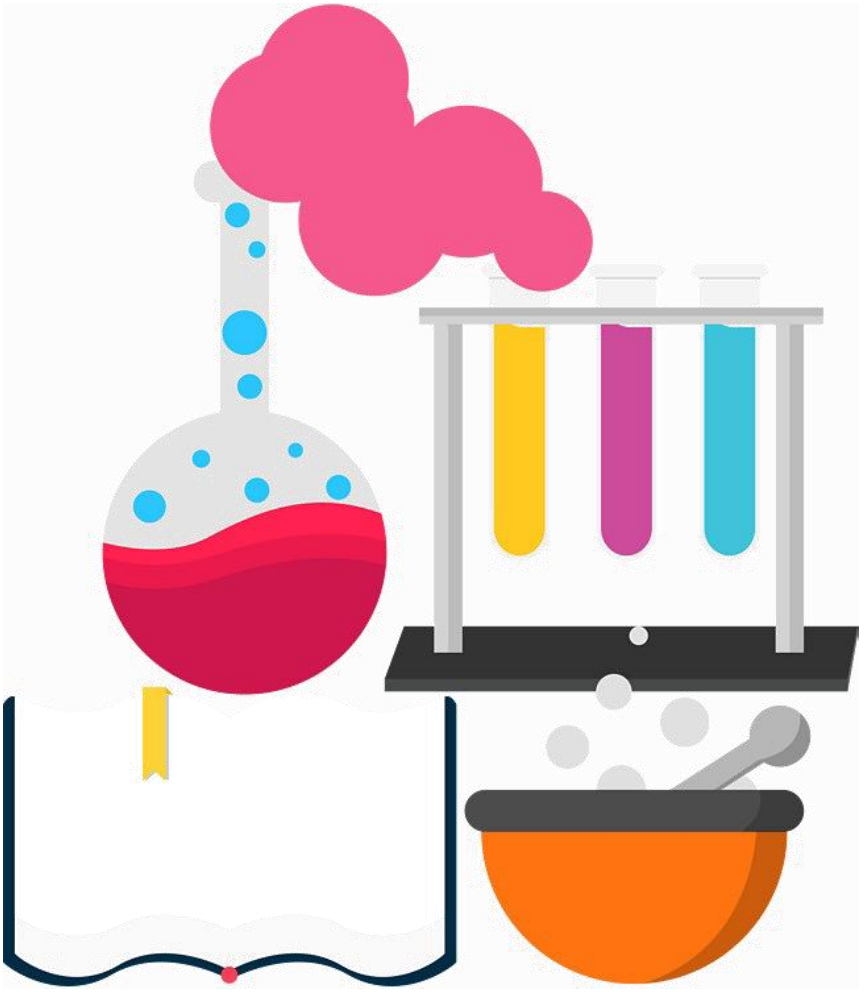
ZONAL INSTITUTE OF EDUCATION AND TRAINING, CHANDIGARH

सेक्टर 33-सी, चंडीगढ़ / SECTOR-33 C, CHANDIGARH

वेबसाईट WEBSITE : zietchandigarh.kvs.gov.in

ईमेल , E-MAIL :kvszietchd@gmail.com

दूरभाष /, Phone : 0172-2921841; 2921994



पुनरीक्षण समिति / VETTING TEAM

- श्री मुन्ना लाल, प्राचार्य, पीएम श्री के.वि. नरेला– मुख्य समन्वयक
- श्री राजवंश गुप्ता, स्ना. शि. (जीव-विज्ञान), पीएम श्री के.वि. नरेला – समन्वयक
- श्रीमती रेणु कुमारी भाटी, स्ना. शि. (रसायन विज्ञान), पीएम श्री के.वि. नरेला – पुनरीक्षक
- श्रीमती मुकेश खुरिया, स्ना. शि. (भौतिकी विज्ञान), पीएम श्री के.वि. नरेला – पुनरीक्षक
- श्रीमती प्रियंका वत्स, स्ना. शि. (रसायन विज्ञान) , पीएम श्री के.वि. मस्जिद मोठ – पुनरीक्षक
- श्री पंकज जांगीड, प्र.स्ना.शि. (विज्ञान), पीएम श्री के.वि. पुष्प विहार– पुनरीक्षक
- श्रीमती मीना गुप्ता, प्र.स्ना.शि. (विज्ञान), पीएम श्री के.वि. सैक्टर 8, रोहिणी– पुनरीक्षक
- श्रीमती रेखा गर्ग, प्र.स्ना.शि. (विज्ञान), पीएम श्री के.वि. टैगोर गार्डन– पुनरीक्षक

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 (Derivationnot 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**.**

INDEX

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.

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:
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.

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

TYPES OF CHEMICAL REACTIONS:

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

1. $CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)$ (highly exothermic)
   (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. $C_6H_{12}O_6(aq) + 6O_2(aq) \longrightarrow 6CO_2(aq) + 6H_2O(l) + energy$
   (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. Thermolysis ($\triangle$) → Therm – Heat , lysis- breakdown

- $2FeSO_4(s) \xrightarrow{Heat} Fe_2O_3(s) + SO_2(g) + SO_3(g)$
  (Greenish complex) (Brownish substance) (burning hair smell)
- $CaCO_3(s) \xrightarrow{Heat} CaO(s) + CO_2(g)$
  (Limestone) (Quick lime)
- $2AgCl(s) \xrightarrow{Sunlight} 2Ag(s) + Cl_2(g)$ (photolysis)
- $2Pb(NO_3)_2(s \xrightarrow{Heat} 2PbO(s) + 4NO_2(g) + O_2(g)$
- $2AgBr(s) \xrightarrow{Sunlight} 2Ag(s) + Br_2(g)$ (used in photography)
- $2H_2O \xrightarrow{Electrolysis} 2H_2(g) + O_2(g)$

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

- $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$ (Copper sulphate) (Iron sulphate)
- $Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$ (Copper sulphate) (Zinc sulphate)
- $Pb(s) + CuCl_2(aq) \longrightarrow PbCl_2(aq) + Cu(s)$ (Copper chloride) (Lead chloride)
- $Fe_2O_{3(s)} + Al_{(s)} \longrightarrow Al_2O_3 + Fe(l)$ (highly exothermic thermite process to repair railway tracks)

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

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

3. $Pb(NO_3)_2 + KI \longrightarrow PbI_2(s)\downarrow + KNO_3$

Insoluble salts ($\downarrow$) settled down at the bottom are called precipitate, hence such reactions are called precipitation reactions.

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:

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

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

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:

$NH_4Cl\,(s) + H_2O\,(l) + Heat \rightarrow NH_4Cl\,(aq)$

$N_2 + O_2 \longrightarrow 2NO$

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 (i) addition of oxygen (ii) removal of hydrogen (iii) loss of electrons (iv) increase in oxidation state by a molecule, atom, or ion.

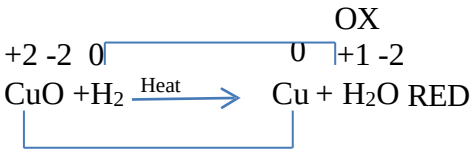
$2Cu + O_2 \longrightarrow 2CuO$

REDUCTION: Reduction refers to (i)addition of hydrogen (ii) removal of oxygen (iii) gain of electrons (iv) decrease in oxidation state by a molecule, atom, or ion.

$CuO + H_2 \longrightarrow Cu + H_2O$

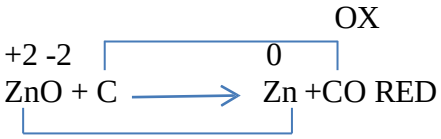
Note : Always choose the species undergoing oxidation and reduction from reactants side only.

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



Some other examples of Redox reactions are:

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



Multiple Choice Questions:

1. 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

2. Which of the following can be decomposed by the action of sunlight?
   (a) Potassium bromide
   (b) Silver bromide
   (c) Magnesium oxide
   (d) Sodium chloride

3. 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

4. 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

5. 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

6. 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

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

8. 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) $Ag + Zn\ (NO_3)_3$

9. 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

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

11. 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

12. 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:

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

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. (b)**	**Q8. (a)**	**Q9. (b)**	**Q10. (b)**
Q11. (b)	**Q12. (c)**	**Q13. (b)**	**Q14. (b)**	**Q15. (b)**

Assignment:

16. 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.

17. On what basis is a chemical equation balanced?
Answer. A chemical reaction is balanced on the basis of law of conservation of mass.

18. 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.

19. 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.

20. Translate the following statement into chemical equation and then balance it Barium Chloride reacts with Aluminium sulphate to give Aluminium Chloride and a precipitate of Barium 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.

21. 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.

22. 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.

23. 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) $CaO\,(s) + H_2O\,(l) \longrightarrow Ca\,(OH)_2 + \text{heat}$

24. Write balanced equations for the following mentioning the type of reaction involved.

(i) Aluminium + Bromine $\longrightarrow$ Aluminium bromide

(ii) Calcium carbonate $\longrightarrow$ Calcium oxide + Carbon dioxide

(iii) Silver chloride $\longrightarrow$ Silver + Chlorine

Answer. (i) $2Al\,(s) + 3Br_2\,(g) \longrightarrow 2AlBr_3\,(s)$

(ii) $CaCO_3\,(s) \longrightarrow CaO + CO_2$

(iii) $2AgCl\,(s) \longrightarrow 2Ag\,(s) + Cl_2\,(g)$

25. (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.

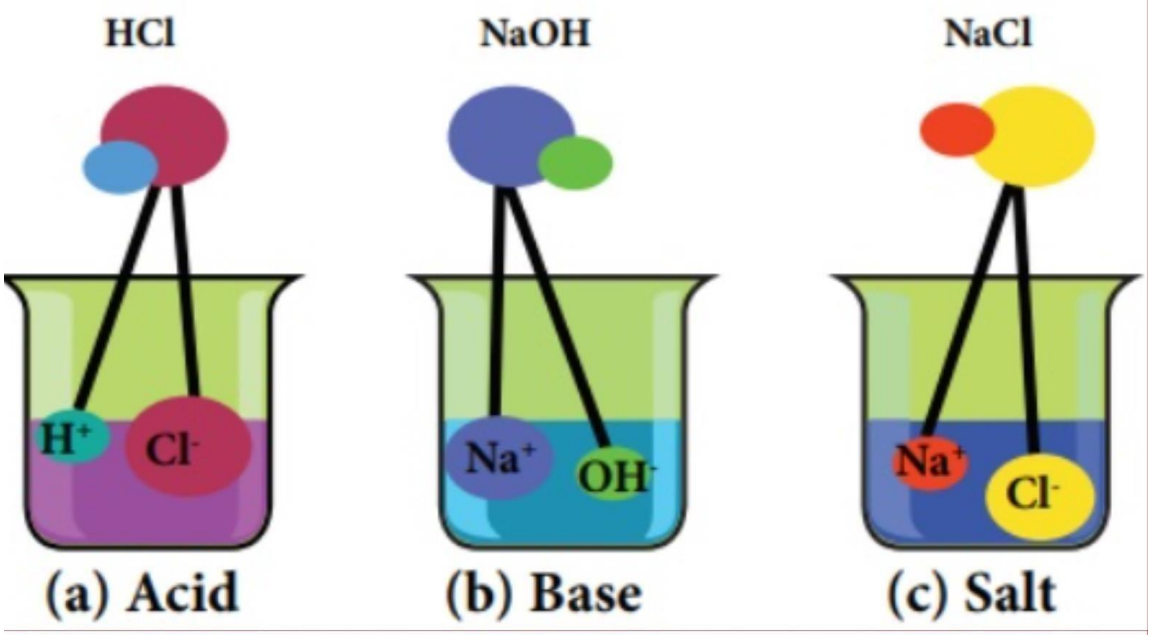
$CuO\,(s) + Zn\,(s) \longrightarrow Cu\,(s) + ZnO\,(s)$

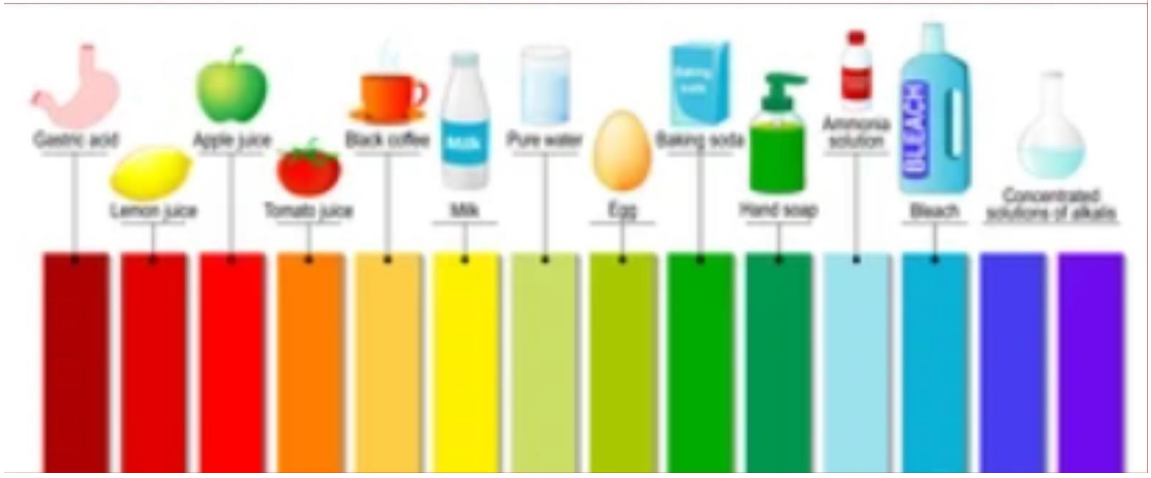
Answer. (a) It is because heat is evolved during respiration.

(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





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:

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

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:

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

(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:

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

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:
$2NaOH\ (aq) + CO_2\ (g) \longrightarrow Na_2CO_3(aq) + H_2O\ (l)$

(iii) Neutralisation Reaction: An acid neutralizes a base when they react with each other and respective salt and water are formed.
Examples:
$HCl\ (aq) + NaOH\ (aq) \longrightarrow NaCl(aq) + H_2O\ (l)$

(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:
$2HCl\ (aq) + CaO\ (aq) \longrightarrow CaCl_2(aq) + H_2O\ (l)$

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

(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.
$HCl\ (aq) + NH_4OH\ (aq) \longrightarrow NH_4Cl\ (aq) + H_2O\ (l)$
(strong acid) weak base acidic salt

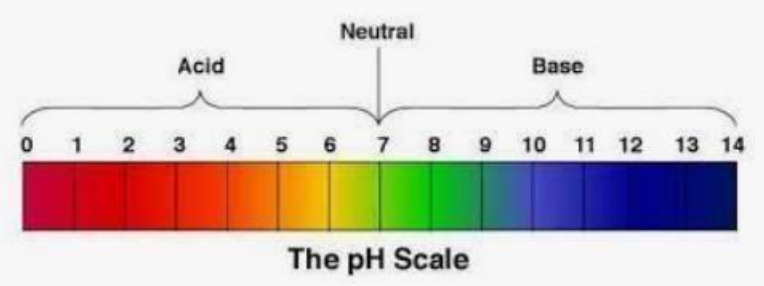
Basic Salts: Salts which are formed after the reaction between a weak acid and strong base are called Basic Salts. For example; Sodium carbonates, Sodium acetate, etc.

$H_2CO_3\ (aq) + 2NaOH\ (aq) \longrightarrow Na_2CO_3\ (aq) + 2H_2O\ (l)$
Weak acid strong base basic salt

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

$CH_3COOH\ (aq) + NaOH\ (aq) \longrightarrow CH_3COONa\ (aq) + H_2O\ (l)$
Weak acid strong base basic salt

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.
$pH = -\log [H^+] = \log \{1/[H^+]\}$
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 Chlor – 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 ($NaHCO_3$): 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.
  $2NaHCO_3 + \text{heat} \rightarrow Na_2CO_3 + CO_2 + H_2O$

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.

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

$$2NaHCO_3 + \text{Heat} \rightarrow Na_2CO_3 + CO_2 + H_2O$$

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:

(ii) It is used in the cleaning of cloths.
(iii) In the making of detergent cake and powder.
(iv) In removing the permanent hardness of water.
(v) 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:

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

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

3. 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

4. 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

5. 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

6. 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

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

8. 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

9. 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

10. 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:

11. 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

12. 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.

13. 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.

14. (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 hydrogen carbonates (Baking soda) neutralizes formic acid giving relief.

15. 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 hydrogen carbonates and tartaric acid. Sodium hydrogen carbonates gives CO_2 which makes cake soft and fluffy. Tartaric acid neutralizes the bitterness due to sodium carbonate produced.

$2NaHCO_3\ (s) \longrightarrow Na_2CO_3\ (s) + CO_2\ (g) + H_2O\ (l)$

16. 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.

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

17. 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**.**

18. 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.

19. 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 ($CaSO_4 .1/_2\ H_2O$)

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

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, wire is made up 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 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 they react with oxygen.

Metal + Oxygen → Metal Oxide

Examples:

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

$$4K + O_2 \longrightarrow 2K_2O$$

Reaction of Sodium with Oxygen: Sodium metal forms sodium oxide when it 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 copper (II) oxide.

$$2Cu + O_2 \longrightarrow 2CuO$$

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

2. Reaction of metals with water: Metals form respective hydroxide and hydrogen gas is liberated when they react with water.

$$\text{Metal} + \text{Water} \longrightarrow \text{Metal hydroxide} + \text{Hydrogen gas}$$

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 it reacts with water.

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

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

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

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.

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

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: 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 on reaction with dilute acid.

$$\text{Metal} + \text{dil. acid} \longrightarrow \text{Metal salt} + \text{Hydrogen}$$

Reaction of Sodium metal with dilute hydrochloric acid: Sodium metal gives sodium chloride and hydrogen gas when sodium reacts 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 , 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 > Au

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 it reacts with water.

$$Na_2O + H_2O \longrightarrow 2NaOH$$

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

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

Similarly,
Aluminium oxide gives sodium aluminate along with water when it 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 $\longrightarrow$ 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.

$$Ag + CuSO_4 \longrightarrow \text{No reaction}$$

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, oxygen, chlorine

Physical properties of non-metals

- **Hardness:** Non-metals are not hard rather they are generally soft. But diamond, an allotrope of carbon 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.

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 they react 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 gas.

$$2C + O_2 \longrightarrow 2CO + \text{heat}$$

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 Sulphurtrioxide, which forms Sulphuric acid when reacts with water.

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

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

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 on 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 reacts with hydrogen to form covalent hydrides.

Non-metal + Hydrogen → Covalent Hydride

Sulphur combines with hydrogen to form a covalent hydride called as Hydrogen sulphide.

$$H_2 + S \longrightarrow H_2S$$

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

$$N_2 + 3H_2 \xrightarrow{Fe} 2NH_3$$

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 obtained 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.

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

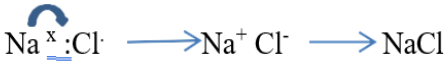
Electronic configuration of sodium: 2, 8, 1 Number of electrons in outermost orbit = 1

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)



Sodium has one valence electron and chlorine has seven valence electrons. Sodium requires to lose one electron to obtain stable configuration and chlorine requires to gain one electron in order to obtain stable electronic configuration. Since, sodium chloride is formed because of ionic bond, thus, it is called Ionic compound.

(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 applied pressure.

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

(iii) Solubility: Ionic compounds are soluble in water but insoluble in organic 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;

$4Fe + 3O_2 \rightarrow 2Fe_2O_3$

$2Fe_2O_3 + xH_2O \rightarrow Fe_2O_3.xH_2O$ (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.

(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.

(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:

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

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

2. Aluminium is used for making cooking utensils. What 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

3. 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

4. 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

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

(a) Na (s) + $2H_2O$ →

(b) Mg (s) + H_2O →

(c) Zn (s) + $2H_2O$ →

(d) Cu (s) + $2H_2O$ →

6. 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

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

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

8. 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

9. 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. (b)**	**Q9. (b)**	

Assignments:

10. 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 known 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.

11. 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.

(iii)

12. Write the electron dot structures for

(a) Potassium and chlorine.

(b) Calcium and sulphur.

(c) Calcium and chlorine.

Answer. (a) KCl (b) CaS (c) $CaCl_2$

13. 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.

14. (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 a copper sulphate solution.

(ii) Some silver pieces are added to 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.

$Zn\ (s) + CuSO_4\ (aq) \longrightarrow Zn\ SO_4\ (aq) + Cu\ (s)$

$Ag\ (s) + FeSO_4\ (aq) \longrightarrow$ No reaction

Reaction will not take place because Ag is less reactive than iron.

15. 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

16. 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.

17. 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.

18. Write two differences between calcination and roasting.

Answer:

Calcination	**Roasting**
(i) It is carried out by heating ore in the absence of air.	(i) 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.

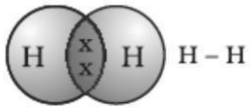
CHAPTER 4
CARBON AND ITS COMPOUNDS

- Carbon cannot form an ionic bond. The atomic number of carbon is 6. Its electronic configuration is 2,4.
- It could gain four electrons forming C^{4-} anion. But it would be difficult for the nucleus with six protons to hold on to ten electrons.
- It could lose four electrons forming C^{4+} cations. But it requires a large amount of energy to remove four electrons.

1. BONDING IN CARBON – THE COVALENT BOND

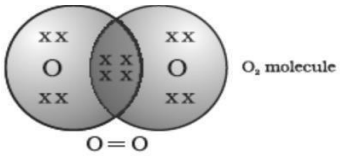
1. **Covalent Bond:** The chemical bond formed by the sharing of electrons between two atoms is called covalent bond.

(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.



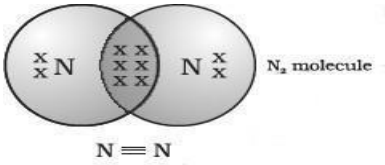
Single bond between two Hydrogen atoms

(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 of electricity.

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

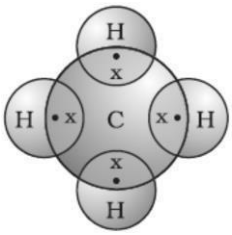
S.No.	Class of compounds	Example	Prefix/Suffix	Structure
1.	Halo alkane	Chloropropane Bromopropane	Prefix -Chloro, - Bromo	$CH_3CH_2CH_2Cl$ $CH_3CH_2CH_2Br$
2.	Alcohol	Propanol	Suffix - ol	$CH_3CH_2CH_2OH$
3.	Aldehyde	Propanal	Suffix - al	CH_3CH_2CHO
4.	Ketone	Propanone	Suffix - one	CH_3COCH_3
5.	Carboxylic acid	Propanoic acid	Suffix - oic acid	CH_3CH_2COOH
6.	Alkenes	Propene	Suffix - ene	$CH_3CH = CH_2$
7.	Alkynes	Propyne	Suffix - yne	$CH_3C = CH$

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:



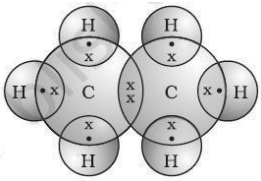
Electron dot structure for methane

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

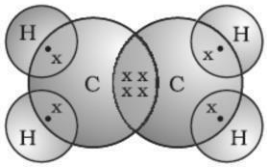
(b) Each carbon atom bonded to three hydrogen atoms

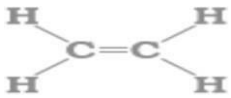
(c) Electron dot structure of ethane



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 ≡ 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.

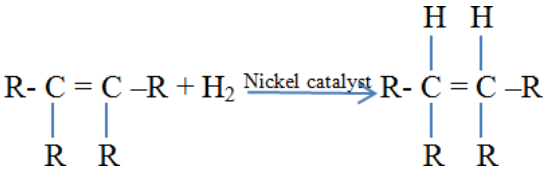
(i) $C + O_2 \longrightarrow CO_2$ + heat and light
(ii) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ + heat and light
(iii) $CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ + heat and light

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: 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, it leads 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) Dehydration: Heating ethanol at 443 K with excess concentrated Sulphuric acid results in the dehydration of ethanol to give Ethene

$$CH_3CH_2OH \xrightarrow{\text{Hot Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

The concentrated Sulphuric acid can be regarded as a dehydrating agent which 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 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

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

(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. The evolved CO_2 is also a test for carboxylic acid.

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

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

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.

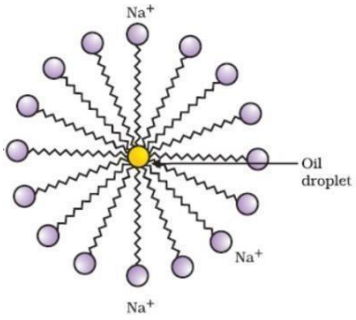
Vegetable oil/Animal fat + NaOH $\xrightarrow{\text{Saponification}}$ Glycerol + Sodium salt of fatty acid (Soap)

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 up 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:

1. 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.

2. Butanone is a four-carbon compound with the functional group

(a) Carboxylic acid. (b) Aldehyde.
(c) Ketone. (d) Alcohol.

3. 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.

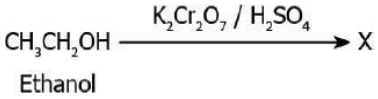
4. The chemical reaction shows the addition of chlorine to methane in the presence of sunlight.

$$CH_4 + Cl_4 \rightarrow X$$

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) $CH_3Cl + H_2SO_4$

5. 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

6. 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

7. 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

8. 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

9. 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

10. 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

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

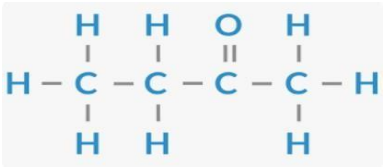
(a) They have high melting and boiling points

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

(c) Both (a) and (b)

(d) None of the above

12. The following image represents a carbon compound.



Which functional group is present in the compound?

(a) Alcohol (b) Aldehyde (c) Carboxylic acid (d) Ketone

13. 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)

14. The number of isomers of pentane is

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

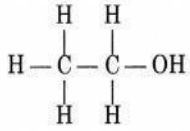
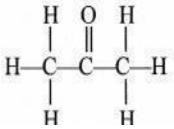
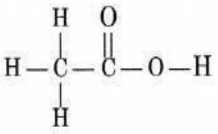
ANSWERS

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 (b)**	

Assignments:

15. 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

16. Write the IUPAC names of the following compounds.

(A) 
(B) 
(C) 

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

17. 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.

18. 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.

19. 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.

2**0.** 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}).

21. 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.

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

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

Answer:

(*i*) $C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ (Combustion)

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

23. 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.

24. 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.

25. 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.

26. (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.

Dip a strip of blue litmus paper in the solution of ethanoic acid

Chapter – 5
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.

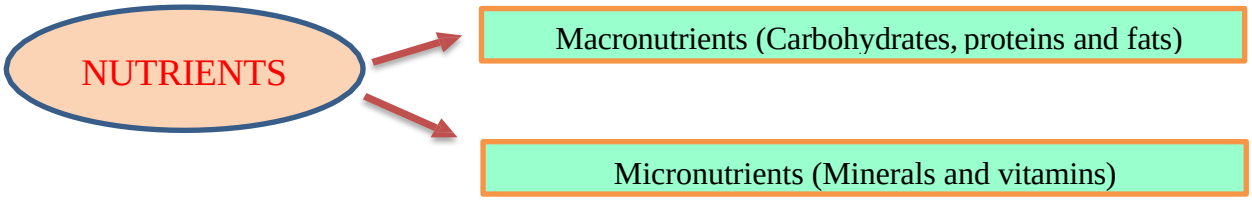
IMPORTANT LIFE PROCESSES

NUTRITION | RESPIRATION | 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.



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.

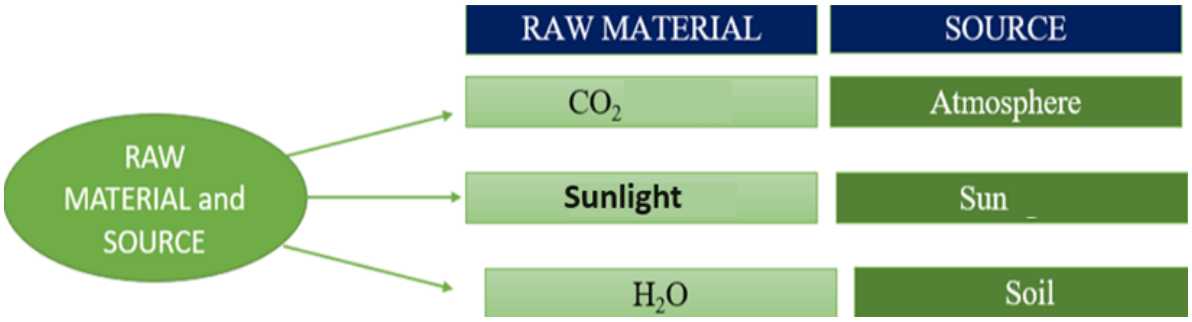
PHOTOSYNTHESIS

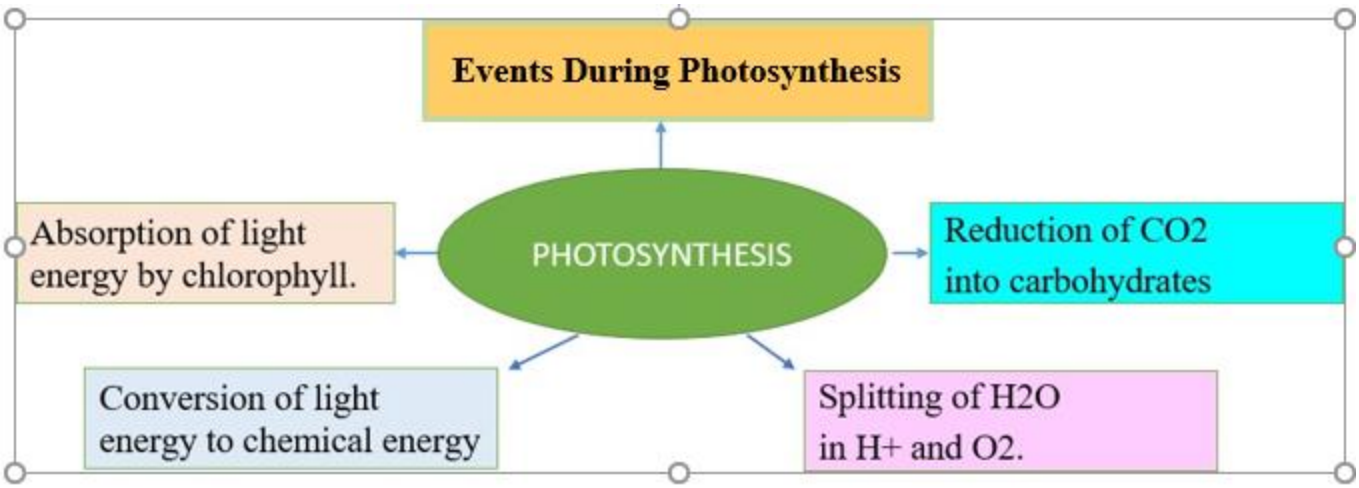
The process by which plants in the presence of chlorophyll sunlight, water, and carbon dioxide to form carbohydrates and release oxygen is known as photosynthesis.

