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शिक्षा एवं प्रशिक्षण का आंचलिक संस्थान, चंडीगढ़
ZONAL INSTITUTE OF EDUCATION AND TRAINING, CHANDIGARH

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निदेशक महोदय का संदेश

विद्यार्थियों की शैक्षिक प्रगति को ध्यान में रखते हुए उपयोगी अध्ययन सामग्री उपलब्ध कराना हमारा महत्त्वपूर्ण उद्देश्य है। इससे न केवल उन्हें अपने लक्ष्य को प्राप्त करने में सरलता एवं सुविधा होगी बल्कि वे अपने आंतरिक गुणों एवं अभिरुचियों को पहचानने में सक्षम होंगे। बोर्ड परीक्षा में अधिकतम अंक प्राप्त करना हर एक विद्यार्थी का सपना होता है। इस संबंध में तीन प्रमुख आधार स्तंभों को एक कड़ी के रूप में देखा जाना चाहिए- अवधारणात्मक स्पष्टता, प्रासंगिक परिचितता एवं आनुप्रयोगिक विशेषज्ञता।

राष्ट्रीय शिक्षा नीति 2020 के उद्देश्यों की मूलभूत बातों को गौर करने पर यह तथ्य स्पष्ट है कि विद्यार्थियों की सोच को सकारात्मक दिशा देने के लिए उन्हें तकनीकी आधारित समेकित शिक्षा के समान अवसर उपलब्ध कराया जाए। बोर्ड की परीक्षाओं के तनाव और दबाव को कम करने के उद्देश्य को प्रमुखता देना अति आवश्यक है।

यह सर्वमान्य है कि छात्र-छात्राओं का भविष्य उनके द्वारा वर्तमान कक्षा में किए गए प्रदर्शन पर ही निर्भर करता है। इस तथ्य को समझते हुए यह अध्ययन सामग्री तैयार की गई है। उम्मीद है कि प्रस्तुत अध्ययन सामग्री के माध्यम से वे अपनी विषय संबंधी जानकारी को समृद्ध करने में अवश्य सफल होंगे।

शुभकामनाओं सहित।

मुकेश कुमार
उपायुक्त एवं निदेशक

INDEX

COURSE STRUCTURE
CLASS X
SESSION- 2022-23

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

Syllabus

Theme: Materials

Unit I: Chemical Substances - Nature and Behaviour

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

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

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

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

Theme: The World of the Living

Unit II: World of Living

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

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

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

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

Theme: Natural Phenomena

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

Theme: How Things Work

Unit IV: Effects of Current

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

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

Theme: Natural Resources

Unit V: Natural Resources

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

CHAPTER 1
CHEMICAL REACTIONS AND EQUATIONS

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

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

Chemical Equations:

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

Rules for writing chemical equation:

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

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

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

Representing the Direction of the Chemical Reaction

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

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

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

Representing the Physical States of the Reacting Entities

These symbols may be one of the following:

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

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

Representing the Input of Energy in a Chemical Equation:

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

An example for which is represented below:

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

$$2H_2 + O_2 \rightarrow 2H_2O \qquad (1)$$

Reactants Products

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

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

$$H_2 + \tfrac{1}{2} O_2 \rightarrow H_2O$$

Reactant Product

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

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

Balanced Chemical Equations:

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

EXAMPLE 1:

Write the chemical equation for the formation of magnesium oxide.

Step 1: Magnesium burns in oxygen to give magnesium oxide. Here, the reactants are magnesium and oxygen. The product is magnesium oxide.

Step 2: Thus, the word equation is

Magnesium + Oxygen ⟶ Magnesium oxide

Step 3: Replacing the names with symbols and formulae, we get the chemical equation as

$$Mg + O_2 \longrightarrow MgO$$

Reactants Products

Step 4: The numbers of atoms of the elements are

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

To balance oxygen on both sides, multiply RHS by 2, i.e.,

$Mg + O_2 \longrightarrow 2MgO$

Now, the number of oxygen atoms is balanced but the number of magnesium atoms is not. Therefore, multiply magnesium on the LHS by 2. Thus, the equation becomes

$2Mg + O_2 \longrightarrow 2MgO$

this is the balanced chemical equation.

EXAMPLE 2:

The word-equation represented as –

Zinc + Sulphuric acid ⟶ Zinc sulphate + Hydrogen

The above word-equation may be represented by the following chemical equation –

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

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

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

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

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

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

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

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

Step III:

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

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

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

List some Examples of Chemical Equations.

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

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

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

TYPES OF CHEMICAL REACTIONS:

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

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

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

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

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

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

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

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

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

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

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

$AgNO_3$ (aq) + KCl (*aq*) → AgCl (s) + KNO_3 (aq)

EXOTHERMIC AND ENDOTHERMIC CHEMICAL REACTIONS:

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

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

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

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

NH_4Cl (s) + H_2O (l) + Heat ⟶ NH_4Cl (aq)

N_2 + O_2 $\longrightarrow$ 2NO

Other Endothermic Processes:

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

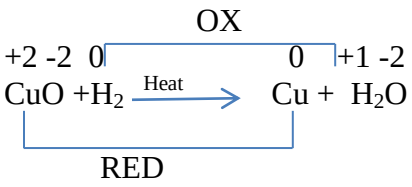
OXIDATION: Oxidation refers to the loss of electrons or increase in oxidation state by a molecule, atom, or ion.
REDUCTION: Reduction refers to the gain of electrons or decrease in oxidation state by a molecule, atom, or ion.
REDOX REACTIONS: A reduction-oxidation or redox reaction is a type of chemical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

$2Cu + O_2 \longrightarrow 2CuO$

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

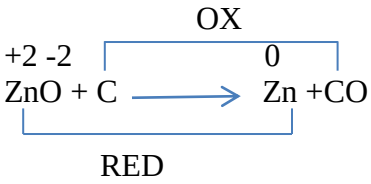
$CuO + H_2 \longrightarrow Cu + H_2O$

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

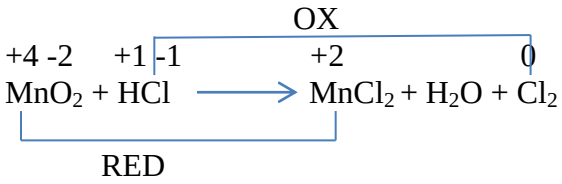


Some other examples of Redox reactions are:

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



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



Assignment:

Q1. What happens chemically when quicklime is added to water filled in a bucket?

Answer. Quicklime reacts with water to form slaked lime and produces lot of heat and hissing sound.

Q2. On what basis is a chemical equation balanced?

Answer. A chemical reaction is balanced on the basis of law of conservation of mass.

Q3. What change in colour is observed when white silver chloride is left exposed to sunlight? State the type of chemical reaction in this change.

Answer. Silver chloride becomes grey. It is a photochemical decomposition reaction.

Q4. A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction?

Answer. $KCl\ (aq) + AgNO_3\ (aq) \longrightarrow AgCl\ (s) + KNO_3\ (aq)$

It is a double displacement reaction. It is also a precipitation reaction as AgCl is a white precipitate.

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

Colourless Yellow ppt.

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

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

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

CHAPTER 2

ACIDS, BASES AND SALTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Acid + Base → Salt + Water

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

Characteristics of salt:

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

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

Neutral, Acidic and Basic Salts:

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

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

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

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

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

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

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

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

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

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

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

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

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

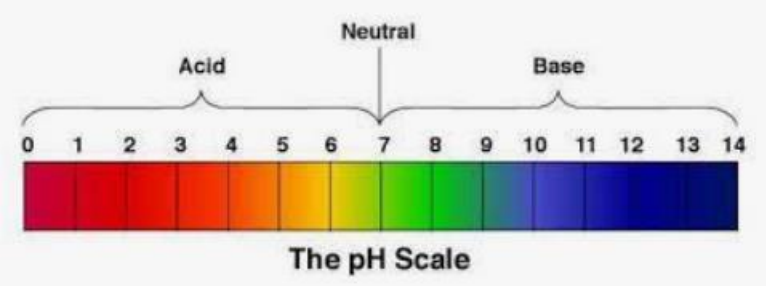
(iii) Basic Salts: Salts which are formed after the reaction between a weak acid and strong base are called Basic Salts. For example; Sodium carbonates, Sodium acetate, etc.
Sodium carbonate is formed after the reaction between sodium hydroxide (a strong base) and carbonic acid (a weak acid).

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

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

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

pH Scale:



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

pH is equal to the logarithm to the base 10, inverse of hydrogen ion concentration.
$pH = -\log [H^+] = \log \{1/[H^+]\} = 10^{-pH}$
Similarly, $pOH = -\log [OH^-] = \log \{1/[OH^-]\}$
And $pH + pOH = pKw = 14$
Higher the hydronium ion concentration present in the solution, lower is its pH value.
For water or neutral solutions: pH = 7
for acidic solutions: pH < 7
for basic solution: pH > 7

Importance of pH everyday life:

(i) pH in our digestive system: Dilute HCl (Hydrochloric acid) helps in digestion of food (proteins) in our stomach. Excess acid in stomach causes acidity (indigestion). Antacids like magnesium hydroxide [$Mg(OH)_2$] also known as milk of magnesia and sodium hydrogen carbonate (baking soda) are used to neutralize excess acid.

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

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

Some Important Chemical Compounds

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

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

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

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

3. Bleaching Powder ($CaOCl_2$): Bleaching powder is also known as chloride of lime. It is a solid and yellowish white in colour. Bleaching powder can be easily identified by the strong smell of chlorine.
When calcium hydroxide (slaked lime) reacts with chlorine, it gives calcium oxychloride (bleaching powder) and water is formed.

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

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

Use of Bleaching Powder:

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

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

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

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

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

Properties of Sodium Bicarbonate:

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

Use of Baking Soda:

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

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

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

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

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

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

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

Use of sodium carbonate:

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

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

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

Plaster of Paris

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

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

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

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

Q4. (a) Write the name given to bases that are highly soluble in water. Give an example.
(b) How is tooth decay related to pH? How can it be prevented?
(c) Why does bee sting cause pain and irritation? Rubbing of baking soda on the sting area gives

relief. How?

Answer. (a) Alkali, e.g. NaOH (Sodium hydroxide).

(b) Lower the pH more will be tooth decay. Acid reacts with $Ca_3(PO_4)_2$ and cause tooth decay. It can be prevented by brushing teeth after every meal.

(c) It is due to formic acid. Sodium hydrogencarbonates (Baking soda) neutralizes formic acid giving relief.

Q5. A white powder is added while baking breads and cakes to make them soft and fluffy. Write the name of the powder. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking.

Answer. Baking powder. It consists of sodium hydrogencarbonates and tartaric acid. Sodium hydrogencarbonates gives CO_2 which makes cake soft and fluffy. Tartaric acid neutralizes the bitterness due to sodium carbonate produced.

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

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

Answer.

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

Lime water turns milky due to liberation of CO_2.

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

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

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

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

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

(ii)What is this process called?

Answer.

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

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

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

CH_3COOH, H_2SO_4, H_2CO_3, HNO_3

Answer. H_2SO_4 and HNO_3 are strong acids.

CH_3COOH and H_2CO_3 are weak acids.

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

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

(b) When this white powder is mixed with water a hard solid mass is obtained. Write balanced

chemical equation for the change.
Answer. (a) Calcium sulphate hemihydrate ($CaSO_4 .1/_2 H_2O$)

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

Q10. How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?
Answer. Bring a burning matchstick near the gas. It burns with 'pop' sound showing that it is hydrogen.

CHAPTER 3

METALS AND NON-METALS

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

Physical Properties of Metals:

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

Chemical Properties of Metals

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

Metal + Oxygen → Metal Oxide

Examples:

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

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

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

$$4Na + O_2 \longrightarrow 2Na_2O$$

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

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

$2Cu + O_2 \longrightarrow 2CuO$

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

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

Metal + Water → Metal hydroxide + Hydrogen

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

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

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

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

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

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

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

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

$Mg + H_2O \longrightarrow MgO + H_2$

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

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

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

$Zn + H_2O \longrightarrow ZnO + H_2$

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

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

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

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

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

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

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

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

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

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

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

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$$

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

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

Metal Oxides

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

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

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

$Na_2O + H_2O \longrightarrow 2NaOH$

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

$K_2O + H_2O \longrightarrow 2KOH$

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

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

$ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$

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

$ZnO + 2HCl \longrightarrow ZnCl_2 + H_2O$

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

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

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

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

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

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

$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

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

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

$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

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

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

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

$Ag + CuSO_4 \longrightarrow$ No reaction

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

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

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

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

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

Physical properties of non-metals

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

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

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

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

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

$C + O_2 \longrightarrow CO_2 +$ heat

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

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

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

$S + O_2 \longrightarrow SO_2$

When hydrogen reacts with oxygen it gives water.

$2H_2 + O_2 \longrightarrow 2H_2O$

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

$CO_2 + H_2O \longrightarrow H_2CO_3$

Sulphur dioxide gives sulphurous acid when dissolved in water.

$SO_2 + H_2O \longrightarrow H_2SO_3$

Sulphur dioxide gives Sulphuric acid when reacts with oxygen.

$SO_2 + 2O_2 \longrightarrow 2SO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$

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

$H_2 + Cl_2 \longrightarrow 2HCl$

$P_4 + 6Cl_2 \longrightarrow 4PCl_3$

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

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

$H_2 + S \longrightarrow H_2S$

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

$N_2 + 3H_2 \longrightarrow 2NH_3$

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

Non-metals do not react with dilute acids.

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

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

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

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

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

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

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

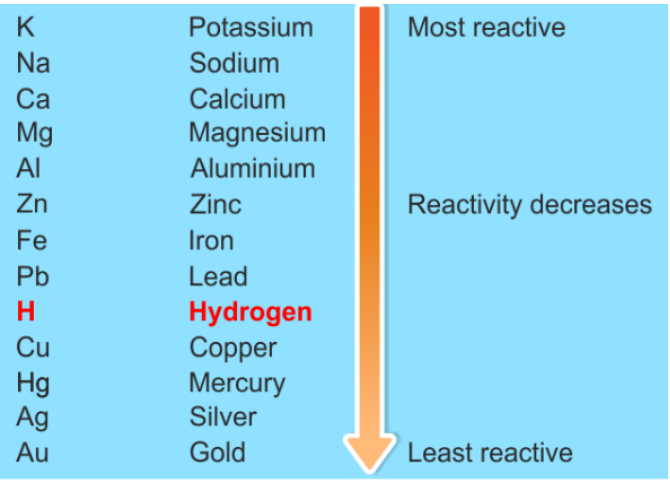
$Cl + e^- \longrightarrow Cl^-$

Difference between Metals and Non-metals:

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

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

The reactivity series is:



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

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

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

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

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

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

2, 8, 1 2, 8

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

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

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

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

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

2, 8, 2 2, 8

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

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

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

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

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

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

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

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

Corrosion and its prevention:

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

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

$$\mathbf{4Fe + 3O_2 \rightarrow 2Fe_2O_3}$$

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

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

(i) Electroplating:

- In this method, an electric current is used to create a thin layer of metal over another metal. It is done to make cheaper metals more appealing as well as to protect them from corrosion.
- This method requires two different metals, an electrolytic solution, and two electrodes in a tank and a battery or source of current that will pass the required current into the solution to carry out the electrolysis.
- When current is passed one electrode gets a positive charge and another gets the negative charge. The ions of the positively charged metal shift to the surface of the negatively charged metal to create a thin layer. For example, when we take brass and copper for electroplating, the copper metal slowly gets deposited or covers the brass and thus a thin coating of copper covers the surface of the brass. Here, the electrolytic solution must contain copper sulphide.

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

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

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

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

Assignments:

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

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

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

Q4. You are given samples of three metals. Sodium, magnesium and copper. Suggest any two activities to arrange them in order of decreasing activity.
Answer. Activity 1: Sodium reacts with cold water vigorously to form sodium hydroxide and hydrogen gas

$$Na\ (s) + H_2O\ (cold) \longrightarrow NaOH\ (aq) + H_2\ (g)$$

Magnesium does not react with cold water but with hot water to form magnesium hydroxide and hydrogen gas.

$$Mg\ (s) + H_2O\ (Hot) \longrightarrow Mg\ (OH)_2\ (aq) + H_2\ (g)$$

Hence sodium is more reactive than magnesium.
Activity 2: $Mg\ (s) + CuSO_4\ (aq) \longrightarrow Mg\ SO_4\ (aq) + Cu\ (s)$

$Cu\ (s) + MgSO_4\ (aq) \longrightarrow$ No reaction

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

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

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

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

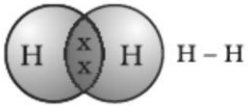
Calcination	Roasting
It is carried out by heating ore in the absence of air.	It is carried out by heating ore in the presence of air.
(ii) It converts carbonate ores into oxides.	(ii) It converts sulphide ores into oxides.

CHAPTER 4
CARBON AND ITS COMPOUNDS

1. BONDING IN CARBON – THE COVALENT BOND

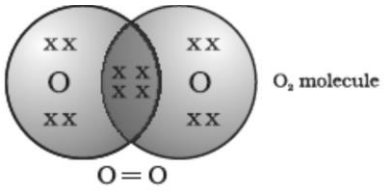
1. Covalent Bond: The chemical bond formed by the sharing of electrons between two atoms is called covalent bond.

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



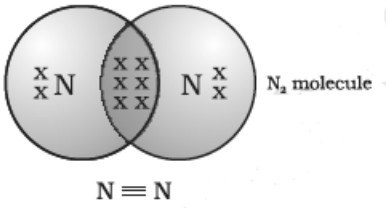
Single bond between two Hydrogen atoms

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



Double bond between two oxygen atoms

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



Triple bond between two nitrogen atoms

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

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

2. VERSATILE NATURE OF CARBON

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

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

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

5. Nomenclature of Carbon Compounds

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

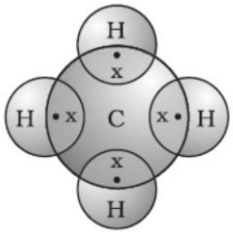
6.	Alkenes	Suffix - ene	Propene	$CH_3CH = CH_2$
7.	Alkynes	Suffix - yne	Propyne	$CH_3C \equiv CH$

Some functional groups in carbon compounds:

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

Saturated and Unsaturated Carbon Compounds

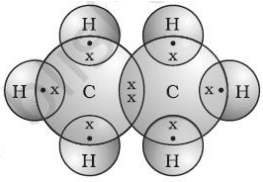
The carbon compounds which contain only carbon and hydrogen are called hydrocarbons. Among these, the saturated hydrocarbons are called alkanes. Methane, Ethane, Propane etc. Methane has a formula CH_4. Hydrogen has a valency of 1. Carbon is tetravalent because it has four valence electrons. In order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



Electron dot structure for methane

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

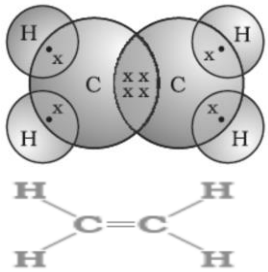
(a) Carbon atoms linked together with a single bond
(b) Each carbon atom bonded to three hydrogen atoms
(c) Electron dot structure of ethane



Electron dot structure for ethane

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

The electron dot structure for Ethene.



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

H - C ≡ C - H

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

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

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

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

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

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

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

CHEMICAL PROPERTIES OF CARBON COMPOUNDS:

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

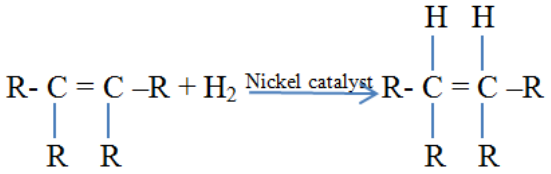
(i) $C + O_2 \longrightarrow CO_2$ + heat and light
(ii) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ + heat and light
(iii) $CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ + heat and light

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

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

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

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



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

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

SOME IMPORTANT CARBON COMPOUNDS - ETHANOL AND ETHANOIC ACID

Properties of ethanol:

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

Reactions of Ethanol:

(i) Reaction with sodium: When ethyl alcohol reacts with sodium leading to the evolution of hydrogen and the other product is sodium ethoxide.

$2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2O–Na + H_2$

(Sodium ethoxide)

(ii) Reaction to give unsaturated hydrocarbon: Heating ethanol at 443 K with excess concentrated Sulphuric acid results in the dehydration of ethanol to give Ethene

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

The concentrated Sulphuric acid can be regarded as a dehydrating agent who removes water from ethanol.

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

Properties of ethanoic acid:

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

Reactions of ethanoic acid:

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

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

(Ethanoic acid) (Ethanol) (Ester)

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

$CH_3COOCH_2CH_3 + NaOH \longrightarrow CH_3COONa + CH_3CH_2OH$

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

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

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

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

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

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

SOAPS AND DETERGENTS:

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

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

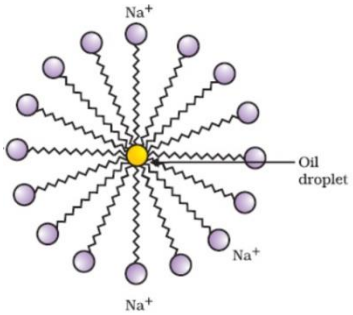
Preparation of soap: On heating with sodium hydroxide, vegetable oil or animal fat forms a sodium salt of fatty acid and glycerol. This process is known as saponification.

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

Cleansing action of soaps:

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

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



Formation of micelles

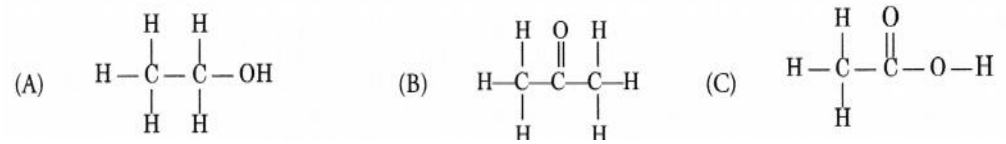
Their long hydrocarbon chains bind to the oil and dirt. As a result, the dirt is surrounded by the non-polar end of the soap molecules. The micelles are water-soluble because of the charged carboxylate end of the soap molecules. As a result, the soap washes away the dirt.

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

Assignments:

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

Q2. Write the IUPAC names of the following compounds.



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CHAPTER – 6

LIFE PROCESSES

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

LIFE PROCESSES

All the vital processes which are required by an organism to survive is called life processes. Nutrition, photosynthesis, transportation, metabolism, respiration, reproduction and excretion are important life process. In multicellular organism life processes occur in various specialized body parts while in unicellular organisms, all these processes are carried out by a single cell

IMPORTANT LIFE PROCESSES

- Nutrition in plants and animals
- Transportation in animals and plants
- Excretion in animals and plants

NUTRITION

- The process, by which an organism takes food and utilizes it, is called nutrition.
- Nutrition is essential for growth and development of organisms. It also provide energy to do different work.
- Nutrition is obtained by material called nutrients. Nutrients may macronutrient (Carbohydrates, proteins and fats) and micronutrients (Minerals and vitamins).

