CHAPTER-WISE PREVIOUS YEARS' QUESTIONS

SCIENCE

HINTS & SOLUTIONS

Class X (CBSE)

CHEMISTRY

Chapter - 1 : Chemical Reactions and Equations

1. $3Fe(s) + 4H_2O(l) \longrightarrow Fe_3O_4(s) + 4H_2(g)$ **[1]**

2. Respiration is the process in which during digestion, the food is broken down to form glucose. Glucose then combines with oxygen in the cells of our body to provide energy. Since energy is released during respiration, so it is considered an exothermic process. **[1]**

3. $2Pb(NO_3)_2(s) \xrightarrow{\text{Heat}} 2PbO(s) + 4NO_2(g) + O_2(g)$ **[1]**

4. Hydrochloric acid (HCl) may be used as the reducing agent to obtain manganese from manganese dioxide. **[1]**

5. When iron nails are dipped in copper sulphate solution for about 30 minutes, iron nails become brownish in colour and the colour of copper sulphate solution changes from blue to light green.

$$\underset{\text{Iron (Grey)}}{Fe(s)} + \underset{\text{Copper sulphate (Blue)}}{CuSO_4(aq)} \longrightarrow \underset{\text{Iron sulphate (Light green)}}{FeSO_4(aq)} + \underset{\text{Copper (Brown)}}{Cu(s)}$$ **[1]**

6. $\underset{\text{(Lead nitrate)}}{2Pb(NO_3)_2(s)} \xrightarrow{\text{Heat}} \underset{\text{(Lead oxide)}}{2PbO(s)} + \underset{\text{(Nitrogen dioxide)}}{4NO_2(g)} + \underset{\text{(Oxygen)}}{O_2(g)}$ **[1]**

Activity:

On heating 2 g of lead nitrate powder in a boiling tube, emission of brown fumes of nitrogen dioxide (NO_2) is observed. **[1]**

7. (i) Ferrous sulphate crystals are light green in colour. On heating, the green colour of the crystals changes to white because of loss of water of crystallisation on heating. **[1]**

   (ii) On strongly heating ferrous sulphate crystals, ferric oxide, sulphur dioxide and sulphur trioxide are formed.

   $2FeSO_4(s) \xrightarrow{\text{Heat}} Fe_2O_3(s) + SO_2(g) + SO_3(g)$ **[½]**

   This is a decomposition reaction. **[½]**

8. When an aqueous solution of sodium sulphate reacts with an aqueous solution of barium chloride, barium sulphate precipitates out along with the formation of solution of sodium chloride. **[1]**

   If the reactants are in solid state, then reaction will not take place between sodium sulphate and barium chloride. **[½]**

   $\underset{\text{Sodium sulphate}}{Na_2SO_4(aq)} + \underset{\text{Barium chloride}}{BaCl_2(aq)} \longrightarrow \underset{\text{Barium sulphate}}{BaSO_4(s)} + \underset{\text{Sodium chloride}}{2NaCl(aq)}$ **[½]**

9. (i) A is manganese dioxide (MnO_2) and B is aluminium powder (Al). **[1]**

   Chemical equation :

   $\underset{A}{3MnO_2(s)} + \underset{B}{4Al(s)} \xrightarrow{\text{Heat}} \underset{D}{2Al_2O_3(s)} + \underset{C}{3Mn(l)} + \text{Heat}$ **[½]**

   Thermal status of the reaction : The reaction is highly exothermic reaction and a lot of heat is evolved. **[½]**

   (ii) The above chemical reaction can be classified as

   (a) Displacement reaction

   (b) Exothermic reaction

   (c) Redox reaction **[Any two] [½ × 2 = 1]**

10. (a) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$ **[1]**

    (b) $2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$ **[1]**

    (c) $2H_2O(l) \xrightarrow[\text{decomposition}]{\text{Electrolytic}} 2H_2(g) + O_2(g)$ **[1]**

11. **Observation** : White silver chloride turns grey in sunlight due to the decomposition of silver chloride into silver and chlorine. **[1]**

    Chemical reaction :

    $\underset{\text{Silver chloride}}{2AgCl(s)} \xrightarrow{\text{Sunlight}} \underset{\text{Silver}}{2Ag(s)} + \underset{\text{Chlorine}}{Cl_2(g)}$ **[1]**

    Type of chemical reaction – Decomposition reaction. **[1]**

12. (i) $\underset{\text{Zinc}}{Zn(s)} + \underset{\text{Silver nitrate}}{2AgNO_3(aq)} \longrightarrow \underset{\text{Zinc nitrate}}{Zn(NO_3)_2(aq)} + \underset{\text{Silver}}{2Ag(s)}$ **[1]**

    Type of reaction – Displacement reaction **[½]**

    (ii) $\underset{\text{Potassium iodide}}{2KI(aq)} + \underset{\text{Lead nitrate}}{Pb(NO_3)_2(aq)} \longrightarrow \underset{\substack{\text{Lead iodide}\\\text{(Yellow ppt.)}}}{PbI_2(s)} + \underset{\text{Potassium Nitrate}}{2KNO_3(aq)}$ **[1]**

    Type of reaction – Double displacement reaction **[½]**

Chapter - 2 : Acids, Bases and Salts

1. The flow of acid rain water into a river make the survival of aquatic life in the river difficult by lowering the pH of river water. **[1]**

2. When fresh milk changes to curd, its pH value decreases because of the formation of lactic acid. **[1]**

3. Answer (d)

   It smells like vinegar and turns blue litmus red **[1]**

4. Answer (d)

   A clear colourless solution **[1]**

5. Answer (d)

   I, II and IV **[1]**

6. Answer (a)

   The acetic acid dissolves readily in water. **[1]**

7. Washing soda : $Na_2CO_3.10H_2O$ **[½]**

   Baking soda is heated to obtain washing soda

   $2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2$ **[½]**

   $Na_2CO_3 + 10H_2O \longrightarrow \underset{\text{(Washing soda)}}{Na_2CO_3.10H_2O}$ **[½]**

   Uses: **[½]**

   (a) It is used for removing permanent hardness of water.

   (b) It is used in manufacturing of sodium compounds such as borax.

   (c) It is used in the manufacture of glass, soap and paper. [Write any one use]

8. The compound is Plaster of Paris *i.e* calcium sulphate hemihydrate ($CaSO_4.½H_2O$)

   $\underset{\substack{\text{Calcium sulphate}\\ \text{dihydrate}\\ \text{(Gypsum)}}}{CaSO_4 \cdot 2H_2O} \xrightarrow[373\,K]{\Delta} \underset{\substack{\text{Calcium sulphate}\\ \text{hemihydrate}\\ \text{(Plaster of Paris)}}}{CaSO_4 \cdot \frac{1}{2}H_2O} + \underset{\text{Water}}{\frac{3}{2}H_2O}$ **[1]**

   Use in hospital :

   It is used as plaster for supporting fractured bones in the right position. **[1]**

9. The colour change will be observed in test tube A only. **[1]**

   The colour of blue litmus solution becomes red as acid turns blue litmus red. **[1]**

10. When 2 mL of dilute HCl is added to 1 g of sodium carbonate, CO_2 is evolved with brisk effervescence along with the formation of water and sodium chloride salt. **[1]**

    $\underset{\substack{\text{Sodium}\\ \text{carbonate}}}{Na_2CO_3(s)} + \underset{\substack{\text{Hydrochloric}\\ \text{acid}}}{2HCl(aq)} \longrightarrow \underset{\substack{\text{Sodium}\\ \text{chloride}}}{2NaCl(aq)} + \underset{\text{Water}}{H_2O(l)} + \underset{\substack{\text{Carbon}\\ \text{dioxide}}}{CO_2(g)}$ **[1]**

11. The equation of chemical reaction involved is

    $2NaOH(aq) + Zn(s) \longrightarrow \underset{\substack{\text{Sodium}\\ \text{zincate}}}{Na_2ZnO_2(s)} + H_2(g)$ **[1]**

    Test to detect the gas :

    Hydrogen gas is evolved whose presence can be confirmed by bringing a burning candle near the mouth of the test tube. Hydrogen gas burns with pop sound. **[1]**

    When the same metal reacts with dilute solution of a strong acid, hydrogen gas is evolved.

    $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$ **[1]**

12. The salt is baking soda ($NaHCO_3$.) **[1]**

    Baking soda is prepared by reacting cold and concentrated solution of sodium chloride with ammonia and carbon dioxide.

    $\underset{\substack{\text{Sodium}\\ \text{chloride}}}{NaCl} + \underset{\text{Water}}{H_2O} + \underset{\substack{\text{Carbon}\\ \text{dioxide}}}{CO_2} + \underset{\text{Ammonia}}{NH_3} \longrightarrow \underset{\substack{\text{Ammonium}\\ \text{chloride}}}{NH_4Cl} + \underset{\substack{\text{Sodium hydrogen}\\ \text{carbonate}}}{NaHCO_3}$

    [1]

    Uses :

    (a) Sodium hydrogencarbonate is also used as an antacid to remove acidity. **[½]**

    (b) It is also used in soda-acid fire extinguishers.

    [½]

13. The acid and the base from which sodium chloride is obtained are HCl and NaOH respectively. **[½ + ½]**

    It is a neutral salt as pH of its aqueous solution is 7. **[½]**

    Sodium chloride is also found in nature in solid form (large crystals). These large crystals are often brown due to impurities. This is called as rock salt. **[1]**

    Beds of rock salt were formed when seas of bygone ages dried up. **[½]**

Chapter - 3 : Metals and Non-metals

1. Answer (a)

   Aluminium is more reactive than zinc as it can displace zinc from its solution. **[1]**

2. Answer (b)

   The blue coloured copper sulphate solution changes to light green iron sulphate solution due to the displacement of copper by iron from copper sulphate solution. **[1]**

3. Answer (d)

   Copper sulphate solution is blue coloured and iron sulphate solution is pale green. **[1]**

4. Answer (d)

   $$\underset{(X)}{Fe(s) + CuSO_4(aq)} \longrightarrow \underset{\text{Greenish}}{FeSO_4(aq)} + Cu(s)$$

   $$\underset{(Y)}{Zn(s) + FeSO_4(aq)} \longrightarrow \underset{\text{Colourless}}{ZnSO_4(aq)} + Fe(s)$$ **[1]**

5. (a) Those metal oxides which show both basic as well as acidic behavior are called amphoteric oxides. **[1]**

   ZnO, Al_2O_3 **[1]**

   (b) Non-metals cannot lose electrons to H^+ to form H_2 gas because non-metals are electron-acceptors. So, they do not react with dilute acids. **[1]**

6. Corrosion of iron to a brown flaky substance in the presence of moist air is called rusting. **[½]**

   Activity to find out the conditions under which iron rusts:

   (i) Take three test tubes and place some clean iron nails in each of them.

   (ii) Label these test tubes as A, B and C.

   (iii) Pour some water in test tube A and cork it.

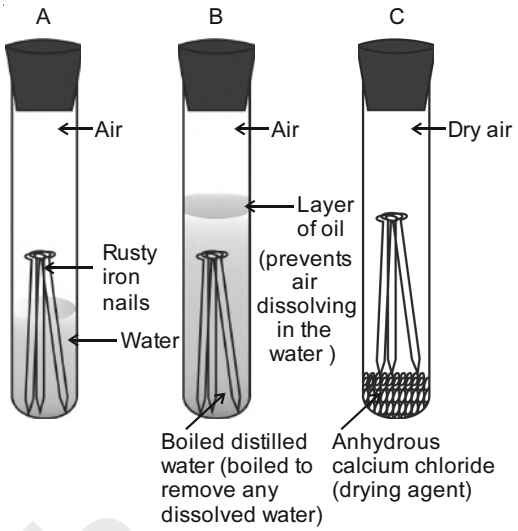
   (iv) Pour boiled distilled water in test tube B, add about 1 mL of oil and cork it. The oil will float on water and prevent air from dissolving in water.

   (v) Put some anhydrous calcium chloride in test tube C and cork it.

   Anhydrous calcium chloride will absorb the moisture, if any, from the air.

   (vi) Leave the three test tubes for a few days. **[1]**

   Observation : After a few days the iron nails in test tube A rusts. In test tubes B and C, no rusting occurs.



[1]

Conclusion : Both air and moisture are necessary for rusting of iron. **[½]**

7. Atomic number of X = 20

   Electronic configuration = 2, 8, 8, 2 **[1]**

   Atomic number of Y = 17

   Electronic configuration = 2, 8, 7 **[1]**

   Molecular formula of the compound formed = XY_2.

   Electron-dot structure of the compound: **[1]**

   $$:\ddot{\underset{\cdot\cdot}{Y}}:^{-}\ X^{+2}\ :\ddot{\underset{\cdot\cdot}{Y}}:^{-}$$

   An ionic bond is formed between the two elements.

8. Name and symbols of the two most reactive metals belonging to group I of the periodic table:

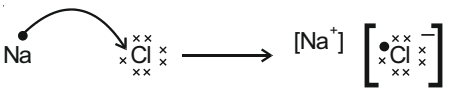
S. No.	Name of metal	Symbol of metal
1.	Sodium	Na
2.	Potassium	K

[1]

Formation of sodium chloride :

$$\underset{2,8,1}{Na} \longrightarrow \underset{\substack{2,8\\ \text{Sodium cation}}}{Na^+} + e^-$$

$$\underset{2,8,7}{Cl^- + e^-} \longrightarrow \underset{\substack{2,8,8\\ \text{Chloride anion}}}{Cl^-}$$



[1]

Sodium and chloride ions, being oppositely charged are held by strong electrostatic forces of attraction to exist as NaCl.

Bond formed between sodium and chloride ion is ionic bond.

The class of compounds formed by the transfer of electrons from a metal to a non-metal are known as ionic compounds or electrovalent compounds. **[1]**

Physical properties of ionic or electrovalent compounds:

(i) Ionic compounds are generally solids and are somewhat hard. **[½]**

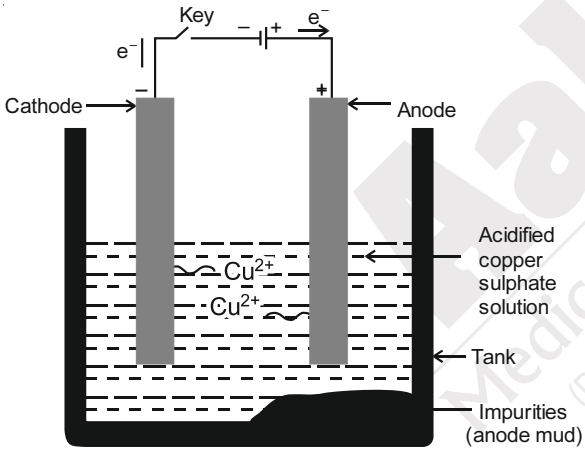
(ii) Ionic compounds have high melting and boiling points. **[½]**

(iii) Ionic compounds are generally soluble in water and insoluble in organic solvents such as kerosene, petrol, etc. **[½]**

(iv) Ionic compounds conduct electricity in aqueous solution and in molten state. They do not conduct electricity in solid state. **[½]**

9. The process of obtaining pure metal from its impure form is called refining of metals. The most widely used method for refining impure metals is electrolytic refining. **[1]**

Electrolytic refining of copper:



[2]

In electrolytic refining of copper, electrolyte is a solution of acidified copper sulphate. The anode is made up of impure copper whereas cathode is made up of a strip of pure copper metal. **[1]**

On passing current through the electrolyte, pure copper metal from the anode dissolves into the electrolyte *i.e.*, acidified copper sulphate and an equivalent amount of pure metal from the electrolyte is deposited on the cathode. **[1]**

The soluble impurities go into the solution, whereas, the insoluble impurities settle down at the bottom of the anode and are known as anode mud.

10. (i) Lezt us consider the extraction of Zn metal from its carbonate ore.

Steps involved are

(a) The ore $ZnCO_3$ is first concentrated by gravity separation method. **[½]**

(b) The ore is calcinated (heated in the absence of air) to convert in to zinc oxide.

$$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2 \uparrow$$ **[½]**

(c) The zinc oxide is reduced by coke to zinc. **[½]**

$ZnO + C \rightarrow Zn + CO$

(d) The impure Zn thus obtained can be purified by electrolysis. **[½]**

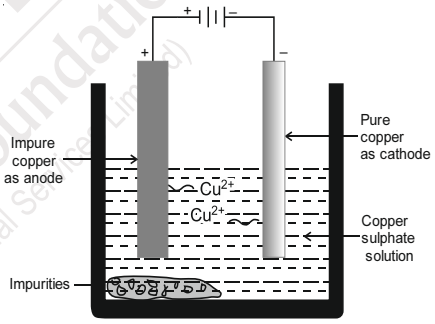
(ii) (a) Copper from its sulphide ore can be extracted simply by heating in air.

The steps involved are

1. $2Cu_2S + 3O_2(g) \xrightarrow{\Delta} 2Cu_2O + 2SO_2$ **[½]**

2. $2Cu_2O + 2Cu_2S \xrightarrow{\Delta} 6Cu(s) + SO_2(g)$ **[½]**

(b) **[2]**



Experimental set up for the electrolytic refining of copper

11. (i)

	Metal	Non-metal	
(a)	Metal oxides are generally basic in nature.	Non-metallic oxides are generally acidic in nature.	**[1]**
(b)	Metals generally react with water to produce hydrogen gas.	Non-metals generally do not react with water or steam.	**[1]**
(c)	Metals are electropositive elements.	Non-metals are electronegative elements.	**[1]**

(ii) (a) Due to the presence of free electrons, most of the metals conduct electricity well. **[1]**

(b) When iron (III) oxide (Fe_2O_3) reacts with heated aluminium, the amount of heat evolved is so large that the metal produced is in molten state and thus used to join cracked machine parts. **[1]**

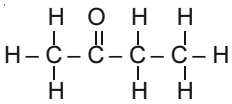
Chapter - 4 : Carbons and its Compounds

1. Two characteristic features of carbon which give rise to a large number of carbon compounds are :

   (a) **Catenation :** Carbon has the unique ability to form bonds with other atoms of carbon giving rise to a large number of molecules *i.e.*, carbon has a tendency to catenate.

   (b) **Tetravalency :** Since carbon has a valency of four, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent element. **[1]**

2. Structure of butanone, $CH_3COC_2H_5$



[1]

3. Answer (c)

   Sodium bicarbonate reacts with acetic acid to release carbon dioxide gas which does not support combustion and hence extinguisher the splinter. **[1]**

4. Ansewr (b)

   Acetic acid reacts with solid sodium hydrogen carbonate vigorously and effervescence is produced due to evolution of CO_2 gas. **[1]**

5. Answer (a)

   Vapours of acetic acid smell pungent like vinegar. **[1]**

6. Answer (c)

   Na_2CO_3 reacts with acetic acid to evolve carbon dioxide gas. **[1]**

7. Answer (b)

   Hard water contains Ca^{2+} and Mg^{2+} ions. Thus the salts which can be added to water to make it hard are calcium sulphate, calcium chloride and magnesium chloride *i.e.*, salts 1, 3 and 6. **[1]**

8. Answwer (d)

   The correct observation are (IV), (I) and (II) **[1]**

9. Answer (B)

   Ethanoic acid is readily soluble in water. **[1]**

10. Answer (C)

    Sodium hydroxide is present in the form of white flakes or pellets. **[1]**

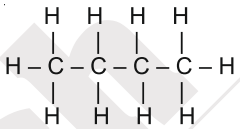
11. Answer (C)

    The reaction is endothermic and the reaction mixture is basic in nature.

    Saponification is defined as the hydrolysis of an ester under basic conditions leading to the formation of sodium salt of fatty acids. It is an endothermic reaction *i.e.*, it absorbs surrounding heat. **[1]**

12. Answer (A) **[1]**

13. There are thirteen covalent bonds ; ten C-H and three C-C bonds, present in a molecule of butane.



[1]

14. Answer (D)

    The purpose of adding common salt is to favour the precipitation of the soap. During saponification, the soap formed remains in a suspended form in the mixture. It is precipitated as a solid from the suspension by the addition of common salt to it. This process is known as salting out of soap. **[1]**

15. Answer (A)

    In test tubes P and Q, lather (foam) is formed by the reaction of soap solution with sodium sulphate and potassium sulphate respectively. They are dissolved in water to give a neutral solution. Sulphates, chlorides and bicarbonates of calcium and magnesium make the water hard. Thus, lather is not formed in the test tubes R and S. **[1]**

16. Carbon dioxide gas gets liberated. When a pinch of sodium hydrogen carbonate is added to acetic acid in a test tube, a brisk effervescence is produced because of the liberation of carbon dioxide gas. When this gas is passed through the lime water, it turns lime water milky.

    This test confirms that the gas liberated is CO_2. The chemical reaction can be represented as

    $CH_3COOH\ (aq) + NaHCO_3(s) \rightarrow CH_3COONa\ (aq) + H_2O(l) + CO_2(g)$

    [1]

17. 1-Butanal

$$CH_3 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - H$$ **[1]**

18. The molecular formula of the 2nd and 3rd members of a homologous series where the first member is ethyne (C_2H_2) is formed by adding -CH_2 group.

2nd member of alkyne series is Propyne (C_3H_4)
$CH_3 - C \equiv CH$

3rd member of alkyne series is Butyne (C_4H_6)
$CH_3 - CH_2 - C \equiv CH$ **[1]**

19. Answer (D)

Hard water can be prepared by dissolving sulphates, chlorides or bicarbonate salts of calcium or magnesium. **[1]**

20. Due to the presence of double and triple bonds in alkenes and alkynes respectively, the addition of hydrogen is possible in them.

The general formula of alkenes is C_nH_{2n} and that of alkynes is C_nH_{2n-2}. Conditions for addition reactions are

- Presence of an unsaturated compound, i.e. an unsaturated hydrocarbon.
- Presence of a species to be added to an unsaturated compound.
- Presence of a catalyst such as finely divided palladium or nickel.

$$\underset{\text{Ethene}}{CH_2 = CH_2} + H_2 \xrightarrow{Ni} \underset{\text{Ethane}}{CH_3 - CH_3}$$ **[2]**

21. Two main observations about the reaction are :

(a) Brisk effervescence of carbon dioxide which turns lime water milky.

(b) It is a neutralisation reaction and heat is released.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$ **[2]**

22. The chemicals required to prepare soap in the lab are : vegetable oil, common salt and 20% sodium hydroxide solution.

On dipping red litmus paper in the reaction mixture, it turns blue. Hence, the reaction mixture of the saponification reaction is basic in nature. **[2]**

23. Compound 'X' on heating with excess conc. sulphuric acid at 443 gives unsaturated compound.

$$\underset{\substack{\text{'X'}\\(\text{Alcohol})}}{CH_3 - CH_2 - OH} + H_2SO_4(\text{conc.}) \xrightarrow{443\ K} \underset{\substack{\text{'Y'}\\(\text{Alkene})}}{CH_2 = CH_2} + H_2O$$

$$\underset{(\text{Alcohol})}{CH_3 - CH_2 - OH} + Na \longrightarrow CH_3 - CH_2 - ONa + \underset{\text{'Z'}}{H_2}$$

Concentrated H_2SO_4 acts as a dehydrating agent

$X \rightarrow C_2H_5OH$

$Y \rightarrow C_2H_2$

$Z \rightarrow H_2$ **[2]**

24. In test tube A the length of the foam (lather) will be longest.

Reason : Soap produces good lather (or foam) with soft water (distilled water) only.

Both test tubes B and C contain hard water and soap forms scum in hard water. **[2]**

25. (i) Covalent compounds do not provide charged particles in aqueous solutions and hence they do not conduct electricity. **[1]**

(ii) Propanone/acetone **[1]**

(iii) CO_2 gas is obtained when ethanoic acid reacts with sodium carbonate. Presence of the gas can be tested by passing the gas through lime water. Carbon dioxide gas turns lime water milky. **[1]**

26. (i) Carbon forms a large number of compounds due to its unique ability to catenate and its tetravalency. **[1]**

(ii) If fuel in the gas burner does not burn completely, then incomplete combustion occurs resulting in production of a sooty flame and hence the vessels get blackened from the bottom. So, the air holes of a gas burner have to be adjusted, for sufficient supply of air for complete combustion. **[1]**

(iii) Use of synthetic detergents causes pollution because they are non-biodegradable in nature. **[1]**

27. The functional groups of organic compounds that can be hydrogenated are alkenes and alkynes.

$$\underset{\text{Ethene}}{H_2C = CH_2} \xrightarrow[\substack{\text{Nickel}\\\text{Catalyst}}]{H_2} \underset{\text{Ethane}}{CH_3 - CH_3}$$

Unsaturated hydrocarbons undergo addition reactions with hydrogen in the presence of catalysts such as palladium or nickel to give saturated hydrocarbons. During this reaction, unsaturated compounds like vegetable oils which are in liquid state are converted to animal fats in solid state. Vegetable oil is an example of natural source of organic compound that are hydrogenated. **[3]**

28. (i) $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{at 443K}]{\text{Conc.}H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O$

[1]

(ii) $\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{\text{Acid}} CH_3COOCH_2CH_3 + H_2O$

[1]

(iii) $CH_3COOCH_2CH_3 + NaOH \longrightarrow CH_3COONa + CH_3CH_2OH$

[1]

29. (i) $CH_4 + O_2 \longrightarrow CO_2 + H_2O$ + Heat and light

[1]

(ii) $C_2H_5OH \xrightarrow[H_2SO_4]{\text{Hot Conc.}} CH_2 = CH_2 + H_2O$ **[1]**

(iii) $NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$

[1]

30. Alkaline potassium permanganate ($KMnO_4$) or acidified potassium dichromate ($K_2Cr_2O_7$) can be used as oxidising agents for conversion of ethanol to ethanoic acid.