The overall reaction occurring in photosynthesis is as follows:

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

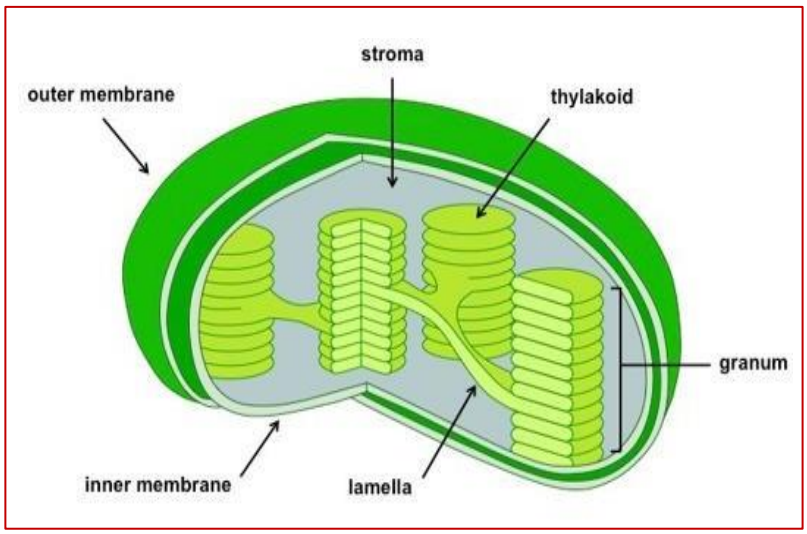
PHOTOSYNTHESIS – Raw Material and Events





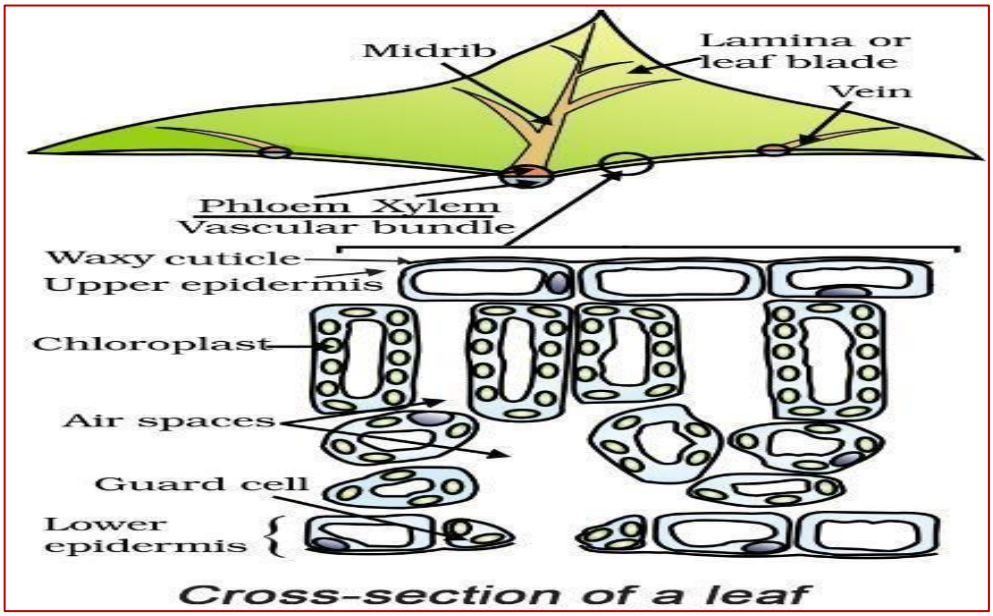
Chloroplast

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



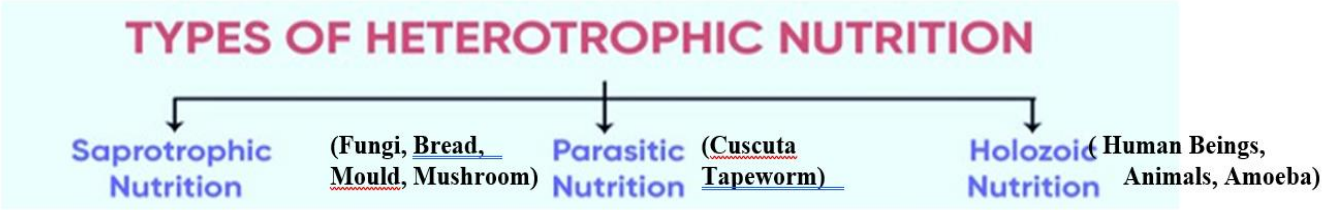
Stomata

Gaseous exchange and transpiration (loss of water as water vapors) take place through tiny pores on the surface of leaves called stomata. Stomata has a pore (stomatal pore) guarded by bean 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 e.g. Plants, Animals or dead and decaying objects.



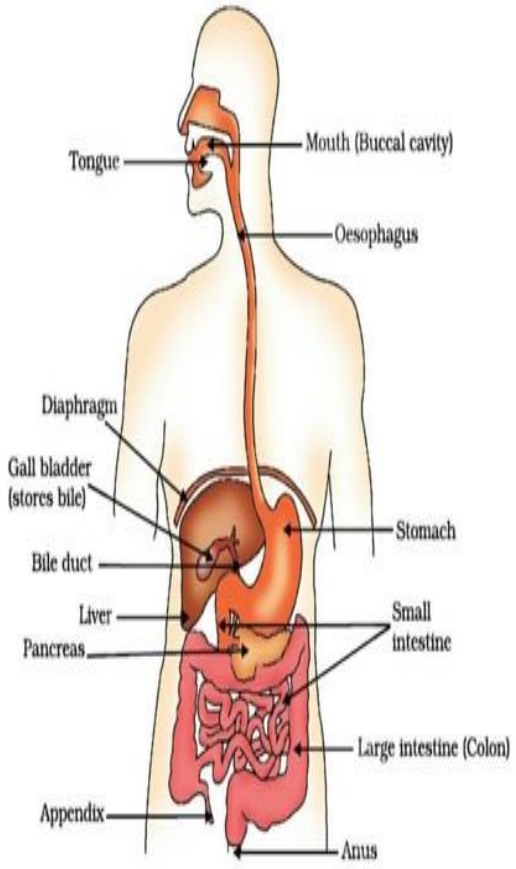
Steps of Holozic Nutrition-

Ingestion 2) Digestion 3) Absorption 4) Assimilation 5) Egestion

Nutrition in amoeba : (Fig 6.5 NCERT Book)

1. Amoeba forms food vacuole and engulfs food with the help of pseudopodia.
2. Breakdown complex substance into simpler ones.
3. Remaining undigested material is thrown out from the surface of cell.

HUMAN DIGESTIVE SYSTEM



BUCCAL CAVITY

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

Saliva contains salivary amylase that breaks down starch.

OESOPHAGUS

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

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

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

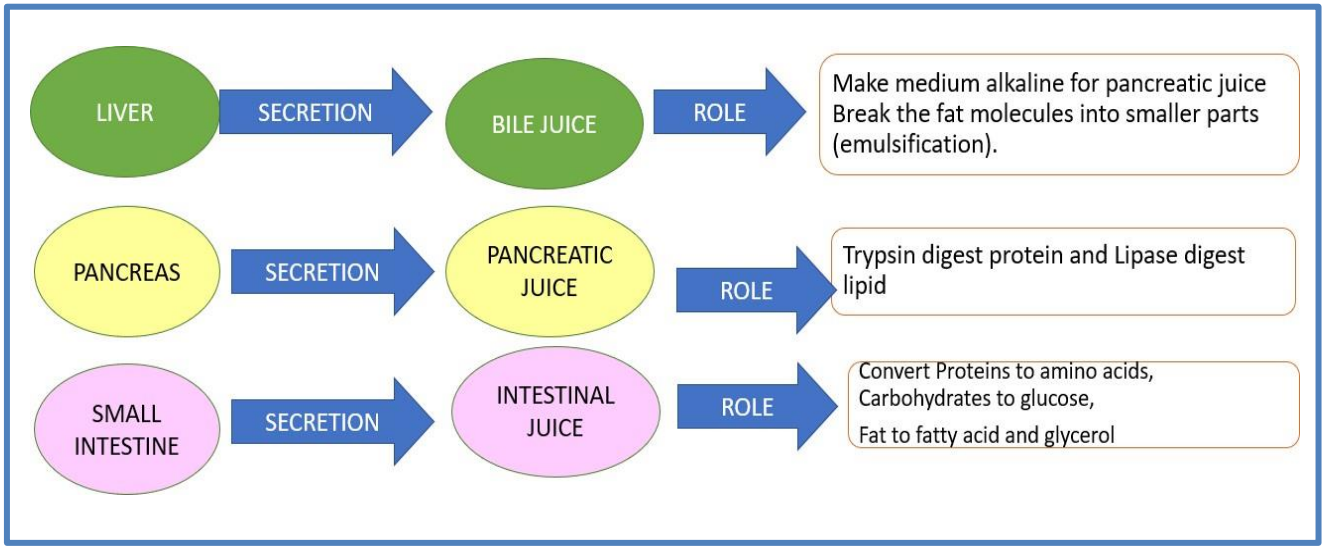
LARGE INTESTINE

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

ANUS

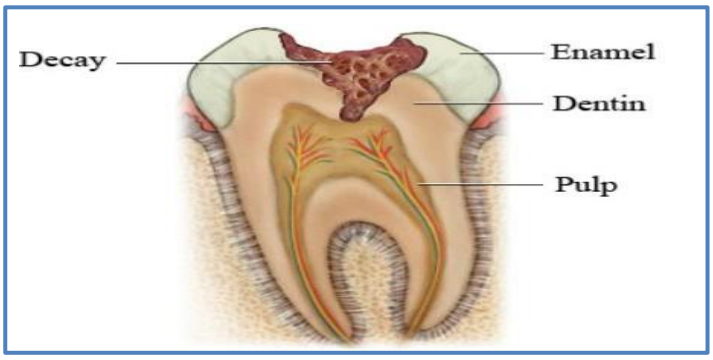
Undigested food is removed from the body via anus.

DIGESTIVE SYSTEM ORGANS AND THEIR ROLES-



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/ Energy currency**

The process of breaking complex organic material into a simpler form with the help of enzymes is called respiration.

Types of respiration and site

Type	Definition	Site
Aerobic respiration	**It occurs in the presence of oxygen**	**Mitochondria**
Anaerobic respiration	**It occurs in the lack of oxygen.**	**Muscle Cells**
Fermentation	**It is a type of anaerobic respiration occurs in a few microorganisms. (Yeast)**	**Cytoplasm**

PROCESS OF RESPIRATION

- Glucose is broken down into pyruvate in the cytoplasm of the cell.
- In the presence of oxygen, pyruvate enters into mitochondria and completely oxidized there to produce CO_2 and energy (ATP).
- In the absence of oxygen pyruvate partially decomposes and forms. Eg- Ethanol in yeast (fermentation), b- Lactic acid in muscle cells.

HUMAN RESPIRATORY SYSTEM

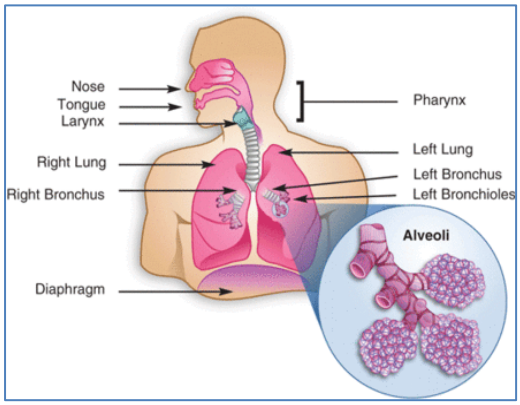
(Consists of the nostril, nasal passage, pharynx, larynx, trachea, bronchi, bronchioles, alveoli, diaphragm, and ribcage.)

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.

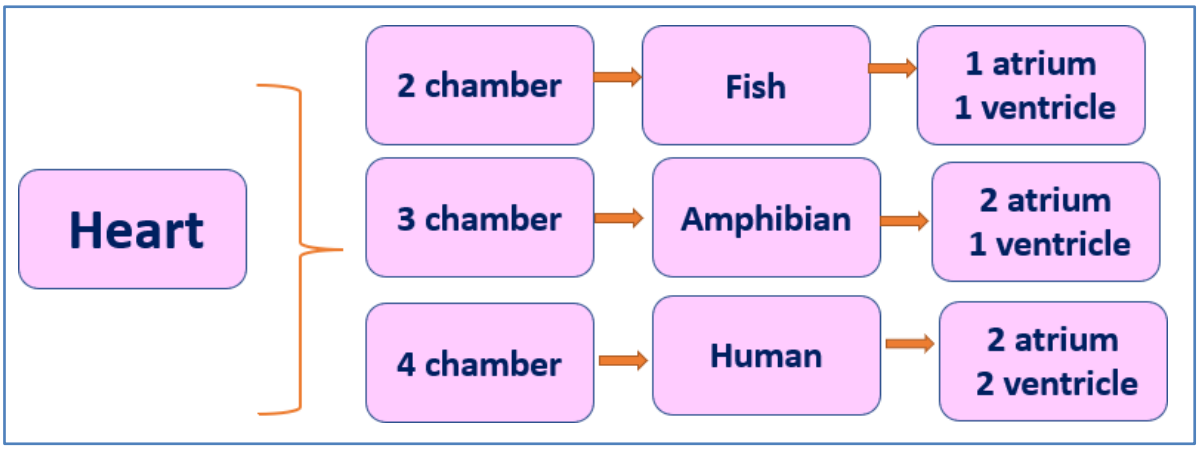
Oxygen enters into blood vessels while CO_2 enters into the alveolar sac. Both oxygen and CO_2 is carried by iron-containing hemoglobin.



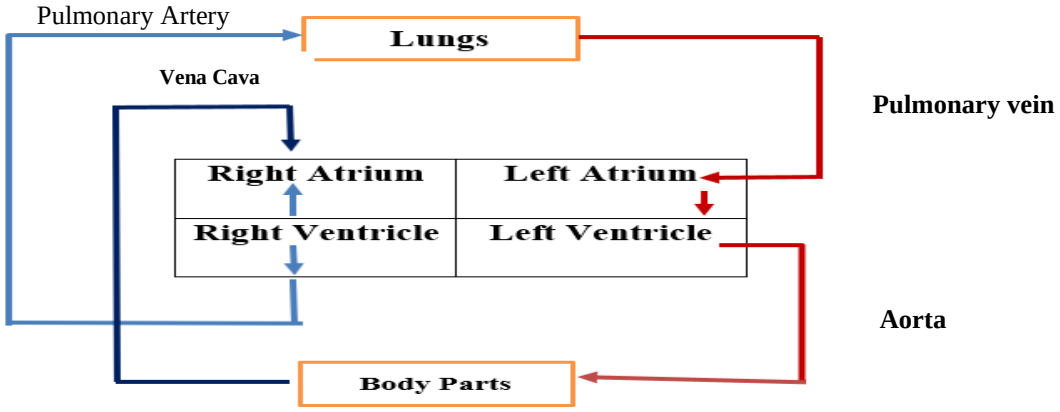
TRANSPORTATION IN HUMAN BEINGS

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**

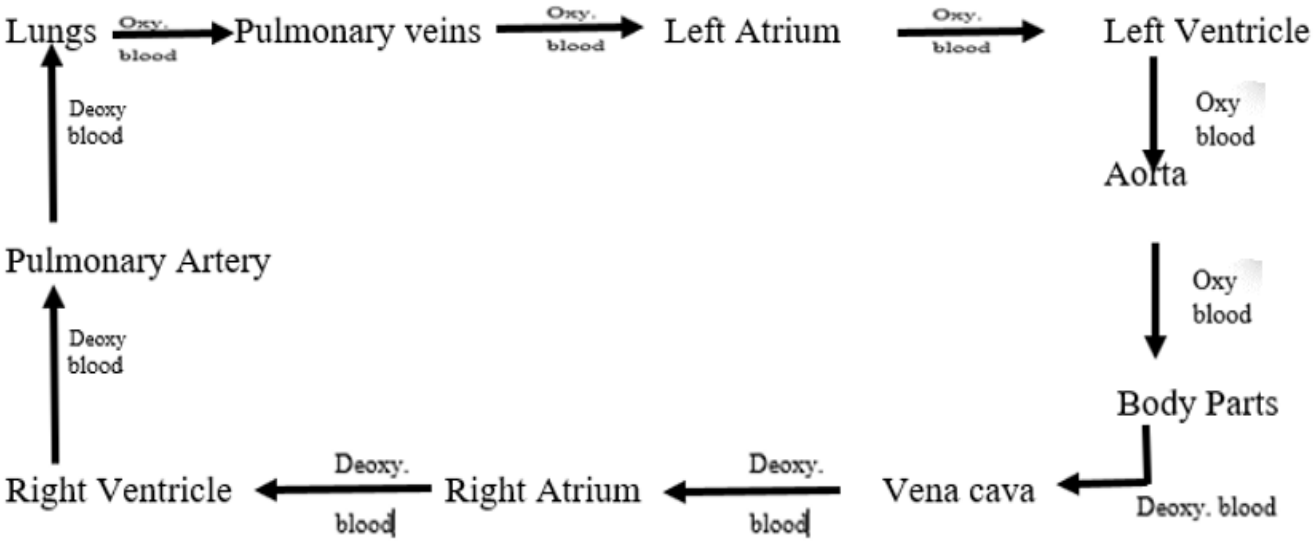
HEART

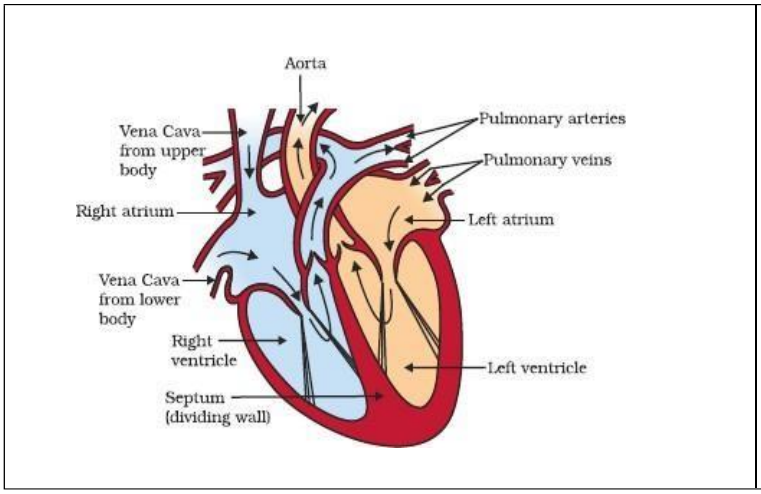


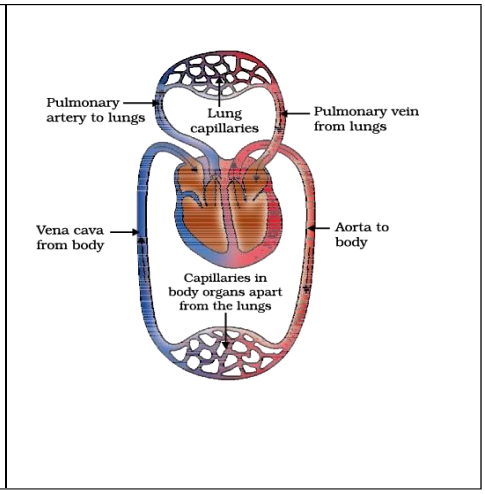
Flowchart



Circulation in human heart:





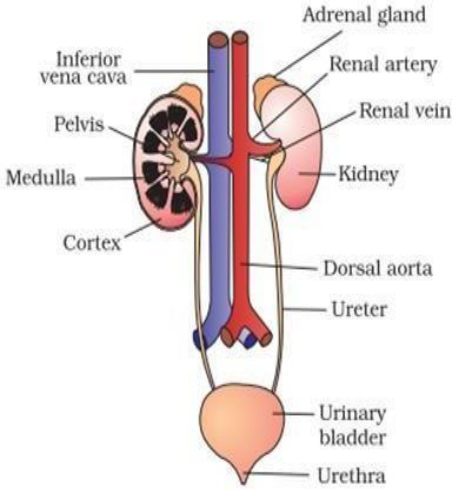


TRANSPORTATION IN PLANTS

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 of thin-walled 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 outside the body through the urethra.

Steps involved in Urine formation:

1. Glomerular Filtration – Filtration of Blood
2. Reabsorption – Glucose, amino acids, salts, water.
3. Secretion – 95%Water, 5% nitrogenous waste such as urea and ammonia.

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 we can 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

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

4. Nature of nutrition in fungi are-

a- Parasite b- Autotrophs c- Saprotrophs d-Mixed autotrophs

Ans: c

5. Which acid is formed in our muscles after vigorous exercise?

Ans: Lactic acid

6. How much energy is released when terminal phosphate linkage in ATP is broken down?

Ans: 30.5 Kj/mol.

SHORT ANSWER TYPE QUESTIONS

1. 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

2. **What is the importance of nutrients?**

Ans: i. Energy production
ii. growth and repair
iii. Protection from disease

3. **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.

4. **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.

5. **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.

6. **Mention the importance of double circulation and Valves 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 of blood.

Valves – Prevent the backward flow of blood

7. **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.

8. **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.

9. (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

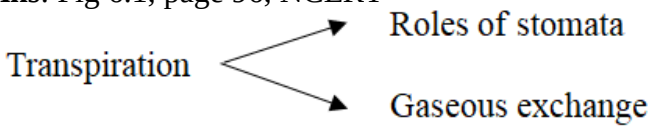
1. **Differentiate the followings-**

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

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

2. **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



3. **Draw a labeled diagram of the structural and functional unit of the kidney. Also, mention its role.**

Ans: Fig: 6.14, page 111, NCERT
Filtration of blood, reabsorption, secretion and excretion of useful and harmful substances present in the blood.

4. **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 day time, water and minerals travel faster through the xylem as compared to the night.
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 in 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. Whereas arteries have high pressure which ensures blood will flow in one direction only.

5. **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.

I**n 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 cava to reach the right atrium. The right atrium transfers the blood into the right ventricle.

6. Mention the location of four major glands associated with the digestive system of humans 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

Secrete HCI- Disinfect food, 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 chime (food coming from stomach) 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)

CHAPTER - 6
CONTROL AND CO-ORDINATION

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-

PHOTOTROPISM	Movement is response to light. Ex- shoot bending toward the light, root bending away from light, movement of sunflower
CHEMOTROPISM	Movement in response to certain chemicals Ex- Growth ofpollen tubes toward ovary
GEOTROPISM	The movementof plants in response to the gravity. Ex- Roots of plant grow downwards, shoots usually grow upward
HYDROTROPISM	Movement of plants in response to water. Ex- Root grows towardswater.
THIGMOTROPISM	The reflexof plants response of touch. Ex- touch-me-not (Mimosa) plant leaves.

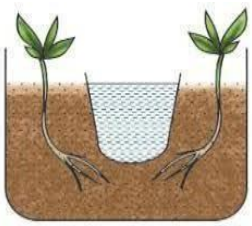
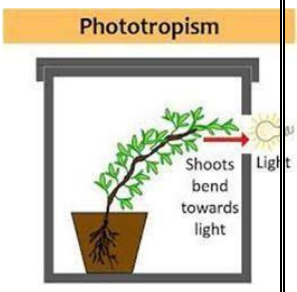
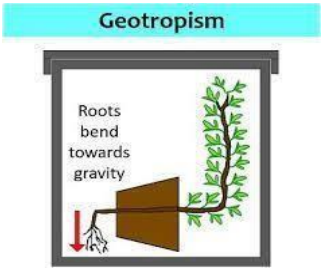


Fig 11.4: hydrotropism





INTRODUCTION OF PLANT HORMONES

Growth and differentiation in plants depend on a few hormones called 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 specific physiological processes.

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

CONTROL AND CO-ORDINATION IN ANIMALS

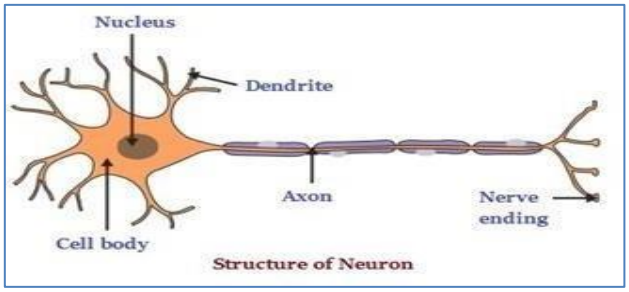
In animals control and coordination is carried out with the help of -

- Nervous system
- Muscular tissue
- Endocrine system: Hormones

Nervous System	
CNS (Central nervous system)	PNS (Peripheral Nervous System)
Brain + Spinal cord	all the nerves associated with the CNS

NEURONS

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

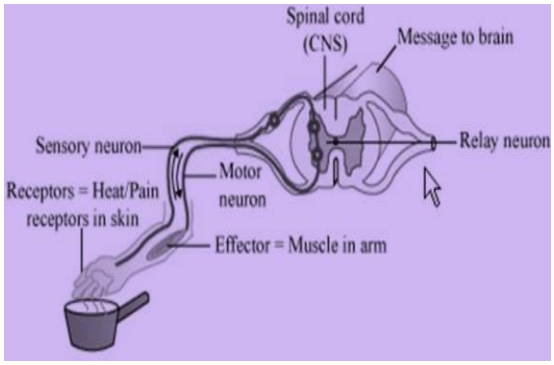


HOW NERVOUS IMPULSE TRAVELS IN BODY

- 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 similar electrical 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 there flex action is called as a reflex arc.
- In these sensory neurons, spinal cord, relay neuron, motor neuron and effector muscles are involved.

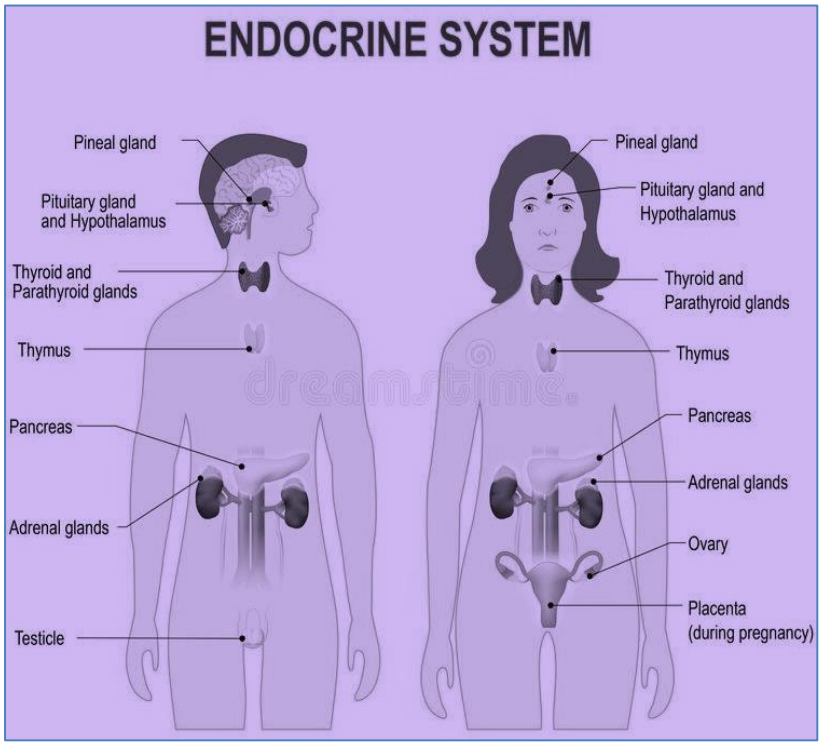


- Stimulus is received by sensory neurons. The sensory neurons transfer sensory impulses to the spinal cord (CNS). Spinal cord processes the stimulus. The motor nerve fiber relays the motor impulses from the nervous system to the effector organs like muscles.

HORMONES IN ANIMALS-

Hormones are chemical messengers which are secreted by the ductless endocrine gland into the blood. Hormones control the activity of certain cells and organs.

Endocrine gland	Hormone	Role
PITUITARY GLAND	Growth hormone	Regulate growth and development
ADRENAL GLAND	Adrenaline	Stress hormones (enable the body ready to deal with 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.

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

Ans: a

3- Testosterone is seccreated from which gland.

a- Throid
b- Pitutary
c- Testes
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- Movement of plant in response to touch.

a- Thigmotroism
b- Geotropism
c- Phototropism
d- Hydrotropism

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. 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.

Ans : 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 effector muscle 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 body function. Fig 7.7, page124, NCERT

13- (a) A person is advised by a doctor to take less sugar in his diet. Name the disease from 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 growth regulators. (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 impulse travels by an electric signal. When it reached to synapse, the neurotransmitters are released in the synaptic cleft.

These neuro transmitters act as stimuli for the next neuron.

CHAPTER -7
HOW DO ORGANISMS REPRODUCE ?