HOW DO LIVING THINGS GET THEIR FOOD?

a- Autotrophic nutrition
b- Heterotrophic nutrition

AUTOTROPHIC NUTRITION

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

PHOTOSYNTHESIS

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

The overall reaction occurring in photosynthesis is as follows:

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2 + 6H_2O_2$$

Glucose

EVENTS OCCUR DURING PHOTOSYNTHESIS

(i) Absorption of light energy by chlorophyll.
(ii) Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.
(iii) Reduction of carbon dioxide to carbohydrates.

Raw material required in photosynthesis	**Source**
CO_2 and O_2	Atmosphere
Radiation	Sunlight
H_2O	Soil

Some facts

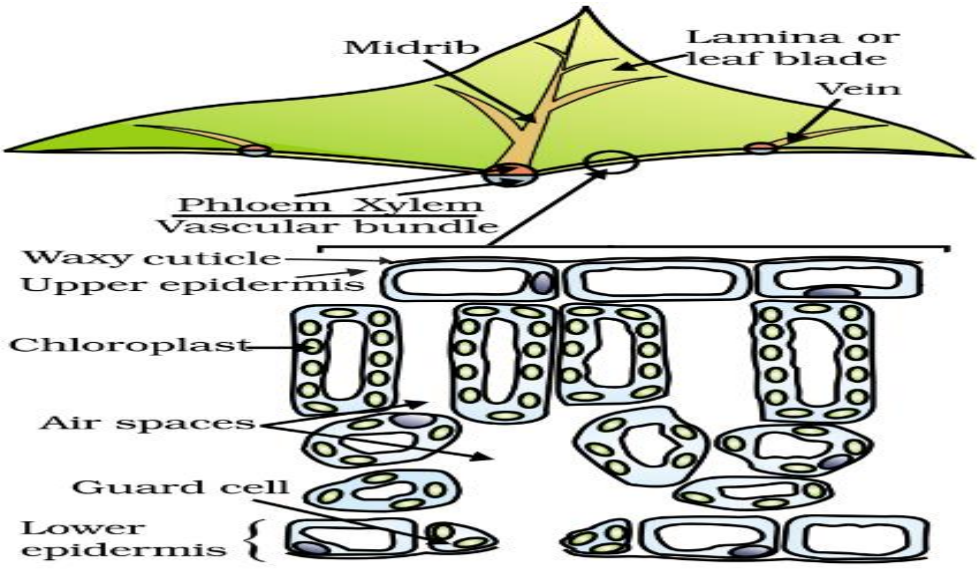
- Photosynthesis is a photochemical reaction.
- Photosynthesis is an oxidation- reduction reaction in which carbon di oxide is reduced to sugar and water is oxidized.

Chloroplast

Contain main photosynthetic pigment chlorophyll and accessory pigments xanthophyll and carotenoids.

Stomata

Gaseous exchange and transpiration (loss of water as water vapours) takes place through minute aperture on the surface of leaves called as stomata. Stomata has a pore (stomata pore) guarded by bean shape guard cells (regulate opening and closing of stomata.

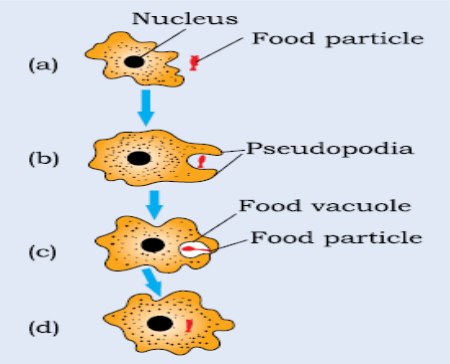


Cross-section of a leaf

HETEROTROPHIC NUTRITION

In this type of nutrition organism obtain their nutrient from other living organism (parasite) e.g. Animals or dead and decaying objects (saprophyte) e.g. Fungi like bread moulds, yeast and mushrooms.

HOW DO ORGANISMS OBTAIN THEIR NUTRITION

• Amoeba captures food with the help of pseudopodia. • Food vacuole is formed containing food particle. • Food is digested.	

NUTRITION IN HUMAN BEING

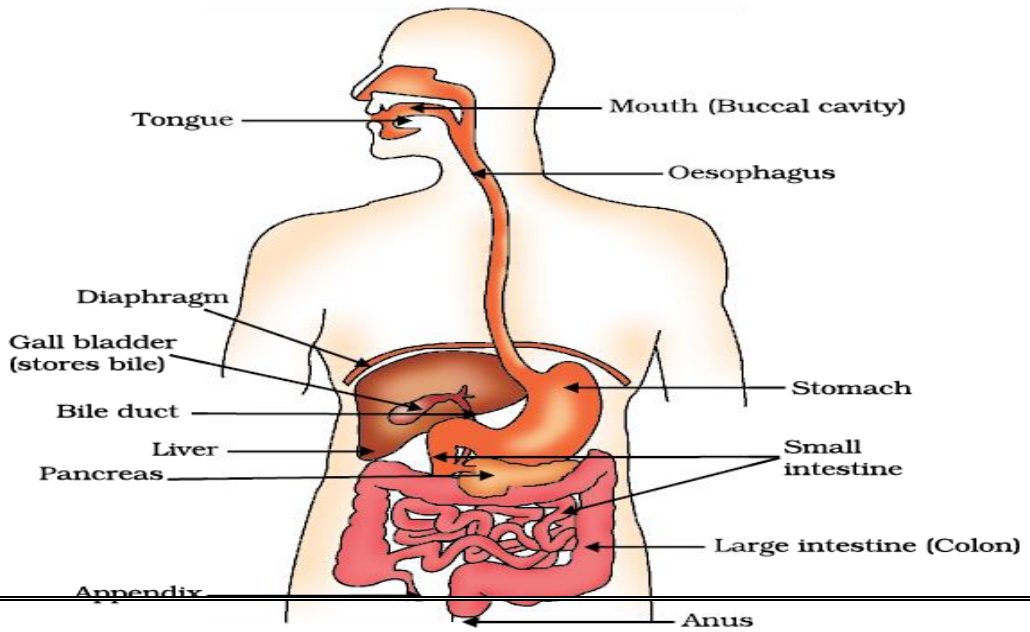
Alimentary canal	Tube like structure from mouth to anus
Salivary glands	3 pair, Secrete saliva
Enzyme	made of proteins (except ribozyme), break the complex foods in to simpler form
Peristaltic movement	Rhythmic movement of food in oesophagus (food pipe) toward stomach
Stomach	Large sac like structure below food pipe
Gastric gland	Present in wall of stomach secrete HCL, Pepsin, Mucus
Small Intestine	It is longest and coiled tube and site of complete digestion of food.

Villi	Small finger like projections on small intestine, increase the surface area for absorption
Large intestine	Small intestine opens into large intestine.it also contain villi to absirb water.

HUMAN DIGESTIVE SYSTEM

i- Food is crushed and mixed with saliva with the help of teeth and tongue.
ii- Saliva contains salivary amylase that break down starch.
iii- By peristaltic movement in oesophagus the food enters stomach.
iv- In stomach food is mixed with HCL, Protein digesting enzyme pepsin and Mucus.
v- HCL kill the germs in food as well as provide acidic medium essential for pepsin. Mucus protects the inner lining of alimentary canal by HCL.
vi- Small intestine receives secretions of liver and pancreas through a common duct. It is site complete digestion of food (carbohydrate, protein and fat)
vii- Unabsorbed food enters into large intestine for further absorption of water.
viii- Undigested food is removed from body via anus.

Organ	Secretion	Role
Liver	Bile juice	Make medium alkaline for pancreatic juice Break the fat molecules into smaller parts (emulsification)
Pancreas	Pancreatic juice	Trypsin digest protein Lipase digest lipid
Wall of small intestine	Intestinal juices	Proteins to amino acids Carbohydrates to glucose Fat to fatty acid and glycerol



DENTAL CARIES (TOOTH DECAY)

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

RESPIRATION

Process of Breaking down of complex organic material into simpler form with the help of enzymes is called reparation.

Types of respiration and site

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

Key words

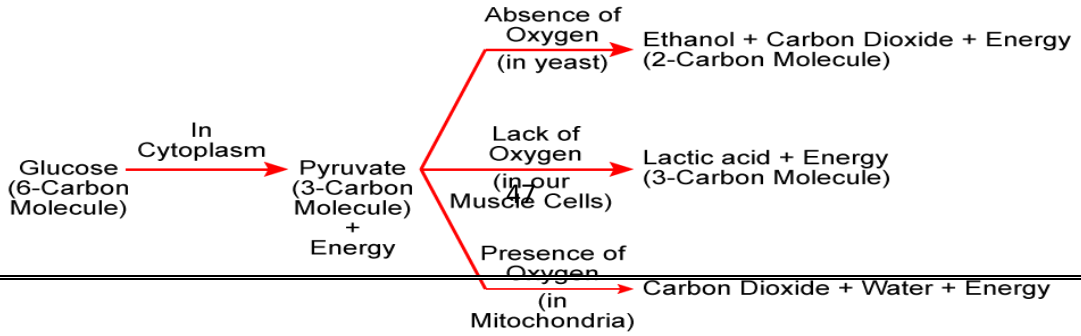
Cytoplasm	Fluid part with in cell
Mitochondria	Site of energy production in plants and animals (power house of cell)
Pyruvate	Intermediate product of respiration
Ethanol	A type of alcohol (C_2H_5OH)
ATP	Adenosine tri phosphate, an energy rich compound

PROCESS OF RESPIRATION

i- Glucose is broken down in to pyruvate in cytoplasm of cell.

ii- In presence of oxygen pyruvate enters into mitochondria and completely oxidized there to produce C2 and energy (ATP).

iii- In absence of oxygen pyruvate partially decompose and form
- a- Ethanol in yeast (fermentation)
- b- Lactic acid in muscle cells



HUMMAN RESPIRATORY SYSTEM

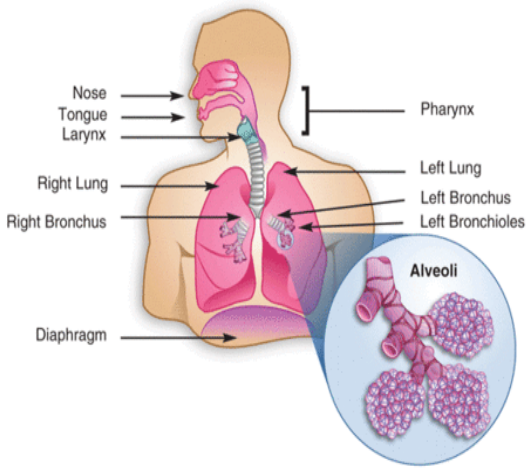
It consists of nostril, nasal passage, pharynx, larynx, trachea, bronchi, bronchioles, alveoli, diaphragm and ribcage.

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

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

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

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



TRANSPORTATION IN HUMAN BEING

Blood	A type of connective tissue consists of RBC, WBC, Platelets and plasma.
Plasma	Fluid portion of blood
Oxygenated blood	Blood carrying oxygen
Deoxygenated blood	Blood carrying carbon dioxide instead of oxygen
Hemoglobin	Iron contacting pigment, carry both oxygen and CO2
Heart chambers	Atrium and ventricle
Systole	Contraction of heart chambers
Diastole	Relaxation of heart chambers
Double circulation	Blood goes through the heart twice
Arteries	Thick walled. elastic , Carry blood away from heart to various organs
Veins	Thin walled, carry blood from different organs to the heart
Platelets	Helps in blood clotting during injury
Lymph / Tissue fluid	Fluid in intercellular space in the tissues. They carry digested and

	absorbed fat.
Sphygmomanometer	Measure blood pressure

HUMAN HEART

i- Human heart is four chambered – two atrium and two ventricles.
Amphibian – three chambered heart, Fish – two chambered heart

ii- These chambers are well separated to avoid mixing of oxygenated and deoxygenated blood.

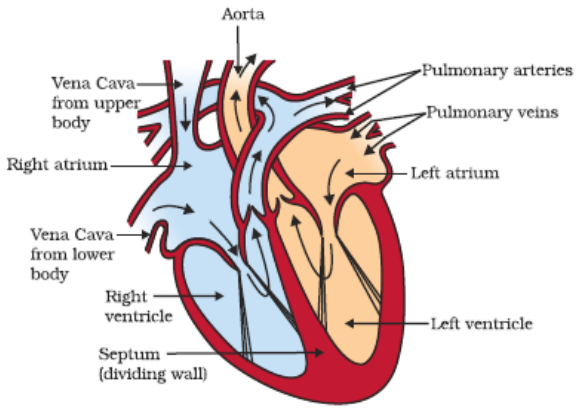
iii- Right atrium and right ventricle contains deoxygenated blood while left atrium and left ventricle contains oxygenated blood.

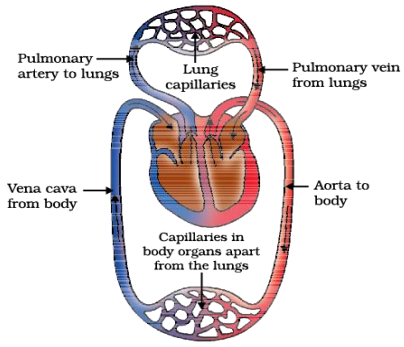
iv- Atrium and ventricles are separated by valves-
- a- Tricuspid valve
- b- Dicuspid valve

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

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

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





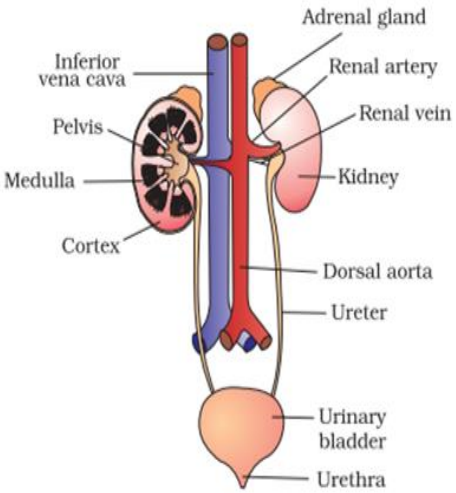
TRANSPORTATION IN PLANTS

Stomata	Gaseous exchange, Transportation (loss of water in form of vapor)
Xylem	Water conduction channels composed of xylem tissue, vessels and tracheid

	Transport water and mineral from root to aerial part (unidirectional)
Phloem	Transport food from the leaves to other part (multidirectional).

EXCRETION

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



EXCRETION IN HUMAN BEING

- Basic filtration unit in kidneys are cluster of thin walled capillaries. These are associated with cup like structure which collects the filtered urine.
- There is reabsorption on glucose, amino acids, salts and water in tubules of nephrons.
- The concentrated urine enters into urinary bladder via ureter and finally pass outside the body through urethra.

EXCRETION IN PLANTS

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

IMPORTANT QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q1- What is the normal systolic and diastolic pressure in human? By which apparatus we can measure it?

Ans: 120/ 80 mm of Hg, Sphygmomanometer

Q2- How is water and minerals transported in plants?

Ans: Water conducting tissue xylem transported mineral in dissolved form with water.

Q3- Mention the mode of nutrition of the followings-

Cuscuta, Fungus

Ans: Cuscuta- Parasite , Fungus- Saprophyte

Q4- Which acid is formed in our muscles after vigorous exercise?

Ans: Lactic acid

Q5- How much energy is released when terminal phosphate linkage in ATP is broken down?

Ans: 30.5 Kj/mol.

SHORT ANSWER TYPE QUESTIONS

Q 6- Why do photosynthesis considered as photochemical reaction?

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

Q7- What is role of followings in photosynthesis-

i- Chloroplast
ii- Water
iii- Carbon dioxide

Ans: Chloroplast trap the sunlight (radiation)

Water undergo photolysis to evolver oxygen

Carbon dioxide reduces to form carbohydrate.

Q 8- Write importance of –

i- Double circulation
ii- Dicuspid and tricuspid valves in heart

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

Importance of Dicuspid and tricuspid valves in heart: prevents the reverse flow of blood from the right ventricle to the right atrium while bicuspid valve prevents the reverse flow of blood from the left ventricle to the left atrium

Q 9- Specify the role of phloem and xylem. Why it is considered that phloem shows multi-directional transportation and xylem unidirectional transportation?

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

Phloem transport food in many directions as from leaves to other part of plants like other leaf, flower, stem, root, storage part.

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

Q 10- What is saliva? State its role in the digestion of food.

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

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

It helps in moistens the food for easy swallowing.

LONG ANSWER TYPE QUESTIONS

Q 11- Differentiate the followings-

I. Vena cava and Aorta
II. Pulmonary artery and Pulmonary vein

III. Anaerobic respiration and fermentation

IV. Bronchi and bronchiole

Ans:

- Vena cava: carries deoxygenated blood from body parts to the heart

Aorta: carries oxygenated blood from heart to the body parts

- Pulmonary artery: carries deoxygenated blood from heart to the lungs

Pulmonary vein: carries oxygenated blood from lungs to the heart

- Anaerobic respiration: respiration without oxygen

Fermentation: respiration without oxygen in microorganisms

- Bronchi: extends from trachea, have incomplete cartilage ring

Bronchioles: extended from bronchi

Q 12- Draw cross section of leaf and label stomata. Also mention any two roles of stomata in plants.

Ans: Fig 6.1, page 96, NCERT

Q 12- Draw labeled diagram of structural and functional unit of kidney. Also mention its role.

Ans: Fig: 6.14, page 111, NCERT

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

Q 13 Give reasons:

i- Ventricles have thicker muscular walls than atria.

ii- Transport system in plants is slow.

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

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

v-Veins have valves whereas arteries do not.

Ans:

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

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

(iii) The aquatic vertebrates like fish have gills to oxygenate blood. Fishes have single circulation. The terrestrial vertebrates like birds and humans have four chambered heart and shows double circulation.

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

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

Q 14- Describe double circulation of blood in human beings. Why is it necessary?

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

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

Q 14- Mention the location of four major glands associated with digestive system of humans and explain function of each?

Ans:

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

ii-Gastric Glands- these are present inside stomach. Gastric glands secrete

HCI- disinfect food, provide acidic medium for digestive juices.

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

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

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

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

Q 15- Explain autotrophic nutrition in plants.

Ans:

- Synthesis of food by photosynthesis- 'photo' means light and 'synthesis' means production. It is the production of food with the help of sunlight.

Photosynthesis equation-

$6CO_2 + 12H_2O \longrightarrow C_6H_{12}O_6 + 6O_2 + 6\,H_2O$

Events of photosynthesis are as follows:

- Absorption of light energy green pigment (chlorophyll).
- Light energy provides energy for activation of reaction.
- Photolysis of water (splitting of water) into Oxygen, H^+ and e^-
- Reduction of CO2 into glucose and Synthesis of ATP.

CHAPTER- 7
CONTROL AND CO-ORDINATION

Control and coordination are the functions of the response against stimulus and hormones.

Animals have nervous system for this act. Plants also show responses by using different mechanism.

Topics

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

TROPIC MOVEMENTS IN PLANTS

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

Phototropism	Movement is response to light. Ex- shoot bending toward the light , root bending away from light, movement of sunflower
Chemotropism	Movement in response to certain chemicals Ex- Growth of pollen tubes toward ovary
Geotropism	The movement of plants in response to the gravity. Ex- Roots of plant grow downwards, shoots usually grow upward
Hydrotropism	Movement of plants in response to water. Ex- Root grows towards water.
Thigmotropism	The reflex of plants response of touch. Ex- touch-me-not (Mimosa) plant leaves.

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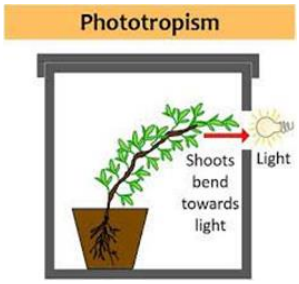
<td> 
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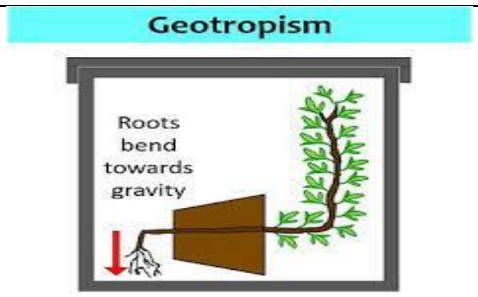
<td> 
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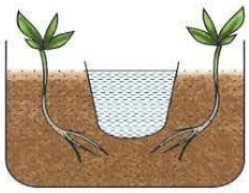
<td> 
Fig 11.4: hydrotropism</td>
<td>Thigmotropism
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INTRODUCTION OF PLANT HORMONES

Growth and differentiation in plants depend on few hormones calls as plant growth regulators/ plant growth hormones/ Phytohormones. These are organic substances which are synthesized in minute quantity in one part of plant body and transported to other part where they show specific physiological processes.

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

CONTROL AND CO-ORDINATION IN ANIMALS

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

- Nervous system

- Muscular tissue
- Endocrine system: Hormones
- Nervous system

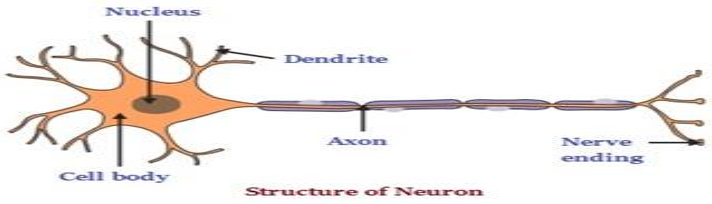
The nervous system is composed of –

i- CNS (Central nervous system)- Brain + Spinal cord

ii- PNS (Peripheral Nervous System)- all the nerves associated with the CNS

NEURONS

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



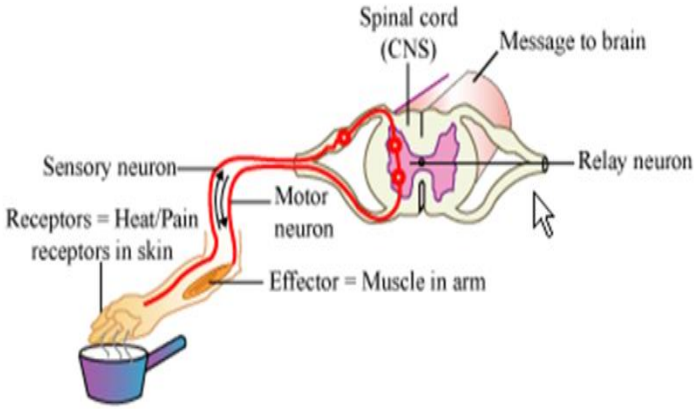
Structure of Neuron

HOW NERVOUS IMPULSE TRAVELS IN BODY

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

REFLEX ACTION

- Reflex action is a sudden and involuntary response to any stimuli.
- It originates in spinal cord.
- Ex- Drawing hand away from hot plate, watering of mouth in response to food etc.
- The neural pathway that controls the reflex action is called as reflex arch. In these sensory neurons, spinal cord, relay neuron, motor neuron and effector muscles are involved.