(i) Litmus test: Ethanoic acid turns blue litmus solution red whereas ethanol being neutral in nature has no effect on litmus solution. **[1]**

(ii) Reaction with sodium carbonate: Ethanoic acid reacts with sodium carbonate to form sodium ethanoate and carbon dioxide gas and water.

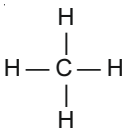
$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$ **[1]**

Ethanol does not react with sodium carbonate.

$CH_3CH_2OH + Na_2CO_3 \longrightarrow$ No reaction **[1]**

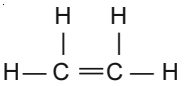
31. (i) **Alkanes:** Hydrocarbons in which the carbon atoms are joined by single covalent bonds are called alkanes. They have general formula C_nH_{2n+2}, where n is the number of carbon atoms. Suffix, –ane is used while naming alkanes.

Methane



Alkenes: Hydrocarbons in which the carbon atoms are joined by a double bond are called Alkenes. They have general formula C_nH_{2n}, where n is the number of carbon atoms. Suffix, -ene is used while naming alkenes.

Ethene



(ii) Alkanes generally burn with clean flame because in them, the percentage of carbon is comparatively low as compared to other unsaturated hydrocarbons. Hence they get oxidised completely by the oxygen present in air. **[3]**

32. Ethanoic acid reacts with ethanol in the presence of concentrated sulphuric acid as a catalyst to produce the ester, ethyl ethanoate. The reaction is slow and reversible.

$CH_3CH_2OH \xrightarrow{\text{alk.}KMnO_4} CH_3COOH$

$\underset{\text{Ethanoic acid}}{CH_3 - COOH} + \underset{\text{Ethyl alcohol}}{CH_3 - CH_2 - OH} \overset{H_2SO_4}{\rightleftharpoons}$

$\underset{\text{Ethyl ethanoate 'X'}}{CH - C - O - CH_2CH_3} + \underset{\text{Water}}{H_2O}$

(i) CH_3–COOH :- Ethanoic acid **[1]**

(ii) CH_3 –CH_2 –OH: - Ethyl alcohol or Ethanol

[1]

(iii) Compound

$X = CH_3 - C - O - CH_2CH_3$: Ethyl ethanoate

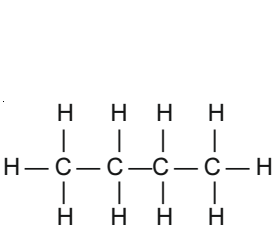
[1]

33. **Structural isomerism :** Molecules which have same molecular formula but different structures are called structural isomers. **[1]**

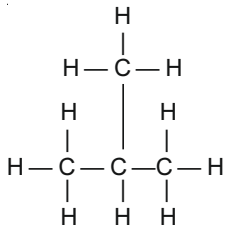
Propane is represented as CH_3–CH_2–CH_3. In alkanes, isomerism arises when a particular compound can be represented in the form of both straight chain and branched chain. **[1]**

The structural formula of propane shows that it does not have sufficient number of carbon atoms to exist in the form of branched isomer. Hence, they it does not exhibit structural isomerism.

Isomers of Butane: There are two isomers. n-Butane and iso-Butane



n-Butane



iso-Butane **[1]**

34. By performing the following tests carboxylic acids can be distinguished from an alcohol.

(a) Test with $NaHCO_3$ solution in water.

When a carboxylic acid reacts with baking soda, carbon dioxide is liberated with a brisk effervescence.

No brisk effervescence is observed when a solution of baking soda is added to alcohol.

[1½]

(b) Test with blue litmus solution.

Carboxylic acid turns blue litmus red. There is no change in colour when a blue litmus solution is added to alcohol. **[1½]**

35. Three different chemical reactions showing the conversion of ethanoic acid to sodium ethanoate:

$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$ **[1]**

$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$ **[1]**

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$ **[1]**

36.

Esterification	Saponification
1. The reaction of carboxylic acid with alcohol in the presence of a little conc. sulphuric acid to form esters, is called esterification.	1. The reaction of an ester with a base such as NaOH, to be converted back to alcohol and sodium salt of carboxylic acid is called saponification reaction. **[1]**
2. Example: Ethanoic acid reacts with ethanol in the presence of a little conc. sulphuric acid to form esters. $C_2H_5OH + CH_3COOH \underset{\text{Conc. } H_2SO_4}{\rightleftharpoons} CH_3COOC_2H_5 + H_2O$	2. Example: Ethyl ethanoate on reaction with sodium hydroxide gives ethanol and sodium ethanoate. **[1]** $CH_3COOC_2H_5 + NaOH \downarrow C_2H_5OH + CH_3COONa$

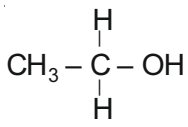
(i) Use of esters:

Esters are used in synthetic flavours, perfumes, cosmetics etc. **[½]**

(ii) Use of saponification reaction:

It is used in the preparation of soaps on a commercial basis. **[½]**

37. Solution: Structural formula of ethanol:



[1]

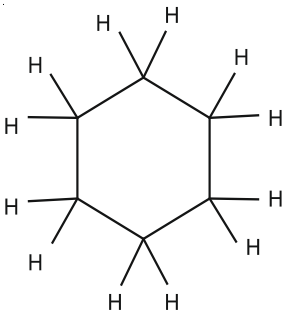
When ethanol is heated with conc. sulphuric acid at 443 K (443 K – 273 = 170 °C) it gives ethene.

$CH_3CH_2OH \xrightarrow[170°C]{\text{Conc.}H_2SO_4} CH_2 = CH_2 + H_2O$ **[1]**

The role of conc. H_2SO_4 in the above reaction is that it is used as a dehydrating agent and causes dehydration of ethanol. **[1]**

38. (i) In carbon compounds the electrons are shared, between atoms and no charged particles are formed. Therefore, they are generally poor conductors of electricity.

(ii)



Name - Cyclohexane
Single bond - 18

[3]

39. (i) Two properties of carbon which lead to a very large number of carbon compounds are :

(a) **Tetravalency:** Carbon has valency 4. Hence, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent element.

(b) **Catenation:** Carbon has the unique ability to form bonds with other atoms of carbon to form long chains, hence giving rise to large molecules.

(ii) A soap molecule has two parts –one hydrophobic part and the other hydrophilic part. When soap is added to water, the hydrophobic part arranges itself towards the dirt and the hydrophilic end arranges itself towards the water. Therefore is micelle is formed.

Micelle formation does not take place when soap is added to ethanol because the hydrophobic part of soap molecules is soluble in ethanol. **[5]**

40. Compounds with same molecular formula but different structures are called isomers. This phenomenon is called isomerism.

Four characteristics of isomers:

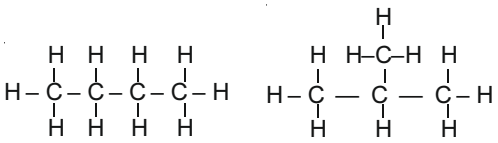
(a) Isomers have different physical properties.

(b) Isomers may have same or different chemical properties.

(c) All isomers have the same number of atoms.

(d) Isomers have different structural arrangements.

Isomers of butane, C_4H_{10}.



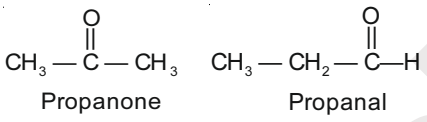
n-Butane 2-Methylpropane **[5]**

41. **[5]**

	Ethanol	Ethanoic acid
Physical properties	1. It exists only in liquid form. 2. It belongs to the family of alcohols. 3. It has a specific smell but not like vinegar.	It can exist both in liquid as well as solid form. It belongs to the family of carboxylic acids. It smells like vinegar.
Chemical properties	1. Reaction with sodium bicarbonate: No salt formation occurs and carbon dioxide gas is also not evolved. 2. It does not give litmus test i.e., no change in the colour of litmus solution..	Reaction with sodium bicar-bonate: It will react with sodium bicarbonate to form a salt and carbon dioxide gas will be released. It turns blue litmus red.

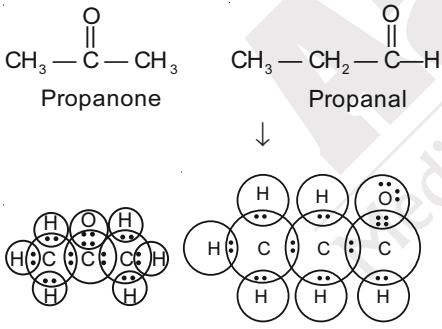
42. (i) Isomers are those compounds which have same molecular formula but different structural formula.

(ii) Two possible isomers of the compound with molecular formula C_3H_6O are :



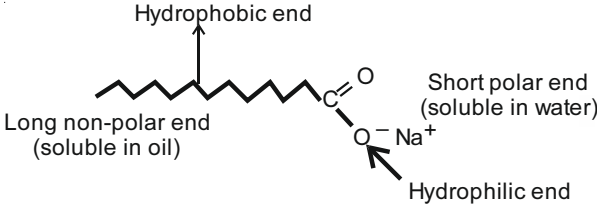
Propanone Propanal

(iii) Electron dot structure



Propanone Propanal **[5]**

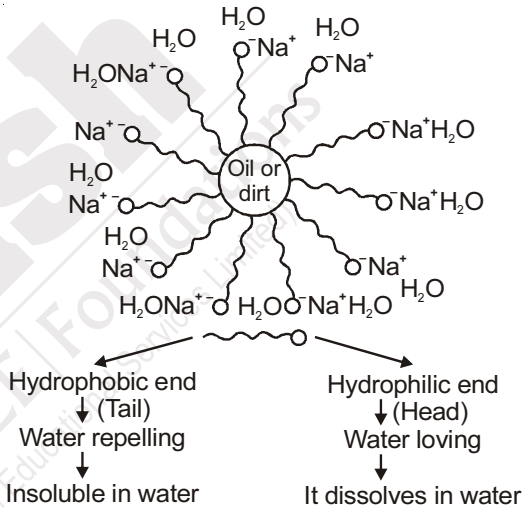
43. Difference between soap and detergent: The molecules of soap are sodium or potassium salts of long-chain carboxylic acids. Detergents are generally sodium salts of sulphonic acids or ammonium salts with chloride or bromide ions etc. Both have long hydrocarbon chain.



Cleansing action of soap can be described as follows:

The long hydrocarbon part of soaps is water repelling (hydrophobic) and is called tail. The ionic part (COO^-, in soap) is water attracting (hydrophilic) and is called head. When soap is dissolved in water, molecules combine to form micelles. The tails are towards the centre and heads are outside in contact with water molecules. Hydrocarbon tails dissolve the grease or dirt and detach them from fabric. Thus, an emulsion of oil (dirt or grease) and fat in water is formed and clothes are cleaned.

Micelles



"A micelle is a spherical cluster of hundreds of molecules of soap in their solution in water".

Soap in the form of a micelle is able to clean the cloth, since the oily dirt will be collected in the centre of the micelle.

Soaps do not form lather in hard water because hard water contains calcium and magnesium salts. Soap molecules react with calcium and magnesium salts to form an insoluble precipitate called scum. Two problems arise because of the use of detergents instead of soap :

(a) Soaps are biodegradable, while detergents are non-biodegradable; hence, detergents accumulate in the environment and cause environmental problems.

(b) Certain phosphate additives are added to detergents. These phosphate additives act as nutrients for algae which form a thick green scum over the river water and upset the animal life in the river. **[5]**

44. $P \xrightarrow{\text{Excess } H_2SO_4} Q \xrightarrow[\text{catalyst}]{H_2/Ni} R \xrightarrow{O_2} 2CO_2 + 3H_2O$

$P \xrightarrow{\text{Excess } H_2SO_4} Q$

$\underset{\text{'P'}}{CH_3CH_2OH} \xrightarrow{\text{Excess } H_2SO_4} \underset{\text{'Q'}}{CH_2 = CH_2}$

$Q \xrightarrow{H_2/Ni \text{ catalyst}} R$

$\underset{\text{'Q'}}{CH_2 = CH_2} \xrightarrow{H_2/Ni \text{ catalyst}} \underset{\text{'R'}}{CH_3 - CH_3}$

$R \xrightarrow{O_2} 2CO_2 + 3H_2O$

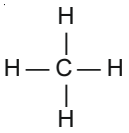
$\underset{\text{'R'}}{CH_3 - CH_3} \xrightarrow{O_2} 2CO_2 + 3H_2O$

$\underset{\substack{P\\\text{Ethanol}}}{CH_3CH_2OH} \xrightarrow{\text{Excess } H_2SO_4} \underset{\substack{Q\\\text{Ethene}}}{CH_2 = CH_2} \xrightarrow[\text{catalyst}]{H_2/Ni}$

$\underset{\substack{R\\\text{Ethane}}}{CH_3 - CH_3} \xrightarrow{O_2} 2CO_2 + 3H_2O$ **[5]**

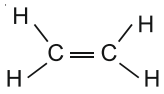
45. Certain compounds contain only carbon and hydrogen. So, such organic compounds are called hydrocarbons.

General formula for the homologous series of alkanes = C_nH_{2n+2}



First member of the alkane family is methane.

General formula for the homologous series of alkenes = C_nH_{2n}



First member of the alkene family is ethene.

General formula for the homologous series of alkynes = C_nH_{2n-2}

First member of the alkyne family is ethyne.

Catalytic hydrogenation is the reaction used to convert unsaturated compounds to saturated compounds.

$CH_2 = CH_2 + H_2 \xrightarrow[300°C]{\text{Nickel}} C_2H_6$ **[5]**

46. Chemical formula of the compound = C_2H_5OH

Name of the compound = Ethanol

Uses of ethanol :

(a) It is used as a solvent in tincture of iodine.

(b) It is used as a solvent in cough syrups.

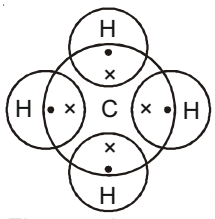
(i) $\underset{\text{Ethanol}}{2C_2H_5OH} + \underset{\text{Sodium}}{2Na} \longrightarrow \underset{\substack{\text{Sodium}\\\text{ethoxide}}}{2C_2H_5ONa} + \underset{\text{Hydrogen}}{H_2}$

Name of the products formed = Sodium ethoxide and hydrogen

(ii) $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\,K]{\text{Hot conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + \underset{\text{Water}}{H_2O}$

Name of the products formed = Ethene and water. **[5]**

47. Methane is a compound of carbon with chemical formula CH_4.



Electron dot structure of methane

Covalent bonds are formed in this compound.

(i) In covalently bonded molecules, the electrons are shared between atoms and no charged particles are formed. Therefore, such compounds are generally poor conductors of electricity.

(ii) Covalently bonded molecules are seen to have strong bonds within the molecule, but have weak inter-molecular forces. This gives rise to low melting and boiling points of these compounds.

When methane burns in oxygen, CO_2, H_2O and a large amount of heat and light is released. **[5]**

Chapter - 5 : Periodic Classification of Elements

1. There are 7 horizontal rows in the Modern Periodic Table. They are called periods. **[1]**

2. The elements are,

   A-(atomic number 12) = Magnesium

   B-(atomic number 18) = Argon

   C-(atomic number 20) = Calcium

   Element calcium and magnesium will show similar properties as they belong to same group (Group II) of the Modern Periodic Table. They have same number of valence electrons and they both are metals while argon is a noble gas. **[1]**

3. (i) Group - 14

   Period - 3

   (ii) Element with electronic configuration 2, 8, 4 is silicon.

   It is a metalloid as it exhibits properties of both metals and non-metals. **[1]**

4. Metallic character decreases from left to right along the period of the Modern Periodic Table because on moving from left to right, size of the atoms decreases and nuclear charge increases. Therefore, the tendency to release electrons decreases. Thus, the electropositive character decreases. **[2]**

5. Electronic configuration of Ca is : 2, 8, 8, 2

   The physical and chemical properties of elements with atomic number 12 and 38 will resemble to those of calcium. **[1]**

   This is because they all belong to the second group and all of them have two electrons in their respective valence shells. **[1]**

6. (i) The electronic configuration of M is 2, 8, 2 **[½]**

   (ii) M belongs to the 2nd group **[½]**

   (iii) M is a metal **[½]**

   (iv) MO **[½]**

7. Valency of an element is determined by the number of electrons in its outer most shell. Hence the number of valence electrons obtained from the electronic configuration of the element gives the valency i.e., the number of electrons lost, gained or shared by the element to attain a noble gas electronic configuration. **[1]**

   The valency of an element of atomic number 9 would be 1 since the number of electrons in its outer most shell is 7 so it needs only one electron to attain the noble gas configuration. **[1]**

8. Electronic configuration is the distribution of electrons in the shells of an atom. Elements, when arranged in order of increasing atomic number (number of electrons or protons), lead us to the classification known as the Modern Periodic Table. **[1]**

   The groups in the Periodic Table signify an identical outer-shell electronic configuration whereas the period indicates the number of shells in which electrons are filled. **[1]**

9. (i)

Element	Group	Period
A	1	3^{rd}
B	2	3^{rd}
C	13	3^{rd}
D	14	3^{rd}
E	15	3^{rd}
F	16	3^{rd}
G	17	3^{rd}
H	18	3^{rd}

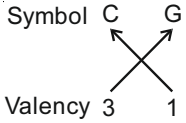
[1]

   (ii) Nature of the compound formed by combination of element B and F is ionic. **[½]**

   (iii) Elements A and B. **[½]**

   (iv) Element H belonging to group 18 is most likely to be found in gaseous state at room temperature. **[½]**

   (v) Formula of the compound formed by combination of C and G is CG_3.



[½]

10. Atomic number = 16

Electronic configuration = 2, 8, 6

(i) Number of valence electrons = 6 **[½]**

(ii) Valency = 2 **[½]**

(iii) Group number =16 **[½]**

(iv) It is a non-metal **[½]**

(v) It forms acidic oxide **[½]**

(vi) XCl_2 **[½]**

11. (i) Br has the largest atomic radius among all because it uses the largest number of electron energy levels since the valence electrons are placed in larger orbitals. **[1½]**

(ii) Fluorine is the most reactive since it has the greatest tendency to gain electrons because it has a higher effective nuclear charge and less number of energy levels than Br and Cl. **[1½]**

12. (i) $_{19}K$ has one electron in the outermost shell and its electronic configuration is 2, 8, 8, 1. **[1]**

(ii) $_4Be$ and $_{20}Ca$ belongs to same group i.e., Group 2.

Electronic configuration:

$_4Be$ – 2, 2

$_{20}Ca$ – 2, 8, 8, 2

$_4Be$ and $_{20}Ca$ have same number of electrons in their outermost shell. **[1]**

(iii) $_9F$ and $_4Be$ belongs to the same period i.e., period 2.

Electronic configuration:

$_9F$ - 2, 7

$_4Be$ - 2, 2

$_4Be$ has a bigger atomic size than $_9F$ because the atomic radius decreases as we move from left to right in the period due to increase in nuclear charge which tends to pull the electrons closer to the nucleus and hence size of atom reduces. **[1]**

13. (i) Atomic number of X = 17

Electronic configuration of X : 2, 8, 7

Number of electrons in outermost shell = 7

So, group number = 17

Number of shells = 3

So, period number = 3

Atomic number of Y = 20

Electronic configuration of Y: 2, 8, 8, 2 **[1]**

Number of electrons in outermost shell = 2

So, group number = 2

Number of shells = 4

So, period number = 4

(ii) X has 7 valence electrons so, it needs 1 electron to complete its octet and Y has 2 valence electrons so, it can donate its 2 electrons to acquire the octet configuration. Hence, X will gain 1 electron and Y will lose 2 electrons, so the chemical reaction is: **[1]**

$X_2 + Y \rightarrow YX_2$

X = Cl (Atomic Number = 17) and

Y = Ca (Atomic number = 20)

So, $Cl_2 + Ca \rightarrow CaCl_2$ **[1]**

14.

Group / Period	1	2	3-12	13	14	15	16	17	18
2	A (Li)					B (N)			C (Ne)
3				D (Al)	E (Si)				F (Ar)

(i) Element E is silicon which forms only covalent compounds. **[½]**

(ii) Aluminium is a metal with the valency 3. **[½]**

(iii) Nitrogen is a non-metal with the valency 3. **[½]**

(iv) Out of D (aluminium) and E (silicon), aluminium has a larger size than silicon. This is because atomic size decreases across the period. **[1]**

(v) Common name for the family to which the elements C (neon) and F (argon) belong is 'noble gas' or 'inert gas'. **[½]**

15. (i) Elements Be, Mg and Ca belong to Group II. **[1]**

(ii) Beryllium (Be) is the least reactive element. This is because, as we move down the group, number of shells increases and the effective nuclear charge decreases. So, the tendency to lose electrons increases. **[1]**

(iii) Calcium has the largest atomic radius. Since, number of shells increases down the group so, atomic radius also increases. **[1]**

16. (i) Element D (19) has one electron in its outermost shell.

Its electronic configuration is 2, 8, 8, 1. **[1]**

(ii) Elements A (4) and E (20) both have two electrons in their outermost shells.

Electronic configuration of A: 2, 2

Electronic configuration of E: 2, 8, 8, 2

Since they both have a valency of two, they belong to group 2 of the Modern Periodic Table. **[1]**

(iii) Elements A (4) and B (9) belong to the second period, and elements D (19) and E (20) belong to the fourth period of the periodic table.

Since the effective nuclear charge increases from left to right in the period, so the atomic radii of the elements decreases.

A (4) has a bigger atomic radius than B (9) and D (19) has a bigger atomic radius than E (20). **[1]**

17. Atomic number of the element = 16

Electronic configuration of the element = 2, 8, 6

The period number is equal to the number of shells which starts filling up in it.

The atom of an element has three shells. So, the period number is 3. **[1]**

The atom of an element has six valence electrons in the outermost shell.

Therefore, the group number of the element will be 16 (6 + 10). **[1]**

The valency of an element is determined by the number of valence electrons present in the outermost shell.

The atom of an element has six valence electrons in the outermost shell, so the valency of the element is 2. **[1]**

18. (i) Electronic configuration of Ca (20): 2, 8, 8, 2 **[½]**

(ii) Rb belongs to Group 1 and all Group 1 elements have one valence electron. **[½]**

(iii) Sr belongs to period 5, and so, it has five shells. **[½]**

(iv) K is a metal with electronic configuration 2, 8, 8, 1. So, it will donate its one electron to acquire the noble gas configuration. **[½]**

(v) The atomic size increases down the group and decreases across a period. So, Rb is the element which has the largest atomic size. **[½]**

(vi) The order is Be < Mg < Ca < Rb **[½]**

19. Period number of element X = 3

Group number of element X = 13

Atomic number of element X = 13

Electronic configuration of element X = 2, 8, 3

(i) Number of valence electrons of X = 3 and valency = 3 **[1]**

(ii) Atomic number of element Y = 8

Electronic configuration of element Y = 2, 6

Valency of element Y = 2

Molecular formula of the compound formed when element 'X' reacts with an element 'Y' is X_2Y_3. **[1]**

(iii) Atomic number of Cl = 17

Electronic configuration of Cl = 2, 8, 7

Valency of Cl = 1

Molecular formula of the compound formed when 'X' reacts with an element 'Cl' is XCl_3. **[1]**

20. Mass number of X = 35

Number of neutrons = 18

Number of protons = Atomic number

= Mass number – Number of neutrons

= 35 – 18 = 17 **[1]**

Electronic configuration of X = 2, 8, 7

Group number of X = 17 **[1]**

Period number of X = 3

Valency of X = 1. **[1]**

21. Properties which appear at regular intervals or in which there is gradual variation at regular intervals are called periodic properties, and the phenomenon is known as the periodicity in properties of elements. **[1]**

Elements in the same group or column in the Modern Periodic Table have the same number of electrons in their outermost shell. Hence, elements of the same group have similar properties. **[1]**

On moving across a period from left to right in the Modern Periodic Table, the tendency to gain electrons increases. This is due to an increase in the nuclear pull and a decrease in atomic size. **[1]**

22. (i) Suppose first group elements be denoted by P

Symbol	P	O
Valency	1	2

Formula of oxide of P = P_2O **[1]**

(ii) Suppose elements of group thirteen be denoted by Q and halogens be denoted by X.