- Reproduction is the biological process by which living organisms produce new individuals (Offspring) similar to themselves.
- It ensures continuity of the species generation after 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.(one male and one female)
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, Plasmodium

Regeneration-

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

Fragmentation-

Individula breaks into two or more fragments give rise to new organism.
Eg. Spirogyra

Budding-

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

Adventitious Bud -

Small buds in the notches of the leaf. These have the ability to grow into new individuals.
Ex- Bryophyllum.

Spore formation -

Spores are produced in sporangia and germinate to produce new individuals.
Rg. Rhizopus (bread mold)

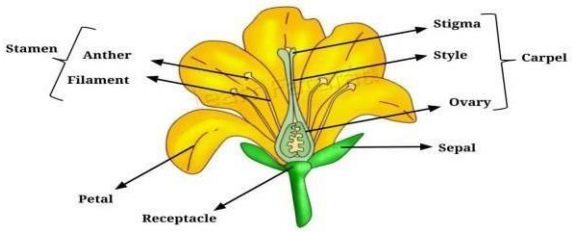
SEXUAL REPRODUCTION

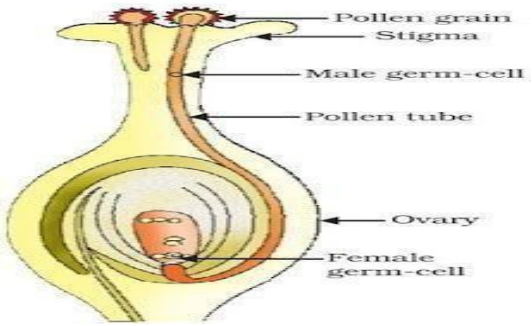
The sexual life cycle can be grouped into –

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

SEXUAL REPRODUCTION IN FLOWERING PLANTS

- Reproductive part of plant is flower. Flower consists of sepals, petals, stamens and carpels.
- Stamen and carpel contain another and ovary respectively.
- Anther produces male gamete. Pollen and ovary contains female gamete egg.
- After pollination pollen fuses with egg to form 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 and seminal 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 egg is 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 cord.
- When egg is not fertilized the inner lining of uterus breaks and comes out through the 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, Warts (Viral infection), Gonorrhea, Syphilis (Bacterial infection)

Population control methods

- Mechanical barrier- Condom

- Hormonal methods- Pills
- Chemical method- Cut, Loops
- Surgical method- Vasectomy(in males) and Tubectomy(in females)

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- Developing embryo gets its nutrition through-

a- Ovary b- Placenta c-Sperm d- Fallopian tube

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

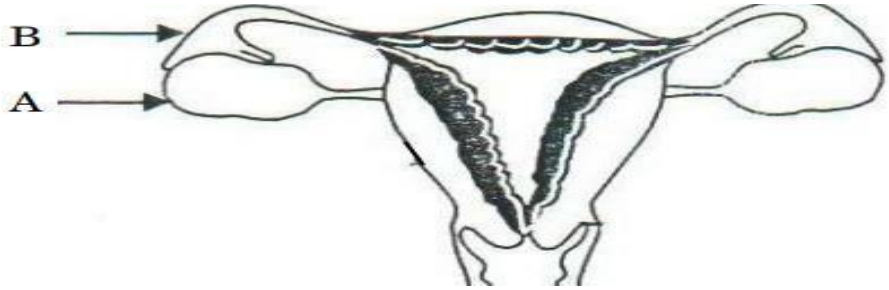
Ans: b

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 testosterone

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

Ans: Leishmania- Binary fission, Rhizopus- Spore formation, 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: STD's are infections transmitted from an infected person to an uninfected person through sexual contact. Example- HIV- AIDS, Syphilis, Genital wart

12- Differentiate asexual and sexual mode of reproduction. Which one shows variation 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

- Sexual reproduction shows variations because Genetic material from both the parents mixed by fertilization.
- Hence Offspring's get both the information and produce mixed characters which are 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 a form of asexual reproduction occurring in plants in which a new plant grows from vegetative propagation like-cutting of stem (Rose), Leaf buds (Bryophyllum)

Importance (Any two)

- Vegetative propagation takes less time
- No variation occur
- No requirement of fusion of gametes
- It 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 waste products 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 multiple fission, 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 multiple fission, 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.

CHAPTER-8
HEREDITY AND EVOLUTION

- The process of transmission of characters from parents to off spring 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 Off springs
- **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 ion herited

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.

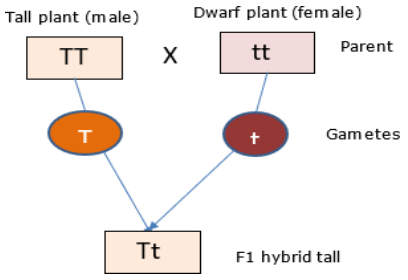
Importance of variations

- Variation enables organisms to adjust and adapt better according to the changing conditions 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.



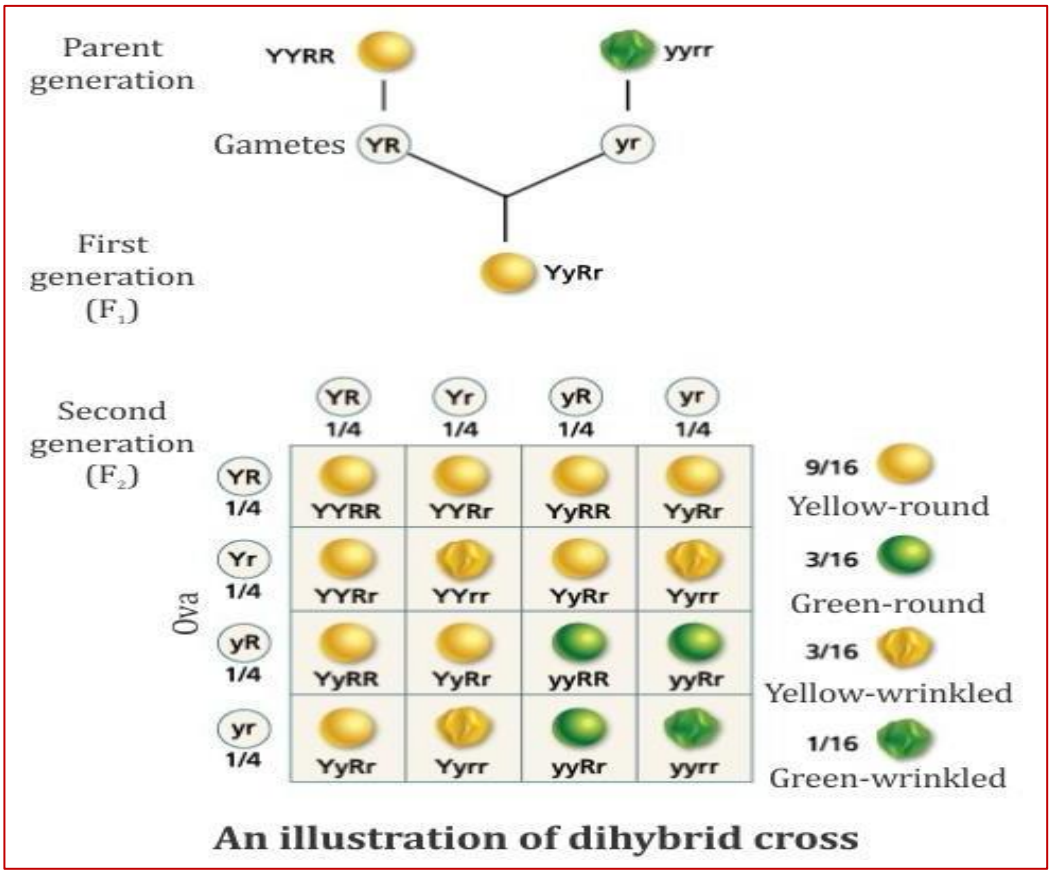
Law of Dominance: When parents having pure contrasting characters are crossed then only one character expresses itself the F1 generation. This character is the dominant character and the character/factor which cannot express itself is called the recessive character.

Law of segregation: The phenomenon of separation of the two alternating factors of 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 character is independent of other pair of character.

- **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 and green 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 and wrinkled green in the ratio of **9 : 3 : 3 : 1** are present.



An illustration of dihybrid cross

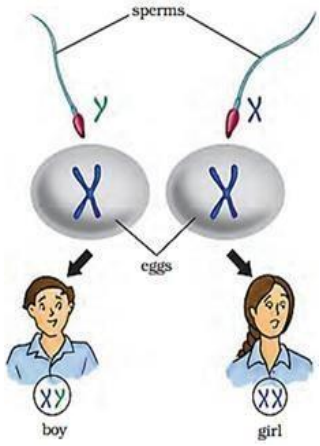
HOW DO TRAITS GET EXPRESSED?

DNA is regulating the authority of making 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 controlled by the gene.
- Both parents contribute equally to the DNA of next-generation during sexual reproduction.

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 within one's lifetime.

IMPORTANT QUESTIONS

Very Short answer 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- Tall 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: a

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 not their 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 of same 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, tt. The 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 conditions of 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 one generation to another. Inherited: attached ear lobe, baldness

Acquired trait: gain after birth (person develops during his lifetime) Acquired: obesity, reading skill

13- (a) Write full 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

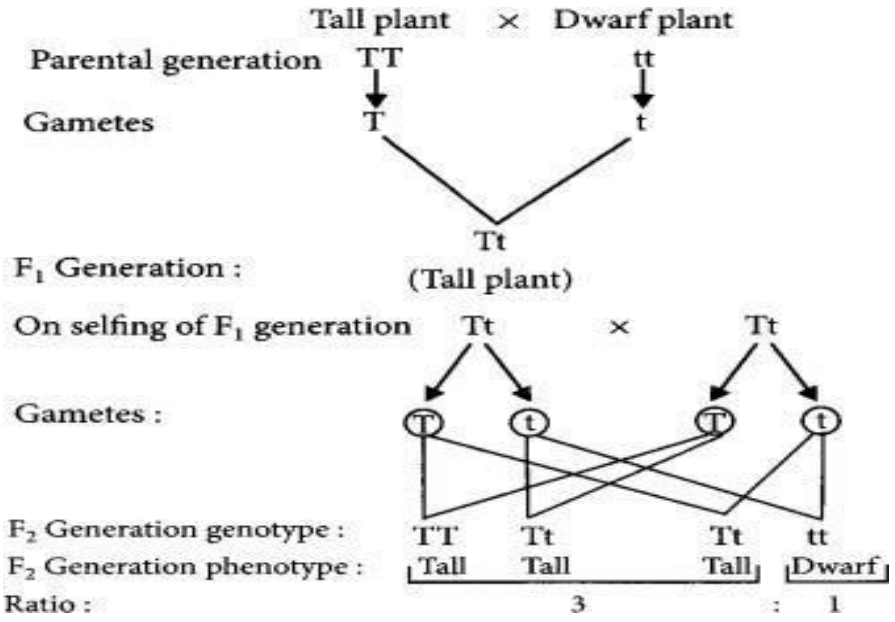
15- Describe law of dominance, the law of segregation and the law of segregation.

Low of dominance: - When parents having pure contrasting characters are crossed then only one character expresses itself in the F1 generation. This character is the dominant character 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 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: the alleles of two (or more) different genes get sorted into gametes independently of one another

1- In a monohybrid cross of tall Pea plants denoted by TT and short pea plants denoted by 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.



Acc to Law of dominance, the trait which is expressed in F1 generation is the dominant trait, although both there dominant and recessive traits are present in F1 generation. In F2 generation, the recessive traits are also expressed along with the dominant traits.

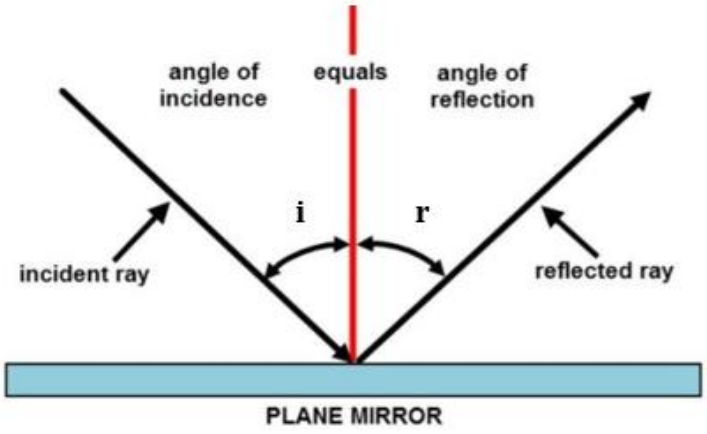
CHAPTER -9

Light Reflection and Refraction

REFLECTION

Reflection of Light: The bouncing back of light from smooth surface is called reflection.
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:

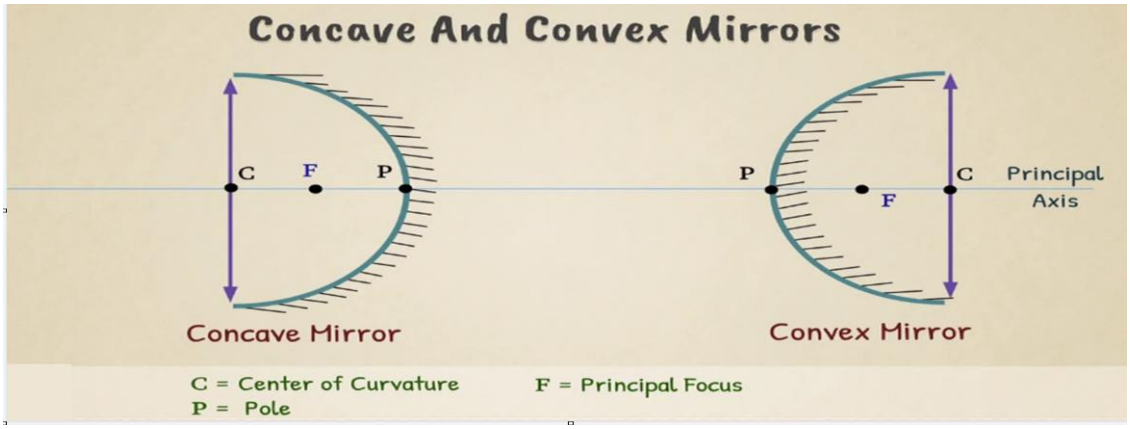


(i) The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.
(ii) Angle of incidence is always equal to the angle if reflection i.e. ∠i = ∠r

Real image: When the rays of light, 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, 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.

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:

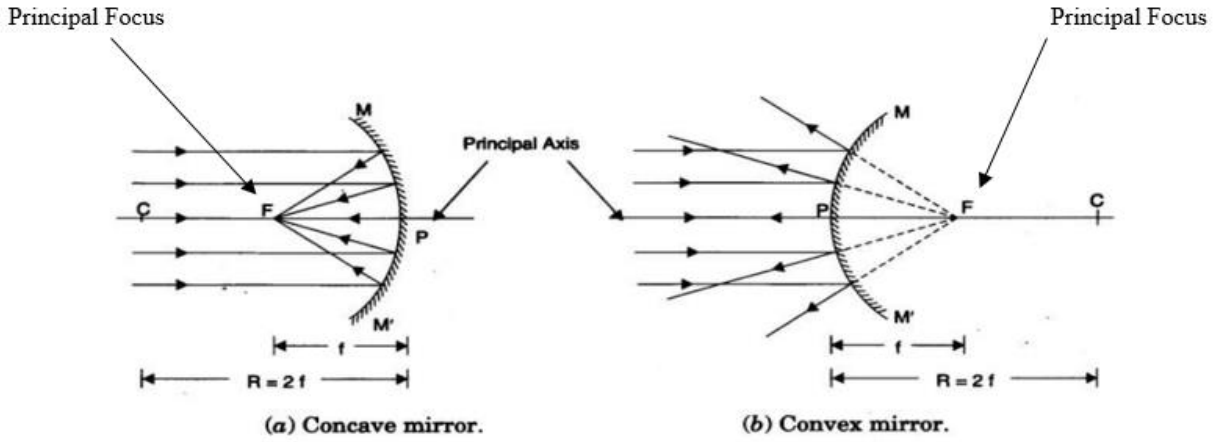
Pole (Vertex): The central point of a mirror is called its pole.

Centre of curvature: The center of the sphere of which the mirror is a part is called the center 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.

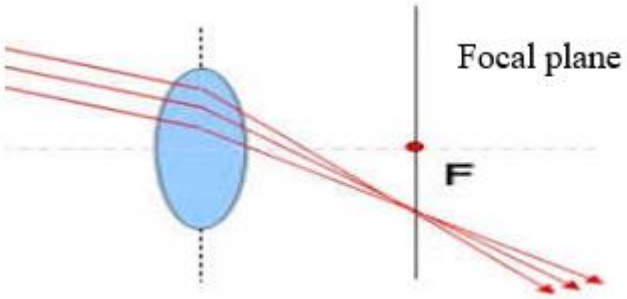
Principal axis: The straight line passing through the pole and the center of curvature of the mirror is called the principal axis.

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 a convex 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.

$$f = R/2$$

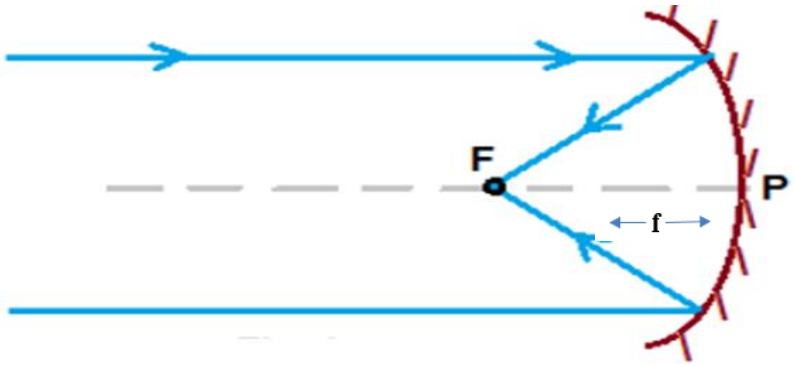


Image formation by Concave mirror

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

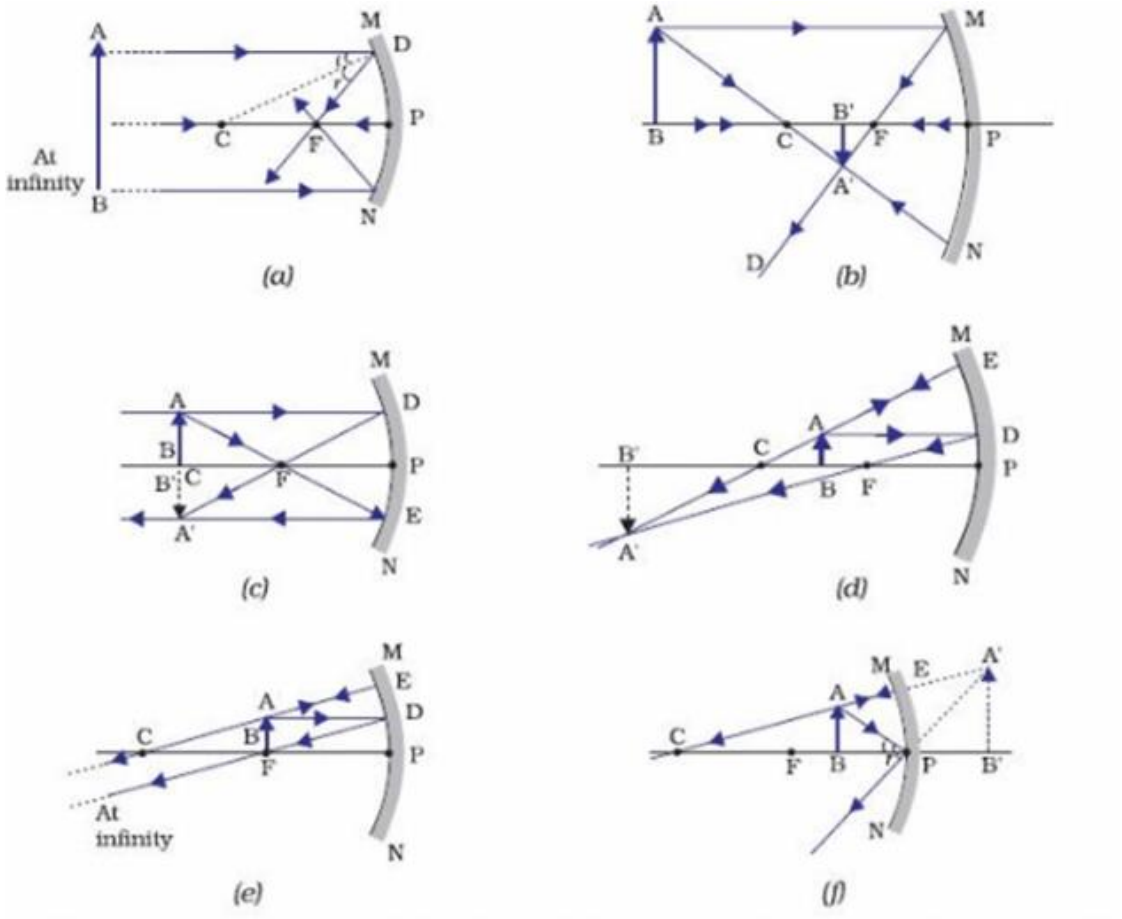
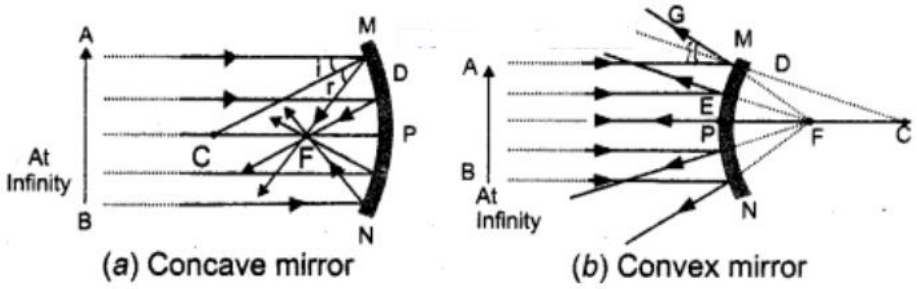


Image formation by Convex mirror

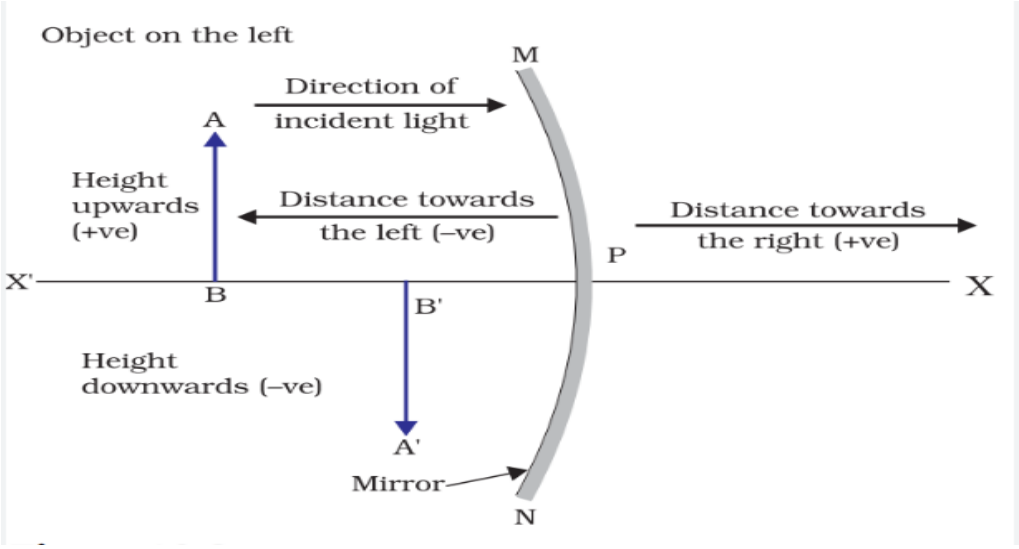
S.No.	Position of object	Position of image	Nature of image	Uses
1.	At infinity	Appears at the principal focus	Virtual, erect and extremely diminished	Used as a rear view mirror
2.	Between infinity and the pole	Appears between the principal focus and the pole	Virtual, erect and diminished	Used as a rear 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: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

Where
f= focal length
u= object distance
v= image distance

Magnification by Spherical Mirror:
This is the ratio of the height of the image to the height of the object.

$$m = \frac{h_i}{h_o} = -\frac{v}{u}$$

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 optical media is called Refraction of light.

The speed of light is **more** in optically rare medium in comparison of optically denser medium.

Laws of refraction:

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

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

$$\frac{\sin i}{\sin r} = \text{Constant(n)}$$

This constant is called the refractive index of the second medium w.r.t first.

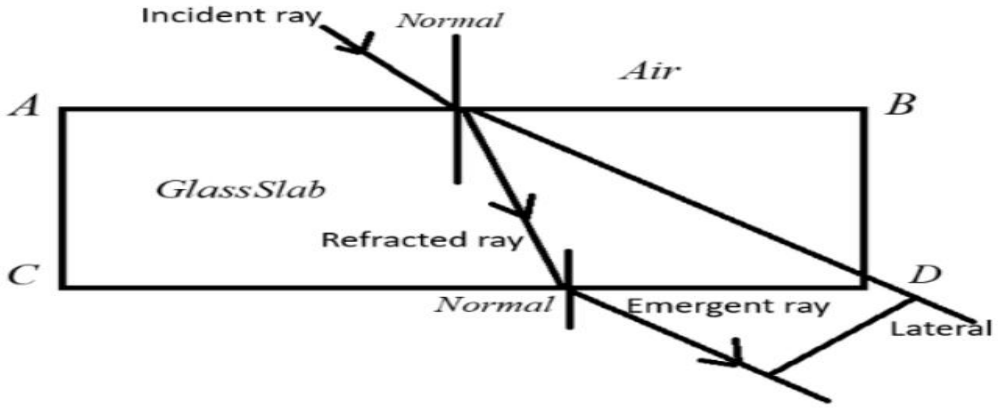
Refractive Index: If c is the speed of light in air and v is the speed of light in medium, then the refractive index of the medium is given by-

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

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

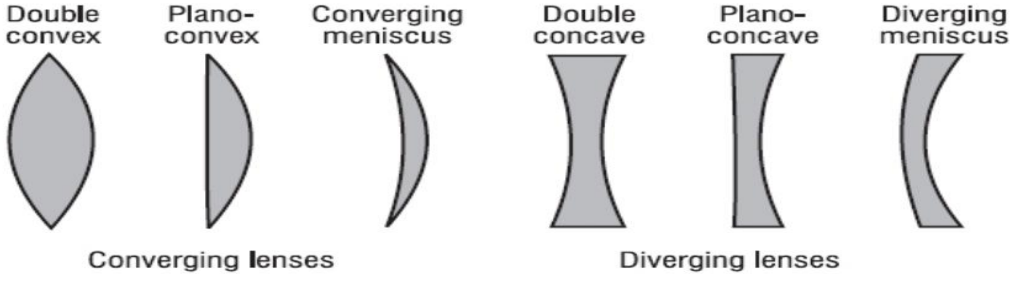
Refraction through a Rectangular Glass Slab:

When light ray pass through into a glass slab, then the emergent ray is parallel to the incident ray. This perpendicular distance between the emergent ray and incident ray is called **lateral displacement**.



i = angle of incidence
r = angle of refraction
e = angle of emergence
Angle of incidence = Angle of emergence, i.e. ∠i = ∠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
1. 	
2. It converges the light rays.	It diverges the light rays.
3. A convex lens is thicker at the center and thinner at the edges.	A concave lens is thicker at the edges and thinner at the center.
4.Used for correction of long-sightedness.	Used for correction of short-sightedness.
5.It is also called a positive lens due to positive focal length in nature.	It is also called a negative lens due to negative focal length in nature.
6.e.g. Human Eye, Camera, etc.	e.g. Lights, Flashlights, etc.

Center of Curvature: The centers of the sphere, of which the lens is a part is called the center of curvature.

Radii of Curvature: The radii of spheres, of which lens is part is called radius of curvature.

OR

The distance between center of curvature and optical center of a lens is called Radii of Curvature

Principal Axis: The line joining the centers of curvature of two surfaces of lens is called principal axis.

Optical Center: The point on principal axis through which a light ray passes undeviated.