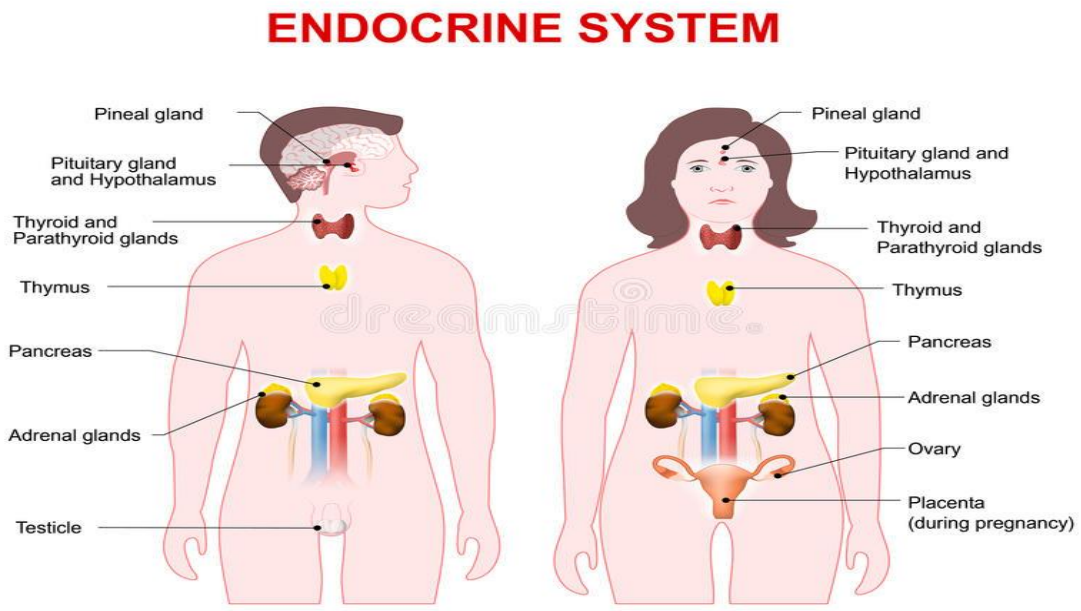


- Stimulus is received by sensory neuron. The sensory neurons transfer sensory impulse to the spinal cord (CNS). Spinal cord process the stimulus. The motor nerve fibre relay the motor impulses from the nervous system to the effector organs like muscles.

HORMONES IN ANIMALS-

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

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



OVARY	Oestrogen	Changes associated with puberty in female

- **GOITER**- Iodine is necessary for formation of thyroxin hormone. If Iodine is in low concentration the thyroid gland swells and causes goiter.
- **GIGANTISM and DWARFISM**- Excess secretion of growth hormone from pituitary gland causes excess growth of body (gigantism) and less secretion result in dwarfism.

IMPORTANT QUESTIONS

Very Short Answer Type Questions-

Q 1- Which Phytohormones is considered as growth inhibitor?

Ans: Abscisic acid.

Q 2 - Which hormone requires Iodine for its synthesis? What will happen if there is deficiency of dietary Iodine?

Ans: Thyroxine, Goiter disease

Q 3- Which hormone helps in lowering the level of blood glucose in human beings?

Ans: Insulin

Q 4- Which hormone is responsible for the development of moustache and beard in man?

Ans: Testosterone

Q 5- Name two tissues that provide control and coordination in multicellular animals.

Ans: Nervous tissue, Endocrine tissue

Short Answer Type Questions-

Q 5- State how concentration of Auxin stimulates the cells to grow longer on the side of the shoot which is away from light?

Ans: When light comes from one side, Auxin diffuses towards the shady side of the shoot. This concentration of Auxin stimulates the cells to grow longer on the side of the shoot which is away from light and plant appears to bend towards light.

Q 6- What is role of synapse in nerve impulse conduction?

Ans: Synapses are gaps between two neurons. When the nerve impulse reaches the dendrites at the end of the axon, chemical messengers called neurotransmitters are released. These chemicals diffuse across the synapse (the gap between the two neurons). The chemicals bind with receptor molecules on the membrane of the second neuron.

Q 7- Draw labeled diagram of neuron.

Fig 7.1 a, Page, 115 NCERT

Q 8- Explain reflex action.

Ans: A reflex action is an automatic (involuntary) and quick reaction to a stimulus that protects the body from potentially dangerous situations like touching something hot.

When body receives strong and sudden stimulus like pressure, temperature or chemicals, then sensory neuron sends message to the spinal cord.

The relay neuron sends the signal to the motor neuron and latter sends a signal to the effector muscle to respond.

Q 9- Compare chemotropism and Hydrotropism.

Ans: chemotropism: Movement due to chemical. E.g.- pollen tube growth on stigma and style.

Hydrotropism: Movement due to water. E.g. growth of root towards water

Q 10- Identify the hormones and related glands by following statements-

i- Regulation of blood sugar , ii- Release during stress condition iii- Female puberty features iv- Dwarfism

Ans: i) Insulin (pancreas gland) , ii) Adrenaline (Adrenal Gland), iii) Estrogen (Ovary) , v) Growth hormone (Pituitary Gland)

Long Answer Type Questions

Q 11- What are endocrine glands? Locate any four endocrine glands of human by drawing suitable diagram.

Ans: endocrine glands are ductless glands and secretes hormone to control and coordinate body function.

Fig 7.7, page124, NCERT

Q 12- You have touched a hot object. Represent diagrammatically the path that leads to a response, i.e. quickly pulling back the hand.

Ans: Fig 7.2, page117, NCERT

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

(b) Name the endocrine gland which secretes growth hormone.

(c) Which glands secrets growth hormone? What will be consequences of Deficiency and Excess secretion of growth hormone?

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

(b) Gland- Pancreas

(c) Gland- Pituitary Gland, Excess secretion: Gigantism, Deficiency: Dwarfism

Q 13 How does chemical coordination occurs in plants?

Ans: In plants, chemical coordination occurs with the help of plant hormones/ Plant growth regulators.

(Phytohormones). Example- Auxin, Cytokinin, Gibberellin, Abscisic acid and ethylene.

These hormones help to coordinate growth, development, and responses to the environment.

Plant hormones are synthesized at different and diffuse to the area where they act.

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

Q 14- What events takes place between synapse of two neurons?

Ans. Synapse is gap between two neurons. In between synapse nerve impulse conducted by chemical process with the help of neurotransmitters (acetylcholine).with in axon nerve impulse travels by electric signal. When it reached to synapse the neurotransmitters are released in synaptic cleft.

These neurotransmitters act as stimulus for next neuron.

Q 15- What are tropic movements? Explain any three types of tropic movement with example.

Ans: Tropic movement is the movement of the plant in response to the stimulus present in the environment. The main types of tropic movements are-

(a) Phototropism – it occur in response to light. , Towards light (positive) e.g. - shoot bends towards light, Away from the light (negative) e.g. - growth of root

(b) Geotropism – It is response to gravity – Positive (towards stimulus) e.g. Root ,

Negative (away from the stimulus) e.g. shoot

CHAPTER- 8
HOW DO ORGANISM REPRODUCE

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

Content:

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

TYPES OF REPRODUCTION

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

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

ASEXUAL REPRODUCTION AND VEGETATIVE REPRODUCTION

i- Fission

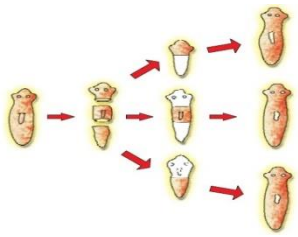
In this organism divide two or more equal part and each develops into identical new individuals.

Amoeba

ii- Regeneration

If the body of a individuals is cut into several pieces, each of its part regrows to the new individual. This process is called as regeneration.

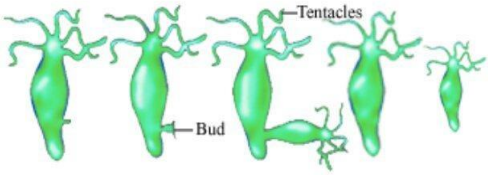
Ex- Planaria



iii- Budding

In this new organism develops on bud (out growth on the parent body). The new organism remains attach to the parent body till it get matures.

Ex- hydra, yeast

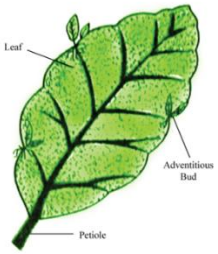


iv- Adventitious bud

Small l buds in the notches of leaf.

These have ability to grow into new individual.

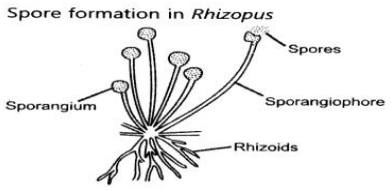
Ex – Bryophyllum



v- Spore formation

Spores are propagules produced in sporangia and germinate to produce new individuals.

Ex.- Rhizopus (bread moulds)



SEXUAL REPRODUCTION

The sexual life cycle can be grouped into –

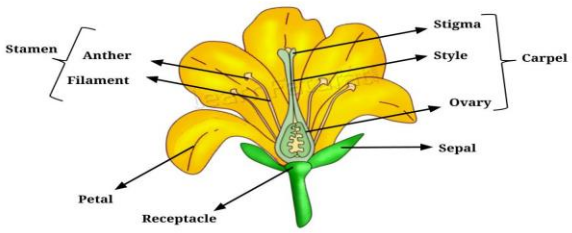
i- Pre-reproductive phase- development to attain sexual maturity (puberty)

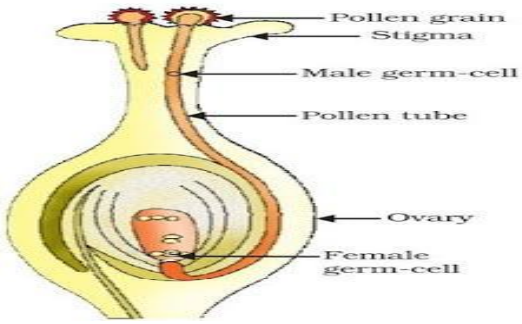
ii- Reproductive phase- sexually mature, able to reproduce, able to produce fertile gametes

iii- Post reproductive phase- after fertilization, development of embryo into new individual

SEXUAL REPRODUCTION IN FLOWERING PLANTS

- Reproductive part of pant is flower. Flower consists sepals, petals, stamens and carpels.
- Stamen and carpel contains anther and over respectively.
- Anther produces male gamete pollen and ovary contains female gamete egg.
- After pollination pollen fuses with egg to for zygote.
- Zygote develops in embryo and within ovule.
- Ovule develops into seed that contains future plant and ovary ripens in fruit.





REPRODUCTION IN HUMAN BEING

Male reproductive system –

- It consists of one pair of testes where sperm formation takes place.
- Testes also secrete hormones like testosterone. Testosterone brings about changes in appearance of boys at the time of puberty.

- Sperm delivered through the vas deferens where secretions of prostate gland and seminal vesicles add their secretions. These secretions help in transportation and provide nutrition to sperm.

Female reproductive system

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

Fertilization

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

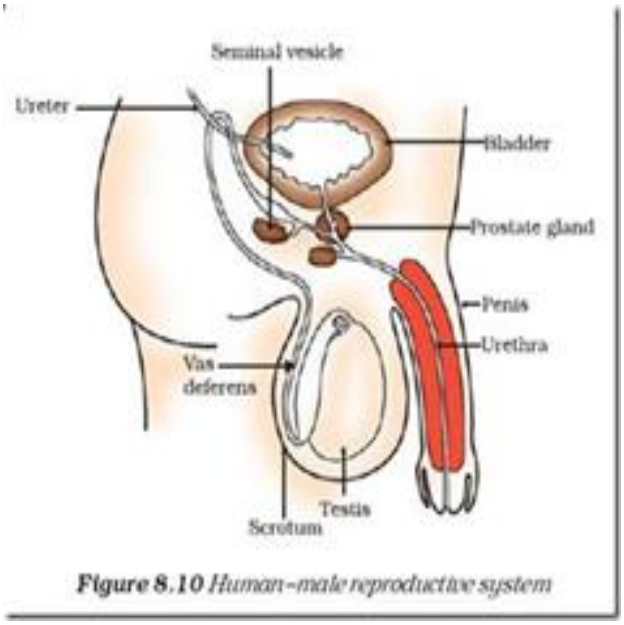
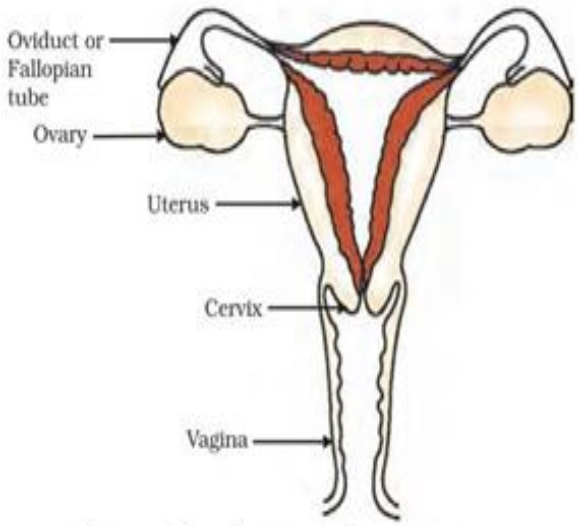


Figure 8.10 *Human–male reproductive system*



Human–female reproductive system

REPRODUCTIVE HEALTH

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

Population control methods

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

- Surgical method- Vasectomy and Tubectommy

Sex determination

It is banned in India as it promotes sex selective abortion of female foetus.

CHILD BEARING AND WOMEN HEALTH

- The risks of childbirth are higher when there are other health problems such as Cancer, Depression, STDs, Urinary tract infection, obesity and Hypertension etc.
- Pregnancy also carries a higher risk for relatively young and old women and for women who have many babies in a short space of time.
- Prevention and care - Proper nutrition and diet should be taken and regular medical checkup should be conducted. This will help in overall mother's physical and mental health as well as will be very much beneficial for baby.

IMPORTANT QUESTIONS

Very Short Answer Type Questions

Q1- 1-What is fission mode of reproduction? Which type fission is observed in amoeba?

Ans: Asexual reproduction by a separation of the body into two new bodies.

Amoeba- Binary fission

Q 2- Define reproduction. Mention its importance

Ans: Reproduction is the process by which new individuals are produced by the parents.

Maintain continuity of species.

Q 3- Mention modes of reproduction in Leishmania, Rhizopus, Planaria, Plasmodium and hydra.

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

Q 4- When a cell reproduces, what happens to its DNA?

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

Q 5- What is pollination? Give example of any two pollinating agents.

Ans: Transfer of pollen from anther to the stigma of a flower is known as pollination.

Examples of pollinating agents: Insect, Wind, Water

Short Answer Type Questions

Q 6- What are sexually transmitted diseases? Give any three examples.

Ans: are infections transmitted from an infected person to an uninfected person through sexual contact.

Example- HIV- AIDS, Syphilis, Genital wart

Q 7: Differentiate asexual and sexual mode of reproduction. Which one shows variation and why?

Ans:

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

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

Q 8: Explain vegetative propagation with the help of two examples. List two advantages of vegetative propagation.

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

Importance

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

Q 9: Write the role of the followings-

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

Ans:

I. Placenta: provides oxygen and nutrients to a growing baby. It also removes waste products from the baby's blood.

II. Ovary: produce egg by process of ovulation

III. Uterine wall: implantation, formation of placenta and umbilical cord, helps in contraction during child birth

IV. Egg fuses with sperm **to form zygote**

Q 10: What could be the reasons for adopting contraceptive methods?

Ans: To prevent -
Unwanted pregnancy, STDs (sexually transmitted diseases)

Long Answer Type Questions

Q11- Draw labeled diagram of male reproductive system and mention the role of – scrotum, prostate gland.

Ans: Fig 8.10, Page 137, NCERT

Q12- What happens when?

I. Planaria gets cut into two pieces

II. A mature Spirogyra filament attains considerable length

III. On maturation sporangia burst?

Ans:

I. Each piece of Planaria grows into a complete organism by process of regeneration.
II. When Spirogyra attains a specific length it breaks into small fragments. Each fragment is able to grow into new individuals.
III. Sporogonium releases spores in air. On soil under favourable conditions spore germinate into new individuals.

Q 12- Why do menstruation occur in females?

Ans: Menstruation is the regular discharge of blood and mucosal tissue from the inner lining of the uterus through the vagina.

It starts between puberty and lasts till menopause.

During this period, the body prepares itself for pregnancy.

Every month one of ovary releases an egg for fertilization.

When fertilization does not takes place the inner lining of uterus get ruptured and released through vagina along with blood vessels and mucus.

Q 13- a-Why is it said that, sexual reproduction promotes diversity of characters in the off springs?

b- Why is variation possible in progeny of sexually reproductive individuals?

Ans: a- It is because sexual reproduction results from the fission of two gametes coming from two different and sexually distinct individuals. This leads to variation, is necessary for evolution.

b- In sexually reproductive individuals variation is possible because copy of DNA in newly formed cell is not identical to copy DNA of original cell.

Q14- (i) List two reproductive parts of a flower.

(ii) How is a unisexual flower different from a bisexual flower? State in brief.

Ans: (i) Male — Stamen, Female — Carpel/Pistil

(ii) Unisexual flower - possesses one types of reproductive organs, either stamens (male flower) or pistils (female flower)

Bisexual flower- contains both the types of reproductive organs

Q15- Describe the fertilization process in flowering plants. Make diagram of germination of pollen on stigma.

Ans:

- After pollination pollen is received by stigma.
- Pollen tube is formed which travels through style and reached to ovule.
- Ovule contains embryo sac where the male gamete of pollen fuses with egg cell.
- Fusion results in formation of zygote. Zygote develops into embryo.
- The ovule develops into seed and ovary into fruit.
- Fig- 8.8, page 135 NCERT

CHAPTER- 9
HEREDITY AND EVOLUTION

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

TYPES OF VARIATION

I- Somatic variations:

Occur in general body cells

It is not inherited

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

II- **Germinal variations**:

Occur in special gamete forming cells only

Inherit in next generation

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

Importance of variations

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

MENDEL'S LAW OF INHERITANCE

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

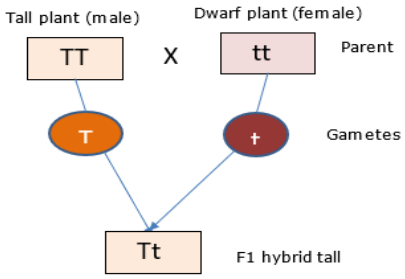
Key Words

Chromosomes	Long thread-like structures present in the nucleus of a cell which contain hereditary information of the cell.
DNA	Deoxyribo nucleic acid, present in DNA
Gene	Part of DNS, controls a specific biological function.
Contrasting characters	A pair of visible characters such as tall and dwarf, white and violet flowers, round and wrinkled seeds, green and yellow seeds etc.
Dominant trait	Visible trait in (F1) generation when condition is heterozygous..
Recessive trait	Can't express itself in presence of dominant trait.
Homozygous	When alleles of same types are present. E.g.- TT, tt.

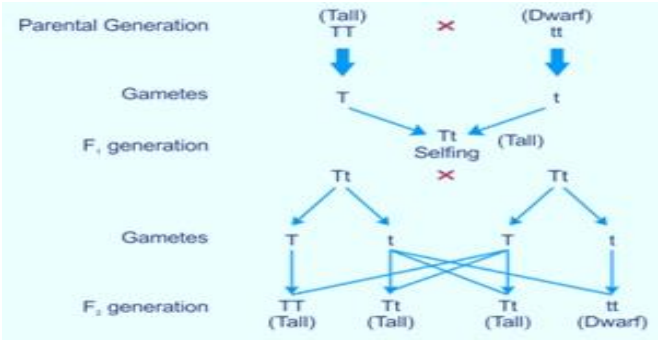
Heterozygous	Two different alleles present together. E.g.- Tt
Genotype	It is genetic makeup of an individual. E.g.- TT, tt, Tt
Phenotype	It is observable feature. E.g.- tall, dwarf
Monohybrid cross	Cross to observe single character. E.g.- height of plant
Dihybrid cross	Cross to observe two characters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

MENDEL'S LAWS OF INHERITANCE

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



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

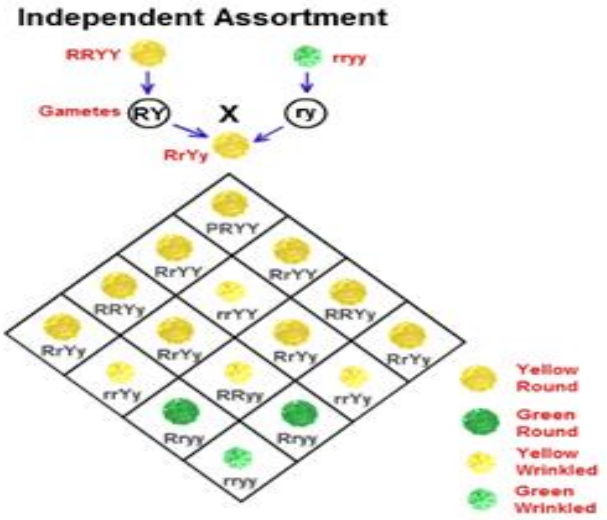


Law of segregation: The phenomenon of separation of the two alternating factors of one character, during gamete formation so that one gamete receives only one factor of a character is called as 'Law of Segregation.

Law of Independent Assortment-

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

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



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

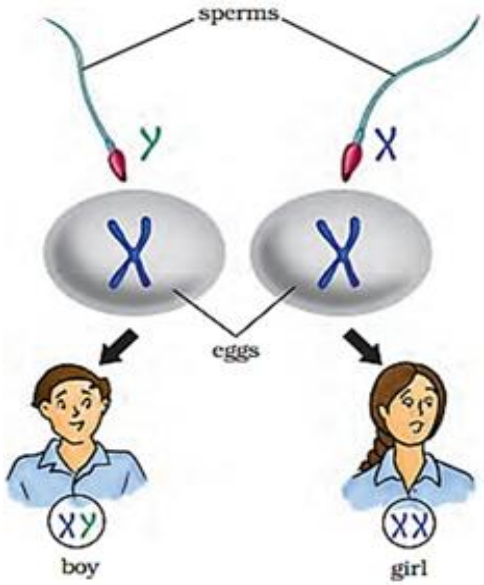
HOW DO TRAITS GET EXPRESSED?

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

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

SEX DETERMINATION IN HUMAN

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



- Human has 23 pair of chromosomes.
- Autosome: 22 pairs (44)
- Sex chromosomes: 01 pair (02). They may be either-

i- Homogametic – XX for female (44 +XX)

ii- Heterogametic XY for male (44 +XY)

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

- In some Reptiles: Temperature at which a fertilized egg is incubated governs the gender.
- Snails: A particular animal can change the gender within one's life time.