Symbol	Q	X
Valency	3	1

[1]

Formula of halide of Q = QX_3

(iii)

Element	A	B
Valency	2	1

Formula of compound formed when an element, A of group 2 combines with an element, B of group seventeen = AB_2 **[1]**

23. (i) (a) Sodium **[½]**

(b) Fluorine **[½]**

(ii) (a) N_2O_5 **[½]**

(b) H_2O **[½]**

(iii) In group VIII of the Periodic Table, cobalt appears before nickel so that elements with similar chemical properties may fall in the same group. **[1]**

(iv) Scandium (Sc) and Germanium (Ge) **[1]**

(v) Atomic mass of lithium = 7

Atomic mass of potassium = 39

So, average of atomic mass = (7 + 39)/2 = 23

Atomic mass of sodium = 23 i.e., both are same hence we can conclude that atomic mass of the middle element is the average of the other two elements. **[1]**

24. (i) We classify elements to systematize their study and make the understanding of properties of elements and compounds simpler. **[1]**

(ii) Criteria used by Mendeleev:

(a) Atomic mass

(b) Properties of hydrides and oxides of elements. **[1]**

(iii) Mendeleev left some gaps in his Periodic Table to leave scope of search for the undiscovered elements. **[1]**

(iv) In Mendeleev's Periodic Table, there was no mention of noble gases since they had not been discovered by that time. **[1]**

(v) The two isotopes of chlorine, Cl-35 and Cl-37 will be placed in the same slot because their chemical properties are same.

[1]

25. (i) Increasing atomic mass and similarity in chemical properties of elements were the two criteria used by Mendeleev to classify the elements. He took the formulae of the oxides and hydrides formed by the elements as the basis for classification of elements. **[1]**

(ii) Mendeleev's periodic law states that "the physical and chemical properties of elements are the periodic function of their atomic masses". **[1]**

(iii) Hydrogen resembles alkali metals in its electronic configuration and halogens as it also exists as a diatomic molecule and combines with metals and non- metals to form covalent compounds hence it could not be assigned a fixed position in Mendeleev's periodic table. **[1]**

(iv) (a) Atomic size decreases from left to right in the periodic table due to increase in nuclear charge. **[1]**

(b) Atomic size increases down the group because new shells are being added as we go down the group. **[1]**

26. (i) Mendeleev left some blank spaces or gaps in the periodic table. He also predicted their properties and named them by prefixing eka to the name of the preceding element in the same group. **[½]**

(ii) **Limitation of Mendeleev's Periodic Table**

(a) Anomalous pairs of elements : Co → 58.9 (atomic weight) was placed before Ni → 58.7 (atomic weight). **[½]**

(b) Position of elements of group VIII : No fixed position was allotted to them in this periodic table. **[½]**

(c) Position of isotopes : Mendeleev classified the elements according to atomic masses so all the isotopes of an element should be given different position but it was not so in Mendeleev's Periodic Table.

Isotopes of hydrogen i.e., $^{1}_{1}H$ (Protium) $^{2}_{1}H$ (Deuterium) $^{3}_{1}H$ (Tritium) **[½]**

(d) Placement of similar elements at different position and dissimilar elements at same position Alkali metals were kept together with coinage metals (Cu, Ag and Au) but similar elements were pH at different position. **[½]**

(e) Anomalous position of hydrogen : No specific position was given to hydrogen in this periodic table. **[½]**

(iii) Each successive period in the Modern Periodic Table is associated with filling up of next shell or energy level. In a period it involves filling of electrons in same shell but increases by 1 in each case. **[1]**

Eg. for second period :

	K	L
$_3Li$ =	2	1
$_4Be$ =	2	2
$_5B$ =	2	3
$_6C$ =	2	4

[1]

27. (i) Dobereiner triad :

Advantage : The three elements of a triad were found to possess similar properties. **[½]**

Limitation : He classified only nine elements. **[½]**

Newland's octave :

Advantage : Elements known at that time were arranged in the increasing order of their atomic weights, the properties of every eighth element were similar to those of the first one. **[½]**

Limitation : This classification did not include elements beyond atomic weight 40 (calcium) **[½]**

Mendeleev :

Advantage : He classified elements discovered till then and left gaps for the elements to be discovered in future. **[½]**

Limitation : Position of rare earths was not clear. They were placed in group III A. **[½]**

(ii) Henry Moseley **[1]**

(iii) The Modern Periodic Law can be stated as "the physical and chemical properties of the elements are the periodic functions of their atomic numbers." **[1]**

Chapter - 6 : Life Processes

1. CO_2 is obtained from the environment and N_2 is obtained from the soil and environment. **[1]**

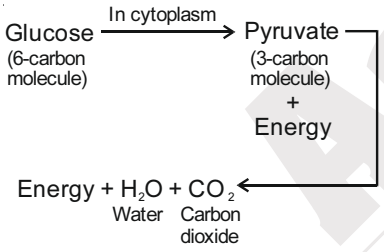
2. Xylem tissue conducts water and minerals from the soil to different parts of the plant. If the xylem tissue is removed, then the transport of water and mineral will not take place and the plant will die. **[1]**

3. The green dot-like structures are chloroplasts. This green colour is due to the presence of chlorophyll. **[1]**

4. (a) Blood vessels: Transport of blood.
   (b) Blood platelets: Clotting of blood.
   (c) Lymph: Carries digested fats.
   (d) Heart: Helps to circulate blood in the whole body by acting as a pump. **[4×½]**

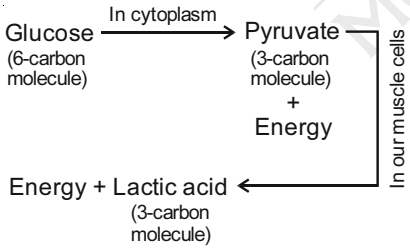
5. Following are the two different ways in which glucose is oxidized to provide energy in human body:

   (i) In presence of oxygen:



[1]

   (ii) In lack of oxygen:



[1]

6. The substance taken in the small test tube kept in the conical flask is KOH (potassium hydroxide) solution. **[1]**

   The CO_2 produced by germinating seeds is absorbed by KOH solution due to which the air from the bent tube moves into the conical flask, which eventually pulls the water up in the bent glass tube. **[1]**

7. (i) Respiratory pigment haemoglobin takes up O_2 from the air in the lungs and carries it to tissues. **[1]**

   (ii) CO_2 is being transported from various tissues into the alveoli by blood and is released during exhalation. **[1]**

   Within the lungs, the trachea divides into smaller and smaller tubes which finally terminate in balloon like structures called alveoli. These alveoli increase the surface area for the exchange of gases. **[1]**

8. The three types of blood vessels are:
   (a) Artery
   (b) Vein
   (c) Capillary **[3×½]**

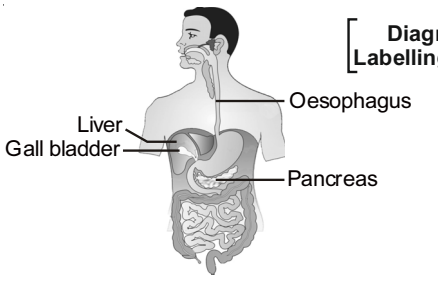
   Features:

   (a) Arteries are the vessels which carry blood away from the heart to various organs of the body. Since the blood emerges from the heart under high pressure, the arteries have thick, elastic walls. **[½]**

   (b) Veins collect the blood from different organs and bring it back to the heart. They do not need thick walls because the blood is no longer under pressure, instead they have valves that ensure that the blood flows only in one direction. **[½]**

   (c) Capillaries are the smallest vessels which have walls and are one-cell thick. Exchange of material between the blood and surrounding cells takes place across this thin wall. **[½]**

9. (a)



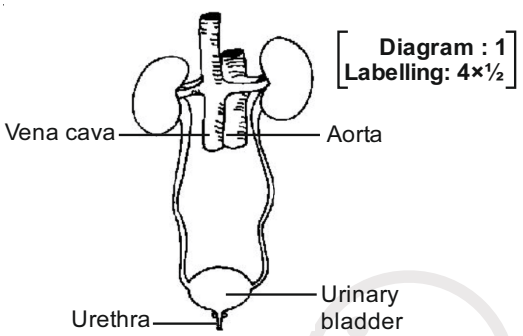
[Diagram : 1 Labelling: 4×½]

(b) Bile does not contain any enzyme, but it plays an important role in digestion because:

(i) The bile salts emulsify fat by acting on large fat globules to break them into smaller globules. This increases the efficiency of pancreatic enzymes. **[1]**

(ii) The food entering the small intestine is acidic. It is made alkaline by the action of bile juice so as to facilitate the action of pancreatic enzymes. **[1]**

10. (a)



[Diagram : 1 Labelling: 4×½]

(b) The two vital functions of kidney are:

(i) It filters out the nitrogenous wastes from the blood and forms urine. **[1]**

(ii) It also regulates the water balance and levels of mineral ions in the body. **[1]**

11. (i) Mouth : In mouth, large food pieces are crushed with the help of our teeth and mixed with saliva secreted by the salivary glands, using the tongue. Salivary amylase, the enzyme present in saliva, breaks down starch to give sugar. **[1]**

(ii) Stomach : The muscular walls of the stomach help in mixing the food thoroughly with the digestive juices secreted by the gastric glands present in the wall of the stomach. These glands release hydrochloric acid, a protein digesting enzyme called pepsin, and mucus, which protects the inner lining of the stomach. The hydrochloric acid creates an acidic medium which facilitates the action of the enzyme pepsin. **[1]**

(iii) Small intestine : The small intestine is the site of the complete digestion of carbohydrates, proteins and fats. It receives the secretions of the liver and pancreas for this purpose.

Bile juice from liver makes the acidic food coming from stomach alkaline for facilitating the action of pancreatic enzymes. Bile also emulsifies fats so as to increase the efficiency of enzyme action. **[1]**

The pancreas secretes pancreatic juice which contains enzymes like trypsin for digesting proteins and lipase for breaking down emulsified fats. **[1]**

The walls of the small intestine contain glands which secrete intestinal juice. The enzymes present in it finally convert the proteins into amino acids, complex carbohydrates into glucose and fats into fatty acids and glycerol. **[1]**

12. (a) The three events that occur during the process of photosynthesis are:

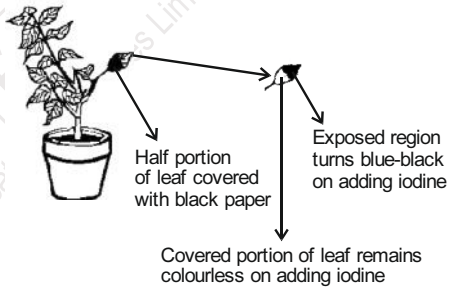
(i) Absorption of light energy by chlorophyll. **[½]**

(ii) Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen. **[½]**

(iii) Reduction of carbon dioxide to carbohydrates. **[½]**

Stomata help in exchange of gases (carbon dioxide and oxygen) for the purpose of photosynthesis. **[½]**

(b) **[1]**



Experimental set-up to show that light is essential for photosynthesis:

(i) Keep a potted plant in a dark room for three days so that all the starch gets used up.

(ii) Now cover one half of a leaf of this plant with black paper or metal foil on both sides.

(iii) Then keep the plant in sunlight for about six hours.

(iv) Pluck the leaf which was half covered and remove the paper or foil.

(v) Mark the covered area.

(vi) Dip this leaf in boiling water for a few minutes.

(vii) Then immerse it in a beaker containing alcohol.

(viii) Carefully place this beaker in a water-bath and heat till the alcohol begins to boil.

(ix) The leaf gets decolourised.

(x) Now, dip the leaf in a dilute solution of iodine for a few minutes.

(xi) Take out the leaf and rinse off the iodine solution. Observe the colour of the leaf.

The part containing starch will be turned blue-black by iodine.

You will find that the portion of the leaf exposed to sunlight will turn blue-black whereas the covered half of the leaf remains colourless. This is because the covered part did not receive sunlight and hence could not form carbohydrates.

This proves that light is essential for photosynthesis. **[2]**

13. (a) Two components of blood are

(i) Blood plasma

(ii) Blood cells **[1]**

(b) Movement of oxygenated blood in the body as follows

Pulmonary veins → Left atrium → Left ventricle → Systemic aorta → All part of the blood **[2]**

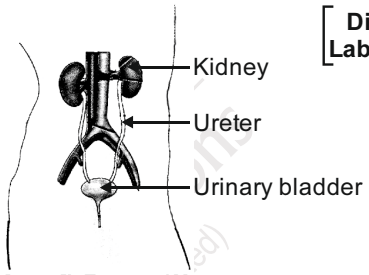
(c) The valves in the heart are to prevent the backflow of blood when the atria or ventricles contract. **[1]**

(d) Arteries are thick walled whereas veins are thin walled. **[1]**

14. (a) The biological process involved in the removal of these harmful metabolic wastes from the body is called excretion. **[1]**

(b) The nephron is the filtration units present in the kidney. **[1]**

(c) **[Diagram : 1½ Labelling: 3×½]**



Excretory system in human beings

Chapter - 7 : Control and Coordination

1. Nervous and muscular tissues provide control and coordination in multicellular animals. **[1]**
2. The spinal cord is protected by the vertebral column or backbone. **[1]**
3. Nastic movements are non-directional and growth independent movements that occur in response to stimuli such as light, temperature, humidity, etc. For example: Touch-me-not plant leaves bend and droop on touching. **[1]**

   Curvature movements are the bending or curving movements of a plant in response to any stimuli. For example: the bending of the shoot tip towards light. **[1]**
4. A hormone is a chemical compound synthesized by a group of cells or endocrine glands that affect cells in other parts of the body and is also used for control and coordination in the organisms. **[1]**

   Thyroid gland secretes the hormone thyroxin. **[½]**

   Thyroxin regulates carbohydrate, protein and fat metabolism in the body so as to provide the correct balance for growth. **[½]**
5. (a) Gustatory receptors – Tongue

   Olfactory receptors – Nose **[1]**

   (b) Dendrite → Cyton → Axon → End point of Neuron **[1]**

   Here, 'a' is cyton and 'b' is axon.
6. Following are the hormones & functions secreted by given glands.

   (a) **Thyroid gland :** Thyroid gland secretes thyroxine hormone.

   Function : Thyroxine regulates carbohydrate, protein and fat metabolism in the body to provide best balance for the growth. **[1]**

   (b) **Pituitary gland :** Pitutary gland secretes growth hormone.

   Function : Growth hormone regulates growth and development of the body. **[1]**

   (c) **Pancreas :** Pancreas secretes insulin hormone.

   Function : Insulin helps in regulating blood sugar level. **[1]**

7. Plant hormones are the organic substances produced in small quantities, which regulate growth, development and other physiological functions. **[1]**

The plant hormones responsible for the following are:

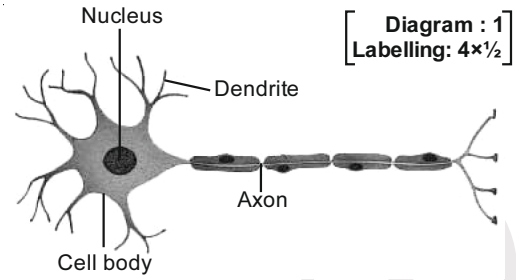
(i) Growth of stem - Auxin / Gibberellins

(ii) Promotion of cell division - Cytokinin

(iii) Inhibition of growth - Abscisic acid

(iv) Elongation of cells - Auxin **[4×½ = 2]**

8. (a)



[Diagram : 1 Labelling: 4×½]

(b) (i) Information is acquired through dendrite.

(ii) From the dendrite to the cell body and then along the axon to its end. **[2×1]**

9. (a) (i) Phototropism: The movement of a plant or it's part in response to light is called phototropism. **[½]**

(ii) Geotropism: The movement of a plant or it's part in response to gravity is called geotropism. **[½]**

Activity to show that light and gravity change the direction that plant part grows in:

(i) Fill a conical flask with water.

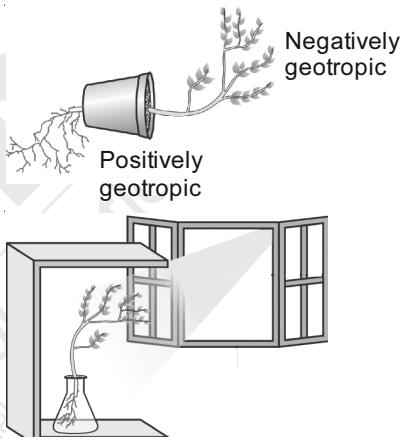
(ii) Cover the neck of the flask with a wire mesh.

(iii) Keep two or three freshly germinated bean seeds on the wire mesh.

(iv) Take a cardboard box which is open from one side.

(v) Keep the flask in the box in such a manner that the open side of the box faces light coming from a window.

(vi) After two or three days, you will notice that the shoots bend towards light and roots away from light.



[3]

(b) (i) Auxin : It promotes growth and cell elongation. **[½]**

(ii) Abscisic acid: It inhibits growth and causes wilting of leaves. **[½]**

Chapter - 8 : How do Organisms Reproduce?

1. Imperfect DNA copying in the reproduction process leads to variations or evolution. **[1]**
2. Answer (d)
   The correct observations are:
   a. Single cells of *Amoeba* and Yeast were undergoing binary fission and budding respectively.
   c. Elongated nucleus was dividing to form two daughter nuclei in *Amoeba*. **[1]**
3. Answer (d) **[1]**
4. Answer (d)
   In the figure, the part marked A is Plumule, B is Radicle and C is Cotyledon. **[1]**
5. Answer (d)
   Yeast reproduces asexually by the process of budding.
   Budding is a type of asexual reproduction in which a new organism is formed from a bud of an existing organism. A small bud is formed at a specific position on the parent cell. The nucleus of parent cell splits and a part of it enters inside the newly formed bud. The bud develops into a new cell or daughter organism. The new organism remains attached to the parent organism till it matures. After attaining maturity it separates from the parent body. **[1]**

OR

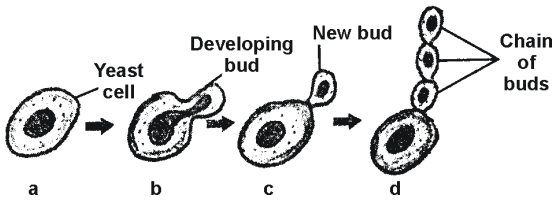
Answer (C)

This is the correct sequence of budding in yeast. **[1]**

6. *Hydra* and *Planaria* have the ability of regeneration. **[2×½]**

7. (a) A fine screw is used to focus the slides of budding in yeast under high power of a microscope. **[½]**

(b) Sequence showing budding in yeast:



[½]

8. Answer (C)

An embryo has two large cotyledons and one embryo axis or tigellum. The upper end of the embryo axis is the plumule, and the lower end of the embryo axis which projects beyond the cotyledons is the radicle. The testa is the thick outer seed coat, and the tegmen is the inner transparent seed coat of seeds. **[1]**

9. Two functions of the ovary of the human female reproductive system are

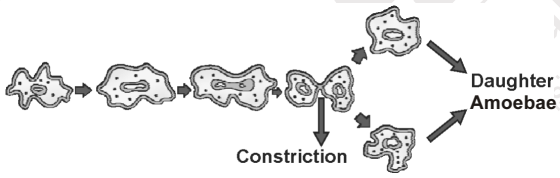
a. It produces ova, which are female gametes.

b. It secretes the female hormones, oestrogen and progesterone. **[2 × ½]**

10. Answer (d)

A dicot embryo consists of radicle, plumule and a pair of cotyledons. Testa, tegmen and micropyle are the parts of the seed coat. **[1]**

11. Binary fission in *Amoeba*:



[4 × ½]

12. Reasons for vegetative propagation:

i. It is done for plants which have lost the capacity to produce seeds.

ii. It helps in producing plants which are genetically similar to the parent plant.

iii. It helps in producing those plants which either produce very few seeds or produce such seeds which are not viable.

iv. It can be used to produce plants which reach maturity and produce fruits and seeds faster. **[4 × ½]**

13. i. Seminal vesicles - It secrete alkaline secretions which lower the pH of semen and provides nourishment. **[1]**

ii. Prostate gland - It increases the motility of sperms. **[1]**

14. It is the age at which the reproductive system becomes functional in human beings. **[1]**

The changes observed in girls at the time of puberty are:

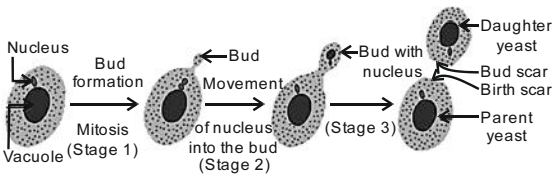
- Breast size begins to increase.
- There is darkening of skin of nipples at the tips of breasts.
- Menstruation begins.
- Deposition of fat in various body parts like thighs and hips.
- High pitched voice. **(Any two) [2×½]**

15. It is a mode of reproduction in which new individuals are produced from a single parent without the involvement of fusion of gametes. **[1]**

The forms of asexual reproduction are - budding, binary fission, regeneration, fragmentation, multiple fission. **(Any two) [2 × ½]**

16. Yeast reproduces asexually by the process of budding. **[½]**

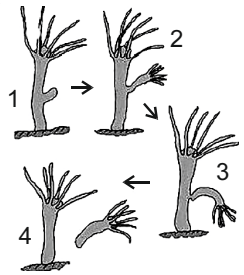
Different stages of budding as observed by the student are depicted below: **[1½]**



17. (a) They produce male germ cells *i.e.*, sperms. **[1]**

(b) They secrete the hormone testosterone which controls secondary sexual characters in males. **[1]**

18. Budding in *Hydra*: **[4×½]**



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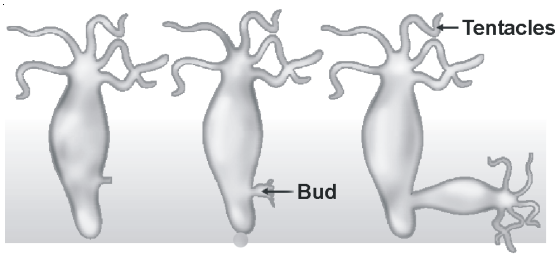


[4×½]

19. (a) (i) Implantation is the event during pregnancy in which a fertilized egg or zygote adheres to the walls of the uterus, inside the female body. **[1]**

(ii) Placenta is a disc like vascular structure embedded in the uterine wall. The placenta supplies nutrients like glucose and oxygen to the developing embryo. It also removes waste substances generated by the embryo. **[1]**

(b) The average duration of human pregnancy is nine months. **[1]**

20. DNA - Deoxyribonucleic acid. **[½]**

DNA is present in the nucleus of the cell. **[½]**

DNA in the cell nucleus is the information source for making proteins and is thereby, responsible for inheritance of features. A basic event in reproduction process is DNA copying, accompanied by the creation of an additional cellular apparatus after which the DNA copies separate, each with its own cellular apparatus.

The consistency of DNA copying during reproduction is important for the maintenance of body design features. Variations occur in the DNA copying reactions during reproduction, due to which the surviving cells are similar to, but subtly different from each other. This inbuilt tendency for variation during reproduction is the basis for evolution. **[2]**

21. HIV stands for Human Immuno Deficiency Virus. **[½]**

Yes, HIV is an infectious agent which spreads through sexual contact. **[½]**

Modes by which can HIV spread:

i. Through sexual contact.

ii. From pregnant mothers to the growing foetus.

iii. Through transfusion of infected blood.

iv. By sharing of needles or syringes. **[4×½]**

22. Sexually transmitted diseases (STD's) are diseases which are usually passed through sexual contact with an infected partner.

i. Sexually transmitted diseases caused due to bacterial infection: Gonorrhea and Syphilis. **[½]**

ii. Sexually transmitted diseases caused due to viral infection: AIDS and Herpes. **[½]**

A key strategy in the prevention of STD's involves screening, diagnosis and treatment of patients as well as their sexual partners to interrupt transmission.

Prevention of transmission of STD's:

(a) Having sex with an infected or any unknown person should be avoided.

(b) Sharing of needles, syringes etc. must be prohibited.

(c) Surgical and dental instruments should be sterilised properly before use.

(d) Avoid blood transfusion from an infected person. Blood should be tested before transfusion.

(e) Adequate medical treatment should be provided to the pregnant woman to protect the child from getting infected.

(Any four) [4 × ½]

23. (a) In *Planaria*, any part of the body which gets cut is capable of regeneration or developing into a complete organism. Regeneration is carried out by specialized cells which proliferate and make large numbers of cells. From these mass of cells, different cells undergo changes to become various cell types and tissues. These changes take place in an organised sequence referred to as development. **[1]**

(b) Differences between Regeneration and Reproduction :

Regeneration	Reproduction
1. This process occurs by asexual method only.	1. This process occurs by asexual and sexual method.
2. The organisms are being cut or broken and each of the broken or being cut part grows into a separate new individual.	2. The individuals give rise to young ones of their own kind.

