विज्ञान
Science

कक्षा / Class X

2026-27

विद्यार्थी सहायक सामग्री
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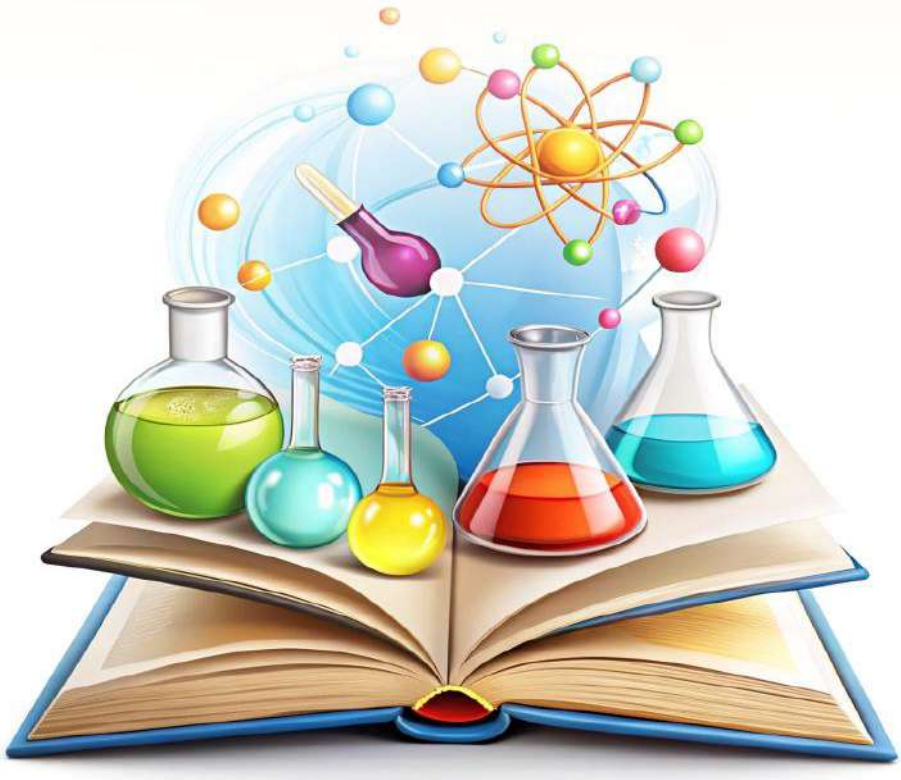

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संदेश

शिक्षा केवल पुस्तकों तक सीमित ज्ञान नहीं है; यह स्वयं को पहचानने, अपने विचारों को विस्तार देने और जीवन की चुनौतियों का आत्मविश्वास से सामना करने की सतत् यात्रा है। केन्द्रीय विद्यालय संगठन का सदैव यह प्रयास रहा है कि प्रत्येक विद्यार्थी के लिए ऐसा शिक्षण वातावरण हो, जहाँ जिज्ञासा को प्रोत्साहन मिले, सीखना आनंददायी बने और प्रत्येक बालक अपनी अंतर्निहित क्षमताओं को पहचानकर उन्हें विकसित कर सके।

राष्ट्रीय शिक्षा नीति 2020 ने शिक्षा को सिर्फ रटने से समझने, सूचना से ज्ञान और ज्ञान से जीवनोपयोगी दक्षताओं की ओर अग्रसर किया है। आज का समय कृत्रिम बुद्धिमत्ता (Artificial Intelligence – AI), डिजिटल नवाचार और निरंतर बदलती तकनीकों का है। ऐसे युग में केवल तथ्यों का ज्ञान पर्याप्त नहीं है; आवश्यक है कि विद्यार्थी मनन- चिंतन करना सीखें, प्रश्न पूछें, समस्याओं का समाधान खोजें और नए विचारों के साथ आगे बढ़ें। यही क्षमताएँ उन्हें भविष्य के लिए तैयार करेंगी।