IMPORTANT QUESTIONS

Very Short Answer Questions

Q1- What are genes?

Ans: A gene is the basic physical and functional unit of heredity. It is made up of DNA.

Q2- In case of round yellow and green wrinkled, which is dominant trait set?

Ans: Round shape of seed and Yellow colour of seed.

Q3- The sex of the children is determined by what they inherit from their father and not their mother." Justify

Ans: because Y sex chromosome is inherited only from father

Q4- Name the scientist who established the laws of inheritance.

Ans: Gregor Johann Mendel

Q5- Where genes are located?

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

Short Answer Questions

Q6- Why did Mendel select Pea plant for his experiment?

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

Q7- **Describe genotype and phenotype with one example of each.**

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

Q8- What is significance of variation?

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

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

Q9- Mention the difference between the inherited and the acquired characters. Give one example of each of the characters that are inherited and the ones that are acquired in humans.

Ans: Inherited trait: obtain from parents (since the time of his birth and are passed on from one generation to another.
Acquired trait: gain after birth (person develops during his lifetime)
Inherited: attached ear lobe, baldness
Acquired: obesity, reading skill

Q 10 - (a) Write foil form of DNA.

(b) Why are variations essential for the species?

Ans: (a) Deoxyribonucleic acid

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

Long Answer Questions

Q 11- Make representation of Dihybrid cross showing phenotypic ratio 9:3:3:1.

Fig. 9.5; page:145,NCERT

Q 12- **Describe law of dominance, law of segregation and law of segregation.**

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

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

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

Q 13- In a monohybrid cross of tall Pea plants denoted by TT and short pea plants denoted by tt, Vaibhav obtained only tall plants (denoted by Tt) in F1 generation. However, in F2 generation she obtained both tall and short plants. Using the above information, explain the law of dominance.

TT x tt ……...Parents

T t

Tt……. F1

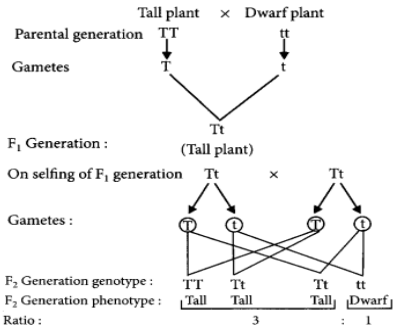
Tt x **Tt** …….self cross

T t T t ……..Gametes

F2

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

Q 14- Mendel crossed tall pea plants with dwarf pea plants in his experiment. Write his observations giving reasons on the F1 and F2 generations.



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

In F2 generation both tall and dwarf are visible. Dwarf is visible only in homozygous condition.

Q 15- State the importance of chromosomal difference between sperms and eggs of humans. Also mention the criteria of sex determination.

Ans:

Human sperm: 22 + XY

Human egg : 2 + XX

Sex of the child will be determined by which sperm type fuses with the egg. Sex of the child will be male if 22 + Y sperm fuses with the egg.

It will be female if 22 + X sperm fuses with the ovum.

Class 10 Science

Light Reflection and Refraction

REFLECTION

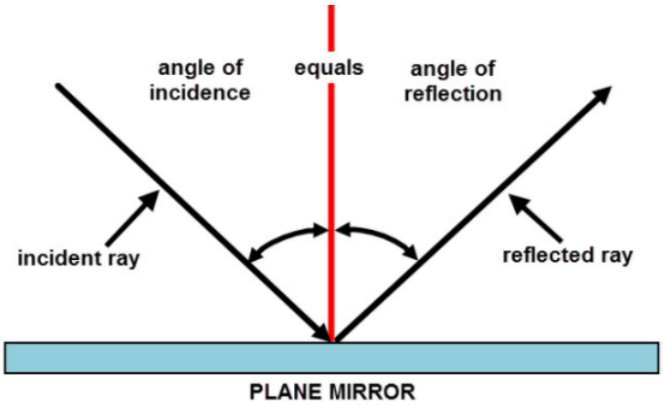
Reflection of Light: The phenomenon of bouncing back of light into the same medium by the smooth surface is called reflection.

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

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

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

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



Laws of reflection: There are two laws of reflection

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

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

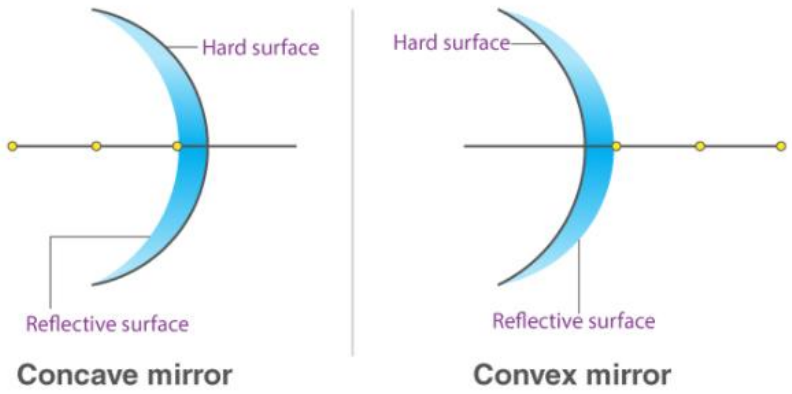
Real image: When the rays of light, after reflection from a mirror, actually meet at a point, then the image formed by these rays is said to be real. Real images can be obtained on a screen.

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

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

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

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



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

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

Some definitions related to Spherical Mirror:

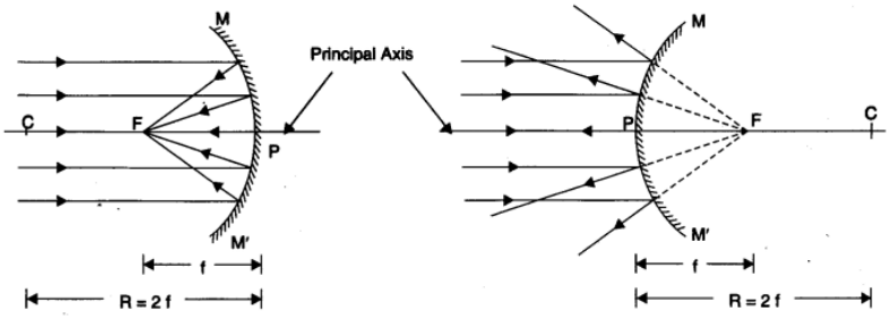
Pole (Vertex): The central point of a mirror is called its pole.

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

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

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

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



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

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

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

$$F = R/2$$

Reflection by Spherical mirror:

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

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

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

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

Image formation by Concave mirror

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

Image formation by Convex mirror

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

Sign Conventions of Spherical Mirror

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

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

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

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

REFRACTION

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

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

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

Laws of refraction:

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

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

Sin i/sin r = n (constant)

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

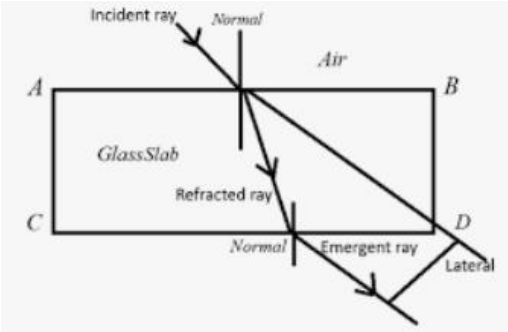
Refractive Index: If c is the speed of light in air and v is the speed of light in medium, then the refractive index of the medium is

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

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

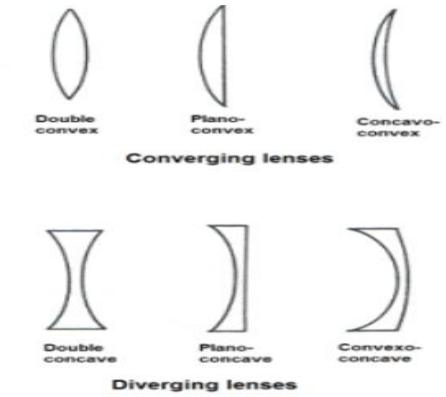
Refraction through a Rectangular Glass Slab:

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



i = angle of incidence, r = angle of refraction and e = angle of emergence
Angle of incidence = Angle of emergence, i.e. ∠i = ∠e

Lens: The transparent refracting medium bounded by two surfaces in which at least one surface is curved is called lens. Lenses are mainly two types: Convex lens and Concave lens.



Difference between Convex and Concave Lenses

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

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

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

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

Image formation by a convex lens

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

Image formation by a concave lens

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

Sign conventions:

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

Lens formula:

1/v-1/u = 1/f

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

m = i/o or m = v/u

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

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

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

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

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

Take u = always negative

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

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

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

m= -ve for real image

= +ve for virtual image

FOR LENS

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

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

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

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

QUESTIONS WITH ANSWERS

Question 1.

What is the magnification of the images formed by plane mirrors and why?

Answer:

The magnification of the image formed by a plane mirror is 1 because size of the image is equal to the size of the object.

Question 2.

What is meant by power of a lens?

Answer: The power of a lens is a measure of the degree of convergence or divergence of light

rays falling on it. The power of a lens is defined as the reciprocal of its focal length in metres.
Power of a lens = 1 /Focal length (in m)
The SI unit of power is dioptre denoted by the letter D. One dioptre is the power of a lens whose focal length is 1 metre.

Question 3

List four properties of the image formed by a concave mirror when object is placed between focus and pole of the mirror.

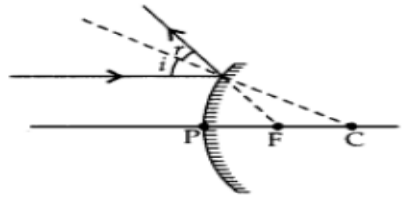
Answer:

Image is virtual, erect, magnified, i.e., bigger than the object and behind the mirror.

Question 4

Draw a ray diagram to show the path of the reflected ray corresponding to an incident ray which is directed towards the principal focus of a convex mirror. Mark on it the angle of incidence and the angle of reflection.

Answer:



∠i = Angle of incidence
∠r = Angle of reflection

Question 5

List four characteristics of the images formed by plane mirrors.

Answer:

The characteristics of the images formed by plane mirrors are:

1. The image formed by a plane mirror is virtual and erect. It cannot be received on a screen.
2. The image formed by a plane mirror is of the same size as the object.
3. The image formed by a plane mirror is at the same distance behind the mirror as the object is in front of the mirror.
4. The image formed in a plane mirror is laterally inverted.

Question 6

List four specific characteristics of the images of the objects formed by convex mirrors.

Answer:

The images of the objects formed by convex mirrors are always-

1. Virtual
2. Erect
3. Diminished and
4. Formed behind the mirror between focus and pole of the mirror.

Question 7

The absolute refractive indices of glass and water are 32 and 43 respectively. If the speed of light is 2×10^8 m/s, calculate the speed of light in (i) vacuum, (ii) water.

Answer:

(i) Given: $v_g = 2 \times 10^8$ m/s (Speed of light in glass)
We know, Absolute Refractive Index of a Medium = Speed of light in Vacuum (c) Speed of light in the Medium

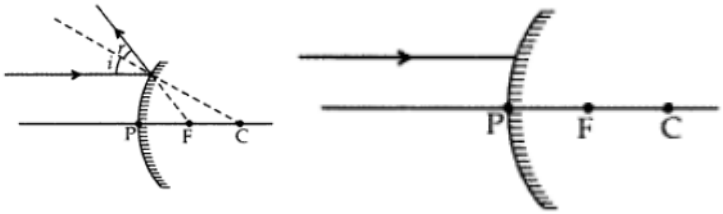
$$n_g = \frac{3}{2}, n_w = \frac{4}{3} \quad \Rightarrow \quad n_g = \frac{c}{v_g} = c = n_g v_g \quad \Rightarrow \quad c = \frac{3}{2} \times 2 \times 10^8$$

$$\therefore \ c = 3 \times 10^8 \text{ m/s}$$

(ii) $n_w = \frac{4}{3}$ $\qquad c = 3 \times 10^8$ m/s

$$\Rightarrow \ v_w = \frac{c}{n_w} = \frac{3 \times 10^8}{\frac{4}{3}} = \frac{3 \times 3 \times 10^8}{4} = 2.25 \times 10^8 \text{ m/s}$$

Question 8
A ray of light is incident on a convex mirror as shown. Redraw the diagram and complete the path of this ray after reflection from the mirror. Mark angle of incidence and angle of reflection on it.
Answer:



Question 9
What is meant by power of a lens? What does its sign (+ve or -ve) indicate? State its S.I. unit. How is this unit related to focal length of a lens?
Answer:

- The power of a lens is a measure of the degree of convergence or divergence of light rays falling on it.
- +ve sign → converging lens/convex lens
  -ve sign → diverging lens/concave lens
- The SI unit of lens is dioptre. One dioptre is the power of a lens whose focal length is 1 metre.

Question 10
"The magnification produced by a spherical mirror is -3". List four information you obtain from this statement about the mirror/image.
Answer:
Magnification produced by a spherical mirror, m = -3

- Image is 3 times magnified than the object.
- Image is inverted (as m has negative sign)
- Image is real.
- Nature of the mirror is concave.

Question 11
The refractive indices of glass and water with respect to air are 3/2 and 4/3 respectively. if speed

of light in glass is 2×10^8 m/s, find the speed of light in water.
Answer:

$$\text{Refractive index of a medium} = \frac{\text{Speed of light in air}}{\text{Speed of light in that medium}}$$

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

Speed of light in glass = 2×10^8 m/s; Speed of light in water = v = ?

$$n_g = \frac{\text{Speed of light in air}}{\text{Speed of light in glass}} \Rightarrow \frac{3}{2} = \frac{\text{Speed of light in air}}{2\times10^8 \text{m/s}}$$

$\therefore$ Speed of light in air = $\frac{3}{2} \times 2 \times 10^8 = 3 \times 10^8$ m/s

$$n_w = \frac{\text{Speed of light in air}}{\text{Speed of light in water}} \Rightarrow \frac{4}{3} = \frac{3\times10^8 \text{m/s}}{v}$$

$$3 \times 10^8 \times \frac{3}{4} = v \Rightarrow v = 2.25 \times 10^8 \text{ m/s}$$

$\therefore$ Speed of light in water = 2.25×10^8 m/s

Question 12

An object is placed at a distance of 30 cm in front of a convex mirror of focal length 15 cm. Write four characteristics of the image formed by the mirror.
Answer:
Four characteristics of the image formed are:

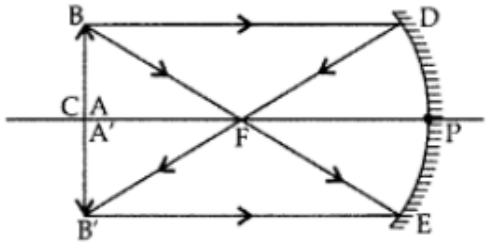
- Image is erect.
- Image is virtual.
- Image is diminished in size.
- The image is formed behind the mirror between P & F points of the mirror.
- The image is laterally inverted.

Question 13

A student places a candle flame at a distance of about 60 cm from a convex lens of focal length 10 cm and focuses the image of the flame on a screen. After that he gradually moves the flame towards the lens and each time focuses the image on the screen.
(a) In which direction-toward or away from the lens, does he move the screen to focus the image?
(b) How does the size of the image change?
(c) How does the intensity of the image change as the flame moves towards the lens?
(d) Approximately for what distance between the flame and the lens, the image formed on the screen is inverted and of the same size?
Answer:
(a) He will move the screen away from the lens to focus the image.
(b) Size of the image goes on increasing.
(c) Intensity of image goes on decreasing.
(d) About 20 cm

Question 14

Draw the ray diagram and also state the position, the relative size and the nature of image formed by a concave mirror when the object is placed at the centre of curvature of the mirror.
Answer:
When the object is at the centre of curvature of a concave mirror, i.e., point C:



The image formed is

- real,
- inverted,
- same size as the object at C, and
- at C.

Question 15

Define, 'refractive index of a transparent medium'. What is its unit? Which has a higher refractive index – glass or water?

Answer:

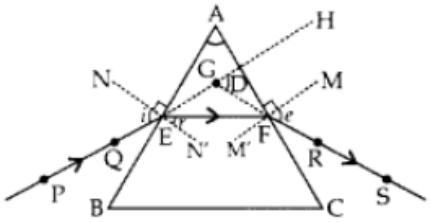
- The light bending ability of a transparent medium is called the refractive index of that medium.
- The ratio of speed of light in vacuum to the speed of light in a medium is called the refractive index of that medium.
  refractive index (of a medium) = Speed of light in vacuum Speed of light in medium
- Since refractive index is a ratio of two similar quantities therefore it has no units.
- The refractive index of glass is more than water.

Question 16

Draw a ray diagram to show the refraction of light through triangular glass prism and mark angle of deviation on it.

Answer:

Refraction of light through triangular glass prism:



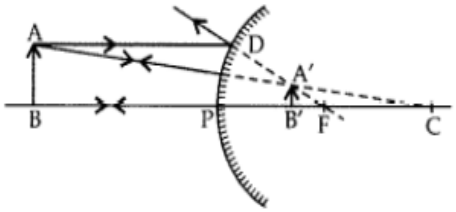
PF – Incident ray
EF – Refracted ray
FS – Emergent ray
∠A – Angle of the prism
∠i – Angle of incidence
∠r – Angle of refraction
∠e – Angle of emergence
∠D – Angle of deviation

Question 17

(i) "The refractive index of diamond is 2.42". What is the meaning of this statement?
(ii) Name a liquid whose mass density is less than that of water but it is optically denser than water.

Answer:
(i) The refractive index of diamond is 2.42. It means that the ratio of the speed of light in air and the speed of light in diamond is equal to 2.42.
Higher is the refractive index of a medium, lower is the speed of light in that medium. Because the refractive index of diamond is very high, therefore the speed of light in diamond is very low.
(ii) Kerosene has the mass density less than water but it is optically denser than water.

Question 18
An object is placed between infinity and the pole of a convex mirror. Draw a ray diagram and also state the position, the relative size and the nature of the image formed.
Answer:
Position, size and nature of image:
Image formed by a convex mirror is virtual, diminished, erect and behind the mirror between its P (pole) and F (focus) point.



Question 19
The image of a candle flame placed at a distance of 45 cm from a spherical lens is formed on a screen placed at a distance of 90 cm from the lens. Identify the type of lens and calculate its focal length. If the height of the flame is 2 cm, find the height of its image.
Answer:
Object distance, u = -45 cm, Image distance, v = +90 cm (real) Focal length, f = ?,
Nature of lens = ?, Height of the object, h_1 = 2 cm, Height of the image, h_2 = ?
According to lens formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{90} - \frac{1}{-45} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{90} + \frac{1}{45} = \frac{1+2}{90} = \frac{3^{1}}{90_{30}} = \frac{1}{30}$$

∴ f = 30 cm
The positive sign of f shows that the given lens is a convex lens of focal length 30 cm.
Magnification,

$$m = \frac{v}{u} = \frac{+90^{2}}{-45} = -2$$

⇒ h2/h1 = -2 ⇒ h2/2 = -2
∴ h = -4
The height of the image is 4.
The negative sign shows that this image is in the downward direction below the axis, i.e., image is inverted.

Question 20
State the type of mirror preferred as (i) rear view mirror in vehicles, (ii) shaving mirror. Justify your answer giving two reasons in each case.
Answer:

(i) Convex mirror is used as rear view mirror in vehicles because the image formed in a convex mirror is highly diminished thus a convex mirror gives a wide field of view. Therefore a convex mirror enables a driver to view a much larger area of the traffic behind him.
(ii) Concave mirror is used as shaving mirror because when face is held within the focus of a concave mirror, an enlarged image of the face is seen in the concave mirror.

Question 21

The image of a candle flame placed at a distance of 36 cm from a spherical lens is formed on a screen placed at a distance of 72 cm from the lens. Identify the type of lens and calculate its focal length. If the height of the flame is 2.5 cm, find the height of the image.

Answer:

Object distance, u = -36 cm,

Images distance, v = +72 cm

[+ve sign is due to the image being formed on the screen hence it is real]

Focal length, f = ?, Nature of the lens = ?

Height of the object, h_1 = 2.5 cm, Height of the image, h_2 = ?

According to lens formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{72} - \frac{1}{-36} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{72} + \frac{1}{36} = \frac{1+2}{72} = \frac{3^{1}}{72_{24}} = \frac{1}{24}$$

∴ f = +24 ⇒ +ve sign off shows that the lens is convex having focal Length 24 cm.

$$\text{Magnification, } m = \frac{v}{u} = \frac{72^{2}}{-36} = -2$$

$$\textit{Formula: } m = \frac{h_2}{h_1} = \frac{h_2}{2.5} = -2$$

⇒ $h_2 = -2 \times 2.5 = -5$ cm

- -ve sign of h_2 shows that the image is inverted.
- Thus an inverted, magnified, 5 cm long image is formed on the screen.

Question 22

A 4 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 24 cm. The distance of the object from the lens is 16 cm. Find the position, size and nature of the image formed, using the lens formula.

Answer:

Height of the object, h_1 = 4 cm

Convex lens:

Focal length, f = +24 cm, Object distance, u = -16 cm, Image distance, v = ?

Height of the image, h_2 = ?, Nature of the image = ?v

According to lens formula:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \Rightarrow \quad \frac{1}{v} - \frac{1}{-16} = \frac{1}{24} \quad \Rightarrow \quad \frac{1}{v} + \frac{1}{16} = \frac{1}{24}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{24} - \frac{1}{16} = \frac{2-3}{48} = \frac{-1}{48} \quad \therefore \quad v = -48 \text{ cm}$$

- The image is formed at a distance of 48 cm from the convex lens.
- The minus sign for image distance shows that the image is formed on the left side of the convex lens.
- Only virtual image is formed on the left hand side.

According to formula: m = h2h1, m = vu

$$\frac{h_2}{h_1} = \frac{v}{u} \quad \Rightarrow \quad \frac{h_2}{4} = \frac{-48}{-16} = 3$$

$\therefore h_2 = 3 \times 4 = 12$ cm.

Thus a magnified (12 cm high), virtual and erect image is formed.

Question 23.

A 2.4 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 18 cm. The distance of the object from the lens is 12 cm. Find the position, size and nature of the image formed.

Answer:

$h_1 = +2.4$ cm (upright) (Concave lens) v = ? h_2 = ?

f = +18 cm (for convex lens) u = -12 cm Nature of the image = ?

According to lens formula:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \Rightarrow \quad \frac{1}{v} - \frac{1}{-12} = \frac{1}{18} \quad \Rightarrow \quad \frac{1}{v} + \frac{1}{12} = \frac{1}{18}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{18} - \frac{1}{12} = \frac{2-3}{36} = \frac{-1}{36} \quad \Rightarrow \quad v = -36 \text{ cm}$$

- Image is formed at a distance of 36 cm from the convex lens.
- The negative (-) sign of v shows that the image is formed on the left hand side of the convex lens. Only virtual image is formed on the left hand side

$$m = \frac{v}{u} = \frac{-36^{3}}{-12} = 3 \quad \Rightarrow \quad m = \frac{h_2}{h_1} = \frac{h_2}{2.4} \quad \Rightarrow \quad \frac{h_2}{2.4} = 3$$

$\Rightarrow h_2 = 3 \times 2.4 = 7.2$ cm

- The height of the image is 7.2 cm.
- The positive (+) sign shows that the image is formed above the axis. Thus the image is virtual and erect.