[2 × 1]

24. Asexual reproduction involves single individual which produces new generation whereas sexual reproduction involves two individuals one is male parent and other is female parent to produce new individuals. **[1]**

Sexually reproducing species is likely to have comparatively better chance of survival as it involves two different individuals.

Sexual mode of reproduction incorporates such a process of combining DNA from two different gametes of two different parents *i.e.*, male and female gametes of male and female parents respectively.

Thus sexual reproduction involves variation in the new individuals which helps in survival of the species. **[2]**

25. The DNA copying which is not perfectly accurate in the reproduction process results in variations in populations for the survival of species. The amount of DNA remains constant because the gametes are special type of cells called reproductive cells which contain only half the amount of DNA as compared to the normal body cells of an organism. **[3]**

26. Four methods of contraception used by humans:

Intrauterine devices, oral contraceptive methods, surgical methods and natural methods (coitus interrupts) **[4 × ½]**

Two advantages of adopting such preventive methods :

i. It helps in preventing unwanted pregnancies.

ii. It reduces the chance of getting STDs such as AIDS. **[2×½]**

27. (a) Two reasons for the appearance of variations among the progeny formed by sexual reproduction are :

(i) Sexual reproduction results in new combinations of genes which are brought together during the formation of gametes.

(ii) Gene combinations are different in gametes. **[2×½]**

(b) (i) Part 'A' labelled is pollen grain. **[½]**

(ii) Part 'B' is stigma. The pollen grain reaches the stigma through wind, water or animals. **[½]**

(iii) Part 'C' is the pollen tube. The pollen tube carries the gametes to the embryo sac for fertilisation. **[½]**

(iv) Part 'D' is the egg cell. After fertilisation with the male gametes, the egg cell forms the zygote. **[½]**

28. Reproduction is the ability of living organisms to produce living beings similar to them. **[1]**

Reproduction maintains the number of chromosomes specific to a species in each generation. Multicellular organisms have specialised cells in their gonads, which have only half the number of chromosomes and half the amount of DNA as compared to non-reproductive body cells. So, when these germ cells from two different individuals combine during sexual reproduction to form a new individual, it results in the re-establishment of the number of chromosomes and the DNA content in the new generation. Thus, it provides stability to the population of a species. **[2]**

29. Regeneration is the ability of organisms to generate lost or damaged parts of the body. **[1]**

When a *Hydra* is bisected anywhere in the upper 7th or 8th part of the body column, the upper half will regenerate a foot at its basal end and the lower half will regenerate a head at its apical end; each half generates the organ which it is missing. The regeneration is precise, and the head and foot are always formed specifically at the apical and basal ends, respectively. **[2]**

30. Two types of reproduction:

1. Sexual reproduction
2. Asexual reproduction **[2×½]**

Sexual reproduction is responsible for bringing in more variations in its progeny.

It takes place by the combination of male and female gametes.

Gametes are formed from one cell which involves copying of DNA and the cellular apparatus. DNA copying is not absolutely accurate, and errors result in new variations. With every DNA copied, a new variation is introduced, and this DNA copy may already have several variations accumulated from the previous generations. **[2]**

31. Techniques to prevent pregnancy:

(a) Coitus interruptus **[½]**

(b) Barrier methods like use of condoms, cervical cap and diaphragm. **[½]**

(c) Use of intra-uterine devices such as loop and copper-T **[½]**

Use of intra-uterine devices is not meant for males. **[½]**

The use of these techniques will keep the mother in good health. With a small family size, parents will be able to provide quality resources to the child such as food, clothes and education. This will improve the overall mental and physical well-being of the family. **[1]**

32. Vegetative propagation is a type of reproduction in which several plants are capable of producing naturally through their roots, stems and leaves. **[1]**

Advantages of vegetative propagation:

Plants not capable of producing sexually are produced by this method.

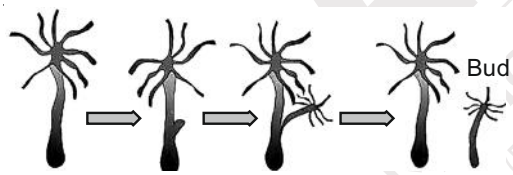
It is a fast and certain method to obtain plants with desired features. **[2×½]**

Disadvantages of vegetative propagation:

There is no possibility for variation.

The new plant grows in the same area as the parent plant which leads to competition for resources. **[2×½]**

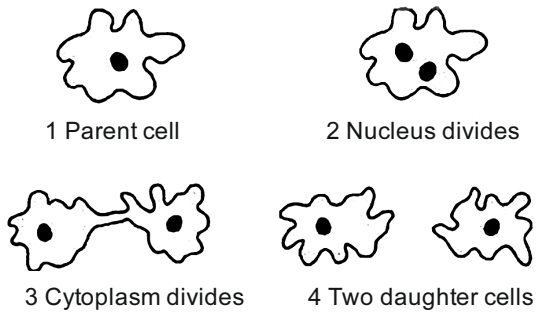
33. In *Hydra*, a bud develops as an outgrowth due to repeated cell divisions at one specific site. These buds develop into tiny individuals and when fully mature, detach from the parent body and become new independent individuals. **[2]**



[3]

OR

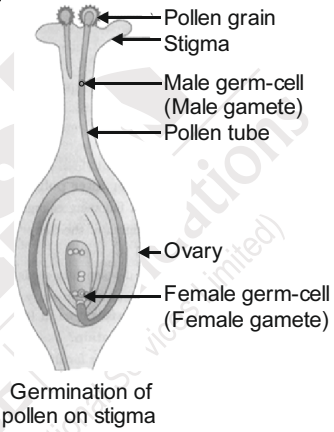
Binary fission is an asexual method of reproduction. *Amoeba* reproduces by this method. During this process, nuclear division takes place first, followed by the appearance of a constriction in the cell membrane, which gradually increases inwards and divides the cytoplasm into two parts. Finally, two daughter organisms are formed. **[3]**



[2]

34. Pollination - Transfer of pollen grains from the anther to the stigma is called pollination. **[1]**

Fertilisation - The process of fusion of male and female gametes to form a zygote which eventually develops into an embryo is called fertilisation. **[1]**



[Diagram : 1 Labelling: 4×½]

OR

i. Testis: It is the organ which produces sperms and the male sex hormone, testosterone. **[1]**

ii. Seminal vesicle: It provides nourishment to sperms. **[1]**

iii. Vas deferens: Vas deferens is a tube transporting spermatozoa from the epididymis to the prostate part of the urethra. **[1]**

iv. Ureter: It carries urine from the kidneys to the urinary bladder. **[1]**

v. Prostate gland: It contributes additional fluid to the ejaculate and also help to nourish the sperms. **[1]**

35. (a) **Function of placenta:**

i. Exchange of nutrients and water between mother and the foetus.

ii. Excretion of nitrogenous wastes from foetus. Nitrogenous waste crosses the placenta and is removed by mother's kidney. **[2×1]**

(b) Ways of preventing pregnancy:

i. **Natural methods:** This method involves withdrawal of penis from vagina just before discharge of semen. **[½]**

ii. **Barrier methods:** In this method, the fertilisation of ovum and sperm is prevented with the help of physical devices such as condoms and diaphragm. **[½]**

iii. **Oral contraceptives:** In this method, tablets or drugs are taken orally. These contain small doses of hormones which prevent the release of eggs and prevent fertilisation. **[½]**

iv. **Surgical methods :** In this method, vas deferens in males and fallopian tube in females are blocked in order to prenent fertilisation. **[½]**

Advantages of using such preventive measures are:

- It helps from unwanted pregnancy.
- It protects the user from sexually transmitted diseases. **[2 × ½]**

36. (a) A - Stigma.

Function - The stigma is a sticky surface where the pollen grains land and germinate. **[1]**

B - Pollen tube.

Function - It carries the pollen grains to the egg cell for fertilisation. **[1]**

C - Egg cell.

Function - It fuses with the male gamete and leads to the formation of the zygote. **[1]**

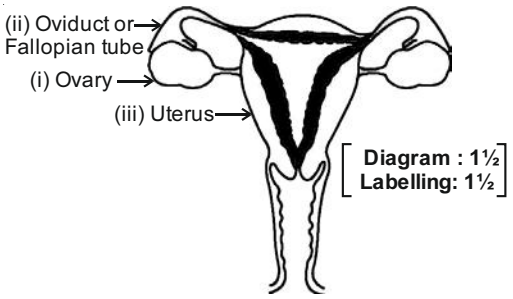
(b) Role of gametes - Gametes carry the entire genetic information of the organism. These gametes upon fusion result in the formation of the zygote, which develops into a new individual. Any deformation in the gametes will lead to deformity in the newly formed offspring. **[1]**

Role of zygote - Zygote is the diploid cell formed by the fusion of male and female gametes during fertilisation in sexual reproduction. Zygote is the first stage in the development process of an organism and it contains all the genetic information of both the parents essential for the growth of the new organism. **[1]**

37. (a) (i) Ovary

(ii) Fallopian tubes

(iii) Uterus



(b) (i) If the uterus receives the zygote, the female becomes pregnant. The embryonic development of the zygote starts immediately. The embryo moves down into the uterus forming a thick and soft lining of blood vessels around itself. This process is called implantation. After implantation, a special tissue develops between the uterine wall and the embryo called placenta, where the exchange of nutrients, oxygen and waste products takes place. **[1]**

(ii) If the egg released by the ovary is not fertilized and the zygote is not formed, then the thick lining of the uterus breaks down and comes out through the vagina in the form of blood and mucous. This is called menstruation. **[1]**

38. (a) A - Pollen grain

B - Pollen tube

C - Ovary

D - Female germ cell **[4 × ½]**

(b) Pollination is the process of transfer of pollen grains from anther to stigma of the flower.

Significance of pollination: Pollination is a significant event because it precedes fertilization. It brings the two types of gametes closer for the process of fertilization. Also, cross pollination introduces variations in the plants due to mixing of different genes which increases adaptability towards environment or surroundings. **[1]**

(c) The male germ cell produced by pollen grain reach to the ovary through a tube that grows from pollen grain and travels through style. The male germ cell fuses with the female germ cell inside ovule to form zygote which is capable of growing into a new plant. **[1]**

After fertilization, ovules develop into the seeds and ovary develops into the fruit. **[1]**

39. (a) Testes produce sperms and secrete a hormone called testosterone. **[1]**

The function of testosterone is to control the development of male sex organs and male features such as a deeper voice, moustache, beard and more body hair as compared to females. **[1]**

(b) i. Fertilisation takes place in the oviduct or fallopian tubes.

ii. Implantation of the fertilised egg occurs in the uterus. **[2 × ½]**

After implantation, a disc-like special tissue called placenta develops between the uterus wall and the embryo. The placenta helps in the exchange of nutrients, oxygen and waste products between the embryo and the mother. Thus, it provides nourishment to the growing embryo. **[2]**

40. The placenta is an organ attached to the lining of the womb during pregnancy. **[1]**

The placenta is composed of both maternal tissue and tissue derived from the embryo. It contains blood spaces on the mother's side and villi on the embryo's side. **[2]**

Functions of the placenta:

1. It provides food and oxygen to the foetus.
2. The foetus gives away waste products and carbon dioxide to the mother's blood for excretion. **[2 × 1]**

41. (i) Ovary : It produces female gametes. One ovum is released by one ovary every month. It also secretes hormones oestrogen and progesterone. **[1]**

(ii) Uterus: It protects and nourishes the developing embryo. **[1]**

(iii) Fallopian tube: It passes down the ovum towards the uterus released by the ovary. **[1]**

Structure of the placenta in human female:

(i) The placenta is a disc which is embedded in the uterine wall.

(ii) It contains villi on the embryo side. The mother's end of the placenta has blood spaces which surround the villi. **[2 × ½]**

Functions of the placenta in human female:

(i) Nutrients and oxygen are received by the foetus from the mother's blood.

(ii) The foetus gives away waste products and carbon dioxide to the mother's blood for excretion. **[2 × ½]**

42. The process of transfer and deposition of pollen grains from the anther to the stigma of the flower is called pollination. **[1]**

There are two different types of pollination :

(i) Self pollination : It is the process of transfer of pollen grains from the anther to the stigma of the same flower. **[1]**

(ii) Cross pollination : It is the process of transfer of the pollen grains from the anther of one flower to the stigma of another flower. **[1]**

Pollination can be achieved by the agents like wind, water and animals. **(Any two) [2 × ½]**

After the pollen lands on a suitable stigma, it has to reach the female germ-cells which are in the ovary. For this, a tube grows out of the pollen grain and travels through the style to reach the ovary and then fertilisation occurs. **[1]**

OR

(a) The given diagram is of female reproductive system. **[½]**

1 - Fallopian tube

2 - Ovary

3 - Uterus

4 - Cervix

5 - Vagina **[5 × ½]**

(b) The birth control methods which deliberately prevent fertilization are referred to as contraception. **[½]**

Advantages of adopting contraceptive measures are :

(i) It prevents unwanted pregnancy.

(ii) It prevents the transmission of STDs.

(iii) It controls the birth rate and determines the size of the population. **[3 × ½]**

Chapter - 9 : Heredity and Evolution

1. Answer (A) **[1]**

   Analogous organs are those which do not share a common ancestry but perform common functions. Hence, wings of insects and wings of bats are analogous organs in animals and potato and sweet potato are analogous organs in plants.

2. Answer (C) **[1]**

3. Answer (D) **[1]**

   Radish and carrot are the modifications of roots. Hence, they are the homologous structures.

4. Answer (B) **[1]**

   Radish and carrot are homologous structures as these are modifications of the root. Tomato and okra are fruits. Potato is a modification of the stem.

5. Answer (a) **[1]**

   Homologous structures are fundamentally same in structure and origin but are modified to perform different functions in different organisms. They indicate common ancestry. From the given plants, carrot and radish are homologous structures because they both are underground roots. While potato is a stem, sweet potato is a root, tomato is a fruit and lady finger is a vegetable.

6. Variation increases the chances of survival of a species in a constantly changing environment. **[1]**

7. Fossils are the remains or traces of animals and plants of the past on rocks. **[1]**

   Fossils give information about evolutionary relationships between different species. **[1]**

8. Example of inherited trait - Shape of the eye or hair colour. **[½]**

   Example of acquired trait - Building of muscles while exercising. **[½]**

   Difference between the inherited and the acquired characters:

Inherited Characters	Acquired Characters
Inherited characters affect the DNA of germ cells and hence can be passed on to the future generations.	Acquired characters do not cause changes in DNA of the germ cells and hence cannot be passed on to future generations.

   [1]

9. In Mendelian experiment, breeding of pea plants bearing violet flowers with pea plant bearing white flower leds to production of all violet coloured flowers (F_1 progeny plants). The plants bearing violet coloured of the flower is dominant over write coloured flower in pea plant. **[2]**

10. **Analogous organs :** These are organs that have different structural design and origin, but perform similar functions. **[1]**

    Homologous organs : These organs have the similar basic structural design and origin, but are evolved to perform different functions. **[1]**

    Analogous organs : Wings of an insect and wings of a bat.

    Homologous organs : Forelimbs of frog and forelimbs of a human. **[2×½]**

11. Different ways in which individuals with a particular trait may increase in population are variation, natural selection and genetic drift.

    Variation : Variation is defined as the occurrence of differences among the individuals. No two individuals are exactly alike. Variations arising during the process of reproduction can be inherited and lead to increased survival of the individuals. **[1]**

    Natural selection : It results in adaptations in population to fit their environment better. Thus, natural selection directs evolution in the population of a particular species. **[1]**

    Genetic drift : The change in the frequency of certain genes in a population over generations is called genetic drift. **[1]**

12. J.B.S. Haldane suggested that life must have developed from the simple inorganic molecules which were present on Earth soon after it was formed. He speculated that the conditions on Earth at that time could have given rise to more complex organic molecules which were necessary for life. The first primitive organisms

would arise from further chemical synthesis. Later on, Stanely L. Miller and Harold C. Urey conducted experiments to understand the origin of organic molecules. They created an atmosphere similar to that thought to exist on early Earth (this had molecules like ammonia, methane and hydrogen sulphide, but no oxygen) over water. This was maintained at a temperature just below 100°C and sparks were passed through the mixture of gases to simulate lightning. At the end of a week, 15% of the carbon (from methane) had been converted to simple compounds of carbon including amino acids which make up protein molecules. This is considered as evidence for origin of life on the Earth from inanimate matter. **[3]**

13. Homologous organs, analogous organs and vestigial organs help to identify evolutionary relationships.

Homologous organs are those organs which have similar basic structure but have been modified to perform different functions. *Example* - forelimbs of reptiles, frog, lizard, bird and humans are homologous organs. Such homologous characteristics help to identify an evolutionary relationship between apparently different species. **[1]**

Analogous organs are those organs which are different in basic structure but perform the same function. *Example* - wings of bird and wings of bat. **[1]**

Vestigial organs are certain reduced and non-functional organs present in some organisms. *Example* - vermiform appendix in human body. **[1]**

14.

Homologous Organs	Analogous Organs
Homologous organs are organs which are dissimilar in shape, size and function but their origin, basic plan and development are similar.	Analogous organs are organs which are similar in shape and function but their origin, basic plan and development are dissimilar.

[2]

Wings of a bird and bat should be placed in the category of analogous organs as they are similar in function but are different in their structure and development. **[1]**

15. Evolution is a gradual change in the characteristics of a population of animals or plants over successive generations.

Evolution cannot be equated with progress. There is no real 'progress' in the idea of evolution. Evolution is simply the generation of diversity and the shaping of the diversity by environmental selection. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time. However again, it is not as if the older designs are inefficient! One of the simplest life forms, bacteria inhabits the most inhospitable habitats like hot springs, deep-sea thermal vents and the ice in Antarctica. **[3]**

16. (a) Blue **[1]**

(b) 25% **[1]**

(c) 1 : 2 **[1]**

17. The process by which new species develop from the existing species is known as speciation. The important factors which could lead to speciation are :

i. Geographical isolation of a population caused by various type of barriers such as mountain ranges, rivers and seas.

ii. Genetic drift caused by drastic changes in the frequencies of particular genes by chance alone.

iii. Variations caused in individuals due to natural selection. **[3×1]**

18. Some traits are determined by the combined effect of more than one pair of genes. These are referred to as polygenic or continuous, traits.

An example of this is human stature. The combined size of all of the body parts from head to foot determines the height of an individual. There is an additive effect. The sizes of all of these body parts are, in turn, determined by numerous genes. Human skin, hair, and eye color are also polygenic traits because they are influenced by more than one allele at different loci. The result is the perception of continuous gradation in the expression of these traits. **[3]**

19. Chromosomes are thread-like structures found in the nucleus at the time of cell division. They are made of proteins and DNA. **[1]**

In sexually reproducing organisms, the gametes undergo meiosis, and hence, each gamete contains only half a set of chromosomes. When two gametes fuse, the zygote formed contains the full set of chromosomes. Hence, the formation of gametes by meiosis helps to maintain the number of chromosomes in the progeny. **[2]**

20. **(a) Speciation :** The process by which new species develop from the existing species is known as speciation.

The factors which could lead to speciation are:

i. Geographical isolation of population caused by various types of barriers such as mountain ranges, rivers and seas. This leads to reproductive isolation because of which there is no flow of genes between separated groups of population.

ii. Genetic drift caused by drastic changes in the frequencies of particular genes by chance alone.

iii. Variations caused in individuals because of natural selection. **[1½]**

(b) Natural Selection : Natural selection is the process of evolution of a species whereby characteristics which help individual organisms to survive and reproduce are passed on to their offspring, and those characteristics which do not help are not passed on. Charles Darwin proposed the theory of natural selection. According to him, nature selects the fittest.

There are always changes in the progeny when an animal reproduces by sexual reproduction.

Example : If one of the progeny of deer is tall and the other is short, then the tall one with long legs will survive. Because the progeny with short height cannot reach the leaves of tall trees and cannot get food, they will starve and hence die. Thus, it proves the theory of natural selection. **[1½]**

21. (a) **Homologous organs :** Organs which have the same basic structure but different functions are called homologous organs.

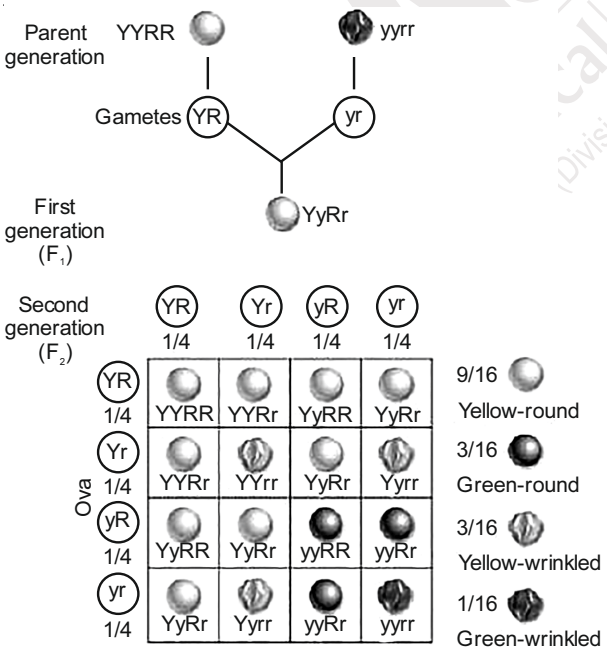
Example : The forelimbs of a man, lizard, frog, bird and bat have the same basic design of bones, but they perform different functions. The forelimbs of a man are used for grasping, the forelimbs of a lizard are used for running, the forelimbs of a frog are used to prop up the front ends of the body when at rest and the forelimbs of a bird and bat are modified for flying. Hence, all these organisms use their forelimbs for performing different functions, but the forelimbs have originated from the same structural pattern. **[1]**

(b) **Analogous organs :** Organs which have different basic structure but similar appearance and perform similar functions are called analogous organs. Example: The wings of an insect and a bird have different structures, but they perform the same function of flying. Because the wings of insects and birds have different structures but perform similar functions, they are analogous organs. **[1]**

(c) **Fossils :** The remains of dead animals or plants which lived in the remote past are known as fossils. The fossils provide evidence for evolution. For example, a fossil bird called *Archaeopteryx* looks like a bird, but it has many other features which are found in reptiles. It has feathered wings like those of birds but teeth and tail like those of reptiles. Therefore, *Archaeopteryx* is a connecting link between the reptiles and birds and hence suggests that birds have evolved from reptiles. **[1]**

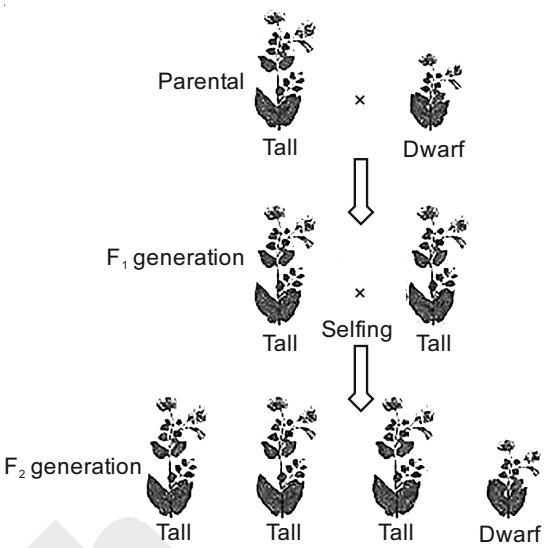
22. All living things are identified and categorised on the basis of their body design in form and function. After a certain body design comes into existence, it will shape the effects of all other subsequent design changes simply because it already exists. So, characteristics which came into existence earlier are likely to be more basic than characteristics which have come into existence later. This means that the classification of life forms will be closely related to their evolution. On connecting this idea of evolution to classification, it is seen that some groups of organisms with ancient body designs have not changed very much. However, other groups of organisms have acquired their particular body designs relatively recently. Because there is a possibility that complexity in design will increase over evolutionary time, it may not be wrong to say that older organisms are simpler, while younger organisms are more complex. **[3]**

23. Mendel carried out dihybrid crosses by crossing two pea plants differing in contrasting traits of two characters. For example, he crossed a pea plant having yellow colour and round seed characters with another pea plant bearing green colour and wrinkled seed characters. In the F_2 generation, he obtained pea plants with two parental and two recombinant phenotypes as yellow round and green wrinkled (parental) and yellow wrinkled and green round (recombinant). This indicated that traits separated from their original parental combinations and got inherited independently. **[1]**



[2]

24. Mendel explained that it is possible that a trait is inherited but not expressed in an organism with the help of a monohybrid cross.