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

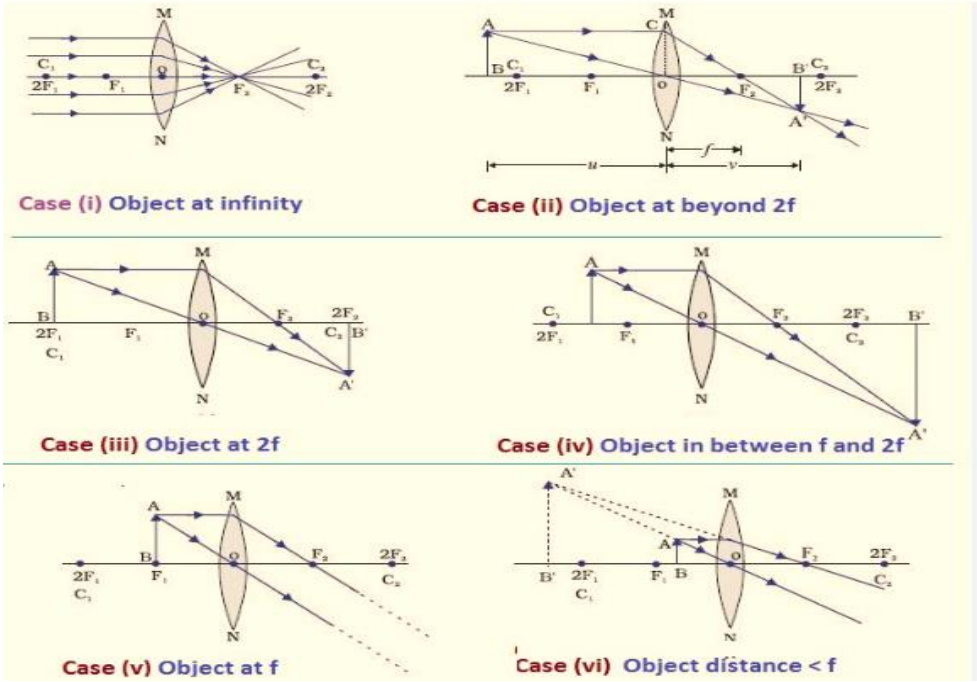
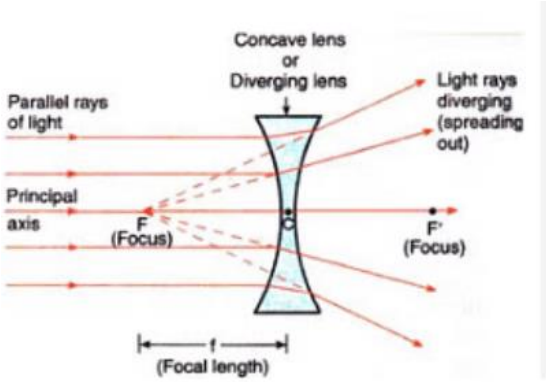
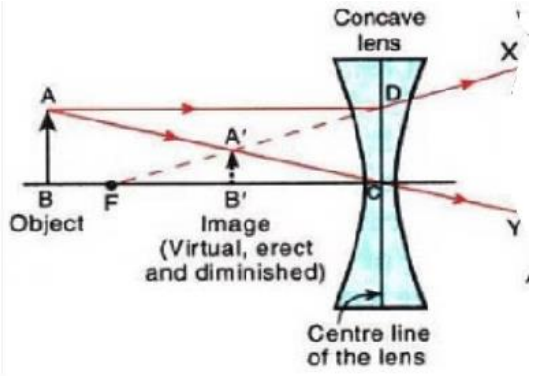


Image formation by a concave lens

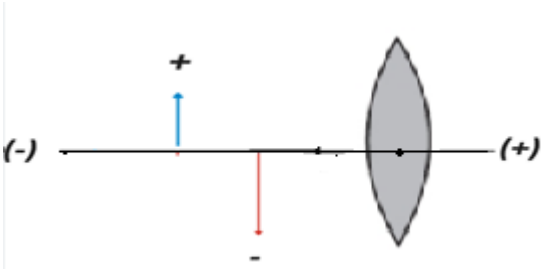
S.No.	Position of object	Position of image	Nature of image	Uses
1.	At infinity	Appears at the principal focus on the same side as that of the object	Virtual, erect and extremely diminished	Spectacles for short sightedness
2.	Between infinity and the lens	Appears between the principal focus and the lens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

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

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'

$$m = \frac{h_i}{h_o} = \frac{v}{u}$$

(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 (in meter). Power is measured in dioptre.

$$P = \frac{1}{f(in\ meter)}$$

SI unit of power of lens in diopter (D)

For combination of lenses,

$P = P1 + P2 + P3 + \ldots..$

$P_0 = P1 + P2 + P3 + \ldots..$

Remember the following points to solve any numerical <u>for mirrors</u>

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

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) $= \frac{size\ of\ image}{size\ of\ object} = \frac{-v}{u}$

m= -ve for real image

= +ve for virtual image

<u>FOR LENS</u>

LENS 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 lens, -ve for concave lens

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

MAGNIFICATION(m) $= \frac{v}{u} = \frac{f-v}{f} = \frac{f}{f+u}$

m = -ve for real image

= +ve for virtual image

QUESTIONS FROM PREVIOUS BOARD EXAMS

1. The laws of reflection hold true for:

(a) plane mirrors only
(b) concave mirrors only
(c) convex mirrors only
(d) all reflecting surface

Answer: The laws of reflection hold true for all reflecting surface.

2. List four characteristics of the images formed by plane mirrors. (Delhi 2015, AI2011)

Answer: Characteristics of the image formed by a plane mirror are

(i) image distance is same as that of object distance from mirror.
(ii) image formed is virtual and erect
(iii) image formed is of the same size as that of the object
(iv) image formed is laterally inverted (left appears right and right appears left).

3. State the two laws of reflection of light. (Delhi 2011)

Answer: Laws of reflection of light states that

(i) The angle of incidence is equal to the angle of reflection. (<i=<r)
(ii) The incident ray, the reflected ray and the normal to the mirror at the point of incidence all lie in the same plane.

4. When an object is kept within the focus of a concave mirror, an enlarged image is formed behind the mirror. This image is

(a) real
(b) inverted
(c) virtual and inverted
(d) virtual and erect (2020)

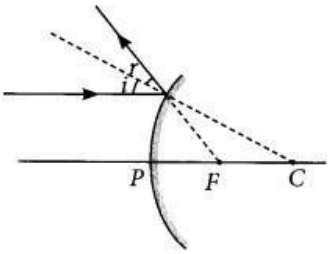
Answer (d) When an object is placed between the principal focus and pole of a concave mirror, an enlarged virtual and erect image is formed behind the mirror.

5. What is the magnification of the images formed by plane mirrors and why? (Delhi 2015)

Answer: Magnification of images formed by plane mirrors is unity because for plane mirrors, the size of the image formed is equal to that of the object.

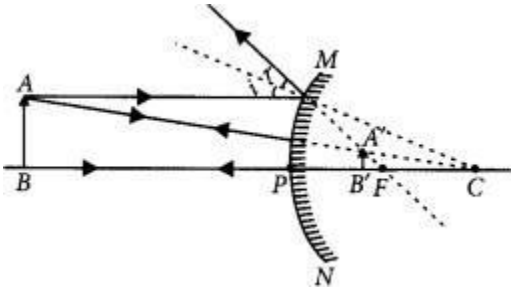
6. Draw a labelled ray diagram to show the path of the reflected ray corresponding to an incident ray of light parallel to the principal axis of a convex mirror. Mark the angle of incidence and angle of reflection on it. (AI 2019)

Answer:



7. If the image formed by a spherical mirror for all positions of the object placed in front of it is always erect and diminished, what type of mirror is it? Draw a labelled ray diagram to support your answer. (2018)

Answer: If the image formed by a spherical mirror is always erect and diminished then it is convex mirror.



8. An object is placed at a distance of 30 cm in front of a convex mirror of focal length 15 cm. Write four characteristics of the image formed by the mirror. (Delhi 2017)

Answer: Four characteristics of the image formed by the given convex mirror are :

(i) Virtual (ii) Erect

(iii) Diminished (iv) Image is always formed behind the mirror between pole and focus.

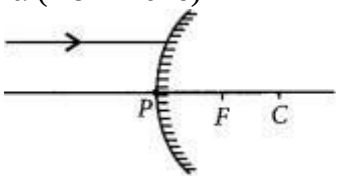
9. An object is placed at a distance of 12 cm in front of a concave mirror of radius of curvature 30 cm. List four characteristics of the image formed by the mirror. (Delhi 2017)

Answer : Radius of curvature (R) = 30 cm, object distance is 12 cm in front of the mirror. Thus, we can say that object is placed between focus and pole. Four characteristics of the image formed by the given concave mirror when object is placed between pole and focus are:

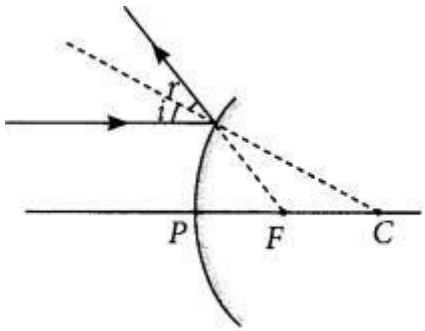
(i) Virtual (ii) Erect

(iii) Enlarged (iv) Image is formed behind the mirror

10. A ray of light is incident on a convex mirror as shown in fig. Redraw the diagram and complete the path of this ray after reflection from the mirror. Mark angle of incidence and angle of reflection on it. (Delhi 2016)



Answer

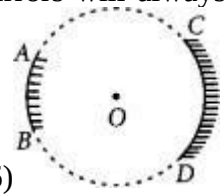


11. Name the type of mirrors used in the design of solar furnaces. Explain how high temperature is achieved by this device. (AI 2016)

Answer: Concave mirrors are used in the designing of solar furnaces.
When a solar furnace is placed at the focus of a large concave mirror, it focuses a parallel beam of light on the furnace. Therefore, a high temperature is attained at the point after some time.

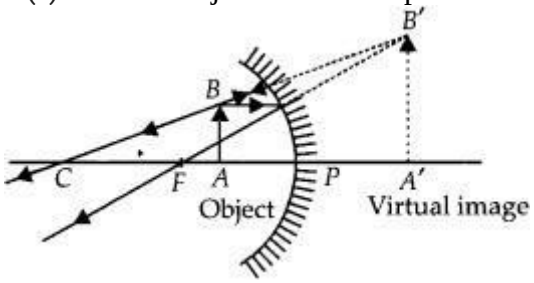
12. "The magnification produced by a spherical mirror is -3". List four information you obtain from this statement about the mirror/ image. (AI 2016)
Answer: Negative sign of magnification indicates that the image is real and inverted. Since the image is real and inverted, the mirror is concave and magnification of -3 indicates that the image is magnified. Thus the object is placed between C and F of the mirror.

13. AB and CD, two spherical mirrors, are parts of a hollow spherical ball with its center at O as shown in the diagram. If arc AB = $\frac{1}{2}$ of arc CD, what is the ratio of their focal lengths? State which of the two mirrors will always form virtual image of an object placed in front of it and why?



(Foreign 2016)
Answer: Focal length of a mirror is given by Focal length = Radius of curvature/2
Since both the mirrors have same radius of curvature, therefore focal length of the two mirrors will be same, i.e.,
$\frac{f1}{f2} = \frac{1}{1}$
Since virtual image is always formed by convex mirror. The mirror AB will always form virtual image.

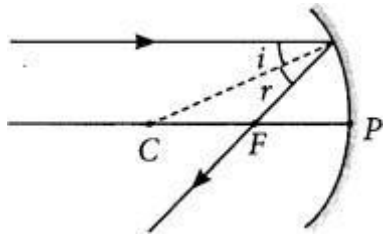
14. The linear magnification produced by a spherical mirror is +3. Analyse this value and state the (i) type of mirror and (ii) position of the object with respect to the pole of the mirror. Draw a ray diagram to show the formation of image in this case. (Foreign 2016)
Answer: Positive value of the magnification indicates that image is virtual and erect.
(i) Since the image is magnified, the mirror is concave.
(ii) The object is between pole and focus of the mirror as shown



The image produced in second case will be real and inverted.

15. Draw a ray diagram to show the path of the reflected ray corresponding to an incident ray of light parallel to the principal axis of a concave mirror. Mark the angle of incidence and angle of reflection on it. (Delhi 2014)

Answer:



16. List two possible ways in which a concave mirror can produce a magnified image of an object placed in front of it. State the difference if any between these two images. (AI2014)

Answer: A concave mirror can produce a magnified image of an object when object is placed:

(1) In between its pole and its focus

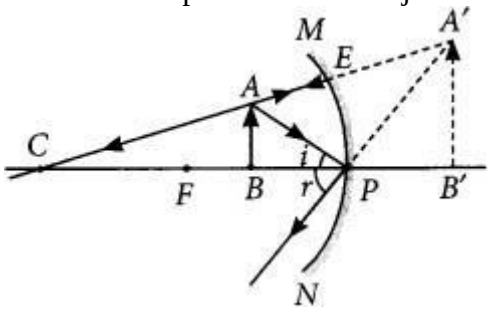
(2) In between its focus and its center of curvature. Difference, between these two images:

The image produced in first case will be virtual and erect.

The image produced in second case will be real and inverted.

17. The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should the position of the object be relative to the mirror? Draw ray diagram to justify your answer. (AI 2014)

Answer: The position of the object should be between P and F

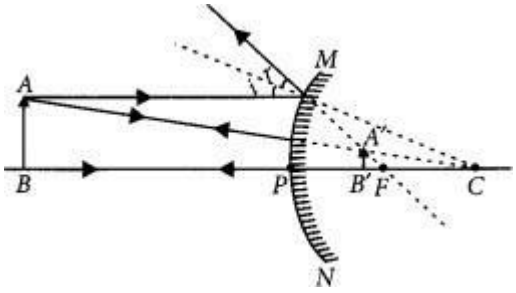


18. The linear magnification produced by a spherical mirror is +1/3. Analysing this value state the (i) type of mirror and (ii) the position of the object with respect to the pole of the mirror. Draw any diagram to justify your answer. (AI 2014, Foreign 2014)

Answer:

(i) Convex mirror

(ii) Between infinity and the pole of the mirror.

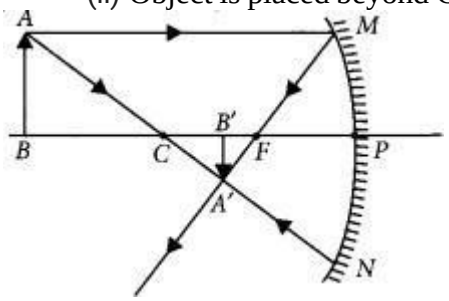


19. The linear magnification produced by a spherical mirror is -1/5. Analysing this value state the (i) type of spherical mirror and (ii) the position of the object with respect to the pole of the mirror. Draw ray diagram to justify your answer. (Foreign 2014)

Answer

(i) Concave mirror

(ii) Object is placed beyond C.



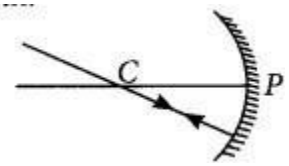
20. Draw ray diagrams for the following cases when a ray of light:

(i) passing through centre of curvature of a concave mirror is incident on it.

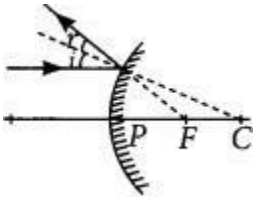
(ii) parallel to principal axis is incident on convex mirror.

(iii) is passing through focus of a concave mirror incident on it. (2020)

Answer (i) Ray of light passing through centre of curvature of concave mirror, after reflection

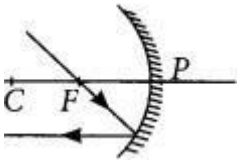


(ii) Ray of light parallel to the principal axis is incident on a convex mirror after reflection appear



to diverge from the principal focus of a convex mirror.

(iii) Ray of light passing through focus of a concave mirror after reflection will emerge parallel to principal axis.



21. A concave mirror is used for image formation for different positions of an object. What inferences can be drawn about the following when an object is placed at a distance of 10 cm from the pole of a concave mirror of focal length 15 cm?

a. Position of the image

b. Size of the image

c. Nature of the image

Draw a labelled ray diagram to justify your inferences. (2020)

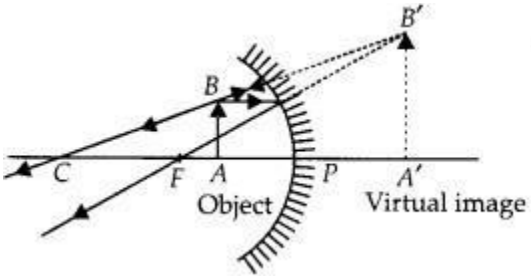
Answer: Given, f = -15 cm, u = -10 cm.

Thus the object is placed between the principal focus and pole of the mirror.

(a) The position of the image will be behind the mirror.

(b) The size of the image will be highly enlarged.

(c) The nature of the image will be virtual and erect.



22. The image of a candle flame placed at a distance of 30 cm from a mirror is formed on a screen placed in front of the mirror at a distance of 60 cm from its pole. What is the nature of the mirror? Find its focal length. If the height of the flame is 2.4 cm, find the height of its image. State whether the image formed is erect or inverted. (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 mirror formula,

$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$ or $\frac{1}{f}=(-1-2)/60=-3/60=-120$

or f = – 20 cm

Hence, focal length is 20 cm

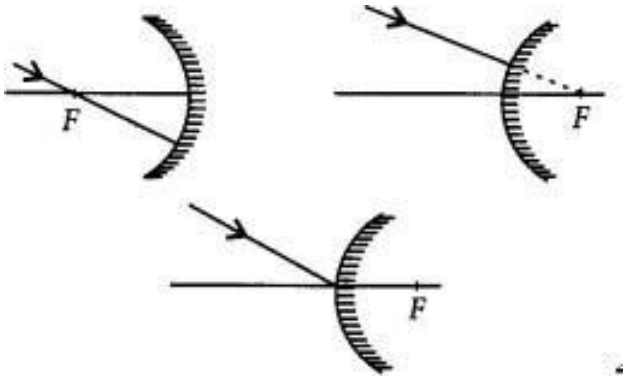
Also, magnification, m = $\frac{h\prime}{h}=\frac{-v}{u}$or, m =- $\frac{-60}{-30}$ = -2 or $\frac{h\prime}{h}$ = -2 or h' = – 2 × 2.4 = – 4.8 cm

As the image formed is real, therefore the mirror is concave.

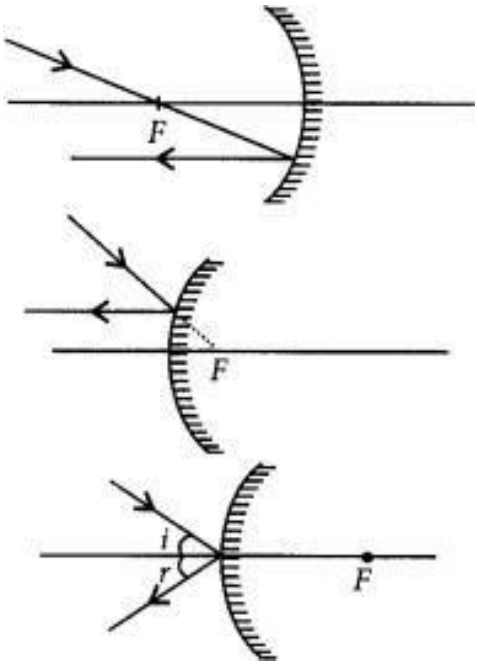
The height of the image is 4.8 cm.

The image formed is enlarged and inverted.

23. Draw the following diagram in which a ray of light is incident on a concave/convex mirror, on your answer sheet. Show the path of this ray, after reflection, in each case.



Answer: The path of the rays are shown in figure.

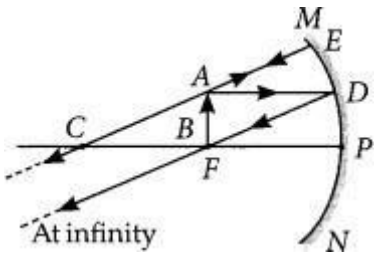


24.. The image of an object formed by a mirror is real, inverted and is of magnification -1. If the image is at a distance of 40 cm from the mirror, where is the object placed? Where would the image be if the object is moved 20 cm towards the mirror? State reason and also draw ray diagram for the new position of the object to justify your answer. (AI 2016)

Answer . Since the image formed by the mirror is real and inverted, therefore the mirror is concave and magnification of the mirror will be

$m = \frac{-v}{u} \Rightarrow -1 \Rightarrow v = u$

i.e., object and image both are formed at the centre of curvature, i.e., 40 cm from the mirror. Now, if the object is moved 20 cm towards the mirror, the object will be at the focus of the mirror and therefore



the image will be formed at infinity.

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 mirror is

$f = uv/u+v = -15\times(-30)/-15-30) = f = 450/(-45) = -10$ cm

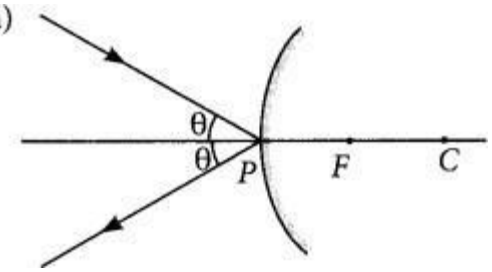
If the object is shifted 10 cm towards the mirror, then the object is between principal focus and the optical centre and the image formed will be virtual and erect.

25.. Draw a ray diagram to show the path of the reflected ray in each of the following cases. A ray of light incident on a convex mirror:

(a) strikes at its pole making an angle 0 from the principal axis.
(b) is directed towards its principle focus.
(c) is parallel to its principal axis. (Foreign 2015)

Answer

(a)



(b) Refer to answer 17.

(c) Refer to answer 6.

26. A student wants to project the image of a candle flame on a screen 48 cm in front of a mirror by keeping the flame at a distance of 12 cm from its pole.

(a) Suggest the type of mirror he should use.

(b) Find the linear magnification of the image produced.

(c) How far is the image from its object?

(d) Draw ray diagram to show the image formation in this case. (AI 2014)

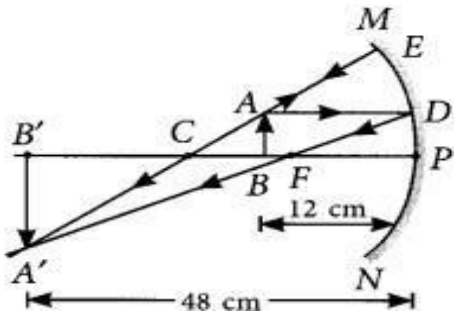
Answer

(a) Concave mirror

(b) Linear magnification, m = $\frac{-v}{u} = \frac{-(-48)}{-12} = -4$

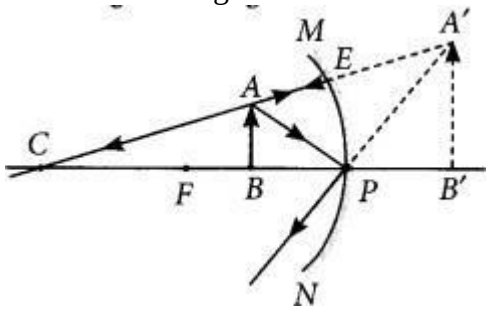
(c) The distance between the image and the object
= 48 – 12 = 36 cm

(d)



27. . A student wants to obtain an erect image of an object using a concave mirror of 12 cm focal length. What should be the range of distance of the candle flame from the mirror? State the nature and size of the image he is likely to observe. Draw a ray diagram to show the image formation in this case. (Foreign 2014)

Answer: To obtain an erect image, the object is placed in between pole and the focus of the concave mirror. So range of distance of the candle flame from the mirror is in between 12 cm.
Nature of the image = Virtual and erect. Size of the image = Enlarged



28.. Mention the types of mirrors used as (i) rear view mirrors, (ii) shaving mirrors. List two reasons to justify your answer in each case. (Delhi 2013, Delhi 2012)

Answer:

(i) Convex mirror is used as rear-view mirror because

(a) it gives erect image.

(b) it gives diminished image thus provides wider view of traffic behind the vehicle.

(ii) Concave mirror is used as shaving mirror because

(a) it gives erect image when mirror is close to the face.

(b) it gives enlarged image of the face so that a person can shave safely.

29. Calculate the magnification of the image of an object placed perpendicular to the principal axis of a concave mirror of focal length 15 cm. The object is at a distance of 20 cm from the mirror. (Delhi 2013)

Answer: Given, focal length of concave mirror, f = -15 cm

Object distance, u = -20 cm Image distance, v = ?

Using mirror formula,

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

$$\text{or} \quad \frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{-15}-\frac{1}{-20}=\frac{-4+3}{60}$$

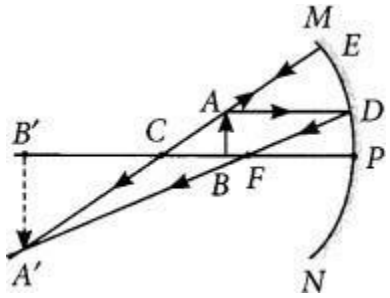
$$\frac{1}{v}=\frac{-1}{60} \quad \text{or} \quad v=-60 \text{ cm}$$

Using magnification formula, m = –v/u = -(−60/−20) or m = -3 So, the magnification, m = -3.

29A. to construct ray diagram, we use two light rays which are so chosen that it is easy to know their directions after reflection from the mirror. List these two rays and state the path of these rays after reflection. Use these rays to locate the image of an object placed between center of curvature and focus of a concave mirror. (AI2012)

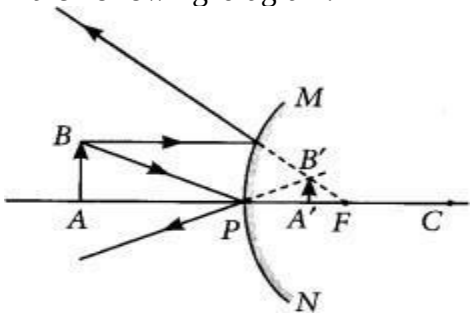
Answer: A ray parallel to the principal axis, after reflection, will pass through the principal focus in case of a concave mirror or appear to diverge from the principal focus in case of a convex mirror.

A ray passing through the center of a curvature of a concave mirror or directed in the direction of the center of curvature of a convex mirror, after reflection, is reflected back along the same path. The light rays come back along the same path because the incident rays fall on the mirror along the normal to the reflecting surface.



30. With the help of a ray diagram explain why a convex mirror is preferred for rear view mirrors in the motor cars. (Foreign 2011)

Answer: Convex mirror is preferred for rear view mirrors in motor cars because no matter where the object is located in front of convex mirror, it always gives erect and diminished image of the object, so that driver is able to see the large traffic view in small area and the image is erect. This can be interpreted from the following diagram.



31. An object 4.0 cm in size, is placed 25.0 cm in front of a concave mirror of focal length 15.0 cm.

(i) At what distance from the mirror should a screen be placed in order to obtain a sharp image?

(ii) Find the size of the image.

(iii) Draw a ray diagram to show the formation of image in this case. (2020)

Answer:

(i) Given, h = 4 cm,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u} \text{ or } \frac{1}{v}=\frac{1}{f}-\frac{1}{u}$$

$$=\frac{1}{-15}-\frac{1}{-25}=\frac{-25+15}{15\times 25}$$

$$\therefore \quad v=\frac{15\times 25}{-10}=-37.5 \text{ cm}$$

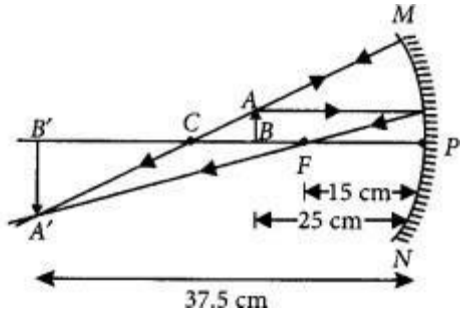
(ii) Magnification, $m=\frac{h'}{h}=\frac{-v}{u}$

$$\therefore \quad h'=\frac{-v}{u}\times h=\frac{37.5}{-25}\times 4=-6 \text{ cm}$$

u = -25 cm (concave mirror), f = -15 cm Using mirror formula,

Thus, the image is real and inverted.

(iii)

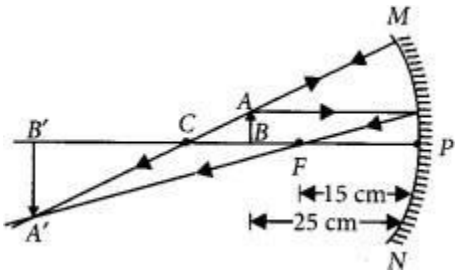


32. (a) A concave mirror of focal length 10 cm can produce a magnified real as well as virtual image of an object placed in front of it. Draw ray diagrams to justify this statement,

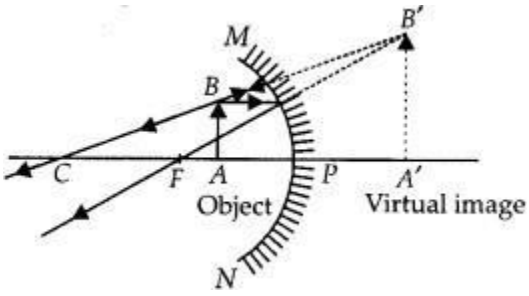
(b) An object is placed perpendicular to the principal axis of a convex mirror of focal length 10 cm. The distance of the object from the pole of the mirror is 10 cm. Find the position of the image formed. (2020)

Answer

(a) A magnified real image is produced in a concave mirror when the object is placed between principal focus and center of curvature.



A magnified virtual image is produced in a concave mirror when the object is placed between the pole and the principle focus of the mirror.



(b) Given, f = +10 cm (convex mirror) and u = -10 cm from mirror formula,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u} \quad \text{or} \quad \frac{1}{v}=\frac{1}{f}-\frac{1}{u}$$

$$\text{or} \quad \frac{1}{v}=\frac{1}{10}-\frac{1}{-10}=\frac{-10-10}{-100}$$

$$\therefore \quad v=\frac{-100}{-20}=5\text{cm} \text{ behind the mirror.}$$

33. (a) To construct a ray diagram, we use two rays which are so chosen that it is easy to know their directions after reflection from the mirror. Use these two rays and draw ray diagram to locate the image of an object placed between pole and focus of a concave mirror.

(b) A concave mirror produces three times magnified image on a screen. If the objects placed 20 cm in front of the mirror, how far is the screen from the object? (Delhi 2017)

Answer:

(a) Two lights rays whose path of reflection are priorly known are:

(i) When the incident ray passes through the center of curvature of a concave mirror, it gets reflected in the same path.

(ii) When the ray is incident obliquely to the principal axis, towards the pole of mirror, it gets reflected back by making equal angles with the principal axis (laws of reflections).

Suppose an object is placed between focus and pole of the concave mirror. Then by using the above two rays, the image of the object can be located as

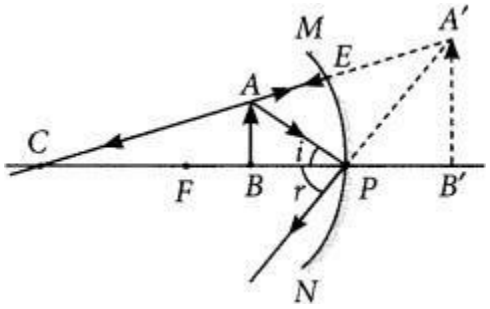


Image formed is virtual, erect, magnified and it is formed behind the mirror.

(b) Given: Magnification, m = – 3 Object distance, u = – 20 cm Magnification, m = −v/u or -3 = −v/−20
or v = -60 cm

The screen is placed in front of the mirror at a distance of 60 cm from the pole.
Thus, the screen is placed 40 cm (= 60 cm – 20 cm) away from the object.
in the mirror.