Question 24.

A 5 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 12 cm. The distance of the object from the lens is 8 cm. Find the position, size and nature of the

image formed.
Answer:
f = +12 cm (for convex lens), h_1 = 5 cm, u = -8cm
v = ?, h_2 = ?, Nature of the image = ?
According to lens formula:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \Rightarrow \quad \frac{1}{v} - \frac{1}{-8} = \frac{1}{12} \quad \Rightarrow \quad \frac{1}{v} + \frac{1}{8} = \frac{1}{12}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{12} - \frac{1}{8} = \frac{2-3}{24} = \frac{-1}{24} \quad \Rightarrow \quad v = -24 \text{ cm}$$

- Image is formed at a distance of 24 cm from the convex lens.
- The negative (-) sign of v shows that the image is formed on the left hand side of the convex lens and only virtual image is formed on the left hand side.

A virtual image is formed at 24 cm from the lens.

$$\therefore m = \frac{v}{u} = \frac{24^3}{8} = 3 \quad \Rightarrow \quad m = \frac{h_2}{h_1} \quad \Rightarrow \quad \frac{h_2}{5} = 3$$

$\therefore h_2 = 3 \times 5 = 15$ cm

- Thus size of the image is 15 cm.
- The positive (+) sign shows that the image is formed above the axis.

Question 25.
The image of a candle flame placed at a distance of 30 cm from a spherical lens is formed on a screen placed at a distance of 60 cm from the lens. Identify the type of lens and calculate its focal length. If the height of the flame is 2.4 cm, find the height of its image.
Answer:
Object distance, u = -30 cm,
Image distance, v = +60 cm
[+ve sign is due to the image formed on the screen, hence it is real]
f = ?, Type of lens = ?
Height of the object, h_1 = 2.4 cm, Height of the image, h_2 = ?
According to lens formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{60} - \frac{1}{-30} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{60} + \frac{1}{30} = \frac{1+2}{60} = \frac{3^1}{60_{20}} = \frac{1}{20}$$

$\therefore$ f = + 20cm
The positive (+ve) sign of/shows that the lens is convex having focal length 20 cm.
Now Magnification,

$$m = \frac{v}{u} = \frac{\cancel{60}^{2}}{\cancel{30}} = -2$$

The negative (-ve) sign of h_2 shows that the image is inverted.

Question 26

An object of height 5 cm is placed perpendicular to the principal axis of a concave lens of focal length 10 cm. Use lens formula to determine the position, size and nature of the image if the distance of the object from the lens is 20 cm.

Answer:

Height of the object, h_{21} = 5 cm, Focal length of the concave lens, f = -10 cm

Position of the object, v = ?, Size of the object, h_2 = ?

Object distance, u = -20 cm,

According to lens formula:

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

$$\Rightarrow \frac{1}{v} = \frac{-1}{10} - \frac{1}{20} = \frac{-2-1}{20} = \frac{-3}{20} \quad \therefore \quad v = \frac{-20}{3} = -6.67 \quad \therefore \quad \textbf{Image distance = -6.67cm}$$

The negative (-) sign for image distance shows that image is formed on the left side of the concave lens. So the image is virtual.

$$\text{Magnification, } m = \frac{v}{u},\ m = \frac{h_2}{h_1} \quad \therefore \quad m = \frac{\cancel{-}\frac{20}{3}}{\cancel{-}10} = \frac{\cancel{20}^{2}}{\cancel{10} \times 3} = \frac{+2}{3} = 0.67$$

$$\Rightarrow \frac{h_2}{h_1} = \frac{v}{u} \quad \therefore \quad h_2 = \frac{h_1 \times v}{u} = \frac{5 \times -20}{3 \times -20} = \frac{5}{3} \quad \Rightarrow \quad \textbf{m = +1.66 cm}$$

Since $h_2 < h_1$ therefore image is diminished. The positive (+) sign for the magnification shows that image is erect and virtual.

Question 27

A spherical mirror produces an image of magnification -1 on a screen placed at a distance of 50 cm from the mirror.

(a) Write the type of mirror.

(b) Find the distance of the image from the object.

(c) What is the focal length of the mirror?

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

Answer:

If magnification, m = -1; v = 50 cm

If the magnification has minus sign, then the image is real and inverted.

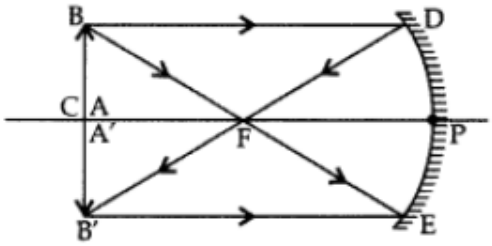
∴ v = -50 (for real image) ∵ m = −vu

⇒ -1 = −(−50)u
u = -50 cm
(a) Since image is formed on the screen therefore the mirror formed real image which is formed by concave mirror only.
(b) Image distance = 50 cm in front of the mirror.
(c)

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u} \quad \Rightarrow \quad \frac{1}{f}=\frac{1}{-50}+\frac{1}{-50} \quad \Rightarrow \quad \frac{1}{f}=-\frac{1}{50}-\frac{1}{50} \quad \Rightarrow \quad \frac{-2}{50}=\frac{-1}{25}$$

$$\therefore f = -25 \text{ cm}$$

(d)



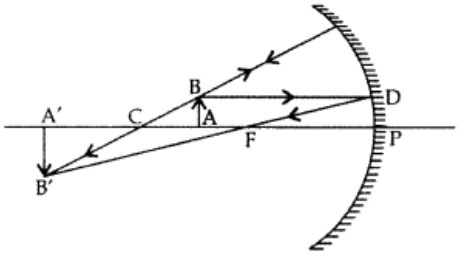
Question 28
A spherical mirror produces an image of magnification -1 on a screen placed at a distance of 40 cm from the mirror:
(i) Write the type of mirror.
(ii) What is the nature of the image formed?
(iii) How far is the object located from the mirror?
(iv) Draw the ray diagram to show the image formation in this case.

Answer:

- Spherical mirror
- m = -1
- Image is formed on a screen
  Image distance, v – 40 m

(i) Concave mirror
(ii) Real image (as it is formed on the screen)
(iii) m = -1
m = −vu
⇒ -1 = −(−40)u
⇒ -u = +40
⇒ u = -40 cm
∴ Object is placed at 40 cm from the mirror.
Question 29
A student wants to project the image of a candle flame on a screen 60 cm in front of a mirror by keeping the flame at a distance of 15 cm from its pole.

(i) Write the type of mirror he should use.
(ii) Find the linear magnification of the image produced.
(iii) What is the distance between the object and its image?
Draw a ray diagram to show the image formation in this case.

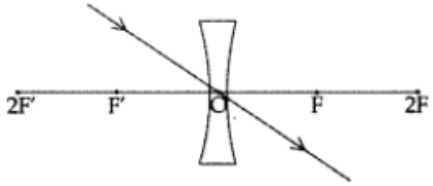


Answer:
Concave mirror
Linear magnification = – Image distance
Object distance
⇒ m = −vu
Object distance Object distance, u = -15 (u is always negative)
Image distance, v = -60 (n is negative for real image)
m = −(−60)(−15)
∴ m = -4
The minus sign in magnification shows that the image formed is real and inverted.
(iii) Distance between object and its image = 45 cm
(iv) Ray diagram:

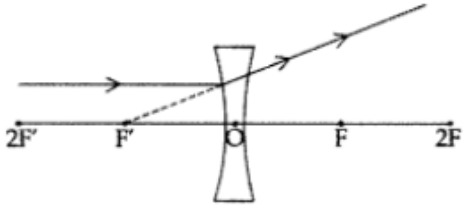
The image formed is real, inverted, magnified and beyond 2f.

Question 30

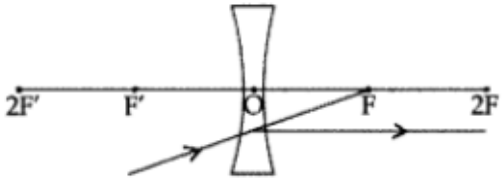
Draw a ray diagram to show the path of the refracted ray in each of the following cases: A ray of light incident on a concave lens is
(i) passing through its optical centre.
(ii) parallel to its principal axis.
(iii) directed towards its principal focus.
Answer:
(i) A ray of light passing through optical centre of a concave lens. An incident ray passing through the optical centre of a lens (concave or convex) goes straight after refraction.



(ii) Light ray parallel to principal axis.



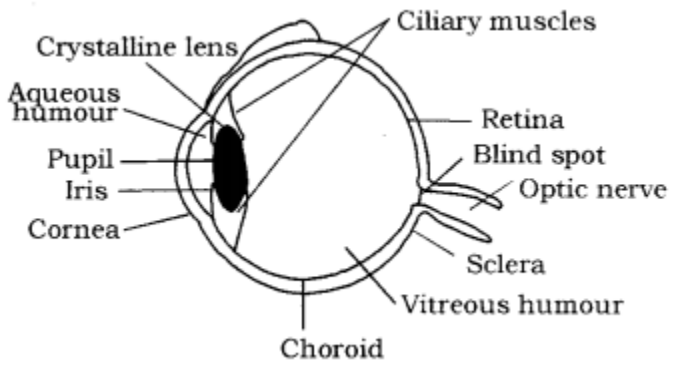
(iii) A ray of light directed towards principal focus.



Chapter- 11
HUMAN EYE AND COLOURFUL WORLD

The Human Eye: It is a natural optical instrument which is used to see the objects by human beings. It is like a camera which has a lens and screen system.

Structure of the Human Eye



The various parts of eye and their functions:

- Retina: It is a light sensitive screen inside the eye on which image is formed. It contains rods and cones. Functions: Captures the light rays focussed by the lens and sends
- Cornea: It is a thin membrane which covers the eye trail. It acts like a lens which refracts the light entering the eye.
- Aqueous humour: It is fluid which fills the space between cornea and eye lens.
- Eye lens: It is a convex lens made of transparent and flexible jelly like material. Its curvature can be adjusted with the help of ciliary muscles.
- Pupil: It is a hole in the middle of iris through which light enters the eye. It appears black because light falling on it goes into the eye and does not come back. Functions: Opens and closes in order to regulate and control the amount of light.
- Ciliary muscles: These are the muscles which are attached to eye lens and can modify the shape of eye lens which leads to the variation in focal lengths.
- Iris: It controls the amount of light entering the eye by changing the size of the pupil. Functions: Controls light level similar to the aperture of a camera.
- Optical nerve: These are the nerves which take the image to the brain in the form of electrical signals.

How Pupil Works?

For Example, you would have observed that when you come out of the cinema hall after watching the movie in the bright sunlight, your eyes get closed. And when you entered the hall from the bright light, you won't be able to see and after some time you would be able to see. Here, the pupil of an eye provides a variable aperture, whose size is controlled by iris.
(a) When the light is bright: Iris contracts the pupil, so that less light enters the eye.
(b) When the light is dim: Iris expands the pupil, so that more light enters the eye.
Pupil opens completely when iris is relaxed.

Colour Blindness: A person having defective cone cells is not able to distinguish between the different colours. This defect is known as Colour Blindness.

Defects of Vision:

Myopia (Short-sightedness): It is a kind of defect in the human eye due to which a person can see near objects clearly but he cannot see the distant objects clearly. **Myopia** is due to
(i) excessive curvature of the cornea.
(ii) Elongation of eyeball.

Hypermetropia (Long-sightedness): It is a kind of defect in the human eye due to which, a person can see distant objects properly but cannot see the nearby objects clearly. It happens due to (i) decrease in the power of eye lens i.e., increase in focal length of eye lens.
(ii) Shortening of eyeball.

Presbyopia: It is a kind of defect in human eye which occurs due to ageing. It happens due to the following reasons
(i) decrease in flexibility of eye lens.
(ii) Gradual weakening of ciliary muscles.
In this, a person may suffer from both myopia and hypermetropia.

Astigmatism: It is a kind of defect in human eye due to which a person cannot see (focus) simultaneously horizontal and vertical lines both.

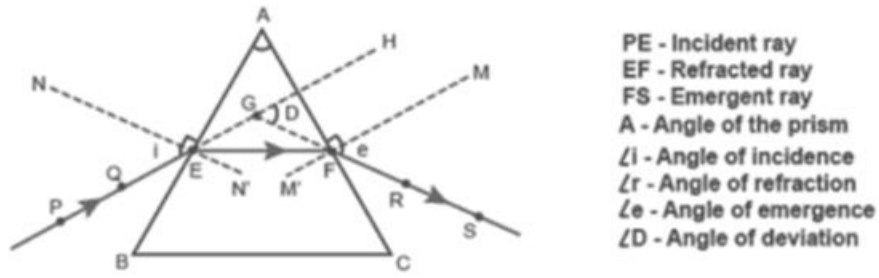
Cataract: Due to the membrane growth over eye lens, the eye lens becomes hazy or even opaque. This leads to a decrease or loss of vision. This problem is called a cataract. It can be corrected only by surgery.

2. Refraction of light through a prism: When a ray of light is incident on a rectangular glass slab, after refracting through the slab, it gets displaced laterally. As a result, the emergent ray comes out parallel to the incident ray. Unlike a rectangular slab, the side of a glass prism are inclined at an angle called the angle of prism.

Prism: A prism is a transparent refracting medium bounded by two plane surfaces, inclined to each other at a certain angle. It has one triangular base and three rectangular lateral surfaces.

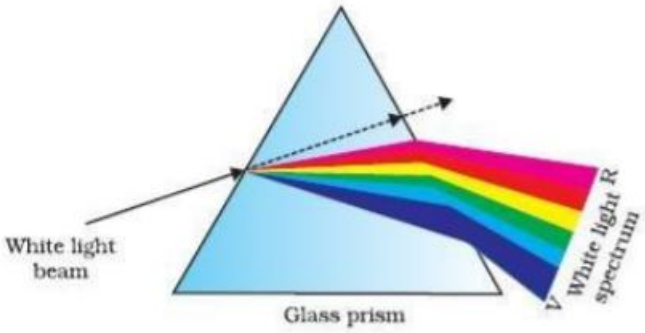
Angle of Prism: Angle between two lateral faces is called angle of prism.

Angle of Deviation: The angle between the incident deviations.



Reflection if light through a triangular glass prism

3. Dispersion of white light by a glass prism: The phenomenon of splitting of white light into its seven constituent colours when it passes through a glass prism is called dispersion of white light. The various colours seen are Violet, Indigo, Blue, Green, Yellow, Orange and Red. The sequence of colours remembers as VIBGYOR. The band of seven colours is called the spectrum. The different component colour of light bends at a different angle with respect to the incident angle. The violet light bends the least while the red bends most.



Dispersion of white light by a prism

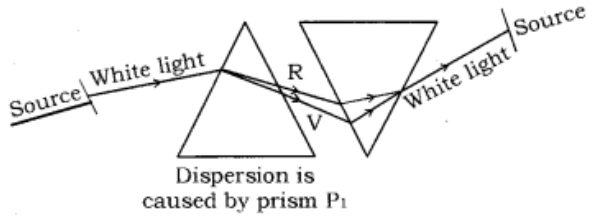
For violet colour, wavelength is minimum and for red colour wavelength is maximum, i.e. frequency for violet colour is maximum and for red colour frequency is minimum.

Composition of white light: White light consists of seven colours i.e., violet, indigo, blue, green, yellow, orange and red.

Monochromatic light: Light consisting of single colour or wavelength is called monochromatic light, example; sodium light.

Polychromatic light: Light consisting of more than two colours or wavelengths is called polychromatic light, example; white light.

Recombination of white light: Newton found that when an inverted prism is placed in the path of dispersed light then after passing through the prism, they recombine to form white light.



Rainbow: It is the spectrum of sunlight in nature. It is formed due to the dispersion of sunlight by the tiny water droplet, present in the atmosphere.

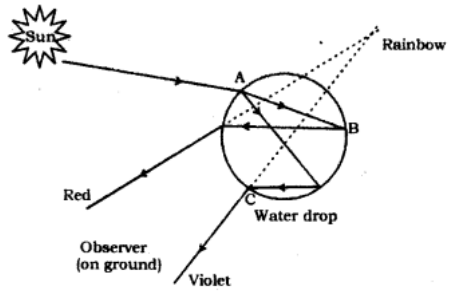
Formation of the rainbow: The water droplets act like small prism. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colours reach the observer's eye.

Conditions for the formation of rainbow are:

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

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

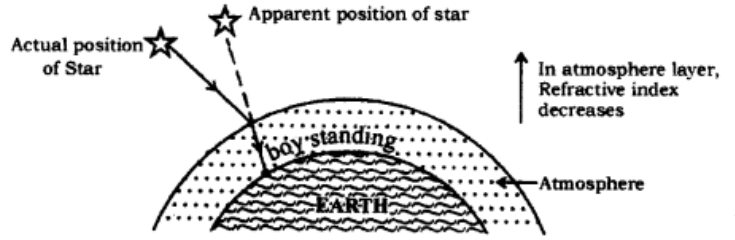
Red colour appears on top and violet at the bottom of rainbow.
A rainbow is always formed in a direction opposite to that of Sun.
At 'A' – Refraction and dispersion take place.
At 'B' – Internal reflection takes place.
At 'C' – Refraction and dispersion take place.



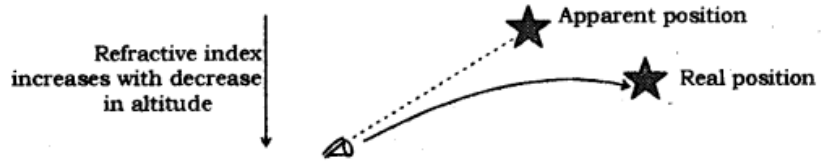
Rainbow formation

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

Appearance of Star Position: It is due to atmospheric refraction of star light.
The temperature and density of different layer of atmosphere keeps varying. Hence, we have different medium. Distant star act as point source of light. When the starlight enters the Earth's atmosphere, it undergoes refraction continuously, due to changing refractive index i.e., from Rarer to denser. It bends towards the normal.
Due to this, the apparent position of the star is different from actual position. The star appears higher than its actual position.



Twinkling of Star: It is also due to atmospheric refraction. Distant star act like a point source of light. As the beam of starlight keeps deviating from its path, the apparent position of star keeps on changing because physical condition of earth's atmosphere is not stationary.
Hence, the amount of light enters our eyes fluctuate sometimes bright and sometime dim. This is the "Twinkling effect of star".



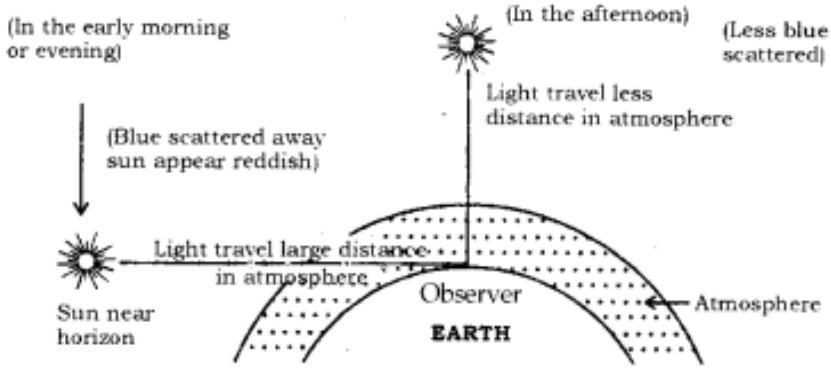
5. Scattering of light: According to Rayleigh' Law of Scattering, the amount of scattered light $\propto 1/\lambda^4$ (λ = wavelength). Scattering of light decreases with increase in wavelength.

Colour of the sky: The sunlight that reaches the earth's atmosphere is scattered in all directions by the gases and dust particles present in the atmosphere.
Sky appears blue; this is because the size of the particles in the atmosphere is smaller than the wavelength of visible light, so they scatter the light of shorter wavelength (blue end of spectrum). The blue colour is scattered more and hence the sky appears blue.

Colour of Sun at Sunrise and Sunset: While sunset and sunrise, the colour of the sun and its surrounding appear red. During sunset and sunrise, the sun is near to horizon, and therefore, the sunlight has to travel larger distance in atmosphere. Due to this, most of the blue light (shorter wavelength) is scattered away by the particles. The light of longer wavelength (red colour) reaches our eye. This give rise to reddish appearance of the sun and the sky.

The danger signal or sign is made of red colour because red colour scatters the most when strikes the small particle of fog and smoke because it has the maximum wavelength (visible spectrum). Hence, from large distance also, we can see the red colour clearly.

At noon sun appears white: At noon, the sun is overhead and sunlight would travel shorter distance relatively through the atmosphere. Hence, at noon, the sun appears white as only little of the blue and violet colours are scattered.



1. Define the power of accommodation?

Ans: The power of the eye lens to focus on objects near or far from the retina by adjusting its focal length is called the power of accommodation.

2. Which part of the human eye provides most of the refraction for the light rays entering the eye?
Ans: Cornea and Aqueous humor provides most of the refraction for the light rays entering the eye.

3. What happens to the image distance in the eye when we increase the distance of an object from the eye?
Ans: When the distance of an object from the eye is increased, the image distance remains the same and the image is formed on the retina of the eye.

4. What happens to the pupil of the eye when the light is very bright?
Ans: When the light is very bright, the pupil's size becomes smaller and limits the extent of light entering the eye.

5. Which part of the human eye conveys the electrical signals generated by the light sensitive cells of the retina to the brain?
Ans: Optic nerves convey the electrical signals generated by the light sensitive cells of the retina to the brain.

6. What would have been the colour of the sky if there had not been any atmosphere around the earth?
Ans: The colour of the sky would be black if there had not been any atmosphere around the earth.

7. For dispersion of light through a prism which colour has a maximum deviation?

Ans: Violet has the maximum deviation for dispersion of light through a prism.

8. What is the least distance of distinct vision of a normal human eye?
Ans: The least distance of distinct vision of a normal human eye is 2525 cm.

9. Name the muscle responsible for bringing change in the focal length of the eye lens?
Ans: Ciliary muscles are responsible for bringing change in the focal length of the eye lens.

10. Name one defect of vision which cannot be corrected by any type of spectacle lens?
Ans: Cataract, clouding of the lens of the eyes is a vision defect that cannot be corrected by any type of spectacle lens.

11. State one effect produced by the scattering of light by the atmosphere?
Ans: Tyndall effect is produced by the scattering of light by the atmosphere.

12. What is the nature of the image formed on the retina of the eye?
Ans: The image formed on the retina of the eye is real and inverted.