[1½]

1. He crossed pure-bred tall plants (TT) with pure-bred dwarf plants (tt).
2. The progeny he received in the first filial generation was tall. The dwarfness did not show up in the F_1 generation.
3. He then crossed the tall pea plants of the F_1 generation and found that the dwarf plants were obtained in the second generation. He obtained three tall plants and one dwarf plant. **[3 × ½]**

25. Organic evolution can be defined as the slow, progressive, natural and sequential development in primitive organisms to form more complex organisms or a new species. **[1]**

Evolution cannot be equated to progress. From lower forms to higher forms it gives rise to more complex body designs even while the simpler body designs continue to flourish. For example, human beings have not evolved from chimpanzees but both have a common ancestor. **[2]**

26. Parents – Tall TT × Short tt

Gametes – (T) (t)

F_1 Generation – Tt

(All tall offsprings) **[1]**

Selfing of F_1 generation

Gametes – Tt (T, t) X Tt (T, t)

F_2 generation –

♀ \ ♂	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (Short)

[1]

F_2 Phenotypic ratio – Tall : Short **[½]**

3 : 1

F_2 Genotypic ratio – TT : Tt : tt **[½]**

1 : 2 : 1

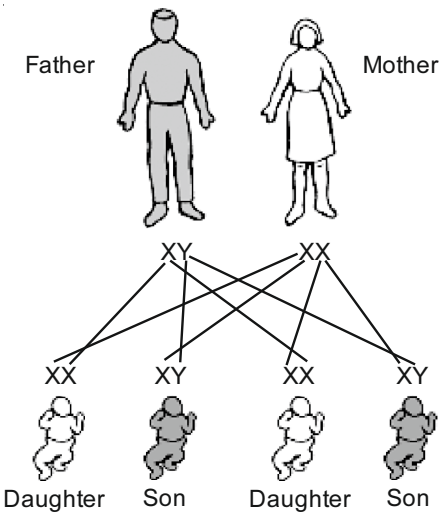
27. Differences between acquired traits and inherited traits : **[3 × 1]**

	Acquired traits	Inherited traits
1.	These traits are gained during the lifetime of an individual.	These traits are controlled by specific genes.
2.	These traits cannot be passed to the progeny.	These traits are passed on from one generation to another.
	Ex. : Pierced earlobes	Ex. : Colour of the eyes

28. In human beings, females have two X chromosomes and males have one X and one Y chromosome. Therefore, the females are represented as XX and males as XY. At the time of mating, large number of sperms are ejaculated from the male reproductive organ (penis), into the female reproductive organ i.e., vagina. They travel towards the fallopian tubes, where only one sperm meets with the egg.

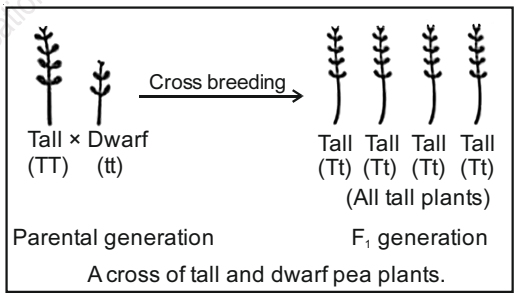
The process of fusion of the sperm and ovum is called fertilisation. The sperm has either X or Y chromosome and egg has only X chromosome. So, if a sperm carrying Y chromosome fuses with the egg, the newly born child will be male and if a sperm carrying X chromosome fuses with the egg, the newly born child will be female. There is an equal chance of fusion of either X or Y chromosome with the egg so we can say that the sex of a new born child is a matter of chance and none of the parent is responsible for it. **[3]**

Sex determination in humans is shown below:



[2]

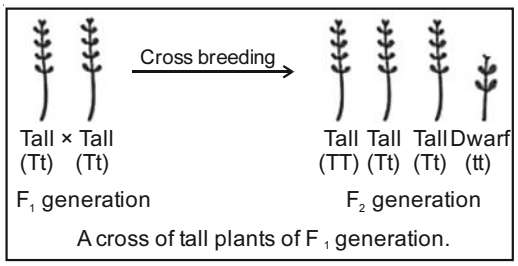
29. (a) Mendel crossed pure bred tall pea plants with pure bred dwarf pea plants and found that only tall pea plants were produced in the first generation and there were no dwarf pea plants. He concluded that the first generation showed the traits of only one of the parent plants-tallness. The trait of the other parent plant- dwarfness- did not show up in the progeny of the first generation.



A cross of tall and dwarf pea plants.

He then crossed the tall pea plants obtained in the first generation (F_1 generation) and found that both tall plants and dwarf plants were obtained in the second generation (F_2 generation) in the ratio of 3 : 1.

Mendel noted that the dwarf trait of the parent pea plant which disappeared in the first generation progeny reappeared in the second generation. In this way, Mendel's experiments with tall and dwarf pea plants showed that the traits may be dominant and recessive.



A cross of tall plants of F_1 generation.

[2½]

(b) When Mendel crossed pure-bred tall pea plants with pure-bred dwarf pea plants, he found that only tall pea plants were produced in the F_1 generation. When he further crossed the tall pea plants of the F_1 generation, he found that the tall plants and dwarf plants were obtained in the ratio 3 : 1 in the F_2 generation.

Mendel noted that all the pea plants produced in the F_2 generation were either tall or dwarf. There were no plants with intermediate height (or medium height) in between the tall and dwarf plants.

In this way, Mendel's experiment showed that the traits (like tallness and dwarfness) are inherited independently. This is because if the traits of tallness and dwarfness had blended (or mixed up), then medium-sized pea plants would have been produced. **[2½]**

30. Evolution is the formation of more complex organisms from pre-existing simpler organisms over a certain period. Accumulation of variation in genetic material forms the basis of evolutionary processes. **[2]**

Fossils provide a unique view into the history of life by showing the forms and features of life in the past. Fossils tell us how species have changed across long periods of the Earth's history.

Importance of fossils to provide evidences in support of evolutionary process:

(i) Some invertebrates living on the sea bed died and were buried in the sand.

(ii) More sand was accumulated and formed sandstone under pressure.

(iii) After millions of years, dinosaurs living in the area died and their bodies were buried in the mud.

(iv) The mud got compressed into the rock, just above the rock containing earlier invertebrate fossils.

(v) Again millions of years later, the bodies of horse-like creatures dying in the area were fossilised in the rocks above the earlier rocks.

(vi) Much later, because of erosion and water flow, some rocks wore out and exposed the horse-like fossils. **[6×½]**

31.

Acquired Trait	Inherited Trait
A trait or characteristic which develops in response to the environment and cannot be inherited.	A characteristic feature inherited from the previous generation.
Example: A person learns to swim.	Example: A girl has brown eyes just like her mother.

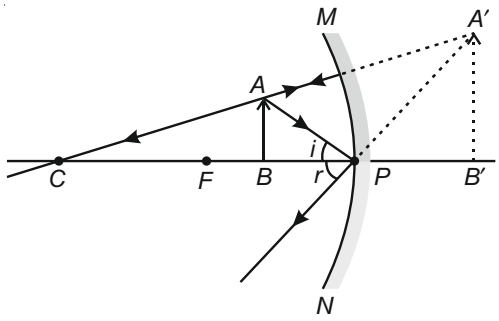
[2]

Only those traits are inherited which are developed because of changes in genes.

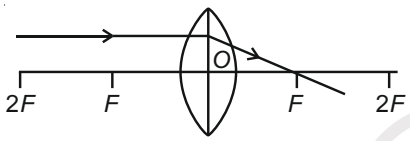
An acquired trait or experience is developed as a response to the environment; it is not inherited. These are not developed due to the changes in genes.

Example : Human beings experiencing weight loss due to starvation. There will be reduction in weight as a response to starvation. This will result in the reduction in the number of body cells or overall body-mass ratio of the individual. It will not have any effect on the genetic constitution of the individual. Because there is no change in the gene of the individual, it is not an acquired trait. **[3]**

Chapter - 10 : Light : Reflection and Refraction

1. 

[1]

2. 

[1]

3. Light has different speeds in different media and it takes such a path of propagation for which time taken is minimum. **[1]**

4. A ray of light passing through the centre of curvature of a concave mirror falls on the mirror along the normal to the reflecting surface. Hence, it gets reflected along the same path following the laws of reflection. **[1]**

5. The nature of the image formed by a concave mirror if the magnification produced by the mirror is +3 is virtual, erect and magnified. **[1]**

6. Answer (c) **[1]**

   Lateral displacement is the sideways shift of the emergent ray from the direction of the incident ray.

7. Answer (d) **[1]**

   A screen, a mirror, holders for them and scale are needed to find the focal length of a concave mirror.

8. Answer (a) **[1]**

   The lens should be moved towards the screen because the distant tree can be considered an object at infinity whose image will be formed at the focus, while earlier the image of nearer grill was formed at a distance farther than the focal length.

9. Answer (a) **[1]**

   The proper sequence to determine the focal length of a convex lens is :

   III - Select a suitable distant object.

   I - Hold the lens between the object and the screen.

   II - Adjust the position of the lens to form a sharp image.

   IV - Measure the distance between the lens and the screen.

10. Answer (d) **[1]**

    The IV observation is the correct one. The ratio of sin*i* and sin*r* given by the fourth choice gives 1.5.

    We know that

    $$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{1.5}{1} = 1.5$$

11. Answer (d) **[1]**

    $\angle i$ and $\angle e$ are not marked correctly. Each angle is supposed to be marked from the normal.

12. Answer (c) **[1]**

    The screen is moved away from the mirror so as to focus the object for a fixed position of the mirror and the object.

13. Answer (d) **[1]**

    The distance between mirror and the screen will give the focal length of the mirror as the mirror focuses the light on the screen.

14. Answer (d) **[1]**

    The parallel rays from the distant object fall on the convex lens and converge at its second principal focus (*i.e.*, where the screen is placed). Then the distance between the screen and the convex lens gives the approximate focal length of the lens *i.e.*, 40 cm.

15. Answer (c) **[1]**

    The light ray passing through the optical centre of the lens does not deviate. The light ray parallel to the principal axis passes through the second focus of the lens. The light ray passing through the first focus becomes parallel to the principal axis after passing through the lens.

16. Answer (b) **[1]**

    Ray (2) is parallel to the principal axis and passes through the second focus of the lens.

Ray (3) passes through the optical centre and does not deviate.

Ray (4) passes through the first focus of the lens and goes parallel to the principal axis.

17. Answer (a) **[1]**

The best set up is given in figure I. The incoming light should not fall perpendicularly as the light will emerge straight and refraction cannot be traced. The light rays should not be very close or far from the normal as the emergent rays are difficult to trace.

18. Answer (d) **[1]**

As the light gets refracted twice at different angles the emergent ray bends at an angle to the direction of incident ray.

19. Answer (A) **[1]**

Since the image is focussed, the spherical mirror is a concave mirror.

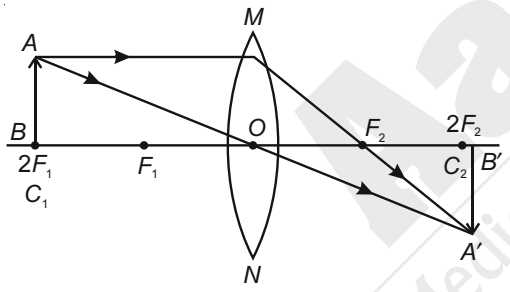
For second mirror the distance is increased to focus the image on the screen. Hence, focal length is more than that of first mirror.

20. Answer (C) **[1]**

Focal length f = 10 cm

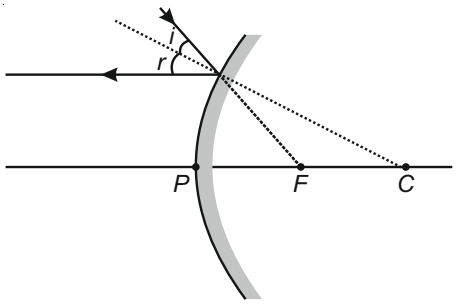
The object is placed at $2F$(2 × 10 = 20 cm).

Hence the image is also formed at $2F$.



Position of object	Position of image	Size of image	Nature of image
At $2F_1$	At $2F_2$	Same size	Real and inverted

21. A light ray is incident on a convex mirror parallel to the principal axis. The ray diagram is shown below



In the above diagram, 'i' is the angle of incidence and 'r' is the angle of reflection. **[1]**

22. Answer (A) **[1]**

In refraction through a rectangular slab, the angle of incidence is equal to the angle of emergence. Also, the angle of refraction should be smaller than the angle of incidence.

23. Answer (B) **[1]**

The focal length of a concave mirror is the distance between its pole and principal focus. That is, the distance of the image formed (screen) from the concave mirror will be equal to the focal length of the concave mirror.

24. Given that object distance, u = –12 cm

Image distance, v = 24 cm

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

$$\Rightarrow \frac{1}{f}=\frac{1}{24}-\frac{1}{-12}$$

$$\Rightarrow \frac{1}{f}=\frac{1}{24}+\frac{1}{12}$$

$$\Rightarrow \frac{1}{f}=\frac{1+2}{24}$$

$$\Rightarrow \frac{-1}{f}=\frac{3}{24}$$

$\Rightarrow$ f = 8 cm

$\therefore$ The focal length of the lens is 8 cm.

Now if the object is moved away from the lens, the screen has to be moved towards the lens. This is because when we move the object away from the lens, the object distance is increased. Hence, by the lens formula, the image distance decreases.

Magnification is given as

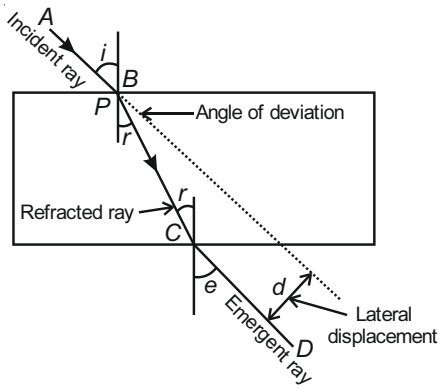
$$m=\frac{v}{u}$$

Because the image distance (v) decreases, the value of magnification also decreases. **[1]**

25. Answer (B) **[1]**

Images obtained on the screen are always diminished and inverted in nature.

26. Answer (a) **[1]**



On entering a glass slab, the incident light gets refracted. According to Snell's law, we get

$$\mu = \frac{\sin i}{\sin r}$$

For glass $\mu > 1$

$\therefore$ $\sin r < \sin i$

or $r < i$

In refraction of light through a glass slab, the emergent ray is parallel to the incident ray. Thus, $\angle i = \angle e$.

27. Given,

$u = -15$ cm (It is to the left of the lens)

$f = -30$ cm (It is a concave lens)

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

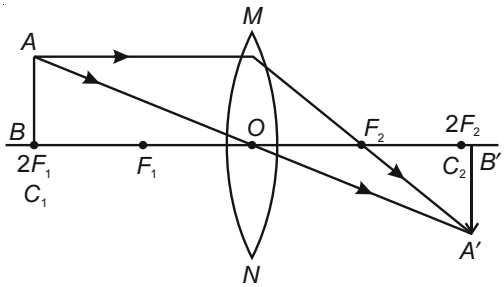
$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{(-30)} + \frac{1}{(-15)}$$

$$\therefore \quad \frac{1}{v} = -\frac{3}{30} = -\frac{1}{10}$$

$\therefore$ $v = -10$ cm

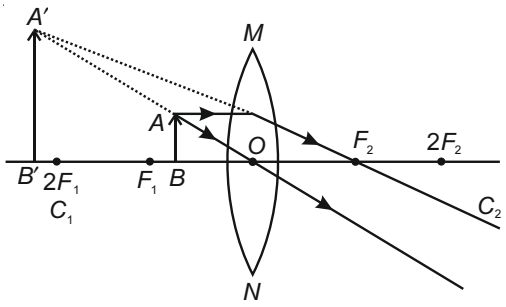
The negative sign of the image distance shows that the image is formed on the left side of the concave mirror. Thus, the image formed by a mirror is virtual, erect and on the same side as the object. **[1]**

28. (a)



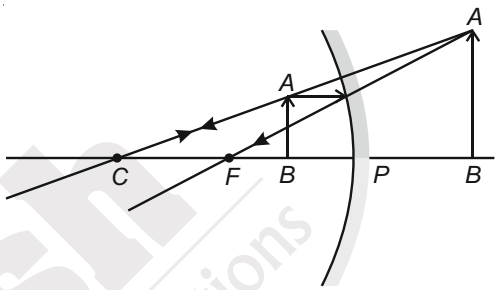
[1]

(b)



[1]

29. At least two rays are required for locating the image formed by a concave mirror for an object. Formation of virtual image by concave mirror : **[1]**



[1]

30. Four characteristics of images formed by a plane mirror are :

(i) The image formed by a plane mirror is always virtual.

(ii) The image formed by a plane mirror is always erect.

(iii) Size of the image is same as the size of the object and the image is laterally inverted.

(iv) The image formed by a plane mirror is at the same distance behind the mirror as object is in front of it. **[4 × ½]**

31. When an object is placed between the focus and the pole of a concave mirror, the image formed is

(i) Virtual

(ii) Enlarged

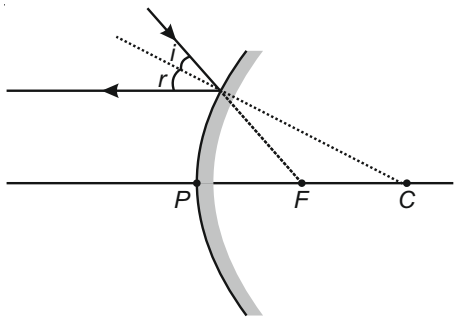
(iii) Behind the mirror

(iv) Erect **[4 × ½]**

32. For magnified and erect image the object is placed between pole *P* and focus *F*. **[1]**

For magnified and inverted image the object is placed either at focus or anywhere between *F* and *C*. **[1]**

33. Ray diagram :



[2]

34. Given : $n_g = \frac{3}{2}$ and $n_w = \frac{4}{3}$

Refractive index of glass,

$$n_g = \frac{\text{Speed of light in air}}{\text{Speed of light in glass}}$$ **[½]**

$$\frac{3}{2} = \frac{\text{Speed of light in air}}{2 \times 10^8}$$

∴ Speed of light in air

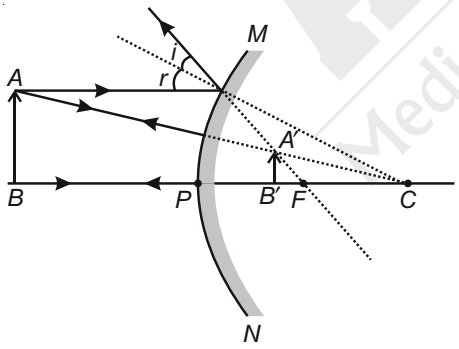
$$= \frac{3}{2} \times 2 \times 10^8 = 3 \times 10^8 \text{ m/s}$$ **[½]**

∴ Thus, the speed of light in air is 3×10^8 m/s.

$$\text{Speed of light in water} = \frac{3 \times 10^8}{4/3}$$

$= 2.25 \times 10^8$ m/s **[1]**

35. To get erect and diminished image mirror used is convex mirror. **[1]**



[1]

36. (i) The lens should be held in vertical position with its face parallel to screen.

(ii) A clear and sharpest image of the distant object should be obtained by suitably adjusting the position of lens.

(iii) At least three observation should be taken.

(iv) Measure the distance between the convex lens and the screen carefully. **[4 × ½]**

37. Focal length, f = +18 cm

Image distance, v = +24 cm

Object distance, u = ?

Magnification, m = ?

According to lens formula :

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$ **[1]**

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

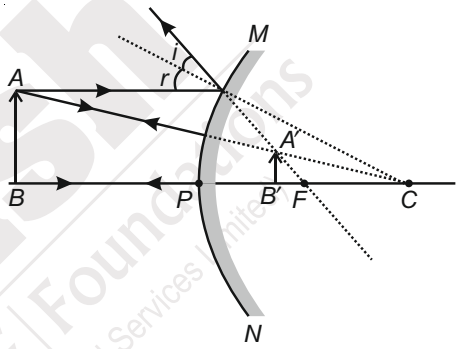
$$\frac{1}{u} = \frac{1}{24} - \frac{1}{18}$$

$$\frac{1}{u} = \frac{3-4}{72}$$

u = 72 cm **[1]**

$$m = \frac{v}{u} = \frac{24}{-72} = -0.33$$ **[1]**

38. **[1]**



An object is placed between infinity and the pole of a convex mirror, the image formed is :

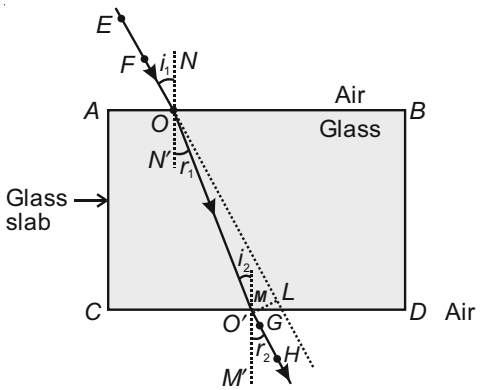
(i) Behind the mirror at focus (F)

(ii) Virtual and erect

(iii) Highly diminished. **[2]**

39. The principle of reversibility of light states that light will follow exactly the same path if its direction of travel is reversed. **[1]**

When light falls obliquely on a rectangular glass slab, the incident ray is parallel to the emergent ray; as shown in the figure. Angle of incidence is equal to the angle of emergence. **[1]**



[1]

40. (i) Convex mirror is used as rear view mirror because : (1) It has a large field of view. (2) It produces erect image of the objects behind the vehicle. **[1½]**

(ii) Concave mirror is used as shaving mirror, because : (1) It produces enlarged image when object is placed close to it. (2) It produces an erect image. **[1½]**

41. Given that :

Object distance, u = –36 cm

Image distance, v = 72 cm

As the image is obtained on a screen it is a real image and hence the spherical lens will be a convex lens. **[1]**

Focal length f = ?

According to lens formula,

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

Substituting the values, we get

$$\frac{1}{72}-\frac{1}{-36}=\frac{1}{f}$$

$$\frac{1}{f}=\frac{1}{72}+\frac{1}{36}$$

$$f=\frac{72}{36}$$

f = 24 cm **[1]**

Therefore the focal length of the lens = 24 cm

It is given that :

Object height, h_1 = 2.5 cm

Image height, h_2 = ?

We know that magnification, $m=\frac{v}{u}=\frac{h_2}{h_1}$

$$\Rightarrow \quad h_2=h_1\times\frac{v}{u}$$

$$h_2=2.5\times\frac{72}{-36}$$

h_2 = –5 cm

The image of the flame formed will be inverted and have a height of 5 cm. **[1]**

42. (a) Concave mirror **[½]**

(b) Linear magnification of a concave mirror is given by :

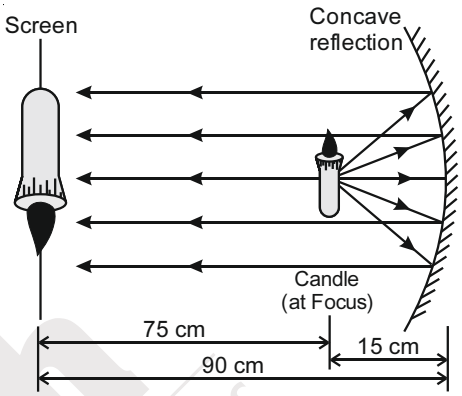
$$m=\frac{-v}{u}$$

$$=\frac{-(-90)}{(-15)}$$

$$=-6$$ **[1]**

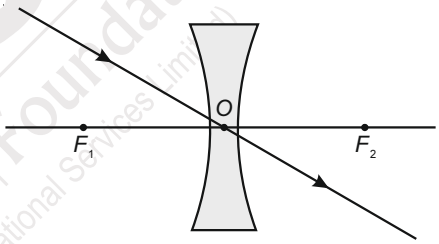
(c) The distance between the object and image = 90 – 15 = 75 cm. **[½]**

(d) Ray diagram



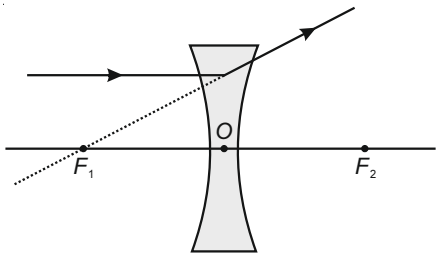
[1]

43. (i) A ray of light passing through the optical centre of the concave lens will emerge without any deviation.



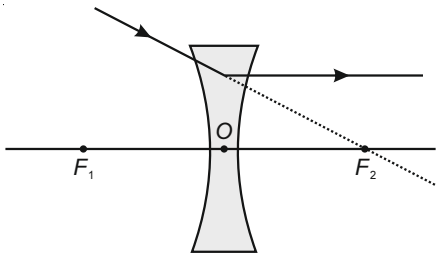
[1]

(ii) A ray of light parallel to the principal axis, after refraction from a concave lens, appears to diverge from the principal focus on the same side of the lens.



[1]

(iii) A ray of light directed towards the principal focus of a concave lens, becomes parallel to its principal axis after refraction through the lens.