34. A student wants to project the image of a candle flame on the walls of school laboratory by using a mirror.

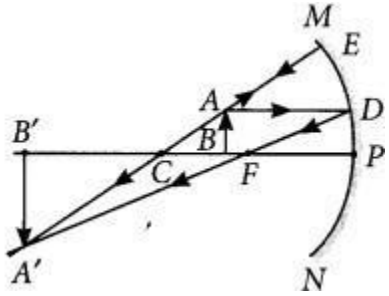
(a) Which type of mirror should he use and why?
(b) At what distance in terms of focal length 'f' of the mirror should he place the candle flame so as to get the magnified image on the wall?
(c) Draw a ray diagram to show the formation of image in this case.
(d) Can he use this mirror to project a diminished image of the candle flame on the same wall? State 'how' if your answer is 'yes' and 'why not' if your answer is 'no' (Delhi 2014)

Answer:

(a) He should use concave mirror to get image of candle flame on the walls of school laboratory. Because concave mirror is a converging mirror and produces real image.

(b) He should place the candle flame in between center of curvature C and principal focus F of the mirror to get the magnified image on the wall.

(c)



(d) Yes, he can use concave mirror to project a diminished image of the candle flame on the same wall. He has to place the candle flame beyond center of curvature to get diminished image.

35.. What is meant by power of a lens? (Delhi 2015)

Answer. Power is the degree of convergence or divergence of light rays achieved by a lens. It is defined as the reciprocal of its focal length.

i.e., P = 1f

36. An object is placed at a distance of 15 cm from a convex lens of focal length 20 cm. List four characteristics (nature, position, etc.) of the image formed by the lens. (AI2017)

Answer:

Given: Object distance, u = – 15 cm Focal length, f = + 20 cm

Using lens formula, As |u| < |f|

The object is placed between F and optical centre of lens.

Thus, the four characteristics of the image formed by the convex lens are:

(i) Erect

(ii) Virtual

(iii) Enlarged image,

(iv) Image is formed on the same side of the lens as the object.

37. What is meant by power of a lens? What does its sign (+ve or -ve) indicate? State its S.I. Unit related to focal length of a lens. (Delhi 2016)

Answer: Power of a lens is its ability to converge as diverge th rays of light on it

Positive sign (+) of power indicates that lens is convex and negative sign (-) of power indicates that lens is concave.

If focal length (f) is expressed in metres, then, power is expressed in dioptre. The SI unit of power is dioptre. Thus, 1 dioptre is the power of lens whose focal length is 1 metre. 1 D = 1 m^{-1}

38. The refractive indices of glass and water with respect to air are 3/2 and 4/3 respectively. If speed of light in glass is 2×10^8 m/s, find the speed of light in water. (AI 2016)

Answer.

$$\text{Given : } {}_a n_g = \frac{3}{2}, \quad {}_a n_w = \frac{4}{3}$$

Speed of light in glass, $v = 2 \times 10^8$ m/s

$$\text{We know, } {}_a n_g = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$$

$$\Rightarrow \quad \frac{3}{2} = \frac{c}{2 \times 10^8} \quad \Rightarrow \quad c = 3 \times 10^8 \text{ m/s}$$

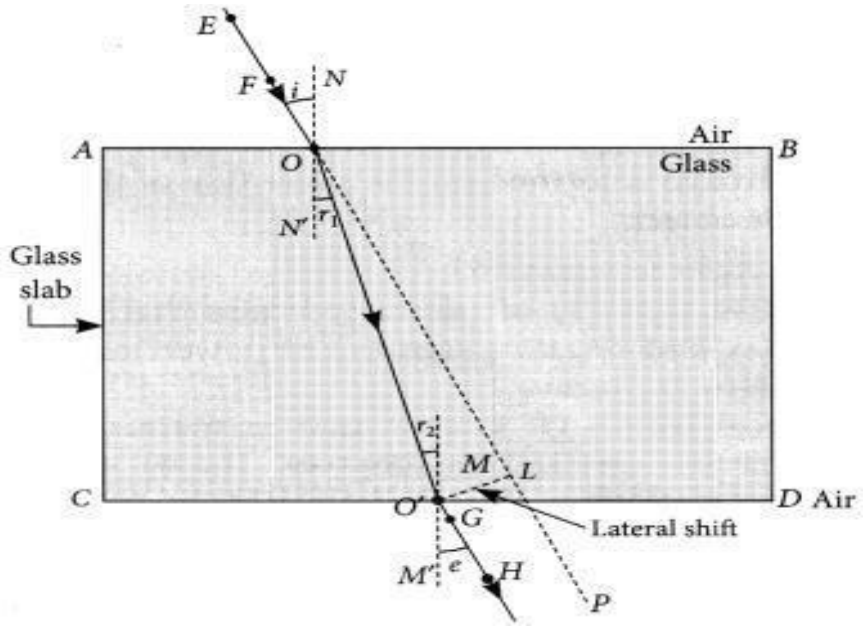
$$\text{Now, } {}_a n_w = \frac{\text{speed of light in air}}{\text{speed of light in water}}$$

$$\Rightarrow \quad \frac{4}{3} = \frac{3 \times 10^8}{v}$$

$$\Rightarrow \quad v = \frac{9}{4} \times 10^8 \text{ m/s} = 2.25 \times 10^8 \text{ m/s}$$

39. "A ray of light incident on a rectangular glass slab immersed in any medium emerges parallel to itself." Draw labelled ray diagram to justify the statement". (Delhi 2013)

Answer



.

40. The absolute refractive indices of glass and water are 1.5 and 1.33 respectively. In which medium does light travel faster? Calculate the ratio of speeds of light in the two media. (Delhi 2013 C)

Answer. Given: refractive index of glass, $n_g = 1.5$ Refractive index of water, $n_w = 1.33$ Since, refractive index of medium,

$$n = \frac{\text{speed of light in air } (c)}{\text{speed of light in medium } (v)}$$

For glass $n_g = c / v_g$ …… (i)

For water $n_w = c / v_w$ …… (ii)

Since velocity of light in medium is inversely proportional to its refractive index, the light will travel faster in optically rarer medium i.e., water.

Dividing (i) by (ii),

$$\frac{n_g}{n_w} = \frac{v_w}{v_g} \quad \text{or} \quad \frac{v_g}{v_w} = \frac{n_w}{n_g}$$

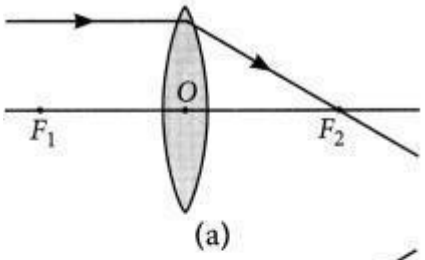
$$\frac{v_g}{v_w} = \frac{1.33}{1.5}$$

So, the ratio of v_g and v_w is 1.33 : 1.5.

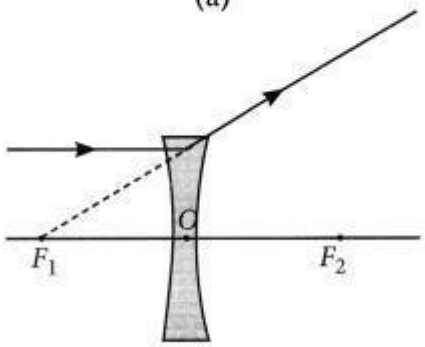
41. To construct a ray diagram we use two light rays which are so chosen that it is easy to know their directions after refraction from the lens. List these two rays and state the path of these rays after refraction. Use these two rays to locate the image of an object placed between 'f' and '2f' of a convex lens. (Foreign 2012)

Answer The two rays are:

(i) A ray of light from the object, parallel to the principal axis, after refraction from a convex lens, passes through the principal focus on the other side of the lens and in case of concave lens, a ray appears to diverge from the principal focus located on the same side of the lens.

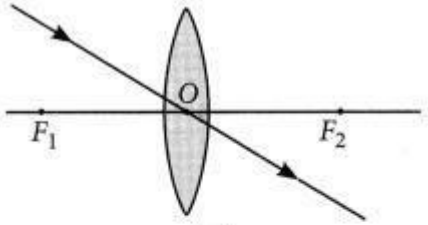


(a)

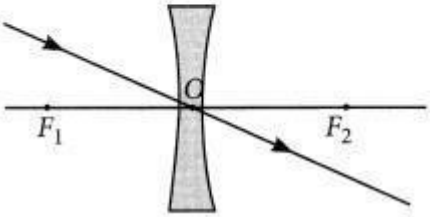


(b)

(ii) A ray of light passing through the optical centre of a lens will emerge without any deviation.

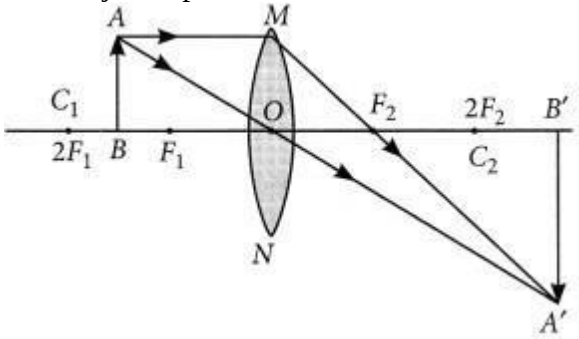


(a)



(b)

When object is placed between F and 2F.



42. State the laws of refraction of light. Explain the term absolute refractive index of a medium' and write an expression to relate it with the speed of light in vacuum. (2018)

Answer.

(a) Laws of refraction of light:

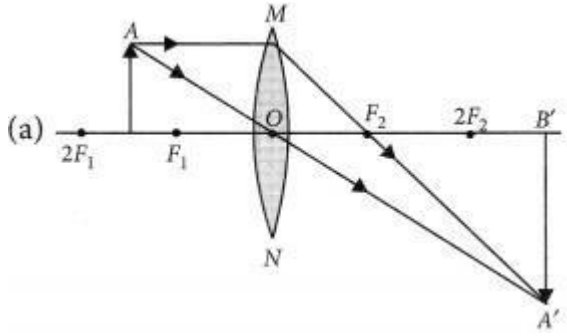
(i) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.

(ii) The ratio of sine of angle of incidence to the sine of the angle of refraction is constant, for the light of a given colour and for the given pair of media.
This law is also known as Snell's law of refraction.
sin i/sin r = constant,
where i is the angle of incidence and r is the angle of refraction.
This constant value is called refractive index of the second medium with respect to the first when the light travels from first medium to second medium.
$\Rightarrow$ constant = $n_{21} = \frac{v1}{v2}$ $\therefore \frac{sin\ i}{sin\ r} = \frac{v1}{v2}$

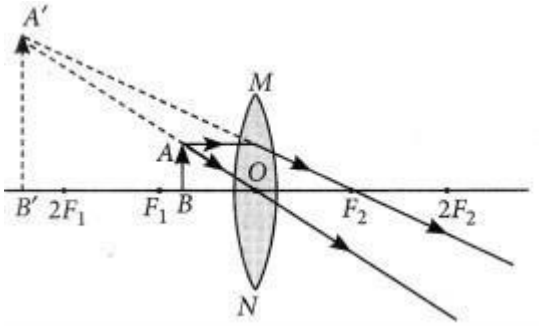
If n is the absolute refractive index of the medium, c is the velocity of light in vacuum and v is the speed of light in a given medium, then $n = \frac{c}{v}$

43. Draw ray diagrams to show the formation of three times magnified (a) real, and (b) virtual image of an object by a converging lens. Mark the positions of O, F and 2F in each diagram. (AI 2017)

Answer:



(b) Ray diagrams of an object placed between F_1 and optical center O of lens can be drawn as follows:

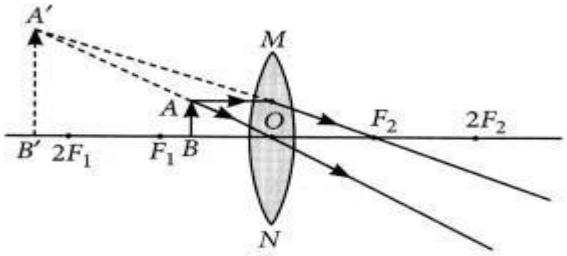


(i) The image formed is virtual and erect.
(ii) Image is formed in front of the lens.
(iii) Image formed is enlarged.

44. The image of an object formed 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 towards the lens, where would the image be formed? State reason and also draw a ray diagram in support of your answer. (AI2016)

Answer: Magnification of -1 indicates that the image is real and inverted and is of the same size as of the object. The object must be at 2f and image also at 2f on the other side.
Total distance between image and object Also 4f = 60 cm $\Rightarrow$ f = 15 cm

If object is moved 20 cm towards the lens, then the object will be between focus and optical center of the lens and image formed will be virtual and erect and on the same side of the lens.



45.

(a) Define focal length of a spherical lens.

(b) A divergent lens has a focal length of 30 cm. At what distance should an object of height 5 cm from the optical center of the lens be placed so that its image is formed 15 cm away from the lens? Find the size of the image also.

(c) Draw a ray diagram to show the formation of image in the above situation. (AI 2016)

Answer:

(a) Distance between the optical centre 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 From the lens formula,

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f} \Rightarrow \frac{-1}{15}-\frac{1}{u}=\frac{-1}{30}$$

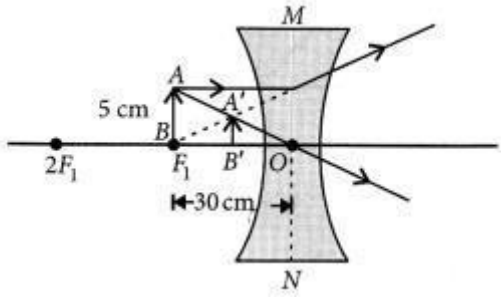
$$\Rightarrow \frac{-1}{u}=\frac{-1}{30}+\frac{1}{15}=\frac{-1+2}{30}=\frac{1}{30} \Rightarrow u=-30\ \text{cm}$$

Object should be placed 30 cm from the optical centre. Also m = $\frac{h'}{h}=\frac{v}{u} \Rightarrow$ h' = h($\frac{v}{u}$)

or h' = 5 × $\frac{-15}{-30}$ = 2.5 cm

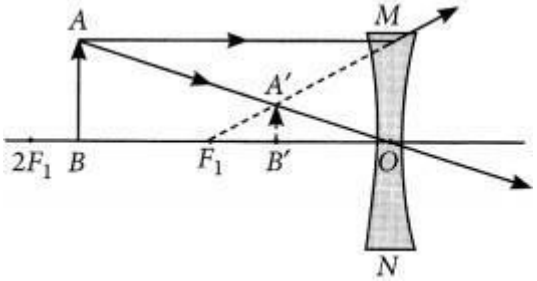
Size of image formed is 2.5 cm

(c)



46. If the image formed by a lens for all positions of the object placed in front of it is always virtual, erect and diminished, state the type of the lens. Draw a ray diagram in support of your answer. If the numerical value of focal length of such a lens is 20 cm, find its power in new cartesian sign conventions. (Foreign 2016)

Answer: Concave lens always forms virtual, erect and diminished image for all positions of the object.



Focal length of the concave lens f = -20 cm = −20 / 100 m

Power of the lens, P = $\frac{1}{f}$(in m) = −100/20 m = -5D

47. State the laws of refraction of light. If the speed of light in vacuum is 3×10^8 m/s, find the absolute refractive index of a medium in which light travels with a speed of 1.4×10^8 m/s. (Foreign 2015)

Answer

Laws of refraction: Refer to answer 74.

The speed of light in vacuum = 3×10^8 m/s

The speed of light in a medium = 1.4×10^8 m/s

∴ Absolute refractive index

$$= \frac{\text{Speed of light in vacuum}}{\text{Speed of light in a medium}}$$

$$n = \frac{3 \times 10^8 \text{ m/s}}{1.4 \times 10^8 \text{ m/s}} = 2.14$$

48. State the laws of refraction of light. If the speed of light in vacuum is 3×10^8 m s^{-1}, find the speed of light in a medium of absolute refractive index 1.5. (Delhi 2014, AI 2014)

Answer: The speed of light in vacuum = 3×10^8 m/s Absolute refractive index =1.5

∴ The speed of light in a medium

$$= \frac{\text{Speed of light in vacuum}}{\text{Absolute refractive index}} = \frac{3 \times 10^8 \text{ m/s}}{1.5}$$

$$= 2 \times 10^8 \text{ m/s}$$

49. An object of height 6 cm is placed perpendicular to the principal axis of a concave lens of focal length 5 cm. Use lens formula to determine the position, size and nature of the image if the distance of the object from the lens is 10 cm. (Delhi 2013)

Answer: Focal length of given concave lens, f= – 5 cm Distance, u = -10 cm, object size, h = 6 cm Image distance, v = ?

Using lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{-5} + \frac{1}{-10} = \frac{-3}{10}$ v = –10/3 = -3.33 cm

So, the image is located 3.33 cm from the lens. Magnification (m) of lens is given by

$m = v/u = -\frac{10/3}{-10} = \frac{1}{3} = 0.33$

m is positive implies that image is virtual and erect. Also, magnitude of m is less than one implies that image is diminished.

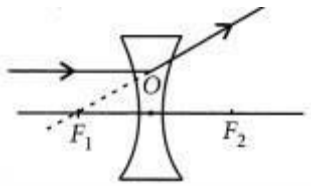
Since $m = \frac{v}{u} = \frac{h'}{h} \Rightarrow \frac{1}{3} = \frac{h'}{6}$ or h' = 2 cm

50. Draw ray diagram to show the path of the refracted ray in each of the following cases. A ray of light incident on a concave lens

(i) is parallel to its principal axis, (ii) is passing through its optical center and (iii) is directed towards its principal focus. (Delhi 2013 C)

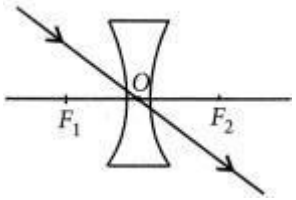
Answer:

(i) A ray of light incident on a concave lens is parallel to its principal axis, the diagram can be drawn as follows:

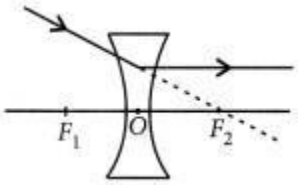


The refracted ray appears to pass through focus on the same side of the lens.

(ii) If a ray of light incident on a concave lens is passing through its optical center then the refracted ray will go without deviation.



(iii) If a ray of light incident on a concave lens is directed towards its principal axis then it will go parallel to principal axis.



51. What is the principle of reversibility of light? Show that the incident of light is parallel to the emergent ray of light when light falls obliquely on a side of a rectangular glass slab. (AI 2011)

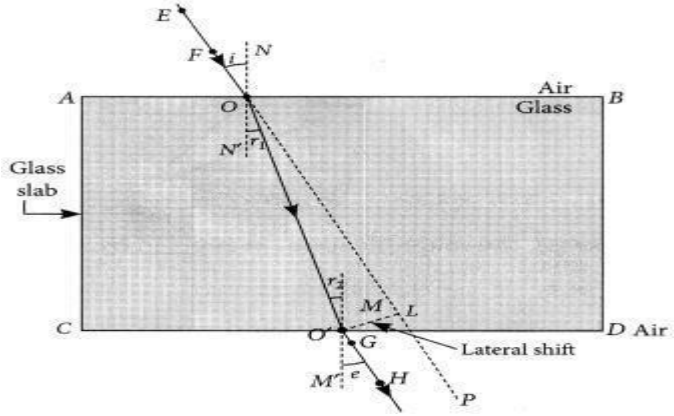
Answer. Principle of reversibility of light states that the light will follow exactly the same path if the direction is reversed.

Using Snell's law of refraction, $\frac{\sin i}{\sin r_1} = \frac{\sin e}{\sin r_2}$

Since $r_1 = r_2$, so i = e

so PQ is parallel to RS.

So, we conclude that incident ray is parallel to the emergent ray.



52. Draw a ray diagram in each of the following cases to show the formation of image, when the object is placed:

(i) between optical centre and principal focus of a convex lens.

(ii) anywhere in front 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)

Answer.

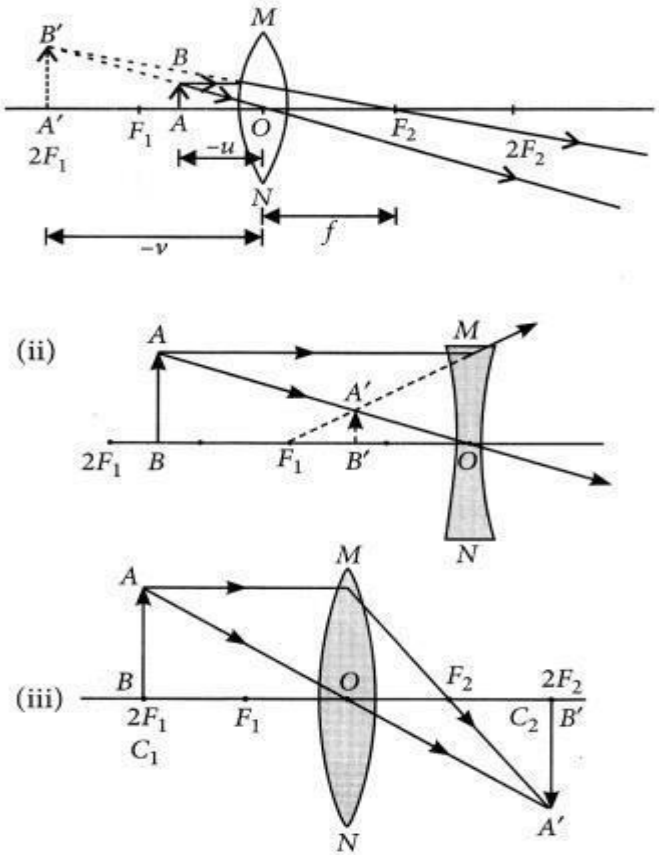
(i) When an object is placed between F and optical center, O of a convex lens, it forms a virtual and erect image. The ray diagram for this situation can be drawn as follows:

In case (i), the magnification, m is given by, m = v/u = −v/−u = positive

i.e., the image formed virtual and erect. In case (ii), the magnification,

m = $\frac{v}{u} = \frac{-v}{-u}$ = positive

i.e., the image formed is virtual and erect.



53. Rishi went to a palmist to show his palm. The palmist used a special lens for this purpose.

(i) State the nature of the lens and reason for its use.

(ii) Where should the palmist place/hold the lens so as to have a real 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 from the palm, use lens formula to find the position and size of the image. (2020)

Answer:

(i) The lens used here is a convex lens and it is used as a magnifying glass because at close range, i.e., when the object is placed between optic center and principal focus it forms an enlarged, virtual and erect image of the object.

(ii) When this lens is placed such that the object is between the center of curvature and the principal focus, the palmist obtain a real and magnified image.

(iii) Given focal length, f = 10 cm and u = -5 cm According to lens formula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u} \text{ or } \frac{1}{v}=\frac{1}{f}+\frac{1}{u}$$

$$\text{or} \quad \frac{1}{v}=\frac{1}{10}+\frac{1}{-5}=\frac{-5+10}{-50}$$

$$\therefore \quad v=\frac{-50}{5}=-10 \text{ cm}$$

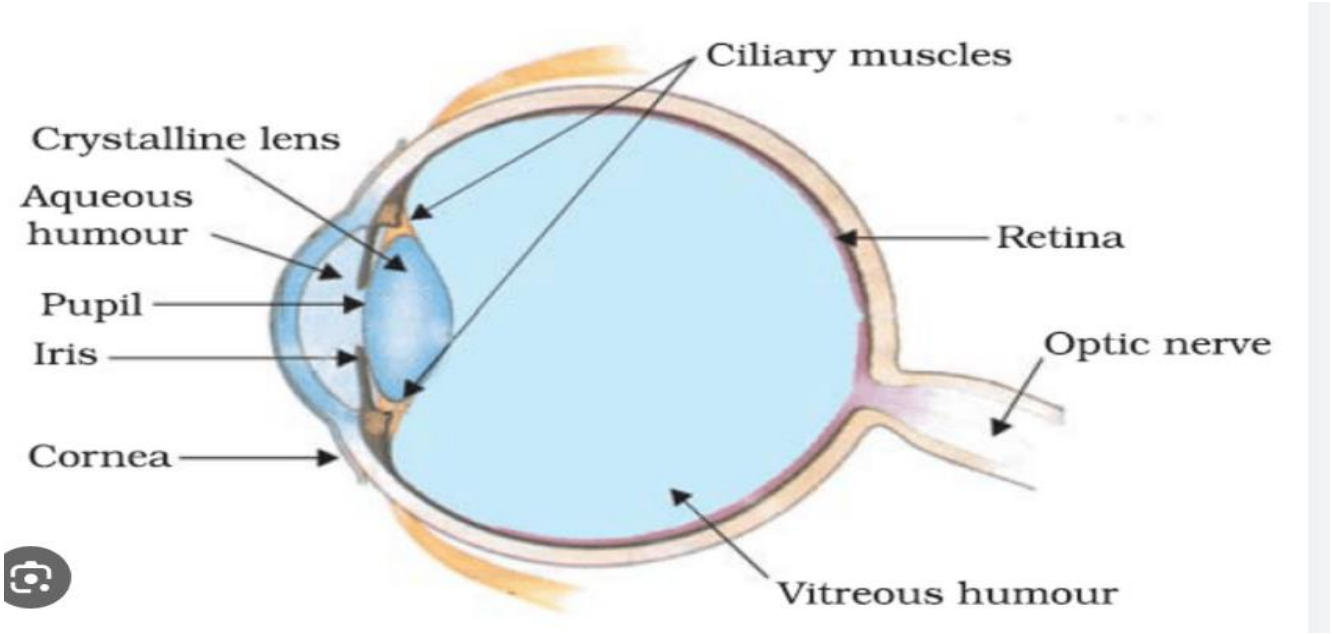
Thus, the image will be formed at 10 cm on the same side of the palm and the size of the image will be enlarged.

Chapter- 10

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:** 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:** 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:** It becomes thinner to focus on distant objects and becomes thicker to focus on nearby objects.
- **Retina:** Consists of numerous nerve cells. It converts images formed by the lens into electrical impulses.
- **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.
2. **Rods:** Rods are the optic nerve cells that are more sensitive to dim lights.

At the junction of the optic nerve and retina, there are no sensory nerve cells called **blind spot.**

DEFECTS OF HUMAN EYES

Myopia (Near – Sightedness) →

A person can see nearby objects clearly, but find it difficult to see far-off objects.

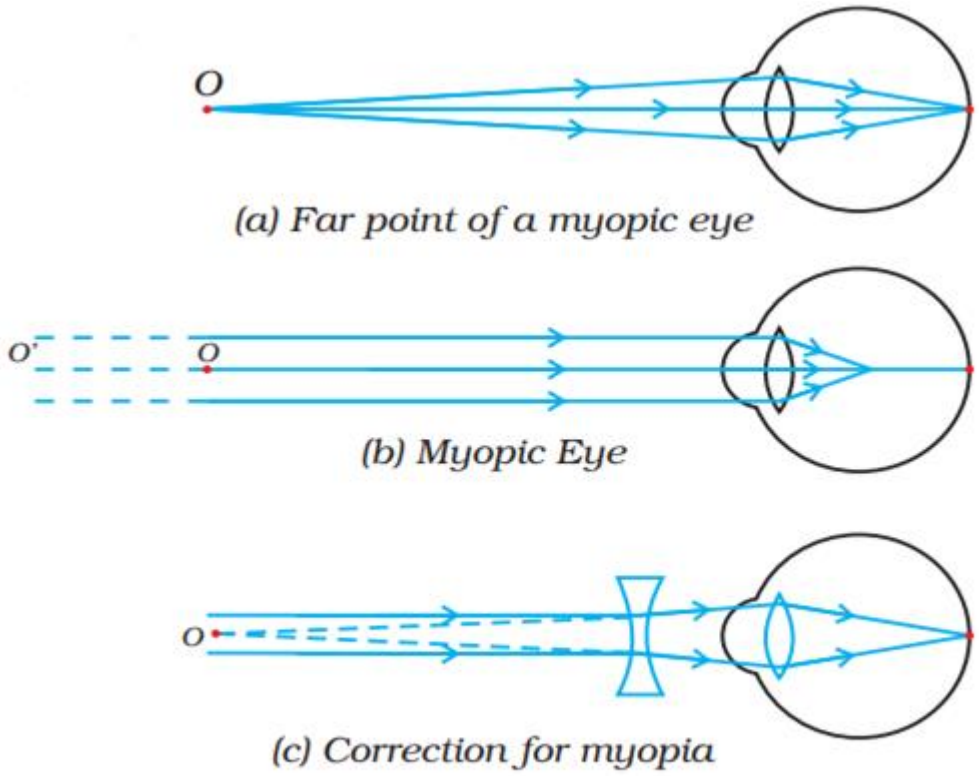
The image is formed near the eye lens; that is why this eye defect is called near - sightedness or myopia.

Myopia can be corrected with concave lenses.

Causes of Myopia (Near – Sightedness) →

It is caused due to:

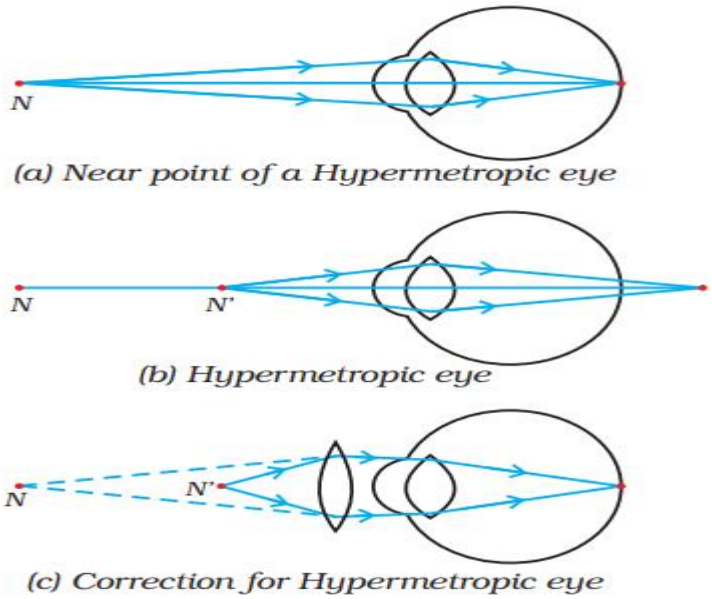
1. Excessive curvature of the eye lens.
2. Elongation of the eye ball.
3. Hereditary or due to uncontrolled diabetes or unattended cataract growths.