13. What type of lens is used for correcting hypermetropia?
Ans: Convex lens is used to rectify hypermetropia or long-sightedness.

14. Who was the first person to obtain the spectrum of sunlight?
Ans: Sir Isaac Newton was the first person to obtain the spectrum of sunlight.

15. As light rays pass from air into glass prisms, are they refracted towards or away from the normal?
Ans: As light rays pass from air into a glass prism they are refracted towards the normal as glass is denser than air.

16. Which colour has the largest wavelength?
Ans: Red colour of light has the longest wavelength in the visible spectrum of light.

17. Which defect of vision can be rectified using a concave lens?
Ans: Myopia (short-sightedness) can be rectified using a concave lens.

18. What phenomenon causes the twinkling of stars on a clear night?
Ans: Atmospheric refraction is the phenomenon that causes the twinkling of stars on a clear night.

19. What is meant by scattering of light?
Ans: Scattering of light is defined as the change in the direction of light on striking an obstacle such as dust, water vapour, etc.

20. Name the phenomenon responsible for the observed twinkling of stars. Will this twinkling be observed by an observer on the moon?
Ans: The phenomenon responsible for the twinkling of stars is atmospheric refraction.

Since the moon has no atmosphere, the observer on the moon will not be able to observe the twinkling of stars.

21. Name the part of the eye that
    a. determines the color of a person's eye

Ans: Iris

b. Controls the amount of light entering the eye

Ans: Iris

22. What is the role of the ciliary muscles?

Ans: The main role of the ciliary muscles is to hold the eye lens in its position. The ciliary muscles contract and relax to focus on near or far away objects by changing the shape of the eye lens which in turn increases or decreases the focal length of the eye lens.

23. Why is a convex lens called a converging lens?

Ans: A convex lens focuses all the parallel light rays at its focus after refraction. Hence, it is called a converging lens.

24. State the role of the eye lenses in the human eye?

Ans: The eye lens focuses the light rays entering the eye on the retina forming a real and an inverted image of the object on the retina.

25. A person with a myopic eye cannot see objects beyond 1.21.2 m distinctly. What should be the corrective lens used to restore proper vision?

Ans: Since the person is myopic and cannot see objects clearly beyond 1.21.2 m, he should use a concave lens having a focal length 1.21.2 m to restore his normal vision.

26. What is the far point and near the point of the human eye with normal vision?

Ans: For a human eye with proper vision, the near point is 2525 cm from the eye and the far point is at infinity.

27. A student has difficulty reading the blackboard while sitting in the last row. What could be the defect the child is suffering from? How can it be corrected?

Ans: Since, the student has difficulty reading the blackboard, sitting in the last row, he is suffering from myopia or short-sightedness. A concave lens of suitable power should be used to correct his vision defect.

28. Why is a normal eye not able to see clearly the objects placed closer than 25 cm?

Ans: The normal eye is unable to see the objects clearly placed closer than 2525 cm because at a distance of 2525 cm power of accommodation gets exhausted. Hence, the eye is unable to focus the light rays on the retina, when the object is placed closer than 2525 cm.

29. Why does the Sun appear reddish early in the morning?

Ans: During sunrise, the sun is at the farthest distance from the earth's surface. The light rays travel a large distance in the Earth's atmosphere before reaching our eyes.

While passing through the atmosphere, the light rays with shorter wavelengths get scattered by the Earth's atmosphere and the red-colored light with the longest wavelength is able to reach our eyes. Hence, the Sun appears reddish early in the morning.

30. Why do we observe random wavering or flicking of the objects near a fire or on a very hot day?
Ans: We observe random wavering or flicking of the objects near a fire or on a very hot day because of atmospheric refraction. The area above the fire is hot and is lighter than the cool air above it due to which its refractive index is low and density also does not remain the same. Therefore, the apparent position of the object flickers.

31. Why are we not able to see things clearly when we come out of a dark room?
Ans: In a dark room, the iris expands the pupil which allows more light to enter the eye. As we come out of the darkroom, a large amount of light enters our eyes and because of the glare, we are not able to see things clearly.

32. What is the function of the optic nerve in the human eye?
Ans: Optic nerve carries the visual information from the retina to the brain in the form of electrical signals.

33. Why do different colours deviate through different angles on passing through a prism?
Ans: Different colours deviate through different angles on passing through a prism because different colours with different wavelengths travel through glass at different speeds and the glass has a different refractive index for different colours.
34. Name the defect of vision in the person
a. Whose near point is more than 2525 cm away?
Ans: Hypermetropia

b. Whose far point is less than infinity.
Ans: Myopia

35. What is a spectrum?
Ans: A continuum of colour obtained by dispersion of white light by passing through a prism is called a spectrum.

36. Why does the clear sky look blue?
Ans: As white light passes through the atmosphere, the tiny particles held in the atmosphere scatter the light of a shorter wavelength. Therefore, blue light having the shortest wavelength is scattered the most and the clear sky appears blue.

37. Can visible light be scattered by atoms/molecules in the earth's atmosphere?
Ans: Yes, visible light is scattered by atoms/molecules in the earth's atmosphere as the size of molecules/atoms is much less than the wavelength of visible light.

38. Why does the sky appear dark instead of blue to an astronaut?

Ans: Outer space does not have an atmosphere. As a result, the light does not scatter into its constituent colors in outer space and hence the sky appears dark instead of blue to an astronaut.

39. What is the basic cause of atmospheric refraction?
Ans: Atmospheric refraction is caused by the bending of light when it passes through the layers of the Earth's atmosphere with different optical densities.

40. What is the range of vision?
Ans: The range of vision of a normal human eye is the distance between the near point and far point of the human eye. Hence, for a normal human eye, it ranges from 25cm to infinity.

CHAPTER 12
ELECTRICITY

1. **Charge:** It is an inherent property of the body due to which the body feels attractive and repulsive forces.There are two types of electric charges:
   (i) Positive and (ii) Negative
   (ii) Like charges are repelling each other.
   (iii) Unlike charges attract each other.
2. **Conductors and insulators**: Those substances through which electricity can flow are calledconductors. All the metals like silver, copper, aluminiumetc. are conductors.
   Those substances through which electricity cannot flow are calledinsulators. Glass, ebonite, rubber, most plastics, paper, dry wood, etc., are insulators.
3. **Electrostatic potential**: The electrostatic potential at any point is defined as the work done inbringing a unit positive charge from infinity to that point. Potential is denoted by the symbol V and its unit is volt. A potential of one volt at a point means that 1 joule of work is done in bringing 1 unit positive charge from infinity to that point.
4. **PotentialDifference**: The amount of work done in moving unit positive charge from one pointto another in an electric field is known as potential difference.
   Potential difference = Work done/Quantity of charge transferred
   If a W joule of work has to be done to transfer Q coulombs of charge from one point to another point, then the potential difference V between the two points is given by the formula:
   Potential difference, V = W/Q
   The SI unit of potential difference is volt (V).
   1 volt: One volt is defined as the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to another.Therefore, 1 volt = 1joule/ 1 coulomb
5. **Voltmeter**: The potential difference is measured by means of an instrument called voltmeter. The voltmeter is connected in parallel across the points where the potential difference is measured. A voltmeter has high resistance.
6. **Electric Current**: The electric current is the rate of flow of electric charges (called electrons) in a conductor.
   If a charge of Q coulombs flows through a conductor in time t seconds, then the magnitude I of the electric current flowing through it is given by
   Current, I = Q/t
   The SI unit of electric current is ampere and it is denoted by the letter A. Electric current is a scalar quantity.

7. **Ammeter**: Current is measured by an instrument called ammeter. The ammeter is connected in series with the circuit in which the current is to be measured. An ammeter should have very lowinternal resistance.
8. **Voltaic Cell**: It is one of the earliest devices which are capable of providing a continuous flow of electric current. It is used for converting chemical energy into electricalenergy. It was invented by Volta in the year 1800.
9. **Ohm's Law**: At constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends. If 1 is the current flowing through a conductorand V is the potential difference across its ends. Then according to Ohm's law

   $I \propto V$

   This can also-be written as:

   $V \propto I$

   $V = IR$

   Where R is a constant called 'resistance' of the conductor. The value of this constant depends on the nature, length, area of cross-section and temperature of the conductor.
10. **Resistance of a Conductor**: The property of a conductor due to which it opposes the flow of current through it is called resistance. The resistance of a conductor is numerically equal to ratio of potential difference across its ends to the current flowing through it. i.e.

    Resistance =Potential difference/Current

    $R = V/I$

    The SI unit of resistance is ohm, which is denoted by symbol Ω.

    1 ohm: If V = 1 volt, I = I ampere, then

    R = 1 volt/1 ampere= 1 ohm

    Thus, the resistance of a conductor is said to be 1 ohm if 1 ampere current flows throughthe conductor when a potential difference of 1 volt is applied across it.
11. Factors affecting the Resistance of a Conductor: The resistance of the conductor depends:
    (i) on its length,
    (ii) on its area of cross-section
    (iii) on the nature of its material.
12. Resistivity: It has been found by the experiments that:
    (i) The resistance of a given conductor is directly proportional to its length.

    $R \propto l$ .....(i)

    (ii) The resistance of a given conductor is inversely proportional to its area ofcross-section.

    $R \propto 1/A$ .....(ii)

By combining the equations (i) and (ii),

$R \propto l/A$

$R = \rho\ (l/A)$

Where $\rho$is called specific resistance or resistivity of the conductor.

When l = 1m, A = $1m^2$, we have ρ = R

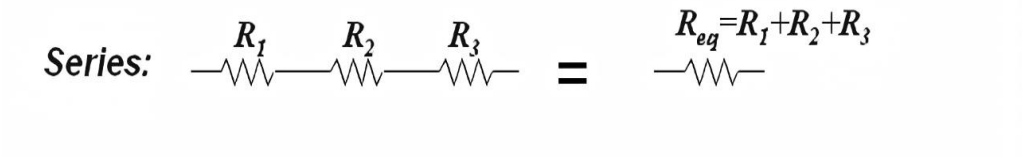
Thus, the resistivity of a conductor is the resistance of unit length and unit area of cross-section of the conductor. The SI unit of resistivity is ohm metre (Ωm).

13. Combination of Resistance: The resistance can be combined in two ways:

(i) In series

(ii) In parallel

(i) Resistance in series:



In series, the total potential difference,

$V = V_1 + V_2 + V_3$ …….(i)

Applying Ohm's law to the entire circuit

V = IR ……(ii)

Applying Ohm's law to each resistance separately, we have

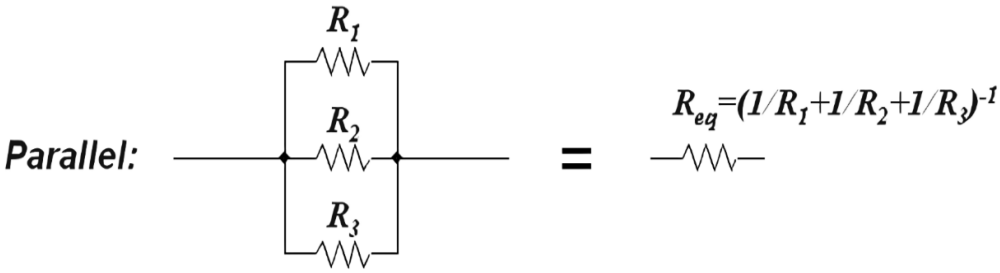
$V_1 = IR_1$; $V_2 = IR_2$; $V_3 = IR_3$ ….(iii)

From equations (i), (ii) and (iii), we have

$IR = IR_1 + IR_2 + IR_3$

$R = R_1 + R_2 + R_3$

(ii) Resistance in parallel:



In parallel, the total current:

$I = I_1 + I_2 + I_3$ …….(i)

Applying Ohm's law to the entire circuit

I = V/R ……(ii)

Applying Ohm's law to each resistance separately, we have

$I_1 = V/R_1$; $I_2 = V/R_2$; $I_3 = V/R_3$ ….(iii)

From equations (i), (ii) and (iii), we have

$V/R = V/R_1 + V/R_2 + V/R_3$

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

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

Power = Work done/Time

$P = W/t = (V \times Q)/t$ …..(i)

The work done by current I when it flows for time t under a potential difference V is given by:

$W = V \times I \times t$ joules [Because W = VQ and Q = It]

Putting the value of W in equation (i), we have

$P = (V \times I \times t)/t = VI$

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

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

The unit of electric power is watt.

Power = V x I

1 watt = 1 volt x 1 ampere

Thus, if a potential difference of 1 volt causes a current of 1 ampere to flow through a wire, the electrical power consumed is one watt.

15. **Electrical Energy**:

Electrical energy = Power x Time

E = P x t

The electrical energy consumed by an electrical appliance depends upon

(i) Powerrating of the appliance

(ii) Time for which it (appliance) is used.

The SI unit of electrical energy is joule.

1joule is the amount of electrical energy consumed when an appliance of 1 watt is used for 1 second.

16. Commercial Unit of Electrical Energy: Kilowatt hour is the commercial unit of electrical energy. One kilowatt hour is the electrical energy consumed when an electrical appliance having 1kW power rating is used for 1 hour.

Energy used = Power x Time

1 kWh = 1 kW x lh

= 1000 w x 60 x 60s

= 1000 Js^{-l} X 3600 s

= 3600000 J= 3.6 x 10^6 J

17. Heating Effect of Current: When an electric current is passed through a high resistance wire, it becomes very hot and produces heat. This effect is called the heating effect of current.

When an electric charge Q moves against a potential difference V, the amount of work done is given by,

W=Qx V ……(i)

But, current, I = Q/t

Q = I xt

From Ohm's law: V = I x R

Now, putting all these values in equation (i), we have

Work done, W = 1^2 x R x t

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

Heat produced, H = 1^2 x R x t joules.

18. Applications Of Heating Effect of Current:

(i) In electrical heating appliances: All electrical heating appliances are based on heating effect of current. For example, appliances, such as electric iron, water heaters and geysers, room heaters, toaster, hot plates are fitted with heating coils made of high resistance wire such as nichrome wire.

(ii) Electric filament bulb: The use of electric filament bulbs (ordinary electric bulbs) is also based on the heating effect of current. Inside the glass shell of electric bulb there is a filament. This filament is made from a very thin high bulb resistance tungsten wire. When current flows through this filament, it gets heated up. Soon, it becomes white hot and starts emitting light.

QUESTIONS WITH ANSWERS

Question 1.
Define electric potential.
Answer:
Electric potential at a point in an electric field is defined as the work done in moving a unit positive charge from infinity to that point in the electric field.
Question 2.
State the relation between work (W), change (q) and electric potential (V).

Answer:
V = W/q.

Question 3.
What is the S.I. unit of electrical potential ?

Answer:
volt.

Question 4.
Define 1 volt electric potential.

Answer:
Electric potential is said to be 1 volt if 1 Joule of work is done in moving 1 coulomb charge from infinity to a point in the electric field.

Question 5.
Is electric potential a scalar or a vector physical quantity ?

Answer:
Electric potential is a scalar physical quantity.

Question 6.
What is meant by potential difference between two points ?

Answer:
Work done per unit charge in moving a unit positive charge from one point to another point in an electric field is called potential difference between two points.

Question 7.
Name the instrument used to measure the electric potential difference.

Answer:
Voltmeter.

Question 8.
Write down the relation between the potential difference between two points A and B in a conductor, work done W in moving a unit charge from point B to A and the charge q.

Or

State the relation between work, charge and potential difference for an electric circuit.

Or

Express work done in an electric field in terms of charge and potential difference.

Answer:

$$V_A - V_B = dV = \frac{W}{q}. \quad \text{That is, potential difference} = \frac{\text{Work}}{\text{Charge}}$$

Question 9.
Mention the factor that maintains the flow of charge through a conductor.

Answer:
Potential difference across the ends of the conductor.

Question 10.
Define electric current.

Answer:
Electric current is defined as the amount of electric charge flowing through any cross-section of a conductor per unit time.

Question 11.
Write down the relation between the electric current I passing in a conductor, change Q flowing in the conductor and time t.

Or

Write the relation between coulomb and ampere?

Answer:

$I = \frac{Q}{t}$. Therefore, 1 ampere = $\frac{1\,\text{coulomb}}{1\,\text{second}}$ = 1 C s^{-1}

Question 12.

State the relation between the current I passing in a conductor, number of electrons (n) flowing through any cross-section of the conductor, magnitude of charge on an electron (e) and time t.

Answer:

I = ne/t.

Question 13.

State SI unit of electric current.

Answer:

ampere (A)

Question 14.

Define 1 ampere electric current.

Answer:

Electric current through a conductor is said to be 1 ampere if 1 coulomb electric charge flows through a cross-section of a conductor in 1 second.

Question 15.

How is the direction of electric current related to the direction of flow of electrons in a wire ?

Answer:

The direction of electric current in a wire is just opposite to the direction of flow of electrons in the wire.

Question 16.

Name the instrument used to measure electric current in a circuit.

Answer:

Ammeter.

Question 17.

How is ammeter connected in the circuit to measure electric current ?

Answer:

Ammeter is connected in series in an electric circuit.

Question 18.

How is voltmeter connected in the circuit to measure electric potential difference ?

Answer:

Voltmeter is connected in parallel across a conductor or resistor in the electric circuit.

Question 19.

Define ohm's law.

Or

State the law that gives the relationship between the potential difference (V) across the two ends of a conductor and the current (I) flowing through it.

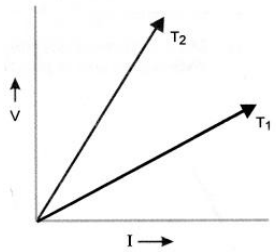
Answer:

Ohm's law states that the electric current flowing through a conductor is directly proportional to the potential difference across the ends of the conductor, provided the temperature and . other physical conditions of the conductor remain the same.

Question 20.
Define electrical resistance of a conductor.
Answer:
It is the property of a conductor to oppose the flow of electric charge through it.
Resistance of a conductor, R = V/I , where V is the potential difference across the conductor and I is the current flowing through the conductor.
Question 21.
State SI unit of resistance.
Answer:
ohm (Ω).
Question 22.
"The resistance of a conductor is IΩ". What is meant by this statement ?
Or
Define 1 ohm resistance.
Answer:
The resistance of a conductor is said to be 1Ω if a potential difference of IV across the ends of the conductor makes a current of 1A to flow through it.
Question 23.
What is the shape of the graph obtained by plotting potential difference applied across a conductor against the current flowing through it ?
Answer:
A straight line passing through the origin and has constant slope.
Question 24.
What is the name the physical quantity which is equal to V/I ?
Or
Name the physical quantity whose unit is volt-ampere.
Answer:
y = R. Therefore, physical quantity is resistance of a conductor.
Question 25.
What does the slope of V-I graph at any point represent ?
Answer:

$$\text{Slope of V-I graph} = \frac{1}{\text{resistane of a conductor}}.$$

Therefore, slope of V-I graph represents reciprocal of the resistance of a conductor resistance of a conductor.
Question 26.
What happens to resistance of a conductor when temperature is increased ?
Answer:
Resistance of a conductor increases with the increase in temperature.
Question 27.
The voltage — current (V-I) graph of a metallic circuit at two different temperature T_1 and T_2 is shown. Which of the two temperatures is higher and why ?
Or
The voltage-current (V-I) graph of a metallic conductor at two different temperatures T_1 and T_2 is shown in figure. At which temperature is the resistance higher ?



Answer:

Slope of I-V graph = resistance of metallic conductor.

Since, slope of I-V graph at temperature T_2 is greater than the slope of I-V graph at temperature T_1, therefore, resistance at T_2 is greater than resistance at T_1 . Since, resistance of a metallic conductor increases with increase in temperature, therefore, $T_2 > T_1$.

Question 28.

How does the resistance of a wire vary with its cross-section area ?

Answer:

Resistance of a wire is inversely proportional to its cross-sectional area. More is cross-sectional area of a conductor, less is the resistance of the conductor.

Question 29.

State the relation between the resistance R of a conductor, resistivity ρ of a conductor, length l of a conductor and area of cross-section A of the conductor.

Or

Write an expression for the resistivity of a substance.

Answer:

$$R = \frac{\rho l}{A} \text{ or } \rho = \frac{RA}{l},$$

where R is the resistance, A is the area of cross-section and l is the length of the substance.

Question 30.

What is electrical resistivity ?

Answer:

Electrical resistivity of a material is defined as the resistance of an object (made of the material) of unit length and unit area of cross-section.

Question 31.

State SI unit of resistivity.

Answer

ohm-metre (Ω-m).

Question 32.

A wire of resistivity 'ρ' is pulled to double its length. What will be its new resistivity ?

Answer:

New resistivity will also be 'ρ' because resistivity of a wire does not depend on its length.

Question 33.

You have a metal, insulator and an alloy. Write these substances in the ascending order of their electrical resistivity.

Answer:

Resistivity of metal < resistivity of alloy < resistivity of insulator.

Question 34.

n resistors each of resistance R are first connected in series and then in parallel. What is the ratio

of the total effective resistance of the circuit in series combination and parallel combination?

Answer:

In series combination, $R_s = nR$

In parallel combination, $R_p = \frac{R}{n}$

$\therefore \quad \frac{R_s}{R_p} = \frac{nR}{R/n} = n^2$

Question 35.

You have two metallic wires of resistances 60 and 30. How will you connect these wires to get the effective resistance of 20 ?

Answer:

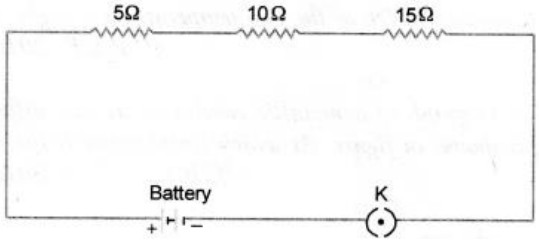
In parallel.

In parallel. $\left(\frac{1}{R} = \frac{1}{6} + \frac{1}{3} = \frac{3}{6} = \frac{1}{2} \text{ or } R = 2\,\Omega\right)$

Question 36.

Draw a schematic diagram of a circuit consisting of battery of two cells each of 1.5 V, 50 resistor, 100 resistor and 150 resistor and a plug key, all connected in series.

Answer:



Question 37.

What is heating effect of electric current ?

Answer:

The production of heat in a conductor due to the flow of electric current through it is called heating effect of electric current.

Question 38.

Write down the relation between heat produced H in a conductor of resistance R through which current I passes for t seconds.

Answer:

$H = I^2Rr$.

Question 39.

State Joule's law of heating.

Answer:

According to Joule's law of heating, the amount of heat produced in a conductor is

1. directly proportional to the square of electric current passing through the conductor,
2. directly proportional to the resistance of the conductor, and
3. directly proportional to the time for which electric current passes through the conductor.