[1]

44. Given : Height of the object, h = 5 cm

Focal length of the concave lens, f = –10 cm

Object distance, u = –20 cm

Using the lens formula, we get

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

$$\Rightarrow \quad \frac{1}{-10}=\frac{1}{v}-\frac{1}{-20}$$

$$\Rightarrow \quad -\frac{1}{10}=\frac{1}{v}-\frac{1}{-20}$$

$$\Rightarrow \quad -\frac{1}{10}-\frac{1}{20}=\frac{1}{v}$$

$$\Rightarrow \quad \frac{-2-1}{20}=\frac{1}{v}$$

$$\Rightarrow \quad \frac{-3}{20}=\frac{1}{v}$$

$\Rightarrow$ v = 6.67 cm **[1]**

Hence, the image is formed 6.67 cm in front of the lens on the same side as the object.

Because v is negative, we can say that the image is virtual. **[1]**

From the magnification formula for the lens, we get

$$m=\frac{h'}{h}=\frac{v}{u}$$

$$h'=\frac{vh}{u}$$

$$\Rightarrow \quad h'=\frac{-6.67(5)}{-20}$$

$\Rightarrow$ h' = 1.67

Hence, the size of the image is h' = 1.67 cm.

Because the height of the image is positive and smaller than the height of the object, the image is erect and diminished. So, we can conclude that the image is virtual, erect and diminished.

[1]

45. Given: Magnification, m = –2

Distance of the image, v = –30 cm

Magnification, $m=-\frac{v}{u}$

$$\therefore \quad u=-\frac{v}{m}=-\frac{(-30)}{(-2)}$$

$\therefore$ u = –15 cm **[1]**

Substituting these values in the mirror formula

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

$$=\frac{1}{(-30)}+\frac{1}{(-15)}$$

$$\frac{1}{f}=-\frac{1}{10}$$

$\therefore$ f = –10 cm **[1]**

When the object is moved 10 cm towards the mirror the new position of the object is

u' = –(15 – 10) = –5 cm

Substituting the new value in the mirror formula

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

$$\frac{1}{v'}=\frac{1}{f}-\frac{1}{u'}=\frac{1}{10}-\frac{1}{(-5)}$$

$$\frac{1}{v'}=\frac{1}{10}$$

$\therefore$ v' = 10 cm

Thus, the image is located 10 cm behind the mirror.

And magnification, $m'=\frac{v'}{u'}=-\frac{10}{(-5)}$

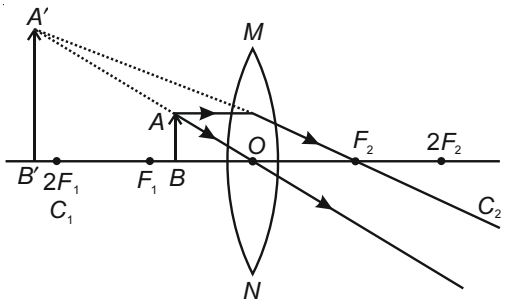
m' = 2

Since magnification is positive the image is erect and virtual.

Thus, the image is erect, virtual and magnified in nature. **[1]**

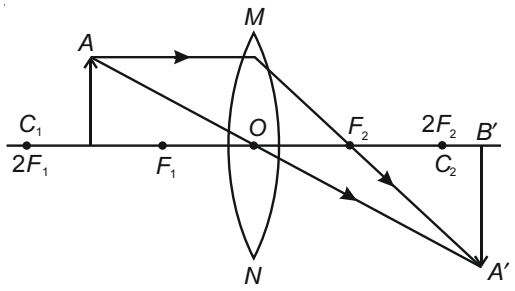
46. Convex lens can form a magnified erect image as well as a magnified inverted image of an object placed in front of it. **[1]**

Position of object	Position of image	Size of image	Nature of image
Between focus F_1 and optical centre O	On the same side of the lens as the object	Magnified	Virtual and erect



[1]

Position of object	Position of image	Size of image	Nature of image
Between F_1 and F_2	Beyond $2F_2$	Magnified	Real and inverted



[1]

47. **Laws of Refraction of light :**

Refraction of light follows the following two laws :

First Law : The incident ray, the normal to the transparent surface at the point of incidence and the refracted ray, all lie in one and the same plane. **[1]**

Second Law : The ratio of sine of the incidence angle ($\angle i$) to the sine of the refracted angle of the medium is called refractive index. It is denoted by n.

i.e., $\frac{\sin i}{\sin r} = n$

Refractive index of second medium with respect to the first medium is denoted by ${}_2n_1$.

Thus, eq.(i) can be written as ${}_2n_1 = \frac{\sin i}{\sin r}$

This law is called Snell's law as it was stated by Prof. Willebrord Snell (Dutch mathematician and astronomer). **[1]**

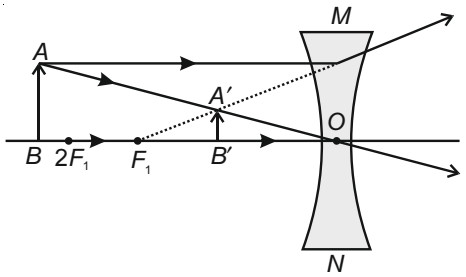
Absolute Refractive index :

Absolute refractive index of a medium is defined as the ratio of the speed of light in vacuum or air to the speed of light in the medium. It is denoted by n.

Then, $n = \frac{\text{Speed of light in air}}{\text{Speed of light in medium}} = \frac{c}{v}$

It has no unit. **[1]**

48. (a) Ray diagram showing the formation of image of an object placed between infinity and optical centre of a concave lens:



[2]

(b) A concave lens always forms a virtual, erect image on the same side of the object.

Focal length of concave lens, $f = -15$ cm

Image distance, $v = -10$ cm

(i) Let 'u' be the object distance; then using lens formula :

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

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

Substituting the values,

$$\frac{1}{u} = \left(\frac{-1}{10}\right) - \left(\frac{-1}{15}\right) = \left(\frac{-1}{30}\right)$$

Or, $u = -30$ cm $= -0.3$ m

Thus, object distance is 30 cm **[1]**

(ii) Magnification, $m = \frac{v}{u} = \frac{-10}{-30} = \frac{1}{3} = 0.33$

[1]

(iii) The positive sign shows that the image is erect and virtual. The image is one-third the size of the object. **[1]**

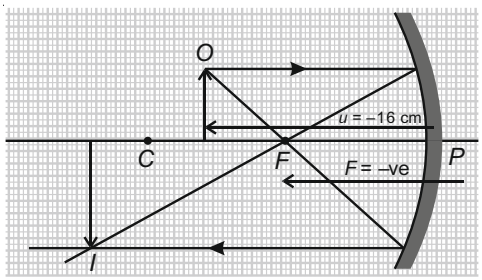
49. Sign conventions of spherical mirror :

(i) Object is always placed to the left of mirror.

(ii) All distances are measured from the pole of the mirror.

(iii) Distances measured in the direction of the incident ray are positive and the distances measured in the direction opposite to that of the incident ray are negative.

(iv) Distances measured along the y-axis (upwards) above the principal axis are positive and that measured along the y-axis (downwards) below the principal axis are negative. **[4 × ½]**



[1]

Given that :

Object distance, $u = -16$ cm

Magnification, $m = 3$

We know that magnification for a spherical Mirror, $m = -\frac{v}{u} = \frac{h_2}{h_1}$

i.e., $-\frac{v}{u} = 3$

$\Rightarrow v = -3u$

Using mirror formula:

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

$\frac{1}{f} = \frac{1}{-16} + \frac{1}{-3\times-16}$

$\frac{1}{f} = \frac{48}{-4}$

$u = -12$ cm **[1]**

Negative sign of focal length implies that the focal length is being measured against the direction of incident light and it is a concave mirror. **[1]**

50. (a) (i) **Optical centre:** The central point of the lens is known as optical centre. It is represented as *O*. The optical centre of a lens has a property that a ray of light passing through it does not suffer any deviation and goes straight.

(ii) **Centre of Curvature:** The centre of sphere of part of which a lens is formed is called the centre of curvature of the lens. Since concave and convex lenses are formed by the combination of two parts of spheres, therefore they have two centres of curvature. One centre of curvature is usually denoted by C_1 and second is denoted by C_2.

(iii) **Principal Axis:** The principal axis of a lens is a line passing through the optical centre of the lens and perpendicular to both the faces of the lens.

(iv) **Aperture:** The diameter of sphere of part of which a lens is formed is called the aperture.

(v) **Principal Focus:** The convex lens converge the rays incident on it after refraction, to a point on the principal axis. This point is known as principal focus of the convex lens.

The rays incident on concave lens appear to diverge from a point on the principal axis. This point is known as the principal focus of concave lens.

(vi) **Focal Length:** The focal length of a lens is the distance between optical centre and principal focus of the lens. **[6 × ½]**

(b) Given,

Image distance : v = +48 cm (It is on the other side of the lens)

Focal length : f = +12 cm (It is a converging lens or convex lens)

Object distance : u = ? (To be calculated)

Now, putting these values in the lens formula :

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ **[½]**

$\Rightarrow \frac{1}{12} = \frac{1}{48} - \frac{1}{u}$

$\Rightarrow \frac{1}{u} = \frac{1}{48} - \frac{1}{12}$

$\Rightarrow \frac{1}{u} = \frac{1-3}{48}$

$\Rightarrow \frac{1}{u} = \frac{-1}{24}$

$\Rightarrow$ u = –24 cm **[½]**

Therefore, the object should be placed at a distance of 24 cm from the convex lens. The minus sign with the object distance shows that the object is on its left side. **[1]**

51. The power of a lens is defined as the reciprocal of its focal length. It is represented by the letter *p*. The power *p* of a lens of focal length f is given as

$p = \frac{1}{f}$

The SI unit of power is dioptre (D). **[1]**

Given:

Focal length of lens *A*, *FA* = +10 cm = +0.1 m **[½]**

Focal length of lens *B*, *FB* = –10 cm = –0.1 m **[½]**

To calculate the power of lens *A* :

The power of lens *A*,

$p = \frac{1}{f_A}$

$\Rightarrow p = \frac{1}{+0.1}$

$\Rightarrow p$ = +10 D **[½]**

The positive sign indicates that it is a converging or convex lens.

To calculate the power of lens *B* :

The power of lens *B*,

$$p = \frac{1}{f_B}$$

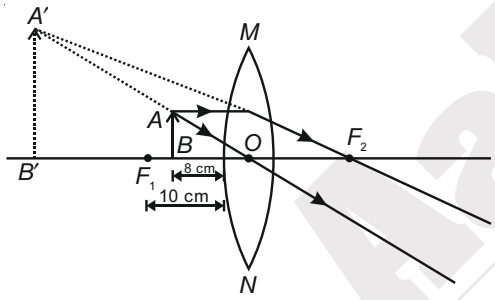
$$\Rightarrow \quad p = \frac{1}{-0.1}$$

$$\Rightarrow \quad p = -10 \text{ D} \qquad \textbf{[½]}$$

The negative sign indicates that it is a diverging or concave lens.

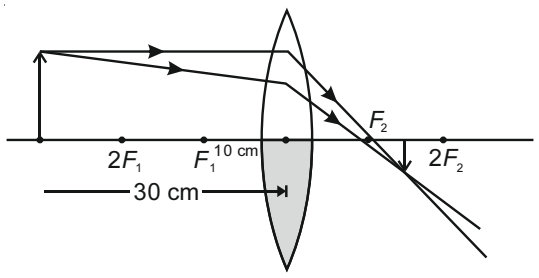
In a convex lens, when the object is placed between the pole and focus, the image formed is always virtual and magnified. **[1]**

On the other hand, a concave lens produces virtual, erect but diminished image. Here the object is placed 8 cm from the lens which is at a distance less than the focal length, *i.e.* less than 10 cm. Thus, the 8 cm position of the object placed in front of the convex lens will produce a virtual and magnified image. The diagram for the same is as shown below :



[1]

52. A convex lens can produce the complete image of the object even though half of the lens is covered. This is because light coming from the object can be refracted from the other half of the lens. However, the intensity of light will be reduced. **[1]**



[1]

Given: Height of the object = h = 4 cm

Focal length of the convex lens = f = 20 cm

Object distance = u = –15 cm

Using the lens formula, we get

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

$$\Rightarrow \quad \frac{1}{20} = \frac{1}{v} - \frac{1}{-15}$$

$$\Rightarrow \quad \frac{1}{20} = \frac{1}{v} + \frac{1}{15}$$

$$\Rightarrow \quad \frac{1}{20} - \frac{1}{15} = \frac{1}{v}$$

$$\Rightarrow \quad \frac{-1}{60} = \frac{1}{v}$$

$$\Rightarrow \quad v = -16 \qquad \textbf{[1]}$$

Hence, the image is formed 60 cm in front of the lens on the same side as the object.

Because v is negative, we can say that the image is virtual. From the magnification formula for the lens, we get

$$m = \frac{h'}{h} = \frac{v}{u}$$

$$h' = \frac{vh}{u}$$

$$\Rightarrow \quad h' = \frac{-60(4)}{-15}$$

$$\Rightarrow \quad h' = 16 \text{ cm} \qquad \textbf{[1]}$$

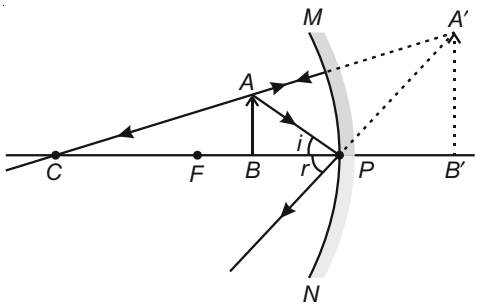
Hence, the size of the image is h' = 16 cm.

Because the height of the image is positive and greater than the height of the object, the image is erect and magnified. So, we can conclude that the image is virtual, erect and magnified. **[1]**

53. (i) To obtain an erect image, the object should be placed within the focus, *i.e.*, between the pole and the focus. Here, the focal length of the mirror is 12 cm.

Hence, the object should be placed at a distance less than 12 cm. **[1]**

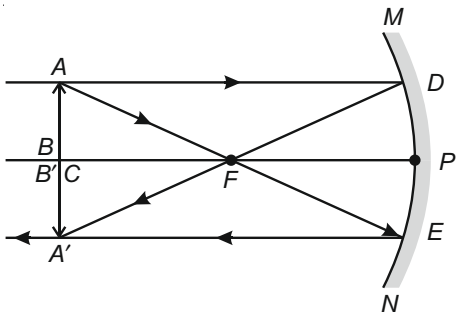
(ii) The image will be larger than the object (enlarged). **[1]**



[1]

(iii) Since f = 12 cm → Centre of curvature = $2f$ = 24 cm

For an object placed at a distance 24 cm, *i.e.*, at the centre of curvature of a concave mirror, the image formed will be real, inverted and of the same size as that of the object. **[1]**



[1]

54. (a) The focal length of a diverging lens is half the value of its radius of curvature. Conventionally, the sign of the focal length of the diverging lens is taken as negative. **[1]**

(b) Given :

f = –20 cm (It is a diverging lens.)

v = –15 cm (Image is formed on the same side of the lens.)

Using the lens formula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$ **[1]**

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

$$=\frac{1}{(-15)}+\frac{1}{(-30)}=-\frac{1}{30}$$

$\therefore$ u = –30 cm **[1]**

Given: Height of the object, h = 6 cm

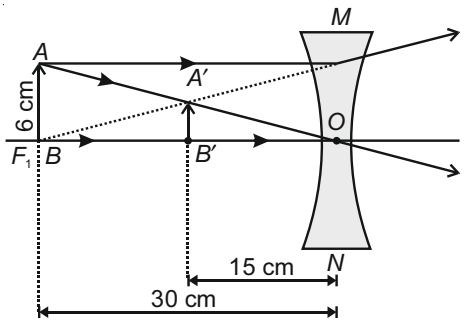
Height of the image, h' = ?

Magnification, $m=\frac{v}{u}=\frac{h'}{h}$

$$\therefore\ h'=h\frac{v}{u}=6\times\frac{(-15)}{(-30)}$$

$\therefore$ h' = 3 cm **[1]**

(c)

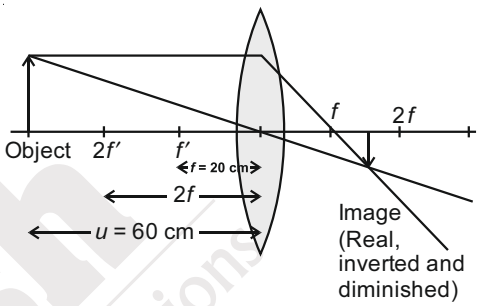


[1]

55. (a) When the object distance and the image distance are the same, it means that the object is placed at $2f$ or the image is formed at $2f$. From the table, it is clear that $2f$ = 40 cm. Therefore, the focal length of the convex lens is 20 cm. **[1]**

(b) Serial number 6 is incorrect. Given that the object is placed at 15 cm which is between the focal length and the lens. Thus, the image should be formed on the same side as the object. The data given in the observation serial number 6 does not satisfy the condition. **[2]**

(c)



[1]

Magnification, $m=\frac{v}{u}$

Let us consider the third observation where

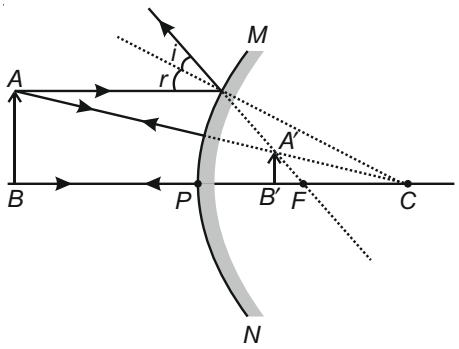
u = –40 cm and v = 40 cm

$$\therefore\ m=\frac{v}{u}=\frac{40}{-40}$$

$\therefore$ m = –1 **[1]**

56. (a) A convex mirror always forms a diminished, erect and virtual image of the object placed in front of it. **[1]**

Position of object	Position of image	Size of image	Nature of image
Between infinity and the pole of the mirror	Between P and F behind the mirror	Diminished	Virtual and erect



[1]

Use of a convex mirror :

(i) Convex mirrors are commonly used as rear view mirrors in vehicles.

(ii) They are preferred because they always give an erect image, although diminished. Also, they have a wider field of view as they are curved outwards. Thus, convex mirrors enable the driver to view a much larger area than would be possible with a plane mirror. **[2 × ½]**

(b) The radius of curvature of a spherical mirror is the radius of the sphere of which the reflecting surface of the spherical mirror is a part and represented by R. **[1]**

Radius of curvature R = 24 cm

Radius of curvature = 2 × focal length

i.e., $R = 2f$

$24 = 2 \times f$

$f = \frac{24}{2} = 12$

f = 12 cm **[1]**

57. Given

f = –30 cm

u = –60 cm

$\therefore \quad \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ **[1]**

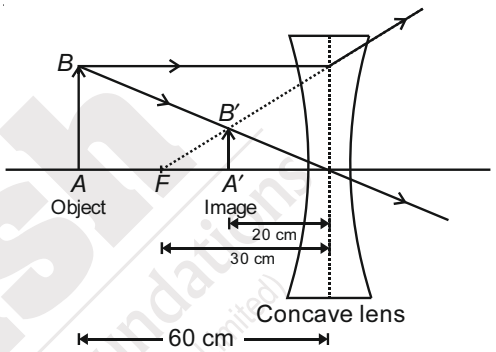
$\Rightarrow \quad \frac{1}{-30} = \frac{1}{v} - \frac{1}{-60}$

$\Rightarrow \quad \frac{1}{v} = -\frac{1}{30} - \frac{1}{60}$

$\Rightarrow \quad \frac{1}{v} = -\frac{3}{60}$

$\Rightarrow \quad v$ = –20 cm **[1]**

Nature	:	Virtual
Position	:	20 cm from the lens, same side as the object
Size	:	Diminished
Erect/Inverted	:	Erect **[1]**



[2]

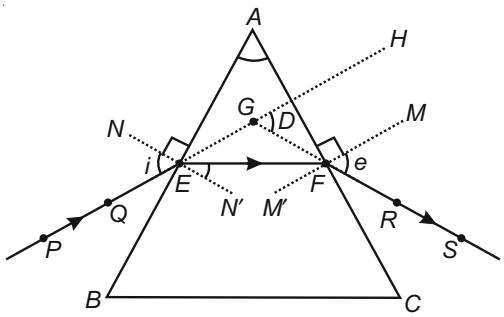
Chapter - 11 : Human Eye and Colourful World

1. Sky looks blue on a clear day because blue colour of light is scattered most by the particles present in the atmosphere. **[1]**
2. Answer (D) **[1]**
3. Answer (B) **[1]**
4. Answer (D) **[1]**

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

The angle between the normal and the emergent ray is the angle of emergence.

The correctly marked angles are shown in the diagram below :



5. Answer (A) **[1]**

The angle between the incident ray and the normal is known as the angle of incidence, and the angle between the emergent ray and the normal is known as the angle of emergence. The emergent ray is bent at an angle with the direction of the incident ray. This angle is called the angle of deviation.

6. Answer (B) **[1]**

Because the emergent ray is parallel to the incident ray, the angle of incidence is equal to the angle of emergence. The refracted ray travels from a rarer medium to a denser medium (considering the first refraction); it bends towards the normal. Thus, the angle of incidence is greater than the angle of refraction.

If we consider the second refraction, then light travels from a denser medium to a rarer medium, due to which it bends away from the normal after refraction. So, in this case, the angle of refraction is again less than the angle of emergence.

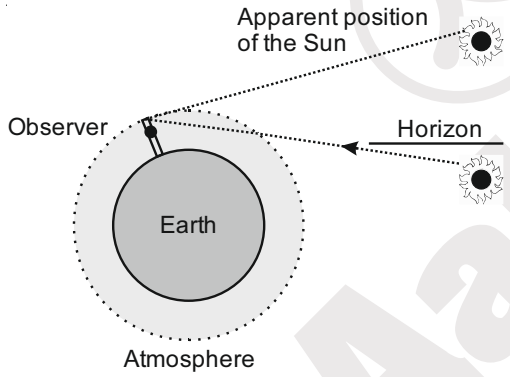
7. (a) Red color will be seen at *Y* and violet colour will be seen at *X*. **[1]**

(b) Different colors of white light travel at different speeds through the glass prism.

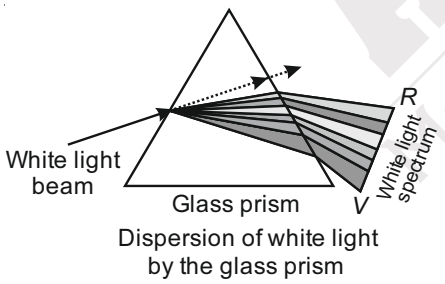
Hence, they bend through different angles with respect to the incident beam of light.

[1]

8. Sunrise takes place when the sun is just above the horizon. But due to refraction of sunlight caused by the atmosphere, we can see the rising sun about 2 minutes before it is actually above the horizon. This happens because when the sun is slightly below the horizon, the sun's light coming from less dense air to more dense air is refracted downwards as it passes through the atmosphere. Because of this atmospheric refraction, the sun appears to be raised above the horizon when actually it is slightly below the horizon. **[2]**



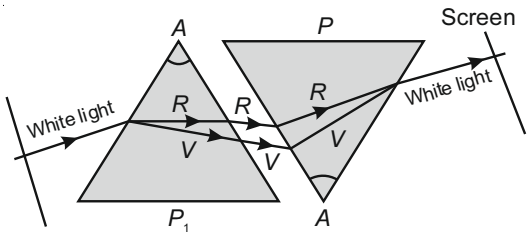
9. **[1]**



Dispersion of white light by the glass prism

Different colours of white light bend through different angles with respect to the incident ray, as they pass through a prism. Thus the rays of each colour emerge along different paths and become distinct. It is the band of distinct colours that we see in a spectrum. **[1]**

10. When a second identical prism is placed in an inverted position with respect to the first prism, recombination of the spectrum occurs and it forms white light again. **[1]**



[1]

11. This effect is called twinkling effect. Atmospheric refraction is the reason behind this effect. **[½]**

Since the stars are very far, they can be taken as point sized objects. As the path of rays coming from the stars keep varying due to atmospheric refraction, the apparent position of the stars fluctuates and the amount of light entering our eyes also varies resulting in a twinkling effect. **[1½]**

12. The ability of an eye to see objects from infinity (far point) upto 25 cm (near point) is called power of accommodation. **[1]**

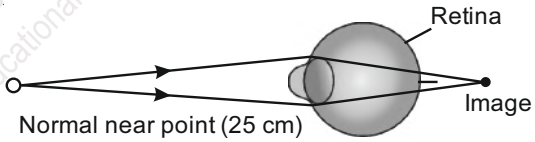
When we look at objects closer to eye, the ciliary muscles contract. This increases the curvature of eye lens. **[1]**

13. Hypermetropia is an eye defect in which distant vision is clear while near vision is blurred. **[1]**

Causes of Hypermetropia :

- Shortening of the eyeball, that is, the eyeball becomes smaller. **[½]**
- Increase in focal length of the eye lens. **[½]**

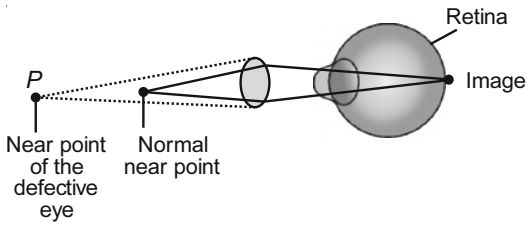
(i)



Hypermetropic Eye

[½]

(ii)



[½]

14. Focal length, f = +18 cm

Image distance, v = +24 cm

Object distance, u = ?