इन्हीं उद्देश्यों को ध्यान में रखते हुए केन्द्रीय विद्यालय संगठन के पाँचों आंचलिक शिक्षा एवं प्रशिक्षण संस्थानों (ZIETs) के माध्यम से, समर्पित एवं अनुभवी शिक्षकों द्वारा कक्षा 9 से 12 के विद्यार्थियों के लिए यह विद्यार्थी सहायक सामग्री तैयार की गई है। यह केवल परीक्षा की तैयारी की संकलन सामग्री नहीं है, बल्कि विषयों को सरलता से समझने, अवधारणाओं को स्पष्ट करने, नियमित अभ्यास करने और आत्मविश्वास के साथ आगे बढ़ने का एक विश्वसनीय साथी है।

इस सामग्री में विषय-वस्तु को विद्यार्थियों की आवश्यकताओं के अनुरूप सरल, व्यवस्थित एवं दक्षता-आधारित दृष्टिकोण से प्रस्तुत किया गया है। मुझे प्रसन्नता है कि इसे हमारे शिक्षकों के अनुभव, नवाचार और विद्यार्थियों के प्रति उनकी प्रतिबद्धता ने समृद्ध बनाया है। मुझे विश्वास है कि यह सामग्री विद्यार्थियों की सीखने की यात्रा को अधिक सहज, रोचक और प्रभावी बनाएगी तथा उन्हें बोर्ड परीक्षाओं के साथ-साथ जीवन की व्यापक चुनौतियों के लिए भी तैयार करेगी।

मेरा विश्वास है कि जब एक जिज्ञासु विद्यार्थी, प्रेरित शिक्षक और सार्थक शिक्षण संसाधन एक साथ आते हैं, तब शिक्षा केवल उपलब्धि का माध्यम नहीं रहती, बल्कि व्यक्तित्व निर्माण की एक सशक्त प्रक्रिया बन जाती है। यही भावना इस विद्यार्थी सहायक सामग्री के केंद्र में है।

मेरी हार्दिक शुभकामनाएँ हैं कि आप सभी सीखने की इस यात्रा में निरंतर आगे बढ़ें, अपने सपनों को नए आयाम दें और ज्ञान, संवेदनशीलता तथा नवाचार के साथ राष्ट्र निर्माण में अपना महत्वपूर्ण योगदान दें।

शुभकामनाओं सहित।

(विकास गुप्ता)

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COURSE STRUCTURE CLASS X (2026-27) Time: 03 Hours Marks: 80

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	5

TABLE OF CONTENTS

Chapter 1: Chemical Reactions And Equations

Theme: Materials
Unit I: Chemical Substances - Nature and Behaviour
Chemical reactions, Chemical equation, Balanced chemical equation, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, endothermic exothermic reactions, oxidation and reduction.

Chemical Reaction:-

A chemical reaction is a process in which one or more substances (the reactants) are converted to one or more different substances (the products)

 # Characteristics of chemical reaction:-

Change in state, Change in colour, Evolution of gas, Change in temperature and Formation of a precipitate.

 # Writing a Chemical Equation:-

Representation of a chemical reaction in terms of symbols and chemical formulae of the reactants and products and some coefficients is known as a chemical equation.

 # Balanced Chemical Equations:-

Balancing of chemical equations is done to justify the Law of Conservation of Mass which states that in a chemical reaction, atoms can't be created or destroyed. This means that the total number of atoms for each element in the starting materials (reactants)must be the same as in the end products, keeping the overall mass the same.

1. Write the unbalanced reaction (skeletal equation)
2. Count the number of atoms of each elemnt and tabulate
3. Multiply whole numbers to reacts and products without changing chemical formulae
4. At last balance H and O . Check and verify. If required repeat step 2 and 3

Skeletal reaction(unbalanced) $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

After Balancing $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

 # TYPES OF CHEMICAL REACTIONS

1. COMBINATION REACTION (A+B → AB)

A reaction in which a single product is formed from two or more reactants is known as a combination reaction.

Example: $CaO(s)+H_2O(l)\rightarrow Ca(OH)_2(aq) +Heat$

(Calcium Oxide is commonly called Quick lime whereas Calcium Hydroxide is commonly called Slaked lime. Slaked lime is used in white washing which upon contact with Atmospheric CO_2 produces a shiny white layer of calcium carbonate. This is also a test for CO_2. Lime water/ slaked lime turns milky on passing carbon dioxide gas through it.
$Ca(OH)_2+ CO_2\rightarrow CaCO_3 + H_2O$.