Hypermetropia(far – sightedness)- A person can see distant objects clearly but cannot see nearby objects distinctly.

It is caused due to:

1. The focal length of the eye lens is too long.
2. Eyeball has become too short.



Correction

This defect can be corrected by putting a convex lens of suitable power in front of the eye.

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.

The defect of far sightedness caused by the loss of elasticity of the eye lens is called presbyopia. Sometimes, a person may have both far sightedness and short-sightedness. People suffering from presbyopia often require bi-focal lenses that contain both concave and convex lenses.

Causes of Presbyopia

It is caused due to:

1. Gradual weakening of the ciliary muscles.
2. Decreasing flexibility of the eye lens.

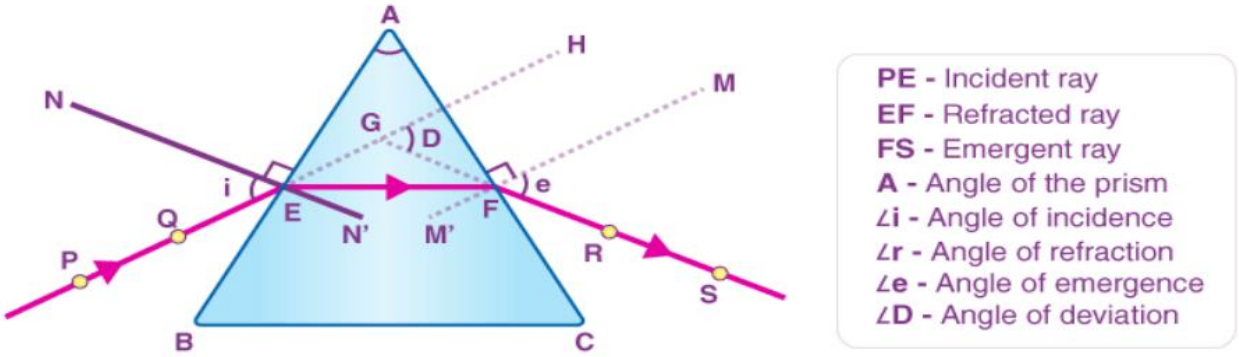
Correction

Presbyopia defect is corrected by using bi-focal lenses, which consist of both concave and convex lenses.

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.

The angle of Prism: The angle between two lateral faces is called the angle of the prism.

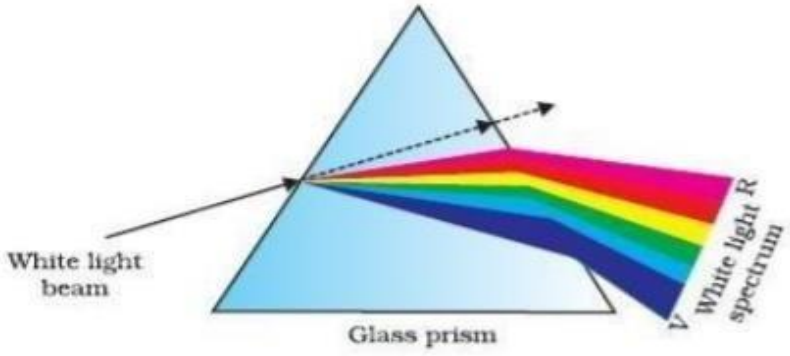
The angle of Deviation: The angle between the incident deviations.



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.

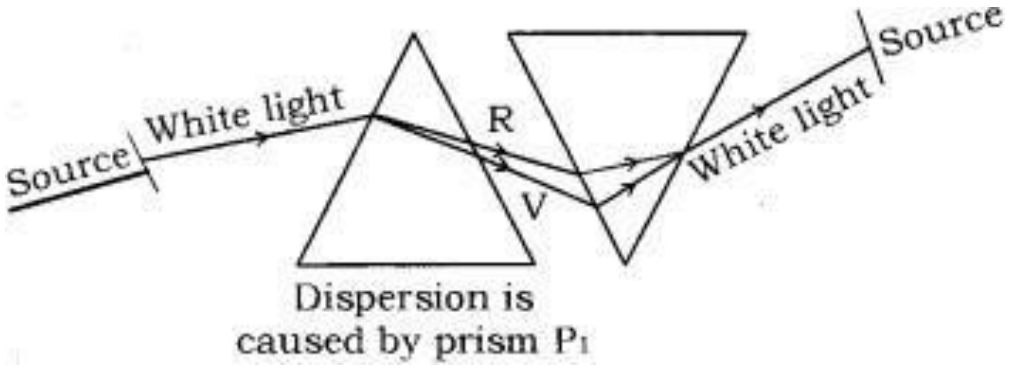
The violet light bends the most while the red bends least.



Dispersion of white light by a prism

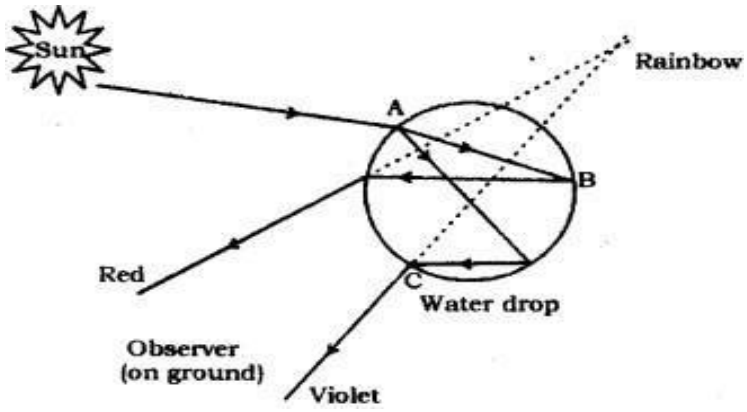
For violet colour, the wavelength is minimum and for red colour wavelength is maximum, i.e. frequency for violet colour is maximum and for red colour frequency is minimum.

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:



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.

Conditions for the formation of rainbow are:

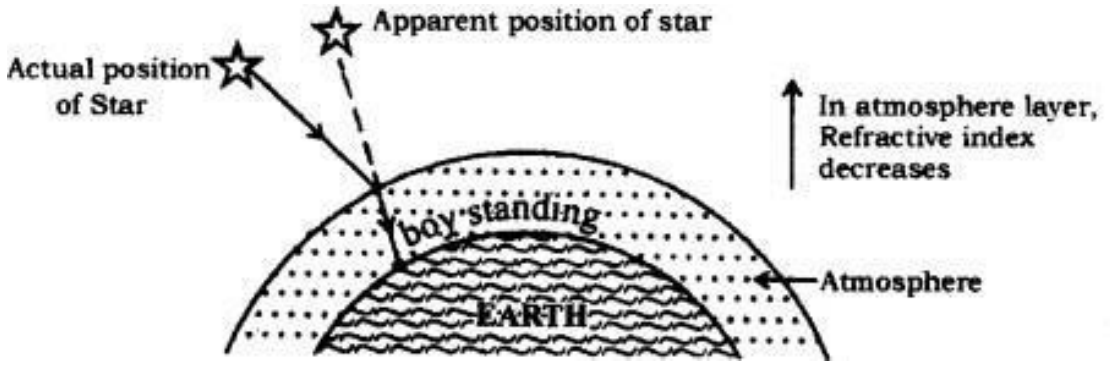
(i) The formation of a rainbow involves a series of physical phenomena refraction, dispersion and internal reflection

(ii) Rainbow is always formed in a direction opposite to that of the sun, i.e. the sun is always behind the observe.

The red colour appears on top and violet at the bottom of the rainbow.

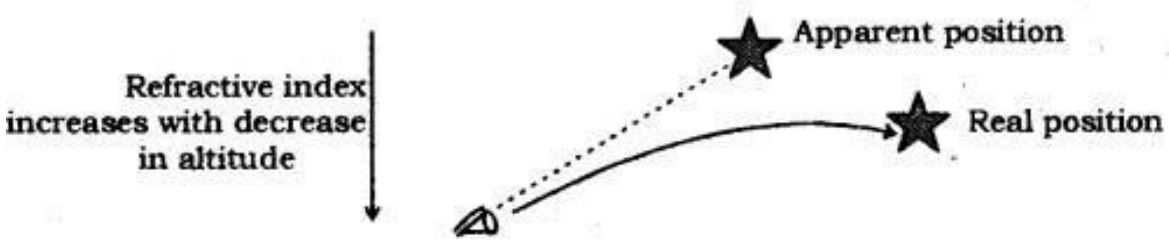
4. **Atmospheric Refraction:** The refraction of light caused by the Earth's atmosphere (having air layers of varying optical densities) is called Atmospheric Refraction.

Appearance of Star Position: It is due to atmospheric refraction of star light.
Distant star act as a point source of light. When the starlight enters the Earth's atmosphere, it undergoes refraction continuously.
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 multiple atmospheric refraction. Distant star act like a point source of light. When light from stars enter the earth's atmosphere, it continuously goes from rarer to denser medium so refraction of light takes place.



Colour of the sky: 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 sky's blue colour forms due to the molecules nitrogen and oxygen.
3. The absence of an atmosphere is what causes the sky to be so dark.
4. Red light is used as a warning signal because, due to its longer wavelength, it is least scattered by particles,

QUESTIONS FROM PREVIOUS BOARD EXAMS

1. : 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. When the ciliary muscles contract, the lens becomes thick and its focal length decreases, thus enabling us to see nearby objects.

2. 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 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.

3. 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.

4. (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)

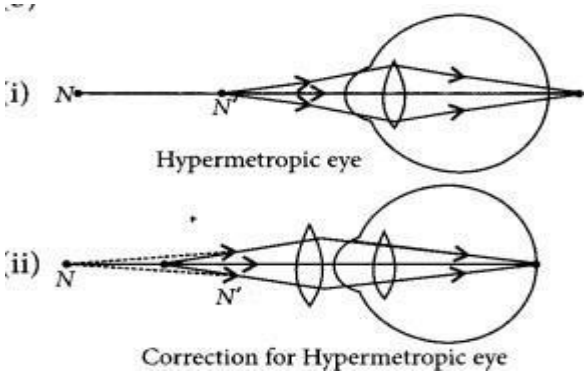
Answer:

(a) Hypermetropia is caused due to following reasons:

(i) Shortening of the eyeball

(ii) Focal length of the crystalline lens is too long.

(b)



5. (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,

(b)

P_N = +3 D.

As P = $\frac{1}{f(m)}$

∴ The focal length of the convex lens needed,

$f_N = \frac{1}{power}$ = 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.

6. A person may suffer from both myopia and hypermetropia defects.

(b) What is this condition called?

(c) When does it happen?

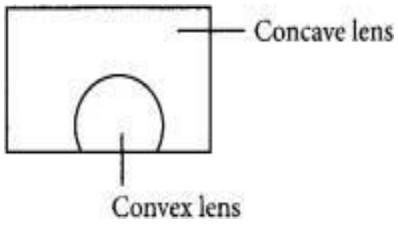
(d) Name the type of lens often required by the persons suffering from this defect. Draw a labelled diagram of such lenses. (2020)

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.

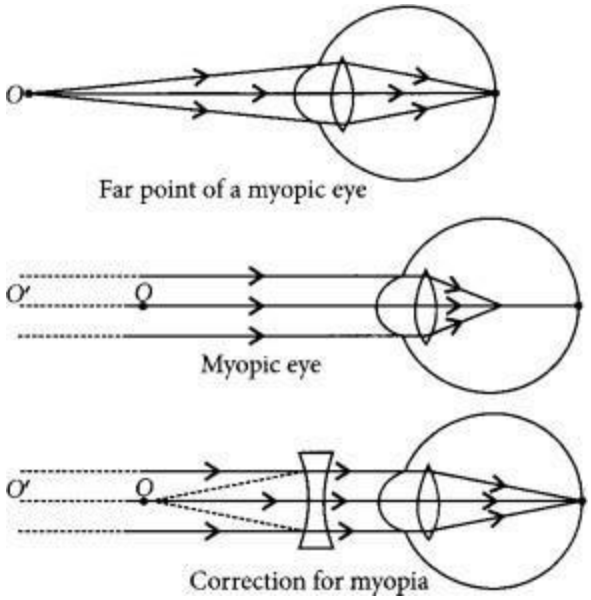
(c) It can be corrected by using bifocal lenses.



7. 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.



8. 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.

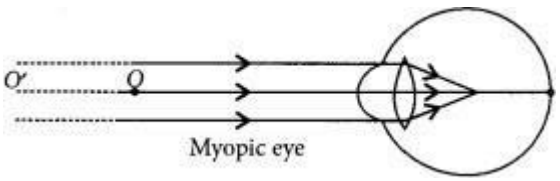
9. A student is unable to see the words written on the blackboard placed at a distance of approximately 3 m from him. Name the defect of vision the boy is suffering from. State the possible causes of this defect and explain the method of correcting it. (2018)

Answer:

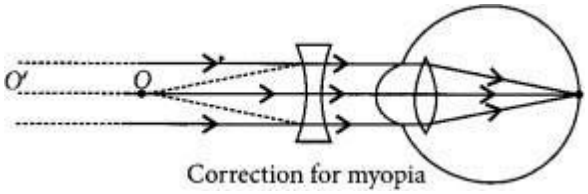
The student is suffering from myopia.

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.



Correction for myopia

10. 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 neighborhoods 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.

11. 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.

(d) define angle of deviation (D). (AI 2011)

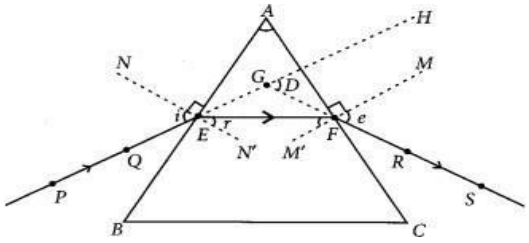
Answer:

i = angle of incidence

(a) PE = incident ray

(b) FS = emergent ray

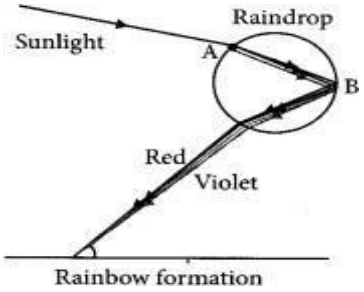
(c) ∠D = angle of deviation



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).

11. Draw a labelled diagram to explain the formation of a rainbow in the sky. (Foreign 2015)

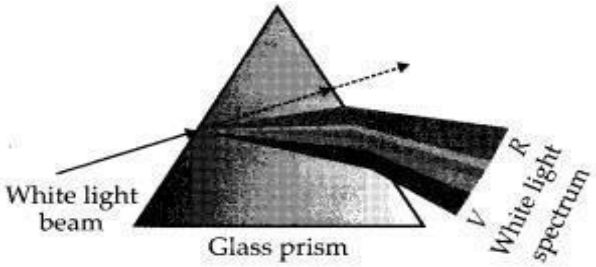
Answer: Rainbow is formed due to the combined effect of dispersion, refraction, internal reflection and again refraction of light.



Point A denotes dispersion and point B denotes internal reflection.

12. 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. The splitting of the light ray occurs due to the different bending angles for each colour



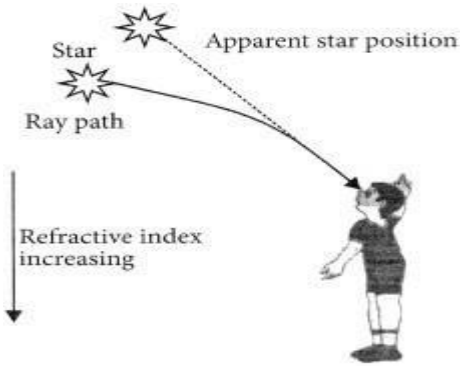
Dispersion of white light by the glass prism

13. Give reasons: Lights of red colour are used for danger signals.

Answer: Since the wavelength of red 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.

14. Why do stars appear to twinkle? Explain. (Foreign 2015)

Answer: The stars are very far away, they are point-sized sources of light. As the path of rays of light coming from the star goes on varying. due to atmospheric refraction, so the stars appear to twinkle.



15. Explain why the planets do not twinkle. (Foreign 2015)

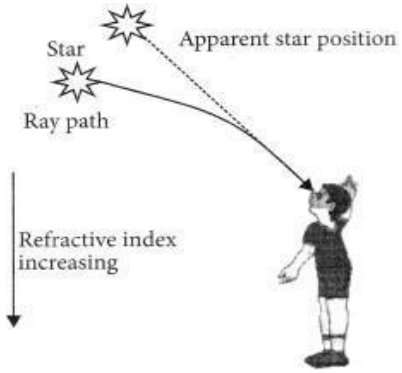
Answer: Planets do not emit light. The planets are much closer to the earth and are the extended source of light. The light coming from various points of the planet due to atmospheric refraction get averaged out. So, no twinkling of planets is seen.

16. A star appears slightly higher (above) than its actual position in the sky. Illustrate it with the help of a labelled diagram. (AI2012)

OR

A star appears slightly above its actual position in sky. Explain.

Answer: A star appears slightly above its actual position in the sky. Starlight undergoes refraction continuously and changes refractive index, before it reaches the earth. Since



the atmosphere bends starlight towards the normal, the star appears slightly above its actual position.

17. 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.

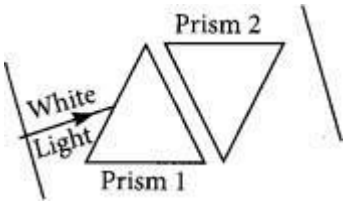
18. What will be the colour of the sky when it is observed from a place in the absence of any atmosphere ? (Delhi 2012)

Answer: If the earth had no atmosphere there would not have been any scattering. Then, the sky would look dark.

19. 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. So, the sky appears blue.

20. (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 called conductors. All the metals like silver, copper, aluminium etc. are conductors.
   Those substances through which electricity cannot flow are called insulators. Glass, ebonite, rubber, most plastics, paper, dry wood, etc., are insulators.
3. **Electrostatic potential**: The work done in bringing a unit positive charge from infinity to that point. Potential is denoted by the symbol V and its unit is volt. 1 volt means 1 joule of work is done in bringing 1 unit positive charge from infinity to that point.
4. **Potential Difference**: The amount of work done in moving unit positive charge from one point to another in an electric field is known as potential difference.
   Potential difference = $\frac{Work\ done}{Quantity\ of\ charge\ transferred}$
   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 = $\frac{W}{Q}$
   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 = $\frac{1\ joule}{1\ coulomb}$
5. **Voltmeter**: The potential difference is measured by 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.
   Current = $\frac{Charge}{Time}$
   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 = $\frac{Q}{t}$
   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. It should have very low internal resistance.
8. **Voltaic Cell**: It is a device which provide a continuous flow of electric current.

9. **Ohm's Law**: At constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends.

   I α V

   This can also-be written as:

   V α I

   V = IR

   Where R is a constant called 'resistance' of the conductor. The value of this constant 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 = $\frac{V}{I}$

    The SI unit of resistance is ohm, which is denoted by symbol Ω. 1 ohm: If V = 1 volt, I = I ampere, then

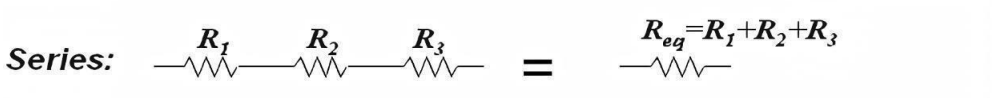
    R = $\frac{1\ volt}{1\ \text{ampere}}$ = 1 ohm

    Thus, the resistance of a conductor is said to be 1 ohm if 1 ampere current flows through the 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.
    (iv) Temperature.

12. **Resistivity:** It has been found by the experiments that:
    (i) The resistance of a given conductor is directly proportional to its length.
    R α l ……(i)
    (ii) The resistance of a given conductor is inversely proportional to its area of cross-section.
    R α1/A …….(ii)
    By combining the equations (i) and (ii), R α l/A
    R = ρ (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). Resistivity of an alloy a higher than that of a metal.

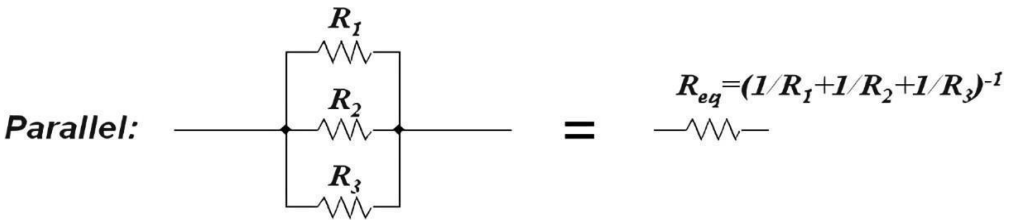
13. **Combination of Resistance:** The resistance can be combined in two ways:
    (i) In series
    (ii) In parallel
    (i) Resistance in series:



Resultant and resistance is always greater than individually resistance.
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:



Resultant resistance is less than the individual resistance.

In parallel, the total current: $I = I_1 + I_2 + I_3$ …….(i)
Applying Ohm's law to the entire circuit $I = \frac{V}{R}$ ……(ii)
Applying Ohm's law to each resistance separately, we have
$I_1 = \frac{V}{R_1}$; $I_2 = \frac{V}{R_2}$; $I_3 = \frac{V}{R_3}$….(iii)
From equations (i), (ii) and (iii), we have $\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$

$= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

14. **Electric Power:** The rate at which work is done by an electric current is known as electric power.

Power = Work done/Time $P = \frac{W}{t} = \frac{(V \times Q)}{t}$ …..(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

$P = \frac{(V.I.\ t)}{t} = VI$

$P = I^2R$ [Because V = IR]

$P = V^2/R$ [Because $I = \frac{V}{R}$] The unit of electric power is watt. Power = V × I

1 watt = 1 volt × 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 × Time, $E = P \times t$

The electrical energy consumed by an electrical appliance depends upon

(i) Power rating of the appliance

(ii) Time for which the 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 × Time 1 kWh = 1 kW × lh

= 1000 w × 60 × 60s (1 KW = 1000 Watt, 1 hr = 3600 seconds)

= 1000 Js^{-1} × 3600 s

= 3600000 J= 3.6×10^6 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,

$W = Q \times V$ ……(i)

But, current, $I = Q/t$ $Q = I \times t$

From Ohm's law: $V = I \times R$

Now, putting all these values in equation (i), we have Work done, $W = I^2 \times R \times t$

This work done is converted into heat energy for maintaining the flow of current I through the conductor for t second.

Heat produced, $H = I^2 \times R \times t$ 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 very thin and high 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

1. A current of 10 A flows through a conductor for two minutes.
(i) Calculate the amount of charge passed through any area of cross section of the conductor.
(ii) If the charge of an electron is 1.6×10^{-19} C, then calculate the total number of electrons flowing.
(Board Term I, 2013)

Answer::
Given that: I = 10 A, t = 2 min = 2 × 60 s = 120 s
(i) Amount of charge Q passed through any area of cross-section is given by I = Q/t
or Q = I × t ∴ Q = (10 × 120) A s = 1200 C
(ii) Since, Q = ne
where n is the total number of electrons flowing and e is the charge on one electron
∴ $1200 = n \times 1.6 \times 10^{-19}$
or $n = 12001.6 \times 10^{-19} = 7.5 \times 10^{21}$

2. Define electric current. (1/5, Board Term 1,2017)
Answer: Electric current is the amount of charge flowing through a particular area in unit time.

3. Define one ampere. (1/5, Board Term 1,2015)
Answer: One ampere is constituted by the flow of one coulomb of charge per second. 1 A = 1 C s^{-1}

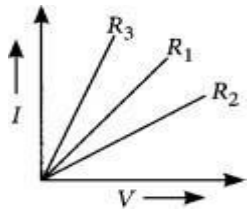
4. Name a device that you can use to maintain a potential difference between the ends of a conductor. Explain the process by which this device does so. (Board Term I, 2013)
Answer: A cell or a battery can be used to maintain a potential difference between the ends of a conductor. The chemical reaction within a cell generates the potential difference across the terminals of the cell, even when no current is drawn from it. When it is connected to a conductor, it produces electric current and, maintain the potential difference across the ends of the conductor.

5. Draw the symbols of commonly used components in electric circuit diagrams for
(i) An electric cell
(ii) Open plug key
(iii) Wires crossing without connection
(iv) Variable resistor
(v) Battery
(vi) Electric bulb
(vii) Resistance (Board Term 1,2017)

Answer:

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	

6. A student plots V-I graphs for three samples of nichrome wire with resistances R_1, R_2 and R_3. Choose from the following the statements that holds true for this graph. (2020)



(a) $R_1 = R_2 = R_3$
(b) $R_1 > R_2 > R_3$
(c) $R_3 > R_2 > R_1$
(d) $R_2 > R_1 > R_3$

Answer: (d) : The inverse of the slope of I-V graph gives the resistance of the material. Here the slope of $-R_3$ is highest. Thus, $R_2 > R_1 > R_3$

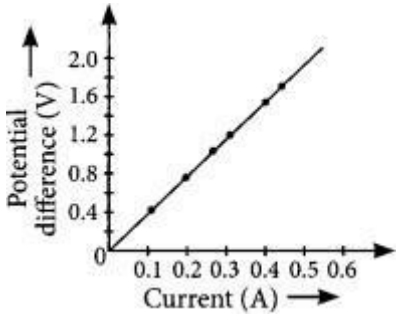
7. State Ohms law. (AI 2019)

Answer: It states that the potential difference V, across the ends of a conductor is directly proportional to the current flowing through it, provided its temperature remains the same. Mathematically,

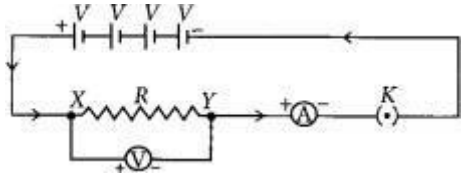
$V \alpha I$ $V = RI$

where R is resistance of the conductor.

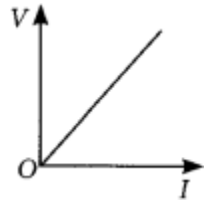
8. A V-I graph for a nichrome wire is given below. What do you infer from this graph? Draw a labelled circuit diagram to obtain such a graph. (2020)



Answer: As graph is a straight line, so it is clear from the graph that V α I.



The shape of the graph obtained by plotting potential difference applied across conductor against the current flowing v. It will be a straight line.
According to ohms law,



V = IR or R = VI
So, the slope of $\frac{V}{I}$ graph at any point represents the resistance of the given conductor.

9. Alloys are used in electrical heating devices rather than pure metals. Give a reason.
Answer: Alloys are utilised in electricity heating devices rather than pure metals because alloys have higher resistivity and hence produce more heat. Furthermore, alloy is non-combustible (or oxidises easily at higher temperature).

10. 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

11. Assertion (A): The metals and alloys are good conductors of electricity.
Reason (R): Bronze is an alloy of copper and tin and it is not a good conductor of electricity.

(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

Answer:(c) Metals and alloys are good conductors of electricity. Bronze is an alloy of copper and tin which are metals and thus is a good conductor of electricity.

12. A cylindrical conductor of length 'l' and uniform area of cross section 'A' has resistance 'R'. The area of cross section of another conductor of same material and same resistance but of length '2l' is (2020)
(a) A/2 (b) 3/2 A (c) 2A (d) 3A

Answer: (c) The resistance of a conductor of length. and area of cross section, A is R = ρlA where ρ is the resistivity of the material.
Now for the conductor of length 21, area of cross-section A' and resistivity ρ. R' = ρl'A' = ρ2lA'
But given, R = R' ⇒ ρlA = ρ2lA or A' = 2A Question 15.

Assertion (A): Alloys are commonly used in electrical heating devices like electric iron and heater.
Reason (R): Resistivity of an alloy is generally higher than that of its constituent metals but the alloys have low melting points then their constituent metals.

(a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
(b) Both (A) and (R) are true, but (R) is not the correct explanation of the assertion (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true. (2020)

Answer: (a)

13. How is the resistivity of alloys compared with those of pure metals from which they may have been formed? (Board Term I, 2017)

Answer: The resistivity of an alloy is generally higher than that of its constituent metals.

14. (i) List three factors on which the resistance of a conductor depends.
(ii) Write the SI unit of resistivity. (Board Term 1, 2015)

Answer:

(i) Resistance of a conductor depends upon the following factors:

(1) **Length of the conductor:** (Greater the length (I) of the conductor more will be the resistance (R).

$$R \alpha L$$

(2) Area of cross section of the conductor: (greater the cross-sectional area of the conductor, less will be the resistance.

$$R \alpha \frac{1}{A}$$

(3) Nature of conductor.
(4) Temperature

(ii) SI unit of resistivity is Ω m.

15. Calculate the resistance of a metal wire of length 2m and area of cross section 1.55×10^{-6} m², if the resistivity of the metal be 2.8×10^{-8} Ωm. (Board Term I, 2013)

Answer:

For the given metal wire, length, l = 2 m
area of cross-section, $A = 1.55 \times 10^{-6}$ m² resistivity of the metal, $p = 2.8 \times 10^{-8}$ Ω m Since, resistance, $R = \rho l/A$
So $R = (2.8 \times 10^{-8} \times 21.55 \times 10^{-6})$ Ω
$= 5.61.55 \times 10^{-2}$ Ω $= 3.6 \times 10^{-2}$Ω or R = 0.036Ω

16. Why are alloys commonly used in electrical heating devices? Give reason. (2018)

Answer:

Alloys are commonly used in electrical heating devices due to the following reasons

(i) Alloys have higher resistivity than metals
(ii) Alloys do not get oxidised or burn readily.

17. If the radius of a current carrying conductor is halved, how does current through it change? (Board Term I, 2014)

Answer: If the radius of conductor is halved, the area of cross-section reduced to (1/4) of its previous value.