Magnification, m = ? **[½]**

According to lens formula :

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$ **[½]**

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

$$\frac{1}{u} = \frac{1}{24} - \frac{1}{18}$$ **[½]**

$$\frac{1}{u} = \frac{3-4}{72}$$

$u = -72$ cm **[½]**

$$m = \frac{v}{u} = \frac{24}{-72} = -0.33$$ **[1]**

15. (a) The process by which the ciliary muscles change the focal length of an eye lens to focus distant or near objects clearly on the retina is called the accommodation of the eye. The ability of the eye to do this is called the power of accommodation of the eye. **[1½]**

(b) To correct this defect of vision, the person must use a concave lens. **[½]**

Focal length of the corrective lens used

= –(Distance of far point of the myopic eye)

= –1.2 m

Power of the lens

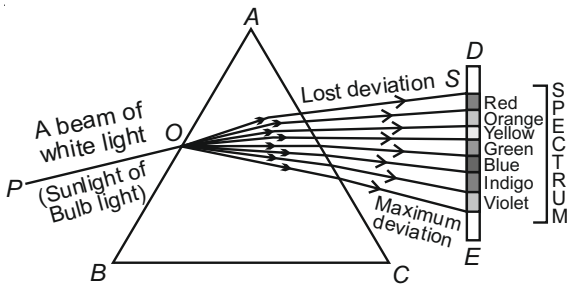
$$= \frac{1}{\text{focal length}} = \frac{1}{-12} = -0.83\,\text{D}$$ **[1]**

16. During sunrise and sunset, Sun is red in colour while at noon, the Sun appears white. **[1]**

At the time of sunrise and sunset, the Sun is near the horizon. The rays from the Sun have to travel a much larger part of the atmosphere to reach an observer on earth. So, most of the blue light gets scattered away.

The red colour which has the largest wavelength is scattered the least and enters into our eyes. Hence, the Sun appears red at the time of sunrise and sunset. **[1]**

At noon, the sun is nearly overhead. The sunlight has to pass through much smaller portion of the Earth's atmosphere. The scattering is much less and the Sun looks white. **[1]**

17. 

(i) Dispersion of light

Cause : The dispersion of white light occurs because colors of white light travel at different speeds through glass prism. Different colours undergo different deviations on passing through prism. **[1]**

(ii) Rainbow is the example of dispersion of light observed in nature.

It is caused due to dispersion of sunlight by water droplets in the atmosphere. It always forms in the direction opposite to the sun. **[1]**

(iii) White light is a mixture of seven colours. The sequence of colours given by the prism is Violet, Indigo, Blue, Green, Yellow, Orange and Red. VIBGYOR is the acronym for this sequence. The red light bends the least and violet light bends the most. **[1]**

18. The curvature of the eye lens can be adjusted by the ciliary muscles. This changes the focal length of the lens. The defect which arises because of the gradual weakening of the ciliary muscles is known as presbyopia. A bifocal lens can be used to correct presbyopia. Answers to the context questions :

(a) Akshay is not able to see from a far distance, so he is suffering from myopia or nearsightedness. A concave lens should be used to correct this defect. **[1]**

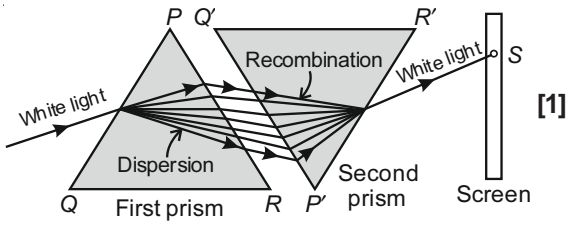
(b) The teacher displayed presence of mind and pro-activeness, and she is of a considerate nature. Salman displayed the virtue of friendship and is caring in nature. **[1]**

(c) Akshay should thank the teacher and Salman in front of the entire class. **[1]**

19. The seven colours of a spectrum can be recombined to give back white light as

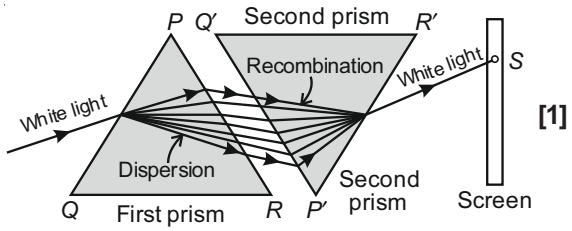
(a) Two identical glass prisms are placed such that their refracting surfaces are in opposite direction (placed inverted). When a beam of light is allowed to fall on the surface of one prism, a patch of ordinary white light is obtained on a screen placed behind the second prism. **[1]**

(b) The first prism disperses the white light into seven coloured rays. The second prism receives all the seven coloured rays from the first prism and recombines them into original white light. This is because the refraction produced by the second prism is equal and opposite to that produced by the first prism. Hence, the light coming out of the second prism will be white. **[1]**



[1]

20. The phenomenon of splitting of white light into its constituent seven colours on passing through a glass prism is called dispersion of light. **[1]**

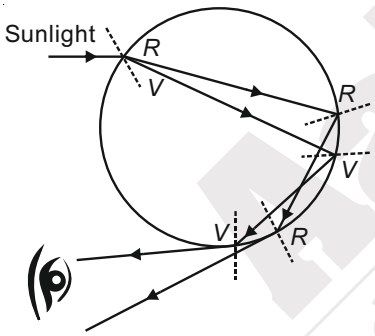


[1]

It is essential to place the two identical prisms in an inverted position with respect to each other because the refraction produced by the second prism is equal and opposite to that produced by the first prism. **[1]**

21. When a bright light focused on our eyes, then light first passes through the cornea and enters into the pupil, where size of pupil contracts which is controlled by iris. Hence less light enters the eye through the pupil. Then light passes through the eye lens and image is formed on the retina. The nature of image formed will be real and inverted. **[3]**

22. Rainbow is a natural optical phenomenon caused by the dispersion of sunlight by tiny water droplet in the Earth's atmosphere. **[1½]**



[1½]

Contribution of a single water droplet suspended in air in the formation of a rainbow

23. (a) (i) Due to scattering of light **[1]**

(ii) Due to atmospheric refraction **[1]**

(iii) At the near point of eye, curvature of eye lens is maximum and focal length is minimum. If object is placed nearer than it, eye lens cannot adjust its curvature. **[1]**

(b) Presbyopia - The defect of vision in which the eye is unable to see nearby as well as far off objects clearly. **[1]**

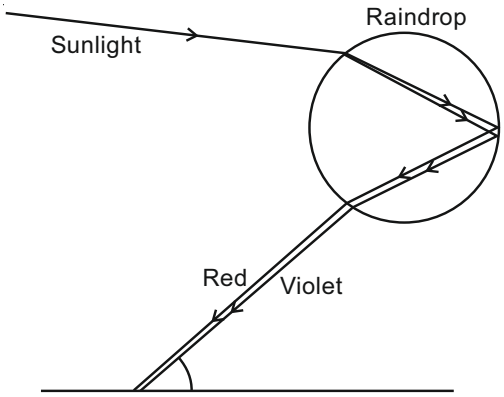
Causes:

Weakening of ciliary muscles. **[½]**

Diminishing flexibility of the eye lens. **[½]**

24. (a) Dispersion - The splitting of white light into its constituent colours. **[½]**

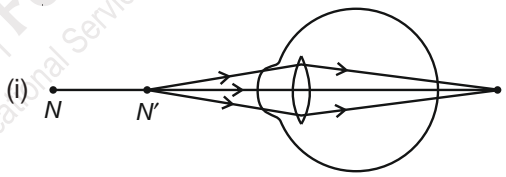
Rainbow formation (figure)



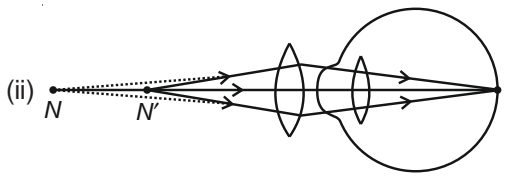
[½]

Water droplets in air refract and disperse the incident sunlight. Then, reflect it internally and finally refract it again when it comes out of the droplet. Due to the dispersion of light and internal reflection, different colours of sunlight reach the observer's eye and are visible in the form of a rainbow. **[1]**

(b) Hypermetropia - The defect of vision due to which a person clearly sees distant objects but cannot clearly see nearby objects. **[1]**



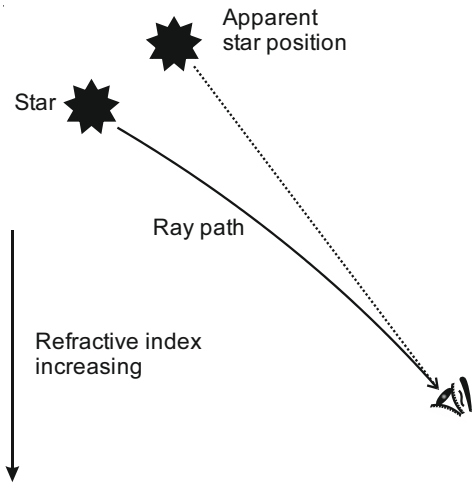
[1]



[1]

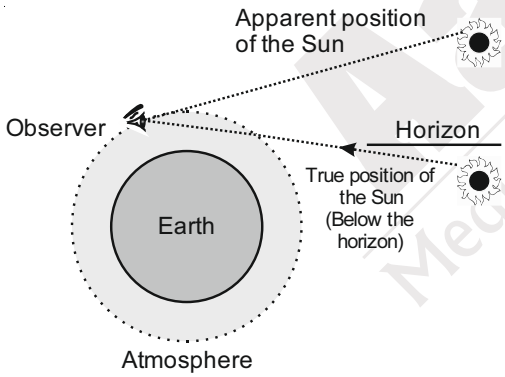
25. The refraction of light by the earth's atmosphere is termed as atmosphere refraction. **[1]**

(a) Stars emit light on their own; when this light travels through the Earth's atmosphere which has variable optical density, the continuously changing atmosphere refracts the light from the stars in different amounts from one moment to the next. The light seems to be bright and dim as it keeps changing because of continuous refraction through the different layers of the atmosphere of the Earth. Hence, we say light twinkles at night. **[1½]**



[½]

(b) The sunrise is advanced because of the atmospheric refraction of sunlight. An observer on the Earth sees the Sun two minutes before the Sun reaches the horizon. A ray of sunlight entering the Earth's atmosphere follows a curved path because of atmospheric refraction before reaching the Earth. This happens because of a gradual variation in the refractive index of the atmosphere. For an observer on the Earth, the apparent position of the Sun is slightly higher than the actual position. Hence, the Sun is seen before it reaches the horizon. **[1]**

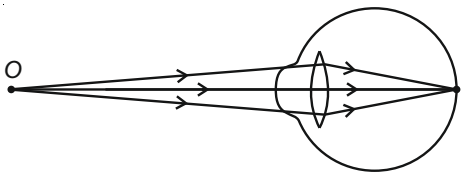


[½]

The increased atmospheric refraction of sunlight occurs also at sunset. In this case, the observer on the Earth continues to see the setting Sun for two minutes after the Sun has dipped below the horizon, thus delaying the sunset. The advanced sunrise and delayed sunset increase the duration of the day by four minutes. **[½]**

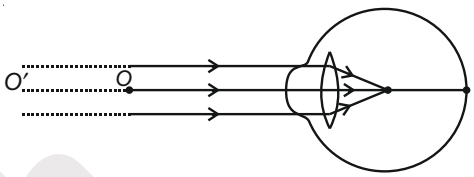
26. (a) This defect may arise due to excessive curvature of the eye lens or elongation of the eyeball.

(i) A person with this defect has the far point nearer than infinity. Such a person may see clearly up to a distance of a few meters.



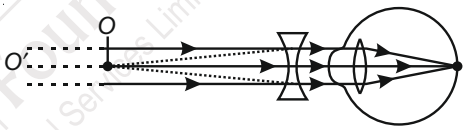
[1]

In a myopic eye, the image of a distant object is formed in front of the retina and not at the retina itself.



[1]

(ii) This defect can be corrected by using a concave lens of suitable power. A concave lens of suitable power will bring the image back onto the retina and thus the defect is corrected.



[1]

(b) Given: Focal length $f = -5$ m

(it is a concave lens)

Power, $P = \frac{1}{f(\text{in m})} = \frac{1}{-5} = -0.2\text{D}$ **[1]**

The negative sign indicates that it is a diverging lens or concave lens. **[1]**

27. (a) His eye suffering from Myopia. **[½]**

Causes of Myopia : The two possible causes of this defect are :

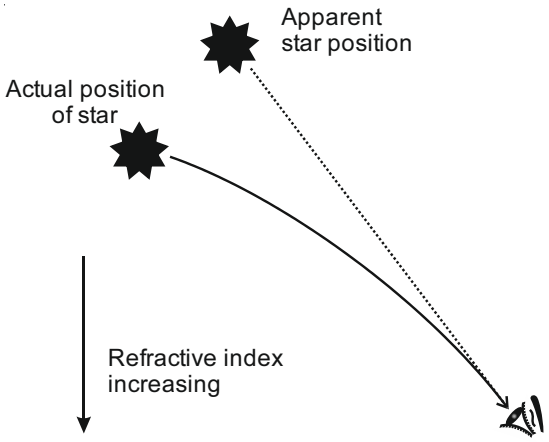
Increase in the length of the eye ball, as if distance of retina from the eye lens has increased. **[1]**

Decrease in focal length of the eye lens when the eye is fully relaxed. This is as if the ciliary muscles holding the eye lens do not relax fully and have some tension. **[1]**

This defect can be corrected by using a concave lens of suitable focal length.

[½]

(b) **Twinkling of Stars**



Due to refraction of light, the apparent position of the star is different from the actual position of the star. The different layers of the atmosphere are mobile and the temperature and the density of layers of atmosphere changes continuously. Hence, the apparent position of the star changes continuously. The change in the apparent position of the star continuously leads to the twinkling of a star. **[2]**

28. (a) (i) **Cornea :** Its function is to act as a window to the world, *i.e.*, to allow the light to enter the eye ball. **[½]**

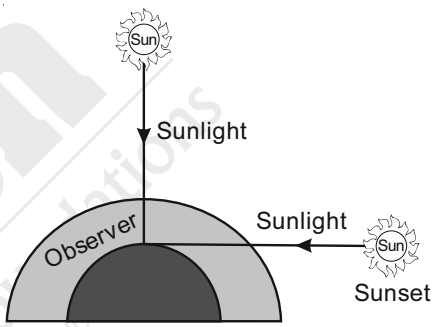
(ii) **Iris :** Its function is to control the amount of light entering in the eye. **[½]**

(iii) **Crystalline lens :** Its function is to focus the images of the objects at different distances, clearly on the retina. **[½]**

(iv) **Ciliary muscles :** Its function is to alter the focal length of the crystalline lens, so that the image of the objects at various distances if clearly focussed on the retina. **[½]**

(b) **Colour of the sun at sunrise and sunset**

At the time of sunrise and sunset, the position of the sun is very far away from us. The sunlight travels longer distance through the atmosphere of the earth before reaching our eyes. Scattering of blue light is more than the scattering of red light. As a result of this, more red light reaches our eyes than any other colour. Therefore at sunset and sunrise sun appears red. **[2]**



This phenomenon will not be observed by an astronaut on moon, since there is no atmosphere so no scattering of light takes place, thus the sun appears dark. **[1]**

Chapter - 12 : Electricity

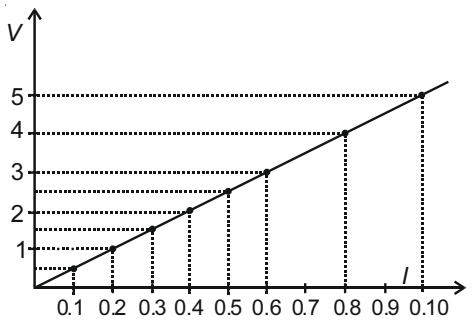
1. 40 W lamps **[1]**
2. To detect the presence of electric current in a circuit. **[1]**
3. Resistivity of an alloy is higher than its constituent metal and alloys do not oxidize as easily as constituent metal at high temperature. That is why the coils of electric toasters are made of an alloy rather than a pure metal. **[2]**
4. $R = \frac{\rho}{A}$ **[½]**

If the length is increased to twice the original length, keeping the area of cross-section same, then resistance will become double of its original value. **[1]**

So new resistance = 2 × 20 = 40 ohm. **[½]**

5. Resistance (R) = slope of line

$$= \frac{1-0.5}{0.2-0.1} = \frac{0.5}{0.1} = 5\,\Omega$$ **[1]**



[1]

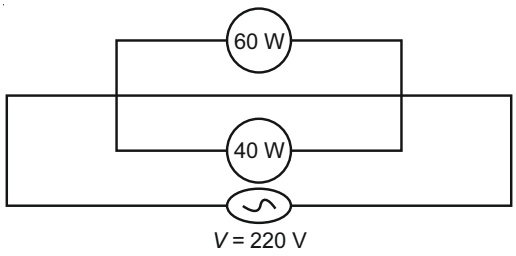
6. Straight line signify that the potential difference applied across the resistor is directly proportional to the current flowing through it.

To determine the resistance from the graph, read the current value, in amperes corresponding to a given voltmeter reading and take the ratio $\left(\frac{V}{I}\right)$. Thus the resistance of conductor is determined in ohms. **[2]**

7. If the pointer is above the zero mark, the zero error is negative. The number of division it is above the zero mark are to be subtracted from reading. **[1]**

   If the pointer is below zero mark, the zero error is positive. The number of division it is below the zero mark are to be added to reading. **[1]**

8. (a)



[1]

(b) $I = \frac{P}{V}$

$I_1 = \frac{60\ W}{220\ W} = \frac{3}{11}\ A$

$I_2 = \frac{40\ W}{220\ W} = \frac{2}{11}\ A$

$I = I_1 + I_2 = \frac{3}{11} + \frac{2}{11} = \frac{5}{11}\ A = 0.45\ A$ **[1]**

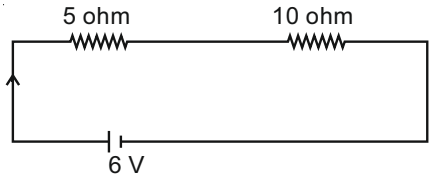
(c) $E = P \times t$ = (40 W + 60 W) × 1 h

= 100 Wh or 0.1 kWh. **[1]**

9. (a) (i) To obtain the minimum current, the resistances should be connected in series. **[½]**

   (ii) To obtain the maximum current, the resistances should be connected in parallel. **[½]**

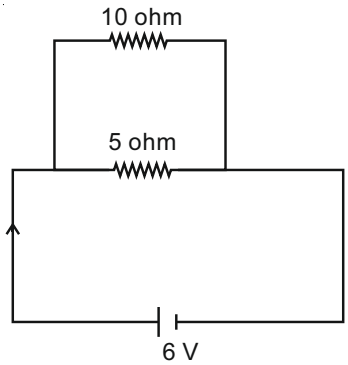
   (b) (i) Resistances in series:



Total resistance in the circuit R = 5 + 10 = 15 ohm

Current in the circuit $I = \frac{6}{15} = 0.4\ A$ **[1]**

(ii) Resistances in parallel:



Total resistance in the circuit

$R = \frac{(5 \times 10)}{(5 + 10)} = \frac{50}{15} = \frac{10}{3}$ ohm

Current in the circuit $I = \frac{6 \times 3}{10} = 1.8\ A$

[1]

10. (a) Joule's law of heating $H = I^2Rt$

When electric current flows through resistance element, the flowing charges suffer resistance, the work done to overcome resistance is converted to heat energy. **[1]**

(b) P_1 = 100 W, V_1 = 220 V

P_2 = 60 W, V_2 = 220 V

$P = VI$

$I_1 = \frac{P_1}{V_1} = \frac{100}{220} = \frac{10}{22} = 0.45\ A$ **[1]**

$I_1 = \frac{P_2}{V_2} = \frac{60}{220} = \frac{3}{11} = 0.27\ A$ **[1]**

11. (a) Resistance of conductor depends on following factor :

   (i) Resistance of conductor is directly proportional to length (l) of the conductor.

   $R \propto l$

   (ii) Resistance of conductor is inversely proportional to area of cross-section of conductor.

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

   (iii) Resistance also depends on a material of conductor (ρ)

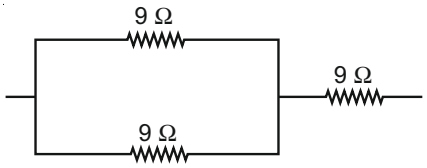
   $\therefore \quad R \propto \rho \frac{l}{A}$

(iv) Resistance and resistivity also depends on temperature. **[1]**

(b) Metals have more free electrons than glass to carry currents. That's why glass is bad conductor and metals are good conductors. **[1]**

(c) Alloys are used rather than pure metals in electrical heating devices, since they have low electrical conductivity and also low melting point. **[1]**

12. (i) $\frac{9\times9}{9+9}=\frac{9\times9}{2(9)}=4.5\ \Omega+9\ \Omega=13.5\ \Omega$ **[1½]**



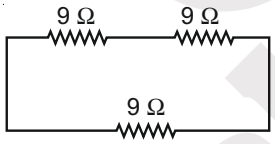
Two 9 Ω resistors are connected in parallel and one in series.

(ii) 2 resistors connected in series

= (9 + 9) Ω = 18 Ω

18 Ω and 9 Ω are connected in series.

$\frac{18\times9}{18+9}=6\Omega$



[1½]

13. Let us take a resistor of resistance R. Let the current flowing through this resistor is equal to I and the potential difference across it is equal to V. Suppose in time t, Q amount of charge flows through the resistor.

Work done in moving this charge,

$W = VQ$ ...(i)

According to the definition of electric current,

$$I=\frac{Q}{t}$$

$Q = I \times t$ **[1]**

Putting this in equation (i),

$W = V \times I \times t$

This work done is dissipated as heat.

Hence, heat produced, $H = W = VIt$

$H = VIt$ ...(ii) **[1]**

According to Ohm's law, $V = IR$.

Putting this in equation (ii),

$H = IR \times It$

$H = I^2Rt$ **[1]**

This relation is known as Joule's law of heating

Numerical :

Power, P = 12 W

Potential difference, V = 12 volt

Time duration, t = 1 min = 60 s

$$P=\frac{H}{t}$$ **[1]**

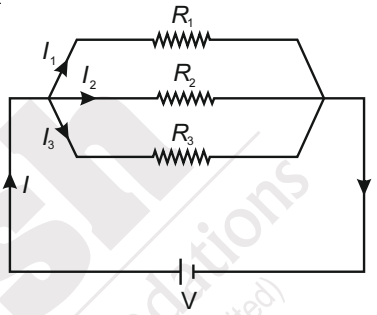
$H = P \times t$

= 12 W × 60 s

= 720 J **[1]**

The heat generated by the instrument is 720 J.

14.



The given figure shows a circuit consisting of three resistors R_1, R_2 and R_3 connected in parallel. The total current in the circuit (I) gets divided among the three resistors as I_1, I_2 and I_3.

Thus, $I = I_1 + I_2 + I_3$ ...(i) **[1]**

Applying Ohm's law for each resistor,

$$\left.\begin{aligned} I_1&=\frac{V}{R_1}\\ I_2&=\frac{V}{R_2}\\ I_3&=\frac{V}{R_3}\end{aligned}\right\}$$ ...(ii)

[1]

Let the equivalent resistance of the circuit be R_{eq}.

Applying Ohm's law for the equivalent circuit,

$$I=\frac{V}{R_{eq}}$$ ...(iii)

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

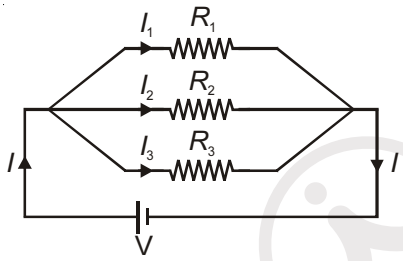
$$\frac{V}{R_{eq}}=\frac{V}{R_1}+\frac{V}{R_2}+\frac{V}{R_3}$$

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

This is the expression for the equivalent resistance of a parallel combination of three resistances. An ammeter has to be connected in series with the combination of all these resistors so that the current passing through the ammeter is equal to the total current through the circuit. **[1]**

The voltmeter has to be connected in parallel to that resistor across which the potential difference has to be measured. **[1]**

15. (a) Consider three resistors R_1, R_2, R_3 connected in parallel with a battery as shown in the figure



The potential difference across each of the resistor is same as the applied voltage, but the value of current across each resistor is different.