Question 40.
Write a mathematical expression for Joule's law of heating. Name one device which works on this principle.
Answer:
$H = I^2 Rt$. An electric heater and electric bulb work on Joule's law of heating.
Question 41.
What is meant by the statement that the rating of fuse in a circuit is 5A ?
Answer:
It means maximum current of 5A can pass through the fuse without melting it.
Question 42.
Name the material used for making the filament of a bulb.
Answer:
Tungsten.
on electric energy and electric power
Question 43.
Define electric energy.
Answer:
It is defined as the work done by a source of electricity to maintain electric current in an electrical circuit.
Question 44.
Define electric power.
Answer:
It is defined as the amount of electric energy consumed in an electric circuit per unit time.
Question 45.
Name the physical quantity expressed as the product of potential difference and electric current.
Answer:
Electric power.
Question 46.
State SI unit of electric power.
Answer:
Volt x ampere (or Watt).
Question 47.
Name the unit used in selling electrical energy to consumers.
Or
What is the commercial unit of energy ?
Answer:
Kilowatt hour (kWh).
Question 48.
Which one is having lesser resistance : A 60 W bulb or a 40 W bulb ?

Answer:

$$\text{Power (P)} = \frac{V^2}{R} \quad \therefore R \propto \frac{1}{P}, \text{ if V is constant.}$$

Hence, bulb of higher wattage will have less resistance. In other words, resistance of 60W bulb is less than the resistance of 40 W bulb.

Question 49.
What is the difference between kilowatt and kilowatt hour.
Answer:
Kilowatt is the unit of electric power and kilowatt hour is the commercial unit of electric energy.
Question 50.
(a) Why an ammeter likely to bum out if you connect it in parallel ?
(b) Why is series arrangement not found satisfactory for domestic lights ?
Answer:
(a) Ammeter is a low resistance device. If it is connected in parallel, a large current flows through it. Hence, large heat is produced and it may burn the ammeter.
(b) If domestic lights are connected in series, then all lights will be switched off even when only one light fuses.
Question 51.
Draw diagrams to show series and parallel combinations of resistors. State three salient features each of both the combinations.
Answer:

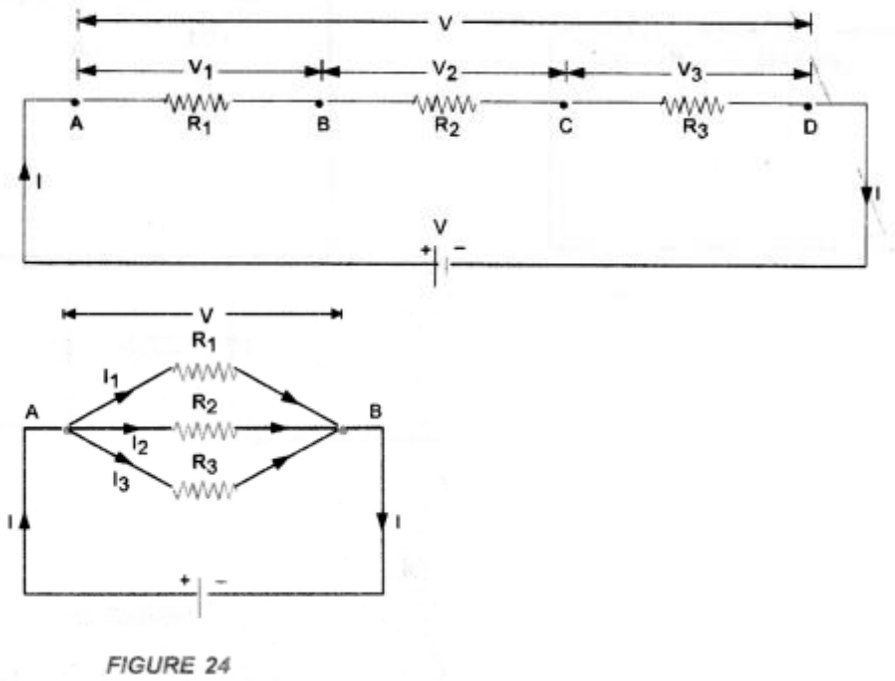


FIGURE 24

Salient features of series combination :

1. The net resistance of the combination is equal to the sum of the resistances of the individual resistor.
2. The current flowing through each resistor is the same.
3. The voltage applied across the series combination of resistors is equal to the sum of potential differences across the individual resistors.

Salient features of parallel combination :

1. The reciprocal of the net resistance of the combination is equal to the sum of the reciprocal of the resistances of the individual resistors.
2. Different amount of current flows through each resistor.

3. The potential difference across each resistor is equal to the voltage applied across the combination.

Question 52.
Why is the tungsten used almost exclusively for filament of electric lamps ?

Or

Why is Tungsten used for the filament in electric bulb ? (CBSE 2011, 2014, 2015)
Answer:
This is because

1. melting point of tungsten is very high (about 3380°C) and
2. it does not oxidise (or burn) even at higher temperatures.

Question 53.
Why do copper or aluminium wires usually used for electricity transmission and distribution purposes ?

Or

Copper and aluminium wires are usually employed for electricity transmission. Explain reason.
Answer:
The resistivities of copper and aluminium are very low, so electric current flows easily through them. Hence, copper and aluminium wires are usually used for electricity transmission and distribution purpose.

Question 54.
Should the heating element of an electric iron be made of iron, silver or nichrome wire **Or**
List two reasons why nichrome is used for making heating element of electrical appliances.
Answer:
It should be made of nichrome wire because

1. resistivity of nichrome is greater than that of iron and silver,so more heat is produced in the nichrome wire due to the flow of current.
2. melting point of nichrome wire is greater than that of iron and silver and hence it does not melt easily on heating.
3. nichrome wire does not oxidise (or burn) easily even at higher temperature.

Question 55.
Two identical immersion heaters are to be used to heat water in a large container. Which one of the following
arrangement would heat the water faster,

1. connecting the heaters in series with the main supply,
2. connecting the heaters in parallel with the main supply ? **Answer:**
   Heat produced in a heater, when connected to main supply,

$$H = \left(\frac{V^2}{R}\right) t.$$

When identical heaters (i.e. having same resistance) are connected in parallel, their

net resistance decreases as compared to when connected in series. Therefore, heaters connected in parallel would heat the water faster as the heat produced in parallel combination is more than the heat produced in series combination, on electric energy and electric power

Question 56.

What is commercial unit of electrical energy ? Express it in joules.

Or

Define 1 kWh. How is this unit of energy related to 1 joule ?

Or

Establish the relationship between 1 kWh and SI unit of energy (joule).

Answer:

Commercial unit of electrical energy is kWh. 1 kWh is the amount of electric energy consumed by 1000 W electric appliance when operates for 1 hour. 1 kWh = 1000 W x 3600 s = 1000 Js^{-1} x 3600 s = 3.6 x 10^6 J.

Question 57.

Two electric bulbs A and B are marked 220V, 40W and 220 V, 60W respectively. Which one of the two has greater resistance ?

Answer:

$$P = \frac{V^2}{R} \text{ or } R \propto \frac{1}{P} \qquad \text{if } V = \text{constant.}$$

Therefore, bulb A (40 W) has greater resistance than the bulb B (60 W)

Question 58.

Define electric power. A device of resistance R is connected across a source ofV voltage and draws a current I. Derive an expression for power in terms of voltage and resistance.

Answer:

Electric power is defined as the amount of electric work or electric energy per unit time.

If W be the amount of electric energy consumed in a circuit in t seconds, then the electric power is given by

$$P = \frac{W}{t} \qquad \ldots(1)$$

Since W = electric energy = VIt

$$\therefore \qquad P = \frac{VIt}{t}$$

$$\text{or} \qquad \mathbf{P = VI} \qquad \ldots(2)$$

Thus, electric power is defined as the product of potential difference applied across the circuit and current flowing through it.

According to ohm's law

$$V = IR$$

$\therefore$ From eqn. (2),

$$P = I^2R$$

Also $$I = \frac{V}{R}$$

$\therefore$ From eqn. (2), $$P = \frac{V^2}{R}$$

Thus, $$P = VI = I^2R = \frac{V^2}{R}$$

Units of Power:

SI unit of power is **watt** (or W)

We know, $P = VI$

$\therefore$ 1 watt = 1 volt × 1 ampere = 1 VA

Chapter- 13
MAGNETIC EFFECTS OF CURRENT

Magnet: Magnetic field and magnetic field lines, Magnetic field due to a current carrying conductor, Right hand thumb rule, Magnetic field due to current through a circular loop. Magnetic field due to current in a solenoid.
Magnet is an object that attracts objects made of iron, cobalt and nickel. Magnet comes to rest in North – South direction, when suspended freely.

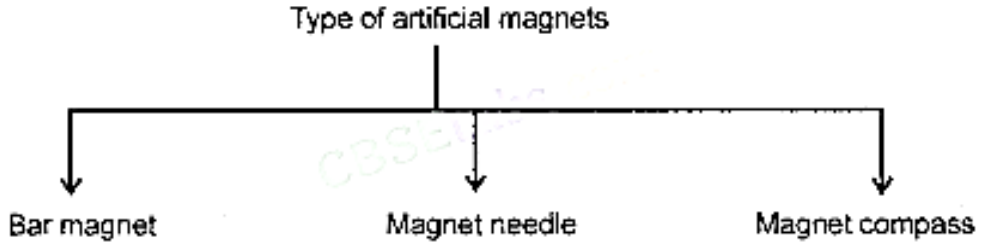
Use of Magnets: Magnets are used

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

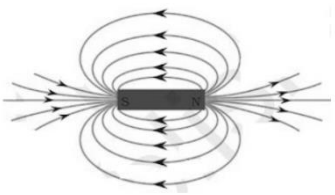
Properties of Magnet

- A free suspended magnet always points towards the north and south direction.
- The pole of a magnet which points toward north direction is called north pole or north-seeking.
- The pole of a magnet which points toward south direction is called south pole or south seeking.
- Like poles of magnets repel each other while unlike poles of magnets attract each other.

Magnetic field: The area around a magnet where a magnetic force is experienced is called the magnetic field. It is a quantity that has both direction and magnitude, (i.e., Vector quantity).



Magnetic field and field lines: The influence of force surrounding a magnet is called magnetic field. In the magnetic field, the force exerted by a magnet can be detected using a compass or any other magnet.
The magnetic field is represented by magnetic field lines.
The imaginary lines of magnetic field around a magnet are called field line or field line of magnet. When iron fillings are allowed to settle around a bar magnet, they get arranged in a pattern which mimicks the magnetic field lines. Field line of a magnet can also be



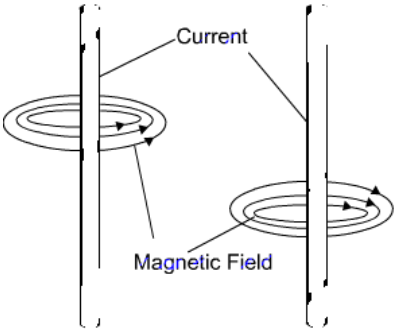
detected using a compass. Magnetic field is a vector quantity, i.e. it has both direction and magnitude.

Direction of field line: Outside the magnet, the direction of magnetic field line is taken from North Pole to South Pole. Inside the magnet, the direction of magnetic field line is taken from South Pole to North pole.

Strength of magnetic field: The closeness of field lines shows the relative strength of magnetic field, i.e. closer lines show stronger magnetic field and vice – versa. Crowded field lines near the poles of magnet show more strength.

Properties of magnetic field lines
(i) They do not intersect each other.
(ii) It is taken by convention that magnetic field lines emerge from North pole and merge at the South pole. Inside the magnet, their direction is from South pole to North pole. Therefore, magnetic field lines are closed curves.

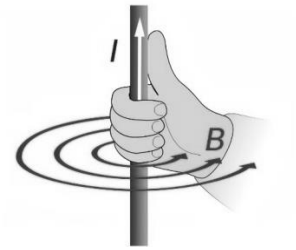
Magnetic field lines due to current a current carrying straight conductor
A current carrying straight conductor has magnetic field in the form of concentric circles, around it. Magnetic field of current carrying straight conductor can be shown by magnetic field lines. The direction of magnetic field through a current carrying conductor depends upon the direction of flow electric current.



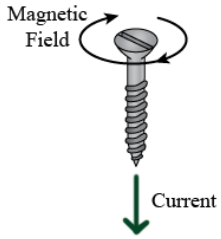
Let a current carrying conductor be suspended vertically and the electric current is flowing from south to north. In this case, the direction of magnetic field will be anticlockwise. If the current is flowing from north to south, the direction of magnetic field will be clockwise.
The direction of magnetic field, in relation to direction of electric
current through a straight conductor can be depicted by using the Right-Hand Thumb Rule. It is also known as Maxwell's Corkscrew Rule.

Right-Hand Thumb Rule: If a current carrying conductor is held by right hand, keeping the thumb straight and if the direction of electric current is in the direction of thumb, then the

direction of wrapping of other fingers will show the direction of magnetic field.



Maxwell's Corkscrew rule: As per Maxwell's Corkscrew Rule, if the direction of forward movement of screw shows the direction of the current, then the direction of rotation of screw shows the direction of magnetic field.

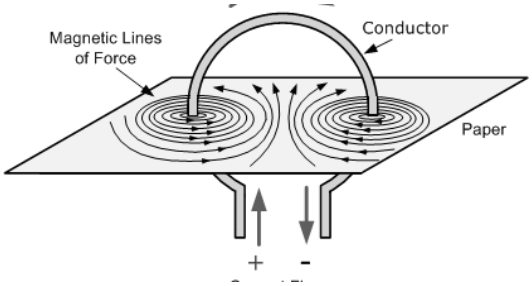


Properties of magnetic field

- The magnitude of magnetic field increases with increase in electric current and decreases with decrease in electric current.
- The magnitude of magnetic field produced by electric current decreases with increase in distance and vice – versa. The size of concentric circles of magnetic field lines increases with distance from the conductor, which shows that magnetic field decreases with distance.
- Magnetic field lines are always parallel to each other.
- No two field lines cross each other.

Magnetic field lines due to a current through a circular loop

In case of a circular current carrying conductor, the magnetic field is produced in the same manner as it is in case of a straight current carrying conductor.



In case of a circular current carrying conductor, the magnetic field lines would be in the form of

iron concentric circles around every part of the periphery of the conductor. Since, magnetic field lines tend to remain closer when near to the conductor, so the magnetic field would be stronger near the periphery of the loop. On the other hand, the magnetic field lines would be distant from each other when we move towards the centre of the current carrying loop. Finally, at the centre, the arcs of big circles would appear as a straight line.

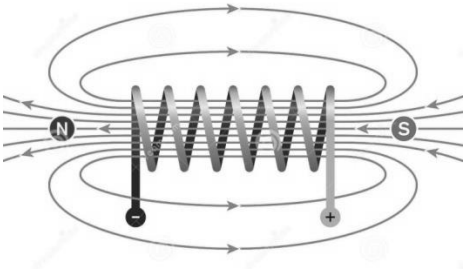
The direction of the magnetic field can be identified using Right Hand Thumb's Rule. Let us assume that the current is moving in anti-clockwise direction in the loop. In that case, the magnetic field would be in clockwise direction, at the top of the loop. Moreover, it would be in an anti-clockwise direction at the bottom of the loop.

Clock Face Rule: A current carrying loop works like a disc magnet. The polarity of this magnet can be easily understood with the help of Clock Face Rule. If the current is flowing in anti – clockwise direction, then the face of the loop shows north pole. On the other hand, if the current is flowing in clockwise direction, then the face of the loop shows south pole.

Magnetic field and number of turns of coil: Magnitude of magnetic field gets summed up with increase in the number of turns of coil. If there are 'n' turns of coil, magnitude of magnetic field will be 'n' times of magnetic field in case of a single turn of coil.

The strength of the magnetic field at the centre of the loop(coil) depends on :
(i) The radius of the coil: The strength of the magnetic field is inversely proportional to the radius of the coil. If the radius increases, the magnetic strength at the centre decreases
(ii) The number of turns in the coil : As the number of turns in the coil increase, the magnetic strength at the centre increases, because the current in each circular turn is having the same direction, thus, the field due to each turn adds up.
(iii) The strength of the current flowing in the coil: As the strength of the current increases, the strength of three magnetic fields also increases.

Magnetic field due to a current in a Solenoid: Solenoid is the coil with many circular turns of insulated copper wire wrapped closely in the shape of a cylinder. A current carrying solenoid produces similar pattern of magnetic field as a bar magnet. One end of solenoid behaves as the north pole and another end behaves as the south pole.



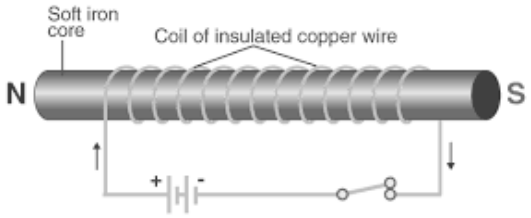
Magnetic field lines are parallel inside the solenoid, similar to a bar magnet, which shows that magnetic field is same at all points inside the solenoid.
Magnetic field produced by a solenoid is similar to a bar magnet.

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

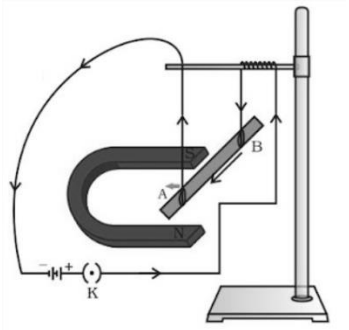
Electromagnet, Fleming's Left-Hand Rule, Electric motor, Electromagnetic induction, Fleming's right hand rule, Electric generator and domestic electic circuits.

Electromagnet: An electromagnet consists of a long coil of insulated copper wire wrapped on a soft iron.

Magnet formed by producing magnetic field inside a solenoid is called electromagnet.



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

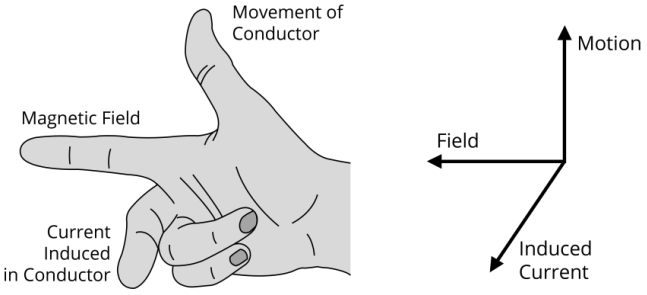


The direction of force over the conductor gets reversed with the change in direction of flow of electric current. It is observed that the magnitude of force is highest when the direction of current is at right angles to the magnetic field.

Fleming's Left-Hand Rule: If the direction of electric current is perpendicular to the magnetic field, the direction of force is also perpendicular to both of them. The Fleming's Left Hand Rule states that if the left hand is stretched in a way that the index finger, the middle finger and the thumb are in mutually perpendicular directions, then the index finger and middle finger of a stretched left hand show the direction of magnetic field and direction of electric current respectively and the thumb shows the direction of motion or force acting on the conductor. The directions of electric current, magnetic field and force are similar to three mutually perpendicular axes, i.e. x, y, and z-axes.

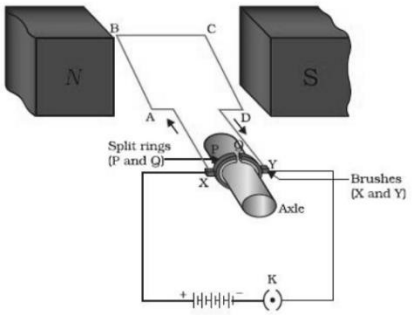
Many devices, such as electric motor, electric generator, loudspeaker, etc. work on Fleming's

Left Hand Rule.



Electric motor: A device that converts electrical energy to mechanical energy. It is of two types : AC and DC Motor.Electrical energy is converted into mechanical energy by using and electric motor. Electric motor works on the basis of rule suggested by Marie Ampere and Fleming's Left Hand Rule.

Principle of Electric Motor: When a rectangular coil is placed in a magnetic field and a current is passed through it, force acts on the coil, which rotates it continuously. With the rotation of the coil, the shaft attached to it also rotates.



Construction: It consists of the following parts ---

Armature: It is a rectangular coil (ABCD) which is suspended between the two poles of a magnetic field.
The electric supply to the coil is connected with a commutator.

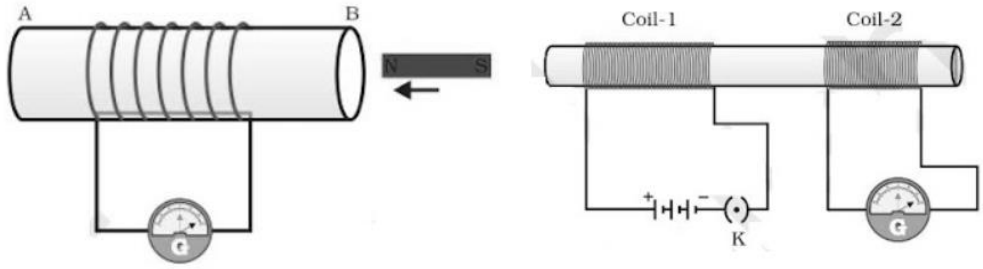
- Commutator or Split – ring: Commutator is a device which reverses the direction of flow of electric current through a circuit. It is two halves of the same metallic ring.
- Magnet: Magnetic field is supplied bv a permanent magnet NS.
- Sliding contacts or Brushes Q which are fixed.
- Battery: These are consisting of few cells.

Working: When an electric current is supplied to the coil of the electric motor, it gets deflected because of magnetic field. As it reaches the halfway, the split ring which acts as commutator reverses the direction of flow of electric current. Reversal of direction of the current, reverses the direction of forces acting on the coil. The change in direction of force pushes the coil, and it

moves another half turn. Thus, the coil completes one rotation around the axle. Continuation of this process keeps the motor in rotation.
In commercial motor, electromagnet instead of permanent magnet and armature is used. Armature is a soft iron core with large number of conducting wire turns over it. Large number of turns of conducting wire enhances the magnetic field produced by armature.
Uses of motors:

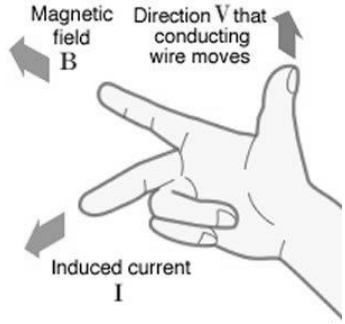
- Used in electric fans.
- Used for pumping water.
- Used in various toys.

Electromagnetic Induction: Michael Faraday, an English Physicist is supposed to have studied the generation of electric current using a magnetic field and a conductor.
Electricity production as a result of magnetism (induced current) is called Electromagnetic Induction.



When a conductor is set to move inside a magnetic field or a magnetic field is set to be changing around a conductor, electric current is induced in the conductor. This is just opposite to the exertion of force by a current carrying conductor inside a magnetic field. In other words, when a conductor is brought in relative motion vis – a – vis a magnetic field, a potential difference is induced in it. This is known as electromagnetic induction.