Since,
R α 1A, resistance will become four times
From Ohm's law, V = IR for given V, I α 1R
So, current will reduce to one-fourth of its previous value.

18. Define resistance of a conductor. State the factors on which resistance of a conductor depends. Name the device which is often used to change the resistance without changing the voltage source in an electric circuit. Calculate the resistance of 50 cm length of wire of cross-sectional area 0.01 square mm and of resistivity 5×10^{-8} Ω m. (Board Term I, 2014)

Answer:

Resistance is the property of a conductor to resist the flow of charges through it. Factors affecting resistance of a conductor:

Refer to Answer: 17(i)

Rheostat is the device which is often used to change the resistance without changing the voltage source in an electric circuit.

We are given, length of wire, l = 50 cm = 50×10^{-2} m cross-sectional area, A = 0.01 mm²
= 0.01×10^{-6} m²

and resistivity, ρ = 5×10^{-8} Ω m. As, resistance, $R = \frac{\rho L}{A}$

∴ $R = \left(5\times10^{-8}\times50\times10^{-2}\ 0.01\times10^{-6}\right)$ Ω
= 2.5 Ω

19. The maximum resistance which can be made using four resistors each of 2 Ω is
(a) 2 Ω (b) 4 Ω (c) 8 Ω (d) 16 Ω (2020)

Answer: (c) : A group of resistors can produce maximum resistance when they all are connected in series.
∴ R_s = 2 Ω + 2 Ω + 2 Ω + 2 Ω = 8 Ω

20. Three resistors of 10 Ω, 15 Ω and 5 Ω are connected in parallel. Find their equivalent resistance. (Board Term I, 2014)

Answer:

Here, R_1 = 10 Ω, R_2 =15 Ω, R_3 = 5 Ω.

In parallel combination, equivalent resistance, (R_{eq}) is given by

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

So, $$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{15} + \frac{1}{5}$$

$$\frac{1}{R_{eq}} = \frac{3+2+6}{30} = \frac{11}{30}$$

$$\therefore \quad R_{eq} = \frac{30}{11}\Omega = 2.73\ \Omega$$

21. List the advantages of connecting electrical devices in parallel with an electrical source instead of connecting them is series. (Board Term I, 2013)

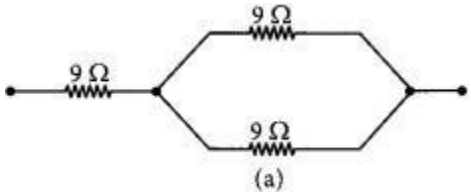
Answer: (a) When a number of electrical devices are connected in parallel, each device gets the same potential difference as provided by the battery and it keeps on working even if other devices fail. This is not so in case the devices are connected in series because when one device fails, the circuit is broken and all devices stop working.

(a) Parallel circuit is helpful when each device has different resistance and requires different current for its operation as in this case the current divides itself through different devices. This is not so in series circuit where same current flows through all the devices, irrespective of their resistances.

22. Show how would you join three resistors, each of resistance 9 Ω so that the equivalent resistance of the combination is (i) 13.5 Ω, (ii) 6 Ω (2018)

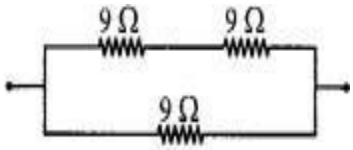
Answer:

(i) The resistance of the series combination is higher than each of the resistances. A parallel combination of two 9 Ω resistors is equivalent to 4.5 Ω. We can obtain 13.5 Ω by coupling 4.5 Ω and 9 Ω in series. So, to obtain 13.5 Ω, the combination is as shown in figure (a).



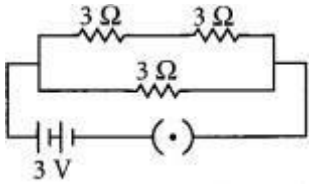
(a)

(ii) To obtain a equivalent resistance of 6 Ω, we have to connect two 9 Ω resistors in series and then connect the third 9 Ω resistor in parallel to the series combination as shown in the figure (b).



(b)

23. Three resistors of 3 Ω each are connected to a battery of 3 V as shown in fig.Calculate the current drawn from the battery. (Board Term I, 2017)



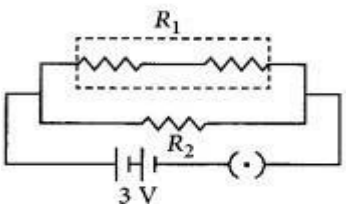
Answer:

As given in circuit diagram, two 3 Ω resistors are connected in series to form R_1; so $R_1 = 3\ \Omega + 3\ \Omega = 6\Omega$

And, R_1 and R_2 are in parallel combination, Hence, equivalent resistance of circuit (R_{eq}) given by

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{3} = \frac{1+2}{6} = \frac{3}{6} = \frac{1}{2}$$



$R_{eq} = 2\ \Omega$
Using Ohm's law, V = IR We get,
$3\ V = I \times 2\ \Omega$
or $I = 3/2\ A = 1.5\ A$
Current drawn from the battery is 1.5 A.
Question 23A.
Two identical resistors are first connected in series and then in parallel. Find the ratio of equivalent resistance in two cases. (Board Term I, 2013)
Answer:
Let resistance of each resistor be R. For series combination,
$R_s = R_1 + R_2$
So, $R_s = R + R = 2R$
For parallel combination,

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \text{or} \quad R_p = \frac{R_1 R_2}{R_1 + R_2}$$

$$\text{So, } R_p = \frac{R \times R}{R + R} = \frac{R}{2}$$

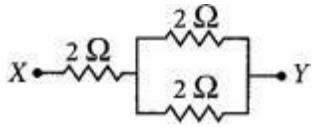
$$\text{Required ratio} = \frac{R_s}{R_p} = \frac{2R}{R/2} = 4:1$$

24. (a) A 6 Ω resistance wire is doubled on itself. Calculate the new resistance of the wire.
(b) Three 2 Ω resistors A, B and C are connected in such a way that the total resistance of the combination is 3 Ω. Show the arrangement of the three resistors and justify your answer.

Answer:

(a) Given resistance of wire, R = 6 Ω
Let L be the length of the wire and A be its area of cross-section. Then
$R = \frac{\rho L}{A} = 6\ \Omega$
Now when the length is doubled, L' = 2L and A' = A/2
$\therefore R' = \rho(2L)/A/2 = 4\rho L/A = 4 \times 6\ \Omega = 24\ \Omega$

(b) Given the total resistance of the combination = 3 Ω
In order to get a total resistance of 3 Ω, the three resistors has to be connected as shown.



Such that, $1R_P = 1/2 + 1/2 = 1$
$\Rightarrow R_p = 1\ \Omega$
and $R_s = 2\ \Omega + 1\ \Omega = 3\ \Omega$

25. Draw a schematic diagram of a circuit consisting of a battery of 3 cells of 2 V each, a combination of three resistors of 10 Ω, 20 Ω and 30 Ω connected in parallel, a plug key and an ammeter, all connected in series. Use this circuit to find the value of the following:

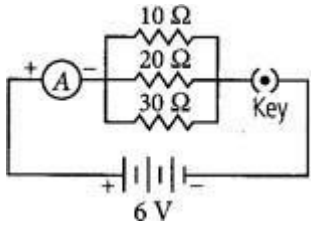
(a) Current through each resistor

(b) Total current in the circuit

(c) Total effective resistance of the circuit. (2020)

Answer:

The circuit diagram is as shown below.



(a) Given, voltage of the battery = 2V + 2V + 2V = 6 V Current through 10 Ω resistance,

$I_{10} = V/R = 6/10 = 0.6$ A

Current through 20 Ω resistance, $I_{20} = V/R = 6/20 = 0.3$ A

Current through 30 Ω resistance,

$I_{30} = V/R = 6/30 = 0.2$ A

(b) Total current in the circuit, $1 = I_{10} + I_{20} + I_{30}$

$= 0.6 + 0.3 + 0.2 = 1.1$ A

(c) Total resistance of the circuit,

$1/R_P = 1/10 + 1/20 + 1/30 = 11/60$

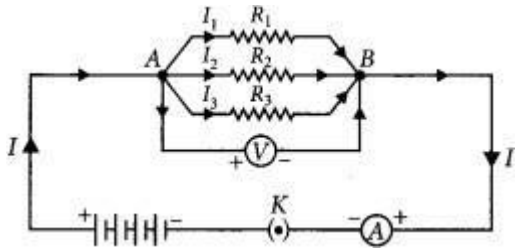
$R_P = 60/11 = 5.4\ \Omega$

26. (a) With the help of a suitable circuit diagram prove that the reciprocal of the equivalent resistance of a group of resistances joined in parallel is equal to the sum of the reciprocals of the individual resistances.

(b) In an electric circuit two resistors of 12 Ω each are joined in parallel to a 6 V battery. Find the current drawn from the battery. (Delhi 2019)

Answer:

(a) Resistors in parallel: When resistors are connected in parallel.



(i) The potential difference across their ends is the same.

(ii) The sum of current through them is the current drawn from the source of energy or cell.

$I = I_1 + I_1 + I_3$ or $V_{R_P} = V/R_1 + V/R_2 + V/R_3$

(iii) The equivalent resistance is given by,

$1/R_P = 1/R_1 + 1/R_2 + 1/R_3$

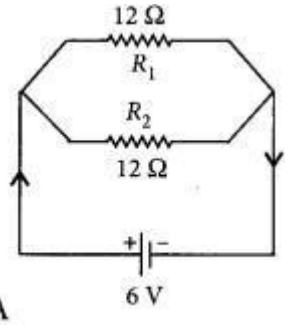
Hence equivalent resistance in parallel combination is equal to the sum of reciprocals of the individual resistances.

(b) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

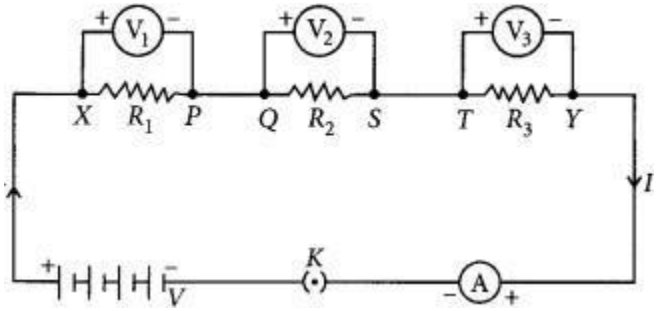
$\frac{1}{R} = \frac{1}{12} + \frac{1}{12} = \frac{2}{12}$

$\Rightarrow \quad R = 6\ \Omega$

$\therefore$ Current, $I = \frac{V}{R} = \frac{6}{6} = 1\ \text{A}$



27. For the series combination of three resistors current in each resistor, establish the relation $R = R_1 + R_2 + R_3$ where the symbols have their usual meanings. Calculate the equivalent resistance of the combination of three resistors of 6 Ω, 9 Ω and 18 Ω joined in parallel. (Board Term I, 2016)



Answer:

Given figure shows the series combination of three resistors R_1, R_2 and R_3 connected across a voltage source of potential difference V.

Let current I is flowing through the circuit.

V_1, V_2 and V_3 are the potential differences across resistors R_1, R_2 and R_3 respectively.

Since, the total potential difference across a combination of resistors in series is equal to the sum of potential difference across the individual resistors.

$\therefore V = V_1 + V_2 + V_3$ **...(i)**

In series current through each resistor is same. Applying the Ohms law, $V_1 = IR_1$, $V_2 = IR_2$ and $V_3 = IR_3$ **(ii)**

If R_s is the equivalent resistance of the circuit, then $V = IR_s$ **...(iii)**

From eqns. (i), (ii) and (iii),

we can write $IR_s = IR_1 + IR_2 + IR_3$

$IR = I(R_1 + R_2 + R_3)$

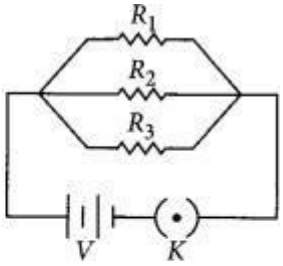
$R_s = R_1 + R_2 + R_3$

We can conclude that when several resistors are joined in series, the resistance of the combination R_s equals the sum of their individual resistances,

R_1, R_2 and R_3

Given: $R_1 = 6\ \Omega$, $R_2 = 9\ \Omega$,

$R_3 = 18\ \Omega$ are connected in parallel. Equivalent resistance, R_{eq}, is given by



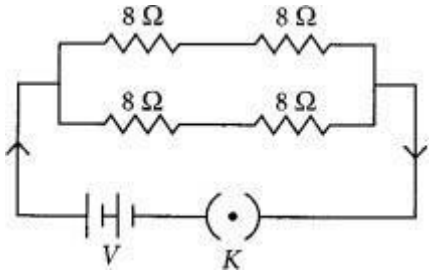
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{9} + \frac{1}{18} = \frac{3+2+1}{18} = \frac{6}{18} = \frac{1}{3}$$

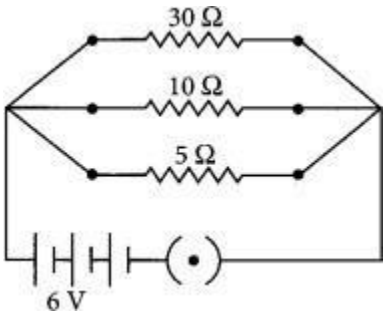
or $R_{eq} = 3\ \Omega$

28. You have four resistors of 8 Ω each. Show how would you connect these resistors to have effective resistance of 8 Ω? (4/5, Board Term I, 2015)

Answer: If you have four 8 Ω resistors and the effective resistance is also 8 Ω then the two 8 Ω resistors are connected in series. Now you have pair of two 16 Ω resistors (8 Ω + 8 Ω). If you connect these resistors in parallel, you will have net resistance 8 Ω.



29. Two wires A and B are of equal length and have equal resistances. If the resistivity of A is more than that of B, which wire is thicker and why ? For the electric circuit given below calculate:



(i) current in each resistor

(ii) total current drawn from the battery, and

(iii) equivalent resistance of the circuit. (Board Term I, 2014) Answer:

Let l_A, a_A and R_A be the length, area of cross-section and resistance of wire A and l_B, a_B and R_B are that of wire B.

Here, $l_A = l_B$ and $R_A = R_B$

If ρ_A and ρ_B are the resistivities of wire A and B respectively then $R_A = \rho_A l_A / a_A$ and $R_B = \rho_B l_B / a_B$, As $R_A = R_B$

$\therefore \rho_A l_A / a_A, \rho_B l_B / a_B$

or $\rho_A \rho_B = a_A / a_B$

Since $\rho_A > \rho_B$ therefore $a_A > a_B$ Hence, wire A is thicker than wire B. For parallel 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) Total current drawn from battery,

$I = I_1 + I_2 + I_3 = 0.2 + 0.6 + 1.2 = 2$ A

(iii) Equivalent resistance of the circuit, R_{eq} can be obtained by Ohm's law $V = I R_{eq}$

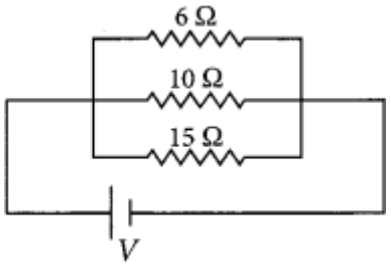
So, $6\ V = 2\ A \times R_{eq}$ or, $R_{eq} = 6/2 = 3\ \Omega$

$1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3$

$1/30 + 1/10 + 1/5 = (1+3+6)/30 = 10/30 = 1/3$

or $R_{eq} = 3\ \Omega$

30. Find the equivalent resistance of the following circuit.



Answer: For the given circuit, $R_1 = 6\ \Omega$, $R_2 = 10\ \Omega$, $R_3 = 15\ \Omega$.

As $1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3$ $1/R_{eq} = 1/6 + 1/10 + 1/15$

$= 5+3+2/30 = 10/30 = 1/3$

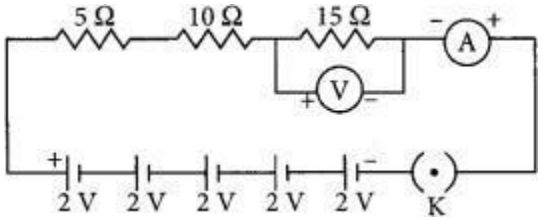
$R_{eq} = 3\ \Omega$

31. Draw a circuit diagram for a circuit consisting of a battery of five cells of 2 volts each, a 5 Ω resistor, a 10 Ω resistor and a 15 Ω resistor, an ammeter and a plug key, all connected in series. Also connect a voltmeter to record the potential difference across the 15 Ω resistor and calculate

(i) the electric current passing through the above circuit and

(ii) potential difference across 5 Ω resistor when the key is closed. (Board Term 1, 2013) Answer:

Potential of the battery, $V = (2 \times 5)\ V = 10$ V Equivalent resistance,



$R_{eq} = R_1 + R_2 + R_3$

$= (5 + 10 + 15)\Omega = 30\ \Omega$

(i) Current through circuit, $I = V/R = 10/30\ A = 1/3\ A$

(ii) Potential across 5 Ω resistor, $V_1 = IR_1$

$= 1/3 \times 5 = 5/3\ V = 1.67\ V$

32. The resistance of a resistor is reduced to half of its initial value. In doing so, if other parameters of the circuit remain unchanged, the heating effects in the resistor will become

(b) two times

(c) half

(d) one-fourth

(e) four times (2020)

Answer: (a):

We know, $H = I^2Rt = V^2/R.\ t$ Now when, $R' = R/2$, $V' = V$ and $t' = t' = V'^2\ t'R' = V^2t/(R/2) = 2V^2\ tR = 2R$

33. (a) Write the mathematical expression for Joules law of heating.

(b) Compute the heat generated while transferring 96000 coulomb of charge in two hours through a potential difference of 40 V. (2020)

Answer: (a) The Joule's law of healing implies that heat produced in a resistor is

(i) directly proportional to the square of current I of a given resistance,

(ii) directly proportional to resistance for a given current, and

(iii) directly proportional to the time for which the current flows through the resistor. i.e., $H = I^2\ Rt$

(b) Given, charge q = 96000 C, time t = 2 h = 7200 s and potential difference V = 40 V

We know, $H = I^2Rt = Q^2/t^2 \times V/Q \times t \times t = VQ$

$= 40 \times 96000 = 3.84 \times 10^6\ J = 3.84\ MJ$

34. Explain the use of an electric fuse. What type of material is used for fuse wire and why? (Board Term I, 2016)

Answer: Electric fuse protects circuits and appliances by stopping the flow of electric current. It consists of a piece of wire made of a metal or an alloy of low melting point, If a current larger than the specified value flows through the circuit, the temperature of the fuse wire increases. This melts the fuse wire and breaks the circuit.

35. (a) Why is tungsten used for making bulb filaments of incandescent lamps?

(b) Name any two electric devices based on heating effect of electric current. (Board Term I, 2015)

Answer:

(a) (i) Tungsten has high melting point (3380°C) and high resistivity.

(ii) It emits light at high temperatures (about 2500°C).

(b) Iron and electric heater are based on heating effect of electric current.

36. Two bulbs of 100 W and 40 W are connected in series. The current through the 100 W bulb is 1 A. The current through the 40 W bulb will be

(a) 0.4 A (b) 0.6 A (c) 0.8 A (d) 1A (2020)

Answer: (d) : Given power of first bulb, $P_1 = 100$ W and second bulb $P_2 = 40$ W Current through 100 W bulb, $I_1 = 1$ A

Current through 40 W bulb, $I_2 = ?$

Since both the bulbs are connected in series, the electric current passing through both the bulbs are same i.e., $I_2 = 1$ A.

37. Write the relation between resistance (R) of filament of a bulb, its power (P) and a constant voltage V applied across it. (Board Term I, 2017)

Answer: $P = V^2/R$

38. Power of a lamp is 60 W. Find the energy in joules consumed by it in 1s. (Board Term I, 2016)

Answer: Here, power of lamp, P = 60 W time, t = 1 s

So, energy consumed = Power × time = (60 × 1) J = 60 J

39. Two lamps, one rated 100 W; 220 V, and the other 60 W; 220 V, are connected in parallel to electric mains supply. Find the current drawn by two bulbs from the line, if the supply voltage is 220 V. (2018, Board Term I, 2014)

Answer: Since both the bulbs are connected in parallel and to a 220 V supply, the voltage across each Bulb is 220 V. Then

Current drawn by 100 W bulb,

I_1 = power rating /voltage applied = 100W/220V = 0.454 A Current drawn by 60 W bulb,

I_2 = 60W/220V = 0.273 A

Total current drawn from the supply line,

$I = I_1 + I_2 = 0.454\text{ A} + 0.273\text{ A} = 0.727\text{ A} = 0.73\text{ A}$

40. How much current will an electric iron draw from a 220 V source if the resistance of its element when hot is 55 ohms? Calculate the wattage of the electric iron when it operates on 220 volts. (Board Term I, 2016)

Answer:

Here, V = 220 V, R = 55 Ω

By Ohm's law V = IR

∴ 220 = I × 55 or I = 220 / 55 = 4A

Wattage of electric iron = Power

$= V^2/R = (220)^2/55 = 880$ W

41. An electric iron has a rating of 750 W; 200 V. Calculate:

(i) the current required.

(ii) the resistance of its heating element.

(iii) energy consumed by the iron in 2 hours. [Board Term 1, 2015]

Answer:

Here, P = 750 W, V = 200 V

(i) As P = VI

I = P/V= (750/200) A = 3.75A

(ii) By Ohm's law V = IR or R = V/ I

∴ R = 200/ 3.75 Ω = 53.3 Ω

(iii) Energy consumed by the iron in 2 hours
= P × t = 750 W × 2h = 1.5 kWh
or E = (750 × 2 × 3600) J = 5.4×10^6 J

42. An electric bulb is connected to a 220 V generator. The current is 2.5 A. Calculate the power of the bulb. (1/3, Board Term I, 2015)

Answer:

Here, V= 220 V, I= 2.5 A
Power of the bulb P = VI = 220 × 2.5 W = 550 W

43. (a) Define power and state its SI unit.
(b) A torch bulb is rated 5 V and 500 mA. Calculate its
(i) power
(ii) resistance
(iii) energy consumed when it is lighted for 2 12 hours.

Answer: (a) Power is defined as the rate at which electric energy consumed in an electric circuit.
$P = VI = I^2R = V^2/R$
The SI unit of electric power is watt (W). It is the power consumed by a device that carries 1 A of current when operated at a potential difference of IV.
1 W = 1 volt × 1 ampere = 1 V A
(a) Given, V = 5 V and I = 500 mA = 0.5 A
(i) Power, P = V × I = 5 × 0.5 = 2.5 W
(ii) As, $P = V^2/R \Rightarrow R = V^2/P = 25/2.5 = 10\ \Omega$
(iii) Given, time t = 2.5 hrs = 9000 s
∴ The energy consumed, E = P × t
= 2.5 × 9000 = 2.25×10^4 J
= 6.25-Watt hour

44. Two identical resistors, each of resistance 15 Ω, are connected in (i) series, and (ii) parallel, in turn to a battery of 6 V. Calculate the ratio of the power consumed in the combination of resistors in each case. (2020)

Answer:

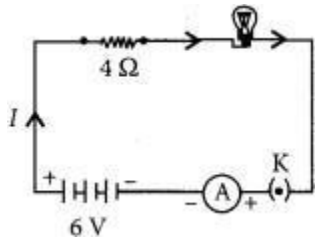
Given, $R_1 = R_1 = 15\ \Omega$, V = 6 V
(i) When connected in series,
$R_s = R_1 + R_2 = 15\ \Omega + 15\ \Omega = 30\ \Omega$
Power, $P_S = V^2/Rs = 36/30$ W
(ii) When connected in parallel,

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_P = \frac{15}{2}\ \Omega$$

$$\therefore \text{ Power, } P_P = \frac{V^2}{R_P} = \frac{36}{15} \times 2 \text{ W}$$

$$\therefore \text{ The ratio, } \frac{P_S}{P_P} = \frac{36}{30} \times \frac{15}{36 \times 2} = \frac{1}{4}$$

45. An electric lamp of resistance 20 Ω and a conductor of resistance 4 Ω. are connected to a 6 V battery as shown in the circuit. Calculate.



(a) the total resistance of the circuit
(b) the current through the circuit,
(c) the potential difference across the (i) electric lamp and (ii) conductor, and
(d) power of the lamp. (Delhi 2019)

Answer:

Resistance of the lamp = 20 Ω
External resistance = 4 Ω

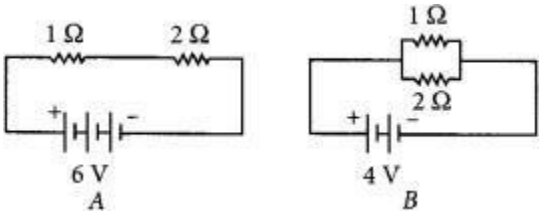
(a) As both the lamp and external resistance are connected in series, therefore the total resistance,
$R_S = R_1 + R_2$
$R = 20 + 4 = 24\ \Omega$

(b) Current, $I = V/R = 6/24 = 0.25$ A

(c) (i) Potential difference across the electric lamp
(Total voltage / total resistance) × resistance of lamp
$= 6/24 \times 20 = 5$ V
(ii) Potential difference across conductor
(Total voltage / total resistance) × resistance of conductor
$= 6/24 \times 4 = 1$ V

(d) Power of the lamp
= (current)² × resistance of lamp
$= (0.25)^2 \times 20 = 1.25$ W

46. Compare the power used in 2 Ω. resistor in each of the following circuits. (AI 2019)



Answer:

In circuit A,

Total resistance, R = l + 2 = 3Ω
Voltage across 2 Ω = $(V_{Total}/R_{Total}) \times 2\ \Omega = 6/3 \times 2 = 4$ V
∴ Power used in 2 Ω resistor, $p = V^2/R = (4)^2/2 = 8$ w
In circuit B, Voltage across both the resistance is same i.e. 4 V and both are connected in parallel combination.
∴ Power used in 2 Ω resistor = $V^2/R = (4)^2/2 = 8$ w
∴ Power used in 2 Ω resistor in each case is same i.e. 8 W.

47. A bulb is rated 40 W; 220 V. Find the current drawn by it, when it is connected to a 220 V supply. Also find its resistance. If the given bulb is replaced by a bulb of rating 25 W; 220 V, will there be any change in the value of current and resistance? Justify your Answer: and determine the change. (AI 2019)

Answer:

In first case, P = 40 W, V = 220 V

Current drawn $I = P/V = 40/220 = 0.18$ A

Also, resistance of bulb,

$R = V^2P = (220)^2/40 = 1210\ \Omega$

In second case, P = 25 W, V = 220 V Current drawn, $I = P/V = 25/220 = 0.11$ A

Also, resistance of the bulb,

$R = V^2P = (220)^2/25 = 1936\ \Omega$

Hence, by replacing 40 W bulb to 25 W bulb, having same source of voltage the amount of current flows decreases while resistance increases.

48.

(a) An electric bulb is connected to a 220 V generator. If the current drawn by the bulb is 0.50 A, find its power.

(b) An electric refrigerator rated 400 W operates 8 hours a day. Calculate the energy per day in kWh.

(c) State the difference between kilowatt and kilowatt hour. (Board Term I, 2013)

Answer:

(a) Here, V = 220 V, I = 0.50 A

Power of the bulb, P = VI = (220 × 0.5) W = 110 W

(b) Energy consumed by electric refrigerator in a day = Power x time

= 400 W × 8 h = 3200 Wh = 3.2 kWh

(c) Kilowatt is unit of power and kilowatt hour is a unit of energy.

49.

(i) State one difference between kilowatt and kilowatt hour. Express 1 kWh in joules.

(ii) A bulb is rated 5V; 500 mA. Calculate the rated power and resistance of the bulb when it glows. (Board Term I, 2013)

Answer:

(i) Refer to Answer: 64(c). 1 kWh = 1000 W × 1 h

= 1000 W × 3600 s = 3600000 J = 3.6×10^6 J

(ii) Here, V = 5 V, I = 500 mA = 0.5 A

Power rating of bulb is

P = VI = (5 × 0.5)W = 2.5W

Resistance of the bulb is $R = V/I = (5/0.5)\ \Omega = 10\ \Omega$

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.

Use of Magnets: Magnets are used

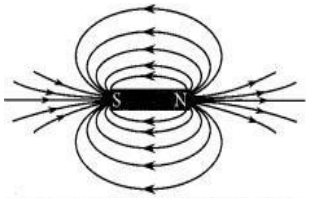
- in refrigerators.
- in radio and stereo speakers.
- in audio and video cassette players.
- in children' toys and;
- on hard discs and floppies of computers.

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



Magnetic field lines around a bar magnet

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.

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.

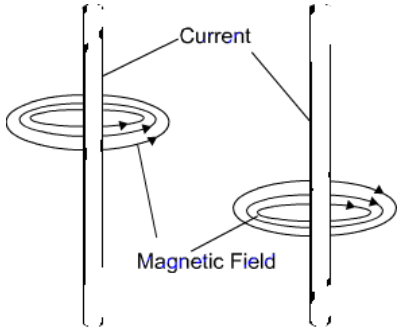
Properties of magnetic field lines

(i) They do not intersect each other because at the point of intersection there will be two direction which is not possible.

(ii) It is taken by convention that magnetic field lines emerge from North pole and merge at the South pole.

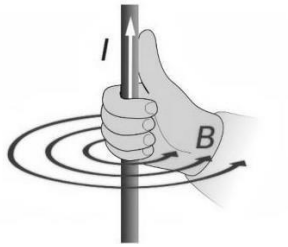
Magnetic field lines due to current a current carrying straight conductor

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.



Properties of magnetic field

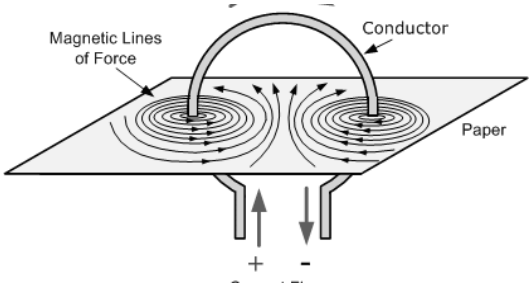
- The magnitude of magnetic field increases with increase in electric current and decreases with decrease in electric current.
- The magnitude of magnetic field produced by electric current decreases with increase in

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 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.