Let I_1, I_2, I_3 be the current flowing through R_1, R_2 and R_3 respectively.

$\therefore\ I = I_1 + I_2 + I_3$ …(i) **[1]**

Let the effective resistance of this parallel combination be R_P, then using, Ohm's law

$$I = \frac{V}{R_P} \quad \text{…(ii)}$$

As V is same for all resistor, therefore

$$I_1 = \frac{V}{R_1},\ I_2 = \frac{V}{R_2},\ I_3 = \frac{V}{R_3} \quad \text{…(iii)} \qquad \textbf{[1]}$$

Hence, from equations (i), (ii) and (iii), we get

$$\frac{V}{R_P} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\boxed{\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} \qquad \textbf{[1]}$$

i.e., the reciprocal of effective resistance in parallel combination is equal to the sum of reciprocals of all the individual resistances.

(b) $\therefore\ \dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$ **[½]**

$$\frac{1}{R_{eq}} = \frac{1}{12} + \frac{1}{12} = \frac{2}{12} \qquad \textbf{[½]}$$

$R_{eq} = 6\ \Omega$

$\therefore\ I = \dfrac{V}{R_{eq}}$ **[½]**

$I = \dfrac{6}{6} = 1$ A **[½]**

16. (a) Here conductor and lamp are in series

$\therefore\ R_{eq} = R_1 + R_2$

$R_{eq} = 4 + 20 = 24\ \Omega$ **[1]**

(b) $\therefore\ I = \dfrac{V}{R_{eq}}$

$I = \dfrac{6}{24} = 0.25$ A **[1]**

(c) (i) Potential difference across the electric lamp

$\therefore\ V_L = IR_L$

$V_L = 0.25 \times 20$

$V_L = 5$ V **[1]**

(ii) Potential difference across the conductor

$V_C = IR_C$

$V_C = 0.25 \times 4$

$V_C = 1$ V **[1]**

(d) Power of the lamp

$\therefore\ P = \dfrac{V_L^2}{R_L}$

$P = \dfrac{(5)^2}{20} = \dfrac{25}{20}$

$P = 1.25$ W **[1]**

Chapter - 13 : Magnetic Effects of Electric Current

1. A series arrangement is not used for connecting domestic electrical appliances in a circuit because :

   (i) Same current flows through each device, but different devices need current of different values to operate.

   (ii) If one device in a series circuit is defective, current is cut off.

   (iii) Total resistance of the circuit increases, so current flowing is reduced.

   (iv) Selective operation of devices is not possible. **[4 × ¼]**

2. Using Fleming's left hand rule we can easily find out that the nature of the charge on the particle is positive. **[1]**

3. To detect the presence of electric current in a circuit. **[1]**

4. Magnetic field - The region around a magnet in which force of the magnet can be experienced. **[1]**

   A compass needle is a small bar magnet so it experiences the force of the other bar magnet when brought near it and deflects. **[1]**

5. (i) A momentary deflection in the galvanometer will be seen, indicating a flow of current in the circuit. **[½]**

   (ii) A momentary deflection in the galvanometer (but in opposite direction) will be seen, indicating a flow of current in the opposite direction in the circuit. **[½]**

   (iii) No deflection in the galvanometer will seen, indicating that not current flows in the circuit. **[½]**

   The phenomenon involved is electromagnetic induction. **[½]**

6. (a) Short circuiting - When neutral and live wire come in direct contact. **[1]**

   Overloading - When too many appliances are connected to a single socket drawing much more current or power than permissible. **[1]**

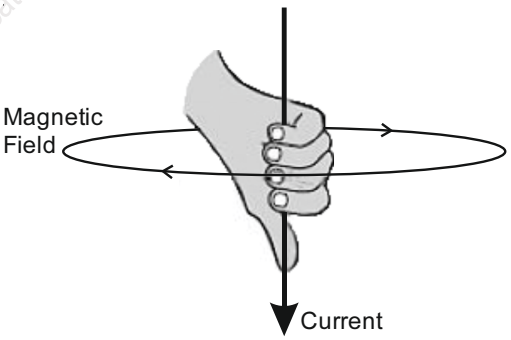
   (b) Resistivity of an alloy is higher than its constituent metal and alloys do not oxidize as easily as constituent metal at high temperature. That is why the coils of electric toasters are made of an alloy rather than a pure metal. **[1]**

7. (a) Magnetic field is a region near a magnetised body where magnetic forces can be detected. **[1]**

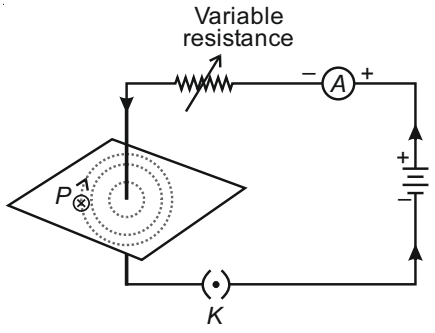
   The direction of the magnetic field line at a place is determined by the direction in which a north pole of the compass needle moves inside it. **[1]**

   (b) Direction of the magnetic field produced around a current carrying conductor is determined by the right hand thumb rule.

   According to this rule, if we hold a current-carrying straight conductor in right hand such that the thumb points towards the direction of current, then fingers will wrap around the conductor in the direction of the field lines of the magnetic field. This is also shown in the figure given below : **[2]**

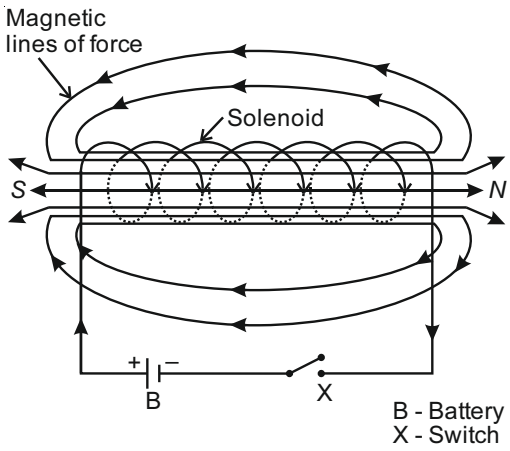


Pattern of field lines due to a current flowing through a straight conductor:



[1]

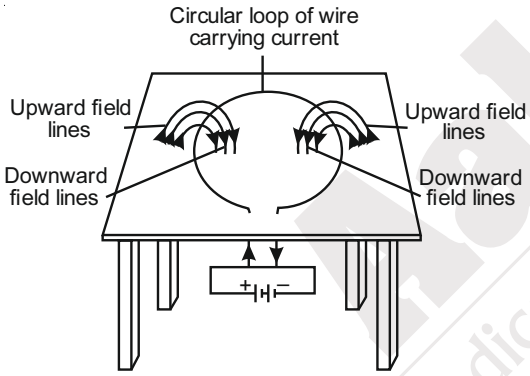
8. (a) A solenoid is a long coil (shaped like a cylinder) containing a large number of close turns of insulated copper wire. **[1]**



[2]

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

(b) Direction of magnetic field inside and outside the loop is given as follows:



[2]

9. (a) Hold the forefinger the centre finger and the thumb of your left hand at right angles to one another. If the forefinger points in the direction of magnetic field, and centre finger points in the direction of current, the thumb gives direction of motion conductor. **[1]**

(b) Electric motor is based on the principal that a current carrying conductor placed perpendicular to the magnetic field experience a force. **[1]**

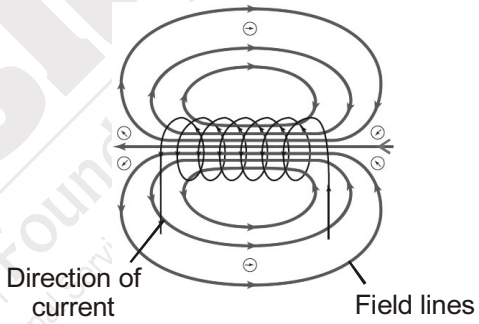
(c) (i) **Armature :** It contains of a single loop of insulated copper wire in the form o a rectangle. **[1]**

(ii) **Brushes :** Two carbon brushes B_1 and B_2 press against the commutator. These brushes act as the contacts between the commutator and the terminals of the battery. **[1]**

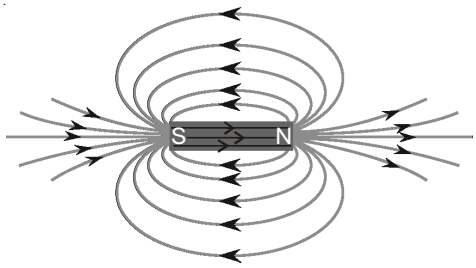
(iii) **Split-ring :** It consists of two halves (R_1 and R_2) of a metallic ring. The two ends of the armature coil are connected to these two halved of the ring. Commutator reverses the direction of current in the armature coil. **[1]**

10. A solenoid is a long cylindrical coil containing a large number of closely spaced turns of insulated copper wire. **[1]**

(i) **[1]**



(ii) **[1]**



Distinguish between the two fields are

(a) The strength of magnetic field due to solenoid can be changed while the magnetic field strength due to bar magnet cannot be changed. **[1]**

(b) Solenoid produces magnetic field so long as current flows in its coils while bar magnet produces a permanent magnetic field. **[1]**

Chapter - 14 : Sources of Energy

1. Ground water. **[1]**

2. Potential energy of water stored in a dam is converted into kinetic energy of the falling water. The water falls on the turbine, so kinetic energy of the flowing water is converted into the kinetic energy of the armature of the generator connected to the turbine. Then kinetic energy is converted into the electrical energy known as hydro-electricity. **[1]**

3. (i) It has high calorific value. **[½]**

   (ii) It burns without smoke. **[½]**

4. Biogas is considered as an ideal fuel because of the following :

   (i) High Calorific Value

   (ii) Produces no smoke on burning

   (iii) Burns smoothly (without explosion)

   (iv) No residue on combustion **[4 × ½]**

5. (a) From wind : Wind energy cannot be harnessed at places where wind does not blow at a minimum speed of 15 km/h. **[1]**

   (b) From tides : There are only few sites suitable for building tidal dams. **[1]**

6. Biogas is the gas made from the anaerobic decomposition of organic matter such as agricultural wastes and animal wastes like animal dung. It is prepared in bio-gas plants. It consists of a methane, carbon dioxide, hydrogen and hydrogen sulphide. **[1]**

   Biogas is considered as an ideal fuel because it :

   (i) It has a high calorific value.

   (ii) It burns without producing smoke.

   (iii) It is a safe and efficient method of waste-disposal.

   (iv) It leaves no residue after burning. **[4 × ¼]**

7. Four limitations in harnessing wind energy on a large scale are :

   (a) Wind energy farms can be established only at those places where wind blows at least with a speed of 15 km/h for the most part of the year.

   (b) There should be some back-up facilities (like storage cells) to take care of the energy needs during a period when there is no wind.

   (c) Establishment of wind energy farms requires large area of land.

   (d) Since the tower and blades are exposed to the vagaries of nature like rain, sun, storm and cyclone, they need a high level of maintenance. **[4 × ½]**

8. Disadvantages of using fossil fuels for the production of energy :

   (i) Burning of fossil fuels (*e.g.* coal and petroleum products) causes air pollution.

   (ii) The oxides of carbon, nitrogen and sulphur which are released on burning fossil fuels are acidic oxides. These cause acid rain which adversely affects our water and soil resources.

   (iii) Greenhouse gases like carbon dioxide released during the combustion of fossil fuels enhances the process of global warming.

   (iv) Fossil fuels were formed over millions of years ago and have limited reserves. If we were to continue consuming these sources at such alarming rates, we would soon run out of energy. **[4 × ½]**

9. (a) Solar energy and wind energy are the renewable sources of energy. **[1]**

   (b) Fossil fuels and uranium are the non-renewable sources of energy. **[1]**

10. Fossil fuels like coal and petroleum are huge reservoirs of carbon and its compounds. On burning fossil fuels, huge reservoirs of carbon present in fossil fuels get converted to carbon dioxide and go into air. The amount of carbon dioxide thus increases in the atmosphere which leads to an increased greenhouse effect leading to excessive heating of the Earth *i.e.*, global warming. **[2]**

Chapter - 15 : Our Environment

1. Our increasing demand for energy is depleting our natural resources and polluting the environment in one or the other way. **[1]**

2. Milk bags and tin cans are the non-biodegradable substances. **[1]**

3. Exploitation and overconsumption of natural resources will ultimately result in their scarcity. **[1]**

4. Grass $\rightarrow$ Insect $\rightarrow$ Frog $\rightarrow$ Snake,

   Frog is the secondary consumer. **[1]**

5. According to the 10% law of flow of energy, 2 J of energy will be available for man in this food chain. **[1]**

6. Fossil fuels like coal and petroleum are huge reservoirs of carbon and its compounds. On burning fossil fuels, huge reservoirs of carbon present in fossil fuels get converted to carbon dioxide and go into air. The amount of carbon dioxide increases in the atmosphere which leads to an increased green house effect leading to excessive heating of the Earth which is called global warming. **[2]**

7. Some of the ways to make people realise that the improper disposal of waste is harmful to the environment are:

   (a) Improper disposal of waste will serve as a breeding ground for mosquitoes and will create favourable conditions for the spread of various diseases.

   (b) Improper disposal of waste will release harmful gases in the environment which makes the environment unclean and unhygienic for normal living of organisms.

   (c) The waste will flow to water bodies along with the rain water and become a threat to aquatic organisms. **(Any two) [2]**

8. Consequences of elimination of decomposers:

   (i) If all the decomposers of earth are eliminated then the dead bodies of plants and animals would not be decomposed into simpler non-polluting substances.

   (ii) Elimination of decomposers would cause imbalance of nutrients as they break complex organic material into simpler substances in different nutrient cycles. **[2]**

9. Four activities which can be done as an environmentalist to conserve natural resources are

   (i) Using public transport for commuting instead of using a personal vehicle.

   (ii) Avoid using clothes, accessories or articles made of animal skin.

   (iii) Using energy-efficient electrical appliances to save electricity.

   (iv) Ensuring no leakage of water taps and pipes at home. **[4×½]**

10. UV rays in the atmosphere split some molecular oxygen (O_2) into free oxygen (O) atoms.

    These atoms combine with molecular oxygen to form O_3.

$$\underset{\text{oxygen molecule}}{O_2} \xrightarrow[\text{(from Sun)}]{\text{UV radiations}} \underset{\text{oxygen atom}}{[O]} + \underset{\text{oxygen atom}}{[O]}$$

$$\underset{\text{oxygen molecule}}{O_2} + \underset{\text{oxygen atom}}{[O]} \longrightarrow \underset{\text{ozone molecule}}{O_3}$$

[1]

Damage to ozone layer will allow UV rays to reach on the surface of earth causing skin cancer, cataract and damage to crops. **[1]**

Release of chlorofluorocarbons in the atmosphere which are used as refrigerants or in fire extinguishers damages the ozone layer. **[1]**

11. (a) All living organisms such as plants, animals and microorganisms interact with one another and also with their physical surroundings such as soil, air and water to maintain a balance in nature. This forms a self sustaining unit called ecosystem. **[1]**

    The two components of the ecosystem are Biotic and Abiotic.

    Biotic system consists of all the living organisms of particular area like humans, animals etc. and the abiotic components consists of air, minerals, soil, water and sunlight. **[1]**

(b) Ponds do not need to be cleaned but aquarium needs to be cleaned because an aquarium does not contain soil and decomposing bacteria which helps in degrading complex organic substances into simple inorganic substances. But ponds or lakes have this ability of self-purification, and therefore these do not need to be cleaned. **[1]**

12. When non-biodegradable substances such as pesticides, enter the food chain, they get accumulated progressively at each trophic level. This results in a cumulative increase in the concentration of the substance in successively higher trophic levels of the food chain. This phenomenon is known as biological magnification. **[1]**

For example - Pesticides entering our food chain through soil or water are not degradable and hence gets progressively accumulated at each trophic level, with maximum accumulation in human bodies. **[1]**

Biomagnification of a toxic substance has the potential to cause harm to organisms, particularly to the tertiary consumers as it gets accumulated in their bodies. **[1]**

13. The flow of energy in the ecosystem is said to be unidirectional because the energy lost as heat from the living organisms of a food chain cannot be reused by plants in photosynthesis. Pesticides are non-biodegradable wastes which pass along the food chain from crops to man or other animals and birds and harm them. **[3]**

14.

Biodegradable wastes	Non-biodegradable wastes
(a) Waste materials which can be broken down to non-poisonous substances in nature in due course of time by the action non-biodegradable wastes	(a) Waste materials which cannot be broken down into non-poisonous or harmless substances in nature are called non-biodegradable wastes
(b) Example: Cattle dung, wool, paper, compost	(b) Example: Plastics, polythene bags, metal articles, glass objects

[2×1]

The changes which people must adopt to dispose non-biodegradable wastes for saving the environment are :

(a) Household waste, chemical waste and hospital waste should be disposed off by dumping them in the low-lying areas of the ground called a landfill.

(b) Broken plastic articles such as buckets, bowls, cups, plates etc. should be sent to plastic processing factories. **[2×½]**

15. (a) It is necessary to conserve our environment because it helps in protecting the ozone layer and helps in maintaining animal and human food chains. **[1]**

(b) Disposal of household waste is carried out in green and blue bins as it is very useful in the separate disposal of biodegradable and non-biodegradable wastes. **[1]**

(c) The two values exhibited are :

(i) Creating environmental awareness among students and society.

(ii) Working hard on prevention of environmental degradation of surroundings. **[2×½]**

16. (a) The two measures to manage the garbage we produce are :

(i) Garbage should be kept in proper place indicated by municipality.

(ii) We can put wet garbage and dry garbage in separate containers so that they can be used for recycling. **[2×½]**

(b) Ways to generate the least garbage are:

(i) We should be careful in kitchen not to cook more food than necessary.

(ii) We can also give green vegetable and food waste to nearby pet animals like cow etc. **[2×½]**

(c) The two values teacher instilled are:

(i) Teacher is environment conscious.

(ii) Teacher wants to make his students responsible citizens. **[2×½]**

17. The problem of waste disposal can be reduced by the following ways:

(a) **Recycling :** Different kind of solid wastes like paper, plastics, etc., can be recycled. For example, waste paper is sent to the paper mills where it is reprocessed to produce new paper.

(b) **Composting :** Biodegradable domestic wastes such as left-over food, fruit and vegetable peels, leaves of potted plants, etc., can be converted into compost by burying them in a pit dug into ground.

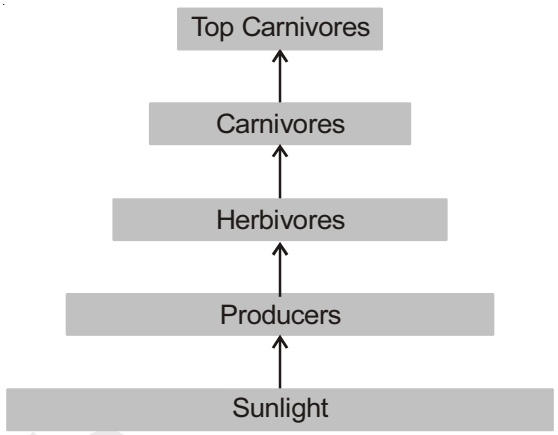
(c) **Biogas and manure :** Organic wastes can also be decomposed anaerobically to yield biogas and manure.

(d) **Burning :** The solid combustible waste is burnt. It however, causes air pollution.

(e) **Sewage treatment plants (STPs) :** The dirty drain water containing urine and faeces, which is carried from our homes by underground pipes (called sewers) is called sewage. Sewage should always be disposed off by treating it in sewage treatment plants (STPs). The treatment results in the production of clean water, which is then discharged into river. **[Any three] [3×1]**

OR

All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. Ecosystem consists of biotic and abiotic components. **[1]**



Block diagram showing flow of energy in an ecosystem. **[2]**

Chapter - 16 : Sustainable Management of Natural Resources

1. Advantages of water stored in the ground are:

   (i) It doesn't evaporate.

   (ii) It spreads out to recharge wells.

   (iii) It provides water for irrigating vegetation cover over a wide area.

   (iv) It is available throughout the year for irrigation and other activities like drinking, bathing, washing and cleaning.

   (v) The recharged ground water of hilly terrains can bring dried up rivers back to life.

   (vi) It prevents floods and water logging.

   (vii) It does not provide breeding grounds for mosquitoes like stagnant water collected in ponds or artificial lakes.

   (viii) It is also relatively protected from contamination by human and animal waste.

   (Any two) [2×1]

2. The following activities can help to reduce the consumption of natural resources:

   (a) Use of materials such as paper should be preferred as they can be reused and recycled.

   (b) Materials like glass and some plastics can be recycled on heating and get easily converted into different products like toys, containers which can be reused again.

   (c) e-wastes such as unused computers, mobiles etc. can be repaired and used again.

   (d) Household wastes such as vegetable wastes etc. can be used as manure for plants. **[4 × ½]**

3. Sustainable management of natural resources is necessary as it yields the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. **[1]**

   Reusing is better than recycling because reuse does not require energy whereas some energy is spent to recycle old objects. **[1]**

4. The term 'biodiversity' refers to the variety of all life forms and habitats found in a defined area. **[1]**

   Two advantages of conserving forests and wild life are:

   (i) They add to the natural beauty of the environment.

   (ii) They provide valuable things which are required for our survival. **[2 × ½]**

5. Four stakeholders which may help in the conservation of forests are:

   (i) The Forest Department of the Government

   (ii) Local People

   (iii) Industrialists who use various forest products for their factories

   (iv) Wildlife and nature enthusiasts **[4×½]**

6. Four activities which can be done as an environmentalist to conserve natural resources are

   (i) Using public transport for commuting instead of using a personal vehicle.

   (ii) Avoid using clothes, accessories or articles made of animal skin.

   (iii) Using energy-efficient electrical appliances to save electricity.

   (iv) Ensuring no leakage of water taps and pipes at home. **[4×½]**

7. Coal and petroleum are categorized as natural resources as they have been formed by natural processes like the degeneration of dead plants and animals biomass buried deep in the earth several million years ago. **[1]**

   It has taken millions of years for the formation of these fossil fuels, and the present rate of consumption of these fossil fuels far exceeds the rate at which they are formed. If exhausted, these resources will not be available for use in the near future, and hence, they should be used judiciously. **[1]**

8. (a) Two ways by which awareness on how to save water can be created in the neighbourhood are :

   (i) By bringing to notice the current situation of drought in rural areas and its dreadful effects on humans and animals.

   (ii) Making people realise the importance of water in life and the shortage of water and its consequences in the near future. **[2×½]**

   (b) Khadin is one way of recharging groundwater. A khadin consists of a 100-300 m long embankment called bund made of earth. The bund is built across the lower edge of the sloping farmland. Rainwater from the catchment area flows down the slope and collects in front of the bund forming a reservoir. Pathways through the bund allow excess water to flow through and collect in shallow wells dug behind the bund. **[2]**

9. Dams are the massive barriers built across rivers and streams to confine and utilise water for various human purposes such as irrigation and generation of electricity. **[½]**

   Various Benefits of Dams :

   (a) Hydroelectric power generation.

   (b) Transfer of water using canals from areas of excess water (source) to water deficit areas.

   (c) Irrigation during dry period.

   (d) Flood control and soil protection.

   (e) Ensure year-round water supply.

   (f) Multipurpose river valley projects also provide inland water navigation. **(Any two)** **[2×½]**

   Problems Caused Due to Dams :

   (a) The enormous weight of water behind the dam could lead to cracks in dams and may result in floods. This will lead to the submergence of large areas of land that might include fertile fields and human settlements.

   (b) Resettlement and rehabilitation problem of displaced people.

   (c) Salts left behind by evaporation increase the salinity of the river and make its water unusable when it reaches the downstream cities.

   (d) There is no equitable distribution of water. Thus, farmers close to the water source grow water intensive crops like sugarcane and rice while farmers farther downstream do not get any water. The woes of these people who have been promised benefits which never arrived are added to the discontentment among the people who have been displaced by the building of the dam and its canal network. **(Any three)** **[3×½]**

10. Water harvesting means "capturing water". Capture, collection and storage of rain water and surface run off in a local area for filling either small water bodies or recharging ground water so that water continues to be available in non-rainy season is known as water harvesting. **[1]**

Advantages associated with water harvesting at community level are :

(a) It increases the production and income of the watershed community.

(b) It also mitigates droughts and floods.

(c) It increases the life of the downstream dams and reservoirs. **(Any two) [2×½]**

Causes for the failure of sustained availability of ground water are :

(a) Loss of vegetation cover.

(b) Diversion for high water demanding crops.

(c) Pollution from industrial effluents and urban wastes. **(Any two) [2×½]**

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