Other examples -

*Burning of Coal $C_{(s)}+O_{2(g)} \rightarrow CO_{2(g)}$

*Burning of natural gas $CH_4(g)+2O_2(g) \rightarrow CO_2(g)+2H_2O\ (g)$

*Burning of magnesium ribbon with white dazzling flame $2Mg_{(s)} + O_{2(g)} \text{ --> } 2MgO_{(s)}$

* $H_{2(g)} + Cl_{2(g)} \text{--> } HCl_{(l)}$ & $H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)}$

Exothermic versus Endothermic Reactions

*A chemical reaction in which heat is produced or evolved is called exothermic reaction. The reaction mixture becomes HOT. (A+B—--> C+ HEAT)

$CaO(s)+H_2O(l) \rightarrow Ca(OH)_2(aq) + Heat$

Other examples-

*Respiration $C_6H_{12}O_{6(s)} + O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)}$ + energy (in the form of ATP)

*Decomposition of vegetable matter into compost.

*Whereas A chemical reaction in which heat is absorbed is called endothermic reaction. (A+ B + HEAT →C)

For example in formation of nitric oxide ($N_2 + O_2$+ heat—-----> 2NO) , evaporation and in photosynthesis heat(energy) is absorbed The reaction mixture becomes COLD.

Review question Section 1

1. 2 g of ferrous sulphate crystals are heated in a dry boiling tube.

(a) List any two observations.

(b) Name the type of chemical reaction taking place.

(c) Write a balanced chemical equation for the reaction and name the products formed

.

2. DECOMPOSITION REACTION. (A------ >B+C)

A reaction in which a compound splits up into two or more simpler substances is known as decomposition reaction. It can be carried out by applying HEAT, LIGHT OR ELECTRICITY.

(i) THERMAL DECOMPOSITION (Decomposition reaction using HEAT)

$FeSO_4(s)$ + Heat ----> $Fe_2O_3(s)$ + $SO_2(g)$ +SO_3 (g)

Ferrous sulphate Ferric oxide Sulphur dioxide Sulphur trioxide

$CaCO_3(s)$ +Heat—-> CaO(s) + $CO_2(g)$

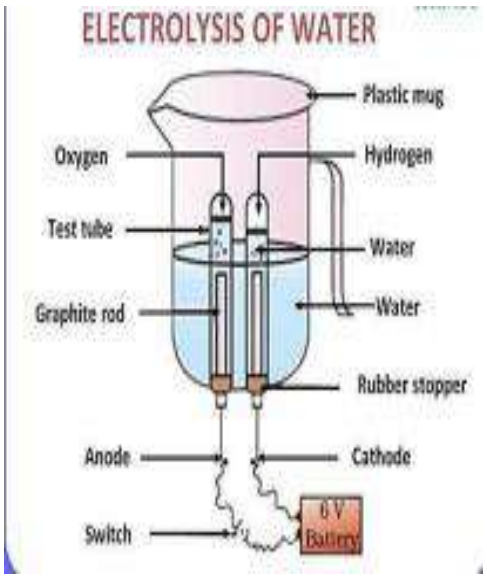
Calcium carbonate Calcium oxide Carbon dioxide (limestone) (Quick lime)

$2Pb(NO_3)2(s)+Heat\text{----------> } 2PbO(s) + 4NO_2+ O_2$

Lead nitrate (Colourless) Lead oxide (Yellow) Nitrogen dioxide(Brown fumes)

$2\ KClO_3(s)$ +Heat—----------$>2KCl(s)$ + $3O_2(g)$

Potassium chlorate Potassium chloride



(ii) ELECTROLYTIC DECOMPOSITION / ELECTROLYSIS

(Decomposition reaction using ELECTRICITY)

Electrolysis of water

$H_2O_{(l)} \rightarrow H_{2(g)} + O_{2(g)}$

* Anode is connected to +ve terminal and cathode is connected to -ve terminal of battery.
* The volume of H_2 gas evolved is twice the volume of O_2.
* O_2 gas is collected at Anode and H_2 gas is collected at Cathode

Other eg. $2NaCl_{(l)}$ —----> Na $_{(s)}$ + Cl_2

(iii) PHOTO DECOMPOSITION / photolysis (Decomposition reaction using LIGHT)

2 AgCl