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.

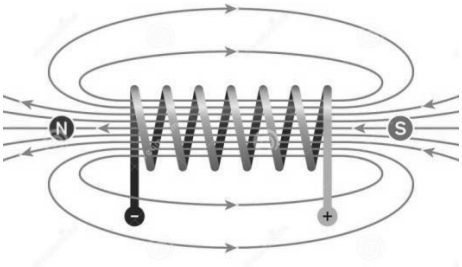
The strength of the magnetic field at the centre of the loop(coil) depends on:

(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.

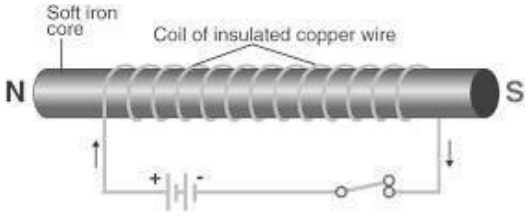


Magnetic field lines are parallel inside the solenoid, similar to a bar magnet, which shows that magnetic field is same at all points inside the solenoid.
Magnetic field produced by a solenoid is similar to a bar magnet.

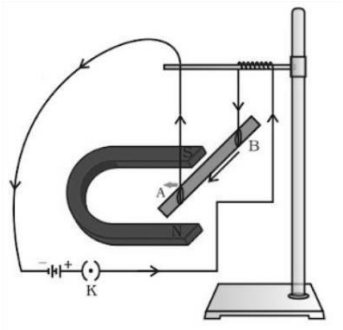
The strength of magnetic field is proportional to the number of turns and magnitude of current. By producing a strong magnetic field inside the solenoid, magnetic materials can be magnetized. Magnet formed by producing magnetic field inside a solenoid is called electromagnet.

Electromagnet, Fleming's Left-Hand Rule, 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.



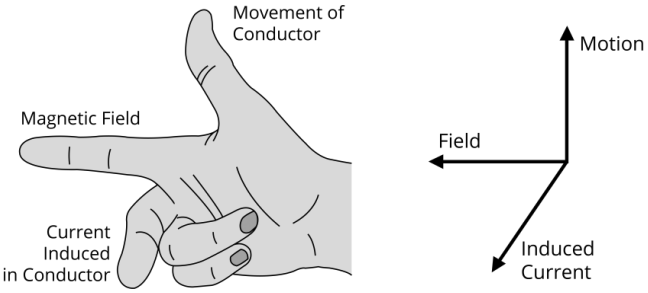
Force on a current carrying conductor in a magnetic field: A current carrying conductor exerts a force when a magnet is placed in its vicinity. Similarly, a magnet also exerts equal and opposite force on the current carrying conductor. This was suggested by Marie Ampere, a French Physicist and considered 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.

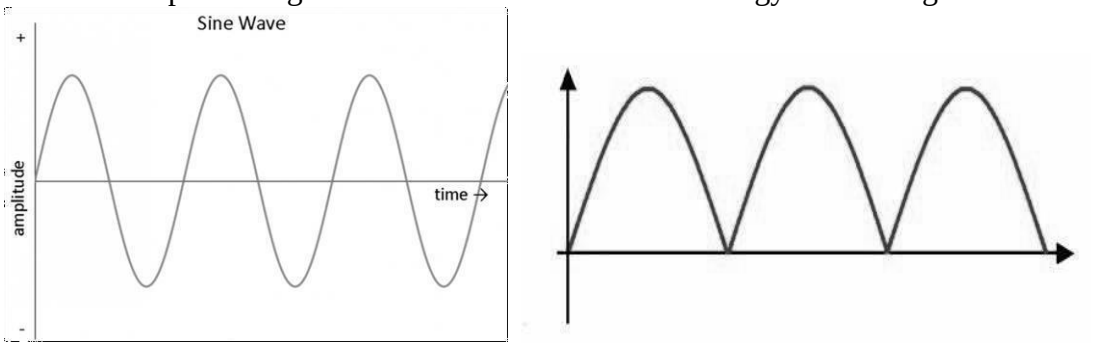
Fleming's Left-Hand Rule: If the direction of electric current is perpendicular to the magnetic field, the direction of force is also perpendicular to both of them. The Fleming's Left Hand Rule states that if the left hand is stretched in a way that the index finger, the middle finger and the thumb are 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.



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.



AC **DC**

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.
- AC can be transmitted over long distances without much loss of energy.

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.

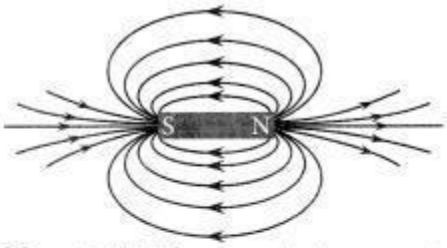
- Fuse is always connected to live wire.
- Fuse is always connected in series to the electric circuit.
- Fuse is always connected to the beginning of an electric circuit.
- Fuse works on the heating effect of current.

QUESTIONS ÏROM PREVIOUS BOARD EXAMS

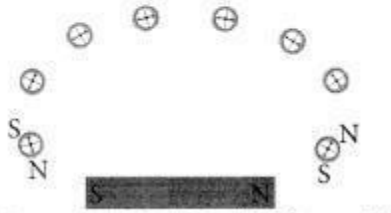
1. What is meant by magnetic field?
Answer: Magnetic field: It is defined as space surrounding the magnet in which magnetic force can be experienced.

2. Design an activity to demonstrate that a bar magnet has a magnetic field around it. (Board Term I, 2017)

Answer: One can easily demonstrate the presence of field lines around a bar magnet using compass needles. Place the magnet on a white sheet and mark its boundaries on sheet. Place the compass near the north pole of magnet and mark the position of needle. Now move the compass such that its south pole occupies the position previously occupied by its north pole. Repeat this step several times and you will have pattern as shown in the figure.



Magnetic field lines around a bar magnet

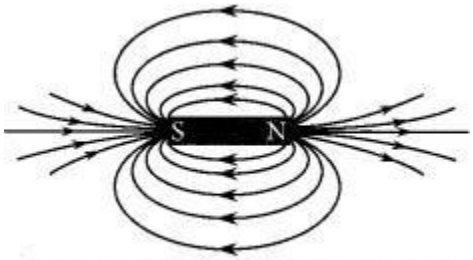


Drawing a magnetic field line with the help of a compass needle

Repeat the above procedure and draw as many lines as you can. These lines represent the magnetic field around the magnet. These are known as magnetic field lines.

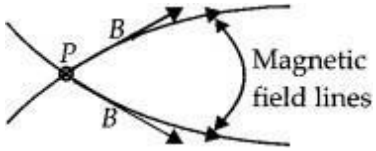
3. What are magnetic field lines? Justify the following statements:
(a) Two magnetic field lines never intersect each other.
(b) Magnetic field lines are closed curves. (Board Term I, 2016)

Answer: Imaginary continuous closed curves used to represent the magnetic field in a region is known as magnetic field lines. It is directed from north pole to south pole outside the magnet and south pole to north pole inside the magnet.



Magnetic field lines around a bar magnet

(a) The direction of magnetic field (B) at any point is obtained by drawing a tangent to the magnetic field line at that point. In case, two magnetic field lines intersect each other at the point P as shown in figure, magnetic field at P will have two directions, shown by two arrows, one drawn to each magnetic field line at P, which is not possible.



(b) It is taken by convention that the field lines emerges from north pole and merge at the south pole. Inside the magnet, the direction of field lines is from its south pole to its north pole. Thus, the magnetic field lines are closed curves.

4. What is meant by a magnetic field? Mention two parameters that are necessary to describe it completely.

Answer: It is defined as the space surrounding the magnet in which magnetic force can be experienced.

Necessary parameters are:

- Magnitude of magnetic field.
- Direction of field lines

5. A compass needle is placed near a current carrying straight conductor. State your observation forthe following cases and give reasons for the same in each case.

(a) Magnitude of electric current is increased.

(b) The compass needle is displaced away from the conductor. (AI 2019)

Answer :

(a) As the amount of magnetic field strength is directly proportional to the amount of current, so the deflection of compass needle increases.

(b) Since magnetic field strength at a point is inversely proportional to the distance from the wire. Hence deflection of compass decreases when it is displaced away from the conductor.

6. State how the magnetic field produced by a straight current carrying conductor at a point depends on

(a) current through the conductor

(b) distance of point from conductor. (Board Term I, 2014)

Answer: Strength of magnetic field produced by a straight current-carrying wire at a given point is

(a) directly proportional to the current passing through it.

(b) inversely proportional to the distance of that point from the wire.

$$\text{i.e., } B \propto \frac{I}{r}\begin{cases} B \rightarrow \text{magnetic field} \\ I \rightarrow \text{current} \\ r \rightarrow \text{distance between wire and point of observation} \end{cases}$$

7. Give reason for the following

(i) There is either a convergence or a divergence of magnetic field lines near the ends of a current carrying straight solenoid.

(ii) The current carrying solenoid when suspended freely rests along a particular direction. (2/3, 2020)

Answer:

(i) There is either a convergence or a divergence of magnetic field lines near the ends of a current carrying straight solenoid because it behaves similar to that of a bar magnet and has a magnetic field line pattern similar to that of a bar magnet. Thus the ends of the straight solenoid behaves like poles of the magnet, where the converging end is the south pole and the diverging end is the north pole.

(ii) The current carrying solenoid behaves similar to that of a bar magnet and when freely suspended aligns itself in the north-south direction.

8. Find the direction of magnetic field due to a current carrying circular coil held:

(i) vertically in North – South plane and an observer looking it from east sees the current to flow in anticlockwise direction,

(ii) vertically in East – West plane and an observer looking it from south sees the current to flow in anticlockwise direction,

(iii) horizontally and an observer looking at it from below sees current to flow in clockwise direction .(Board Term I, 2017)

Answer: According to right hand rule, the direction of magnetic field is

(i) west to east
(ii) north to south
(iii) into the paper.

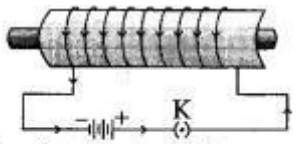
(a) State three factors on which the strength of magnetic field produced by a current carrying solenoid depends.
(b) raw circuit diagram of a solenoid to prepare an electromagnet. (Board Term I, 2016)

Answer

(a) Strength of magnetic field produced by a current carrying solenoid depends upon the following factors:

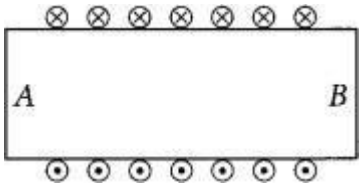
- number of turns in the coil
- amount of current flowing through it
- radius of coil
- Material of core of the solenoid.

(b) A strong magnetic field produced inside a solenoid can be used to magnetise a piece of magnetic material, like soft iron, when placed inside the coil. The magnet so formed is called an electromagnet.

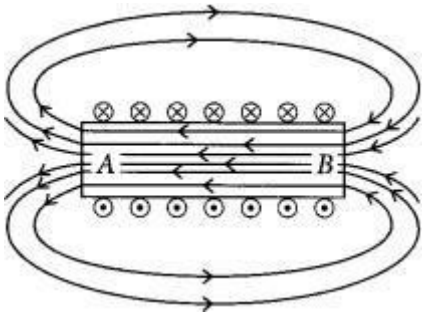


An electromagnet-A current-carrying solenoid coil which is used to magnetise steel rod inside it.

9. Diagram shows the lengthwise section of a current carrying solenoid. ⊗ indicates current entering into the page, ⊙ indicates current emerging out of the page. Decide which end of the solenoid A or B, will behave as north pole. Give reason for your answer. Also draw field lines inside the solenoid.



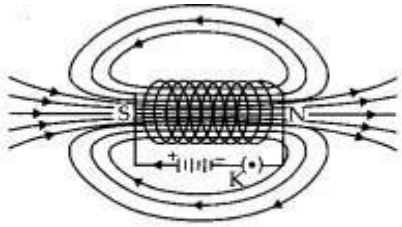
Answer: Using right hand thumb rube we can draw the magnetic field lines around the conductor as shown. From figure, end A of solenoid act as north pole and end B will act as south pole. Insidethe solenoid field lines are in the form of parallel straight lines.



10. Write one application of right-hand thumb rule. (1/3, Board Term I, 2013).
Answer: It is used to find the direction of magnetic field around a current carrying conductor.

11. Why don't two magnetic lines of force intersect each other?
Answer: No, two magnetic field lines never 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.

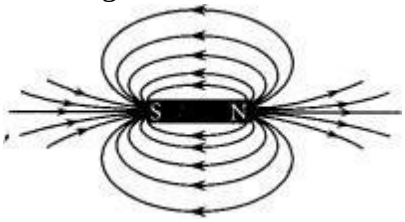
12. What is solenoid? Draw the pattern of magnetic field lines of
(i) a current carrying solenoid and
(ii) a bar magnet.
List two distinguishing features between the two fields. (Delhi 2019)
Answer:
(i) Solenoid: A coil of many circular turns of insulated copper wire wrapped in the shape of cylinder is called solenoid.



Field lines of the magnetic field through and around a current-carrying solenoid

The pattern of magnetic field lines inside the solenoid indicates that the magnetic field is the same at all points inside the solenoid. That is, the field is uniform inside the solenoid.

(ii) Magnetic field lines around a bar magnet.



Following are the distinguishing features between the two fields.
(a) A bar magnet is a permanent magnet whereas solenoid is an electromagnet, therefore field produced by solenoid is temporary and stay till current flows through it.
(b) Magnetic field produced by solenoid is stronger than magnetic field of a bar magnet.

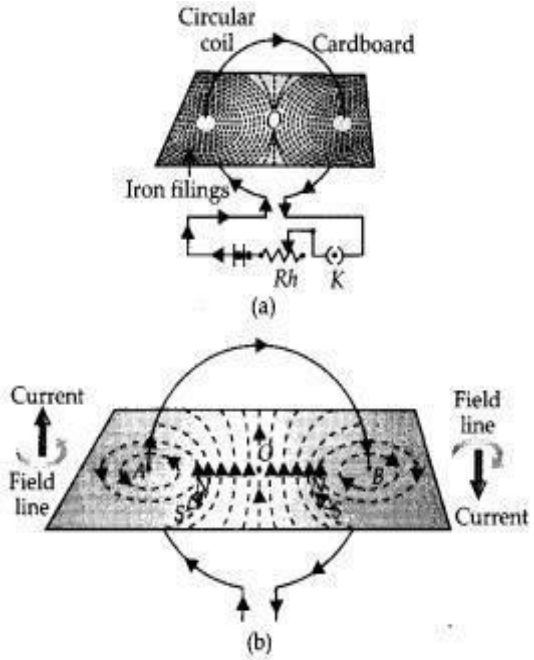
13. What are magnetic field lines? List three characteristics of these lines. Describe in brief an activity to study the magnetic field lines due to a current carrying circular oil. (Board Term I, 2017, 2016)
Answer: Magnetic field lines : These are the imaginary close curves which are used to represent the magnetic field around the magnet.
The properties of the magnetic field lines are listed below:

- Magnetic field lines start at the north pole and end at the south pole.
- Magnetic field lines do not intersect each other, because there can't be two directions of the magnetic field at any one point.
- The degree of closeness of the field lines depends upon the strength of the magnetic field. Stronger the field, closer are the field lines.

In order to find the magnetic field due to a coil, it is held in a vertical plane and is made to pass through a smooth cardboard in such a way that the centre (O) of the coil lies at the cardboard. A

current is passed through the coil and iron filings are sprinkled on the cardboard. These iron filings arrange themselves in a pattern similar to one shown in the figure. This pattern represents the magnetic field lines due to the coil.

In order to find the direction of magnetic field lines, we plot the magnetic field with the help of a compass needle. The pattern of magnetic field lines so obtained is shown in figure (b). From this pattern, the following important conclusion have been drawn.

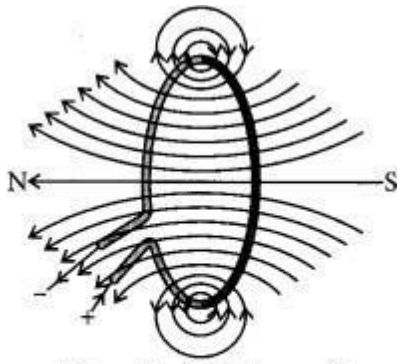


- The magnetic field lines near the coil are nearly circular and concentric. This is due to the reason that the segments of the coil in contact with the board at the points A and B are almost like straight conductors. The direction of the field lines can also be found by applying right-hand thumb rule.
- The field lines are in the same direction in the space enclosed by the coil.
- Near the center of the coil, the field lines are nearly straight and parallel. As such the magnetic field at the center of the coil can be taken to be uniform.
- The direction of the magnetic field at the center is perpendicular to the plane of the coil.
- As we move towards the center of the coil, the strength of magnetic field increases. Magnetic field is maximum at its center. This is due to the reason that the two magnetic field (one due to the semicircular segment of the coil through A and the other due to the semicircular segment through B) assist each other.

The magnitude of the magnetic field at the center of the coil is directly proportional to the current flowing through it and total number of turns and inversely proportional to the radius of the coil. This is due to the reason that the current in all the circular turns of the coil is in the same direction. As such, the resultant magnetic field due to the coil is equal to the sum of the field due to all these turns.

14. Draw the magnetic field lines through and around a single loop of wire carrying electric current. (Board Term I, 2016)

Answer:



Magnetic field lines of the field produced by a current-carrying circular loop.

15. State the use of magnetic field produced inside a solenoid. (Board Term I, 2015)

Answer: Solenoid is used to form strong but temporary magnet called electromagnets. These electromagnets are used in wide variety of instruments and used to lift heavy iron, objects.

16. State the effect of a magnetic field on the path of a moving charged particle. (Board Term I, 2014)

Answer

A charged particle moving in a magnetic field may experience a force in the direction perpendicular to direction of magnetic field and direction of motion of particle. This force deflects the charged particle from its path.

17. State the direction of magnetic field in the following case.

Answer: Using Fleming's left-hand rule, the direction of magnetic field is out of the plane of paper.

18. Write one application of Flemings left hand rule. (Board Term I, 2013)

Answer: Flemings left hand rule is used to find the direction of force on a current carrying conductor placed in a magnetic field acting perpendicular to the direction of current.

19. A current carrying conductor is placed in a magnetic field. Now answer the following.

(i) List the factors on which the magnitude of force experienced by conductor depends.

(ii) When is the magnitude of this force maximum?

(iii) State the rule which helps, in finding the direction of motion of conductor.

(iv) If initially this force was acting from right to left, how will the direction of force change if:

(a) direction of magnetic field is reversed?

(b) direction of current is reversed? (Board Term I, 2017)

Answer:

(i) When a current carrying wire is placed in a magnetic field, it experiences a magnetic force that depends on

(a) current flowing in the conductor

(b) strength of magnetic field

(c) length of the conductor

(d) angle between the element of length and the magnetic field.

(ii) Force experienced by a current carrying conductor placed in a magnetic field is largest when the direction of current is perpendicular to the direction of magnetic field.

(iii) The rule used in finding the direction of motion of the conductor placed in a magnetic field is Flemings left hand rule.

Fleming's left-hand rule is as follows:

Stretch out the thumb, the forefinger, and the second (middle) finger of the left hand so that these are at right angles to each other. If the forefinger gives the direction of the magnetic field (N to S), the second (middle) finger the direction of current then the thumb gives the direction of the force acting on the conductor.

(iv) (a) Direction of force will be reversed when direction of magnetic field is reversed, i.e., now force on conductor will act from left to right.

(b) Direction of force will be reversed, if the direction of current is reversed, i.e., the force on the conductor will act from left to right.

20. State whether an alpha particle will experience any force in a magnetic field if (alpha particles are positively charged particles)

(i) it is placed in the field at rest.

(ii) it moves in the magnetic field parallel to field lines.

(iii) it moves in the magnetic field perpendicular to field lines. Justify your answer in each case. (Board Term I, 2016)

Answer:

(i) No, alpha particle will not experience any force if it is at rest, because only moving charge particle can experience force when placed in a magnetic field.

(ii) No, alpha particle will not experience any force if it moves in the magnetic field parallel to field lines because charge particle experiences force only when it moves at an angle other than 0° with magnetic field.

(iii) Alpha particle will experience a force in the direction perpendicular to the direction of magnetic field and direction of motion of alpha particle.

21. Write the frequency of alternating current (AC) in India. How many times per second it changes its direction? (Board Term I, 2015)

Answer: The frequency of A.C. in India is 50 Hz and it changes direction twice in each cycle. Therefore, it changes direction $2 \times 50 = 100$ times in one second.

22. How is the type of current that we receive in domestic circuit different from the one that runs a clock? (Board Term I, 2014)

Answer: The current that we receive from domestic circuit is alternating current (A.C.) and the current that issuse to run clock is direct current (D.C.). Direct current always flow in one direction whereas the alternating current reverses its direction periodically.

23. Define alternating current and direct current.

Explain why alternating current is preferred over direct current for transmission over long distances.

(Board Term I, 2014)

Answer: Alternating current (A.C.): An electric current whose magnitude changes with time and direction reverses periodically is called alternating current.

Direct current (D.C.): An electric current whose magnitude is either constant or variable but the direction of flow in a conductor remains the same is called direct current.

A.C. can be transmitted to distant places without much loss of electric power than D.C. That is why A.C. is preferred over D.C. for transmission of current over a long distance.

24. At the time of short circuit, the electric current in the circuit.

(a) vary continuously (b) does not change

(c) reduces substantially

(d) increases heavily. (2020)

Answer:

(d) At the time of short circuit, the live and neutral wire come in direct contact, thus increasing the current in the circuit abruptly.

25. Mention and explain the function of an earth wire. Why it is necessary to earth metallic appliances? (Board Term I, 2013)

Answer: Many electric appliances of daily use like electric press, heater, toaster, refrigerator, table fan etc. have a metallic body. If the insulation of any of these appliances melts and makes contact with the metallic casing, the person touching it is likely to receive a severe electric shock. This is due to the reason that the metallic casing will be at the same potential as the applied one. Obviously, the electric current will flow through the body of the person who touches the appliance. To avoid such serious accidents, the metal casing of the electric appliance is earthed. Since the earth does not offer any resistance, the current flows to the earth through the earth wire instead of flowing through the body of the person.

26. Give reason for the following:

The burnt-out fuse should be replaced by another fuse of identical rating (2020)

Answer: A burnt out fuse should be replaced with identical rating because it helps in protecting the circuit from overloading and short circuiting. If a fuse of higher rating is used then it may not melt and cut off the supply during overloading. Similarly, a fuse of lower rating may melt frequently even fora normal flow of current. This results in decreasing the efficiency of the circuit.

27. Give reasons for the following:

(a) It is dangerous to touch the live wire of the main supply rather than neutral wire.

(b) In household circuit, parallel combination of resistances is used.

(c) Using fuse in a household electric circuit is important. (Board Term I, 2017)

Answer:

(a) Live wire is at 220V and neutral wire is at zero volt since the electric current flows from higher potential to lower potential, we can get an electric shock by touching live wire but that is not the case with neutral wire.

(b) In parallel combination, each resistor gets same potential from the source. We can use separate on/off switches with each appliance. Also, in case if any one resistor fails then the circuit will not break. So, it is safe and convenient to connect household circuit in parallel combination of resistors

(c) Fuse is an important safety device. It is used in series with any electrical appliance and protects it from short-circuiting and overloading.

28.

(a) Fuse acts like a watchman in an electric circuit. Justify this statement.

(b) Mention the usual current rating of the fuse wire in the line to

(i) lights and fans (ii) appliance of 2 kW or more power. (Board Term I, 2014)

Answer:

(a) When an unduly high electric current flows through the circuit, the fuse wire melts due to joule heating effect and breaks the circuit. Hence, it keeps an eye on the amount of current flowing and also stops the current if exceeds the maximum value. So, fuse acts like a watchman in an electric circuit.

(b) (i) A fuse of rating 5A is usually used for lights and fans.

(ii) A fuse of rating 15 A is usually used for appliance of 2 kW or more power.

29.

(a) Name two safety measures commonly used in an electric circuit and appliances.

(b) What precaution should be taken to avoid the overloading of domestic electric circuits? (Board Term I, 2017)

Answer:

(a) Fuse and the connection of earthing wire are the two safety measure commonly used in electric circuit and appliances.

(b) Provide fuses/MCBs of proper rating.

30.

(a) Draw a schematic diagram of a common domestic circuit showing provision of

(i) Earth wire, (ii) Main fuse

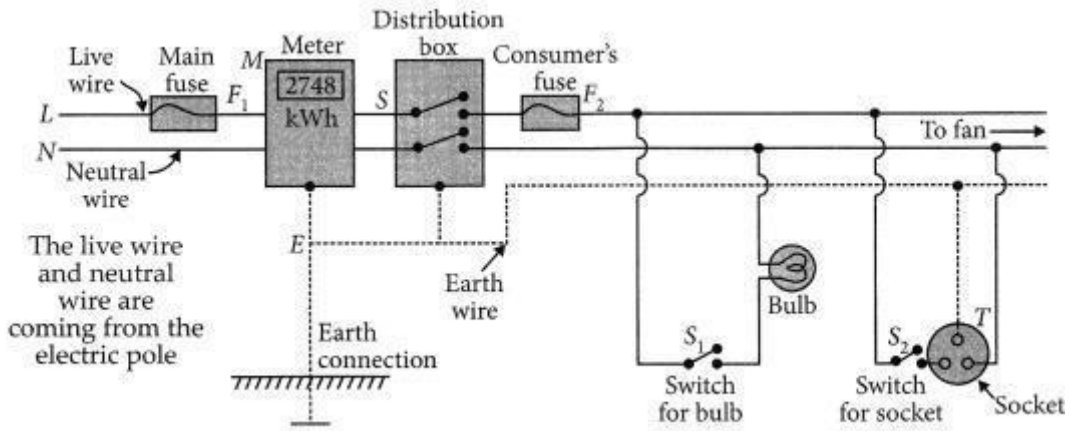
(iii) Electricity meter and

(iv) Distribution box.

(b) Distinguish between short circuiting and overloading. (Board Term I, 2015)

Answer:

(a)



Domestic electric wiring from electric pole to a room

(b) **Overloading :** The condition in which a high current flows through the circuit and at the same time too many appliances are switched on then the total current drawn through the circuit may exceed its rated value.

Short circuiting: The condition when the live wire comes in direct contact with the neutral wire, due to which a high current flow in the circuit.

CHAPTER- 13

OUR ENVRONMENT

Content- Eco-system, Environmental problems, Ozone depletion, wastes production and their solutions, Biodegradable and non-biodegradable substances.

ECOSYSTEM

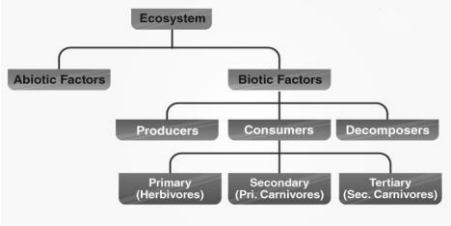
An ecosystem is a system consisting of biotic and abiotic components that function together as a unit.

- Biotic components- all the living things like plant animal etc.
- 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, aquarium.

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 -T3), Tertiary consumers (Sec carnivores -T4), Decomposers

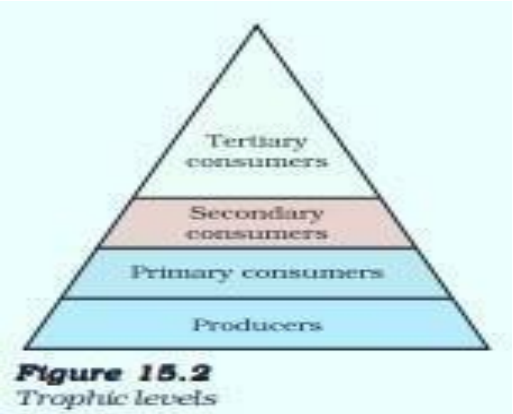


Figure 15.2
Trophic levels

Significance of Food Chains

- The food chain transfer energy from one trophic level to another.
- 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.
- Only 1% solar energy is used by plants.

FOOD WEB

It is inter-connected food chains in an ecosystem.

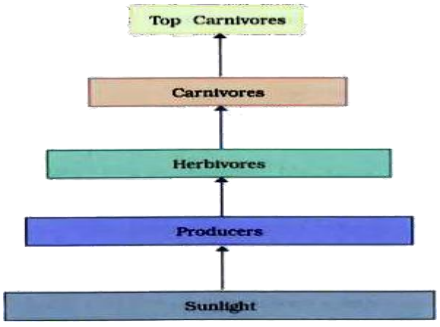
It forms a network of relationship between various species.

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—

$$O_2 \xrightarrow{UV} O+O$$

$$O+O \longrightarrow O_3 \text{ (Ozone)}$$

- 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 WASTE

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.

MAINTAINING THE GARBAGE, WE PRODUCE

- Change in attitudes toward using only biodegradable items.
- Proper disposal of wastes
- Follow Sewage treatment norms
- 3 _R's 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. Ans:

(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?

Ans: 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.

Ans: Decomposers 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, N_2O, 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 plastic release harmful chemicals in soil. Jute bags and cloth bags are the alternatives to the polyethene bags.

(b) Practices to dispose of the waste produced in our homes:

(i) Separation of biodegradable and non- biodegradable wastes.

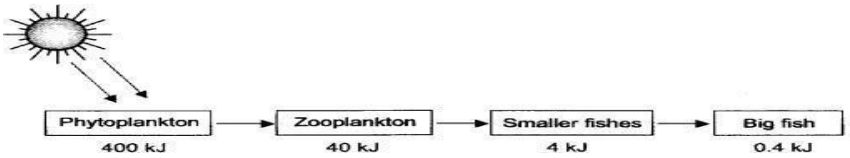
(ii) The biodegradable waste can be converted to manure.

(iii) Non-biodegradable waste should be disposed of 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.