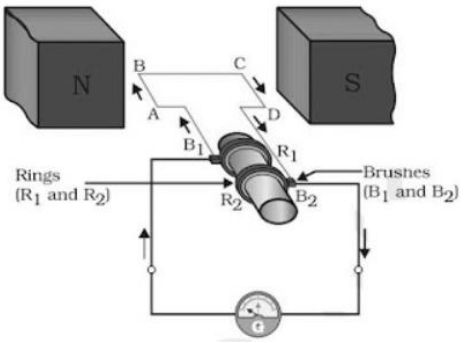
Fleming's Right-Hand Rule: Electromagnetic induction can be explained with the help of Fleming's Right Hand Rule. If the right hand is structured in a way that the index (fore ginger) finger, middle finger and thumb are in mutually perpendicular directions, then the thumb shows direction of induced current in the conductor, in conductor The directions of movement of conductor, magnetic field and induced current can be compared to three mutually perpendicular axes, i.e. x, y and z axes.



The mutually perpendicular directions also point to an important fact that when the magnetic field and movement of conductor are perpendicular, the magnitude of induced current would be

maximum.
Electromagnetic induction is used in the conversion of kinetic energy into electrical energy.

Electric Generator: A device that converts mechanical energy into electrical energy is called an electric generator.
Electric generators are of two types: AC generator and a DC generator. Principle of electric generator: Electric motor works on the basis of electromagnetic induction.

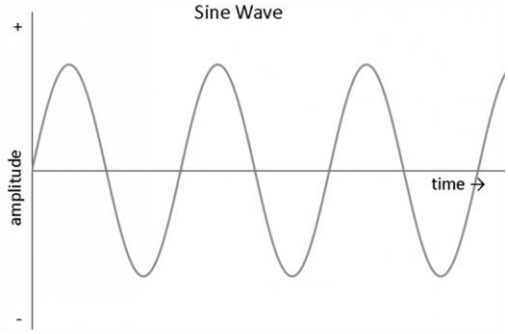


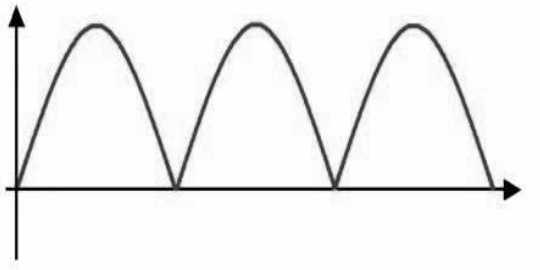
Construction and Working: The structure of an electric generator is similar to that of an electric motor. In case of an electric generator, a rectangular armature is placed within the magnetic field of a permanent magnet. The armature is attached to wire and is positioned in a way that it can move around an axle. When the armature moves within the magnetic field, an electric current is induced. The direction of induced current changes, when the armature crosses the halfway mark of its rotation.

Thus, the direction of current changes once in every rotation. Due to this, the electric generator usually produces alternate current, i.e. A.C. To convert an A.C generator into a D.C generator, a split ring commentator is used. This helps in producing direct current.
Electrical generator is used to convert mechanical energy into electrical energy.

A.C and D.C Current
A.C – Alternate Current: Current in which direction is changed periodically is called Alternate Current. In India, most of the power stations generate alternate current. The direction of current changes after every 1/100 second in India, i.e., the frequency of A.C in India is 50 Hz. A.C is

transmitted up to a long distance without much loss of energy is advantage of A.C over D.C.





D.C – Direct Current: Current that flows in one direction only is called Direct current. Electrochemical cells produce direct current.
Advantages of A.C over D.C

- Cost of generator of A.C is much less than that of D.C.
- A.C can be easily converted to D.C.
- A.C can be controlled by the use of choke which involves less loss of power whereas, D.C can be controlled using resistances which involves high energy loss.
- AC can be transmitted over long distances without much loss of energy.
- AC machines are stout and durable and do not need much maintenance.

Disadvantages of AC

- AC cannot be used for the electrolysis process or showing electromagnetism as it reverses its polarity.
- AC is more dangerous than DC.

Domestic Electric Circuits: We receive electric supply through mains supported through the poles or cables. In our houses, we receive AC electric power of 220 V with a frequency of 50 Hz. The 3 wires are as follows

- Live wire – (Red insulated, Positive)
- Neutral wire – (Black insulated, Negative)
- Earth wire – (Green insulated) for safety measure to ensure that any leakage of current to a metallic body does not give any serious shock to a user.

Short Circuit: Short-circuiting is caused by the touching of live wires and neutral wire and sudden a large current flow.
It happens due to

- damage of insulation in power lines.
- a fault in an electrical appliance.

Overloading of an Electric Circuit: The overheating of electrical wire in any circuit due to the flow of a large current through it is called overloading of the electrical circuit.
A sudden large number of current flows through the wire, which causes overheating of wire and may cause fire also.

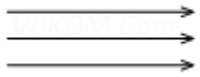
Electric Fuse: It is a protective device used for protecting the circuit from short-circuiting and overloading. It is a piece of thin wire of material having a low melting point and high resistance.

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

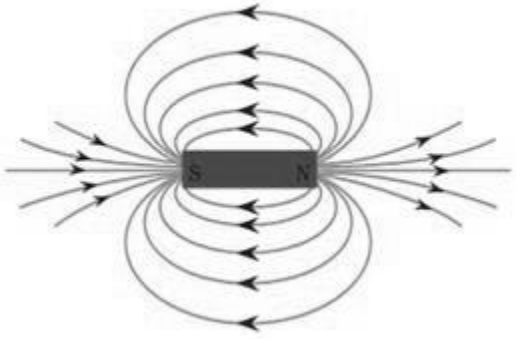
Ans. (i) Magnetic lines of magnetic field is a curve which gives the direction of magnetic field at the point.

1. State two properties of magnetic lines of force?
Ans. (i) Magnetic lines of force are closed continuous curves.
(ii) The tangent at any point on the magnetic line of force which gives the direction of magnetic field at that point.
2. Why does a compass needle deflected when brought near a bar magnet?
Ans. Compass needle experience a force is the magnetic field of a bar magnet due to which it deflects.

3. The magnetic field lines in a given region is uniform. Draw a diagram to represent.
Ans.

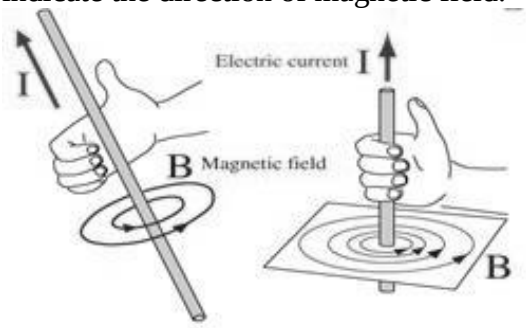


4. Write two ways to induce current in a coil?
Ans. (i) By moving a bar magnet toward or away from the coil.
(ii) By placing a coil near another coil connected across a battery.
5. Draw magnetic field lines around a bar magnet? Give one point of difference between uniform and non- uniform magnetic field.



Ans. The space or region where field is same everywhere is known as Uniform magnetic field. The magnetic field which is unequal in magnitude and direction at every point in the space is called non- uniform magnetic field.
6. Why do not two magnetic field lines intersect each other?
Ans. The two magnetic field lines never intersect each other because at the point of intersection there will be two directions of magnetic field, which is not possible.

7. Name and state rule used to determine the direction of magnetic field produced around a straight conductor carrying current?
Ans. The rule is known as right hand thumb rule if a current carrying conductor is held in our right hand such that thumb points in the direction of current, then the curled fingers of the hand indicate the direction of magnetic field.



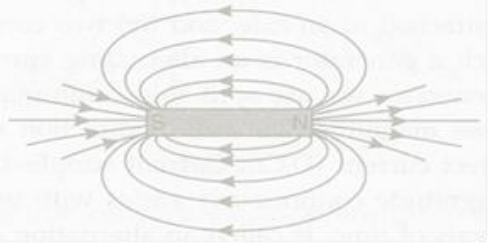
8. What is electric fuse? Where it is connected in a circuit?
Ans. An electric fuse is a safety device which is made up of a wire made of copper or aluminum or a tin lead alloy. An electric fuse must be connected in the path of the circuit so that overloading which can cause fire due to short circuit can be avoided.
9. State the factors on which strength of magnetic field at a point due to a current carrying conductor depends?
Ans. The factors on which strength of a magnetic field at a point depends.
(1) Amount of current (I) flowing through the conductor
(2) Distance (r) from the current carrying conductor.

$$B = \frac{\mu o}{4\pi}\frac{2I}{r}$$

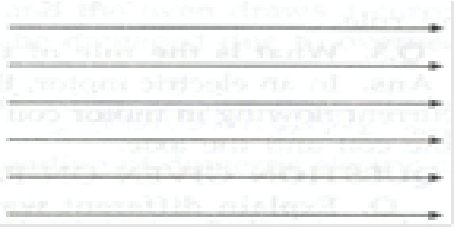
(1) $B \propto I$ (2) $B \propto \frac{1}{r}$

10. What is an electromagnet? Write two uses of an electromagnet?
Ans. When current is passed through a solenoid it behaves as a magnet and is called as an electromagnet.
The two uses of an electromagnet are-
(1) They are used to lift heavy iron pieces.
(2) They are used in many devices like micro phone, radio sets, electric bell etc.
11. State and define S.I unit of magnetic field?
Ans. The S.I unit of magnetic field is Tesla (T). The magnetic field strength is said to be one Tesla if 1meter long conductor carrying 1 ampere current experiences 1 Newton force, when placed perpendicular to the direction of magnetic field.
12. A current carrying conductor is placed perpendicular to the uniform magnetic field. What happens to displacement of the conductor if
(i) strength of current increases
(ii) If horse shoe magnet is replaced by a weak horse shoe magnet.
Ans. The displacement of the conductor
(i)will increase on increasing the current
(ii)Will decrease on using a weak horse shoe magnet.

13. Draw magnetic field around a bar magnet.
Ans. Magnetic field lines are as follows:



14. Why don't two magnetic lines of force intersect each other?
Ans. No, two magnetic field lines can ever intersect each other. If they do, then it would mean that at the point of intersection there are two directions of magnetic field, which is not possible.
15. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.
Ans. As per right-hand rule, we find that inside the loop, the magnetic field lines are directed perpendicular to the plane of paper in the inward direction. Outside the loop magnetic field lines are directed out of the plane paper.
16. The magnetic field in a given region is uniform. Draw a diagram to represent it.
Ans.The uniform magnetic field is represented by parallel equi-spaced lines of equal length as follows:



17. What is the role of the split ring in an electric motor?
Ans. In electric motor, the split ring acts as commutator. Due to its action, the direction of current flowing in motor coil reverses after half turn, giving rise to a continuous rotation of the coil and the axle.
18. State the principle of an electric generator.
Ans. An electric generator is based on the principle of electromagnetic induction. When a rectangular coil is rotated in a uniform magnetic field, an induced emf is generated between the ends of the coil.
19. Which sources produce alternating current?
Ans. A.C. generator and common inverter used in houses for emergency power supply produce alternating current.
20. Name two safety measures commonly used in electric circuits and appliances.
Ans. Two safety measures are:
(a) use of earth wire and proper earthing.
(b) use of fuse.
21. State whether the following statements are true or false.
(a) An electric motor converts mechanical energy into electrical energy.
(b) An electric generator works on the principle of electromagnetic induction.
(c) The field at the centre of a long circular coil carrying current will be parallel straight line

(d) A wire with green insulation is usually the live wire of an electric supply.
Ans. (a) False (b) True (c) True (d) False
22. When is the force experienced by a current-carrying conductor placed in magnetic field largest?
Ans. The force experienced by a current carrying conductor placed in a magnetic field is largest when the conductor is placed with its length in a direction perpendicular to that of magnetic field.
23. Name some devices in which electric motors are used.
Ans. Electric motors are used in all devices where we want to convert electrical energy into Mechanical energy. In our houses, electric motors, coolers, mixer grinders, washing machines, computers etc motor is used.
24.When does an electric short circuit occurs?
Ans. If either the insulation of wires used in an electric circuit is damaged or there is a fault in the appliances, live wire and neutral wire may come in direct contact. As a result, the current in the circuit abruptly rises and short circuiting occurs.
25. Why is the earth pin thicker and longer than the live and the neutral pins?
Ans. it is thicker so that it does not enter into the live or neutral sockets. It is made longer so that it gets connected to the earth terminal earlier than the live and neutral pins. This ensures the safety of the user.

CHAPTER- 15
OUR ENVRONMENT

Content- Eco-system, Environmental problems, Ozone depletion, wastes production and their solutions, Biodegradable and non-biodegradable substances.

ECOSYSTEM

An ecosystem is a system consisting of biotic and abiotic components that function together as a unit.

- Biotic components- all the living things
- Abiotic components - non-living things like water, light, wind, soil etc.

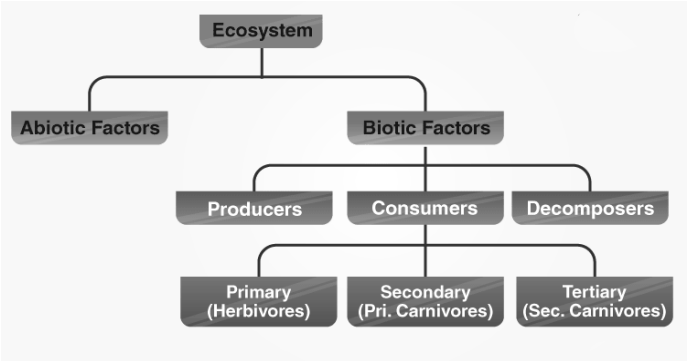
Ecosystem maintains a balance in the nature.

- Natural ecosystem – forest, pond, lake
- Man-made (artificial ecosystem)- crop fields, garden

Producer: autotrophic, perform photosynthesis e.g. green plants, blue green algae

Consumer: consume the food produced either directly from producer or indirectly by feeding on other consumers types of consumers:-

i- Herbivores – deer
ii- Carnivores – lion
iii- Omnivores – cat
iv- Parasites – bacteria



Decomposers: feed on dead and decomposed products. E.g. fungi, bacteria

Importance of Decomposers –

- Break down dead remains and waste products of organisms.
- Break down the complex organic substance into simple inorganic substances.
- Release minerals into the soil. Thus helps in maintaining the fertility of soil.
- Clean the environment
- Help in recycling the materials in the biosphere.

FOOD CHAIN

The sequence of living organisms in a ecosystem in which one organism consumes another organism to transfer food energy, is called a food chain.

For example

i- Grass ----Goat…Tiger
ii- Grass---- insects…..frog……snake…….eagle
iii- Planktons…..insects……fish……crane

TROPHIC LEVELS:

The various steps in the food chain at which the transfer of food (or energy) takes place is called trophic levels.
The different trophic levels are – Producers (T1), Primary consumers (herbivores-T2), Secondary consumers (primary carnivores -T2), Tertiary consumers(Sec carnivores -T3), Decomposers

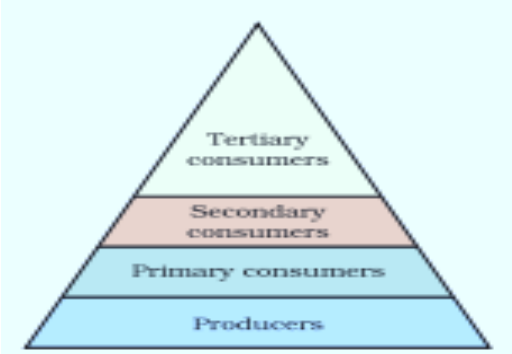
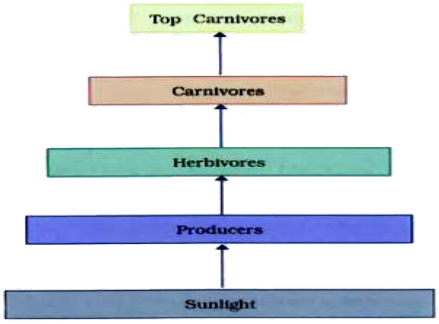


Figure 15.2
Trophic levels

Significance of Food Chains

- The food chain transfer energy from one trophic level to another.
- Autotrophs----------
  heterotrophs…….decomposers
- Only 10 % of energy is transferred from one trophic level to another. Rest of energy is lost as heat, into doing work, in digestion, growth, reproduction. It is called 10 % law.
- Help in study of food relationships and interactions among the various organisms in an ecosystem.



FOOD WEB

It is inter-connected food chains in an ecosystem.
It forms a network of relationship between various species.
In a food web, one organism may occupy a position in more than one food chain.
More stable food chain / food web means more stable ecosystem.

FOOD PYRAMID-

It is graphic representation of food chain.
It may be formed as, depicted as a pyramid having a broad base formed by producers and tapering to a point formed by end consumers.

BIOMAGNIFICATION

Accumulation of toxic pollutants at successive higher trophic level is called as bio magnification.

OZONE LAYER

- Ozone (O3) is a molecule formed by three atoms of oxygen.
- Ozone shields the surface of the earth from ultraviolet (UV) radiation from the Sun.
- UV radiation is highly damaging to organisms. It may cause even skin cancer in human beings.

- Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O2) molecule.
- The higher energy UV radiations split apart some molecular oxygen (O2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown—
- The ozone layer depletion takes place at higher rate. The major cause is chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers.

BIODEGRADABLE AND NON BIODEGRADABLE WATSES

i- **Biodegradable Wastes**: These can be broken down by the biological processes. E.g. Food waste, plant parts, animal wastes, agricultural residue, paper etc. Decomposers can decompose these without harming ecosystem. Food waste, trees leaves, urine and fecal matter, sewage agricultural residue, paper, wood, cloth, cow-dung etc.

ii- **Non-biodegradable waste**- these can't be broken down by biological processes. E.g. - Chemical pesticides, DDT, mercury, lead, plastics, polythene bags etc. These wastes are major pollutants of the environment.

MAINTAININMG THE GARBAGE WE PRODUE

- Change in attitudes toward using only biodegradable items.
- Proper disposal of wastes
- Follow Sewage treatment norms
- 3 'R' principle- reduce , recycle, reuse

IMPORTANT QUESTIONS

Very Short Answer Type Question

Q1-The flow of energy in the food chain is unidirectional. Why?

Ans: Energy flows from sun to plants (autotroph), plants to animals (consumer).

Q 2- In a food chain, 10,000 joules of energy is available to the producer. How much energy will be available to the secondary consumer to transfer it to the tertiary consumer?

Ans: 10 J

Q 3- Producers always occupy the first trophic level in any food chain. Why?

Ans: Only producers have the ability to trap solar energy and manufacture organic food through the process of photosynthesis**.**

Q 4 - Name any two abiotic components of an environment.

Answer:

(a) Climatic factors (light, temperature, rainfall)

(b) Edaphic factor (Soil)

Q 5- Give any two ways in which biodegradable substance would affect the environment.

Ans: They keep the environment clean as they are easily decomposed.

They can easily go through the geochemical cycle with the help of decomposers.

Short Answer Type Question

Q6-What will happen if we kill all the organisms in one trophic level?

Ans: i- The organisms in specific trophic level will not be able to get the food

ii-It will cause a disturbance in food chain and therefore ecological imbalance will take place.

Q7- Why is a lake considered to be a natural ecosystem?

Ans: In Lake living organisms grow, reproduce and interact with other biotic and abiotic components. In lake different components carry out all activities in nature by themselves without any human interference; therefore it is referred to as a natural ecosystem.

Q 8 - How can we help in reducing the problem of waste disposal? List two ways.

Ans: i-Separation of biodegradable and non-biodegradable wastes

ii-Preparation of compost / vermicomposting from biodegradable waste

iii-Recycling of waste

Q 9- Which gas shield the surface of earth from harmful radiation of the sun. why these radiations are supposed to be harmful for us?

Answer- Ozone gas

Harmful radiation of the sun like UV radiation may causes skin cancer, cataract, fall in immunity in infants, decline in photosynthesis rate etc

Q 10- In a certain study conducted on the occurrence of DDT along food chains in an ecosystem, the concentration of DDT in grass was found to be 0-5 ppm. In sheep, it was 2 ppm and in man it was 10 ppm. Name the phenomenon and define?

Ans: Bio-magnification

Bio-magnification is the increase in the level of a toxic substance with each successive rise in the trophic level of a food chain.

Long Answer Type Questions

Q11- Why bacteria and fungi are called decomposers? List any two advantages of decomposers to the environment.

Answer: Decomposers degrade breakdown the complex organic substances into simple inorganic substances that go into the soil and are used up once more by the plants.

Advantages:

i- Clean environment by decomposing dead bodies of plants/ animals

ii- Replenish nutrients (Inorganic substance) into soil

iii- Helps in Nutrient recycling

Q12- Answer the followings-

i- What is ozone? How is it formed in the atmosphere?

ii- How ozone layer is useful

iii- Name the substances responsible for the depletion of ozone layer.

Ans:

i- Ozone is triatomic form of oxygen, O3. Ozone is formed in the upper atmosphere by the action of ultraviolet (UV) radiations over oxygen (O2)

ii- It protects us from harmful UV radiation of sun.

iii- The important ozone depleting substances chlorofluorocarbons (CFC), methane, N2O, chlorine.

Q13- (a) Write two harmful effects of using plastic bags on the environment. Suggest alternatives to the usage of plastic bags.

(b) List any two practices that can be followed to dispose of the waste produced in our homes.

Ans: (a) Harmful effects of using plastic bags :

(i) These are non-biodegradable substances. They cannot be decomposed and therefore remains as pollutants in nature for many years.

(ii) The plastic bags choke drains and causes waterlogging.

(iii)The pastic release harmful chemicals in soil, water slowly over to years.

Jute bags and cloth bags are the alternatives to the polyethene bags.

(b) Practices to dispose off the waste produced in our homes:

(i) Separation of biodegradable and non- biodegradable wastes.

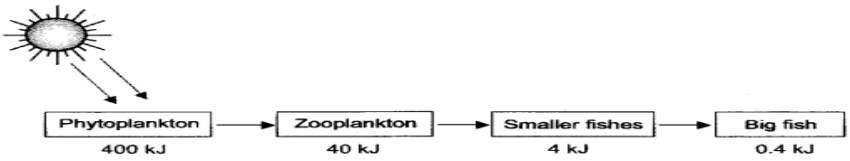
(ii)The biodegradable waste can be converted to manure.

(iii)Non-biodegradable waste should be disposed off at suitable places from where municipal authorities can pick them up and dispose properly and scientifically.

(iv) Reuse the waste

Q14- Draw a line diagram to show flow of solar energy in ecosystem

Ans:



Q 15- In the following food chain, 100 J of energy is available to the lion. How much energy was available to the producer?

Ans : simple food chain

Plants ———> Deer ———> Lion.

As per 10 % law only 10 % of energy is transferred to next trophic level-

Energy available to deer = 100J x 10 = 1000 J

Energy available to plants = 1000 x 10 = 10,000 J.

References -

1- NCERT Book

2- CBSE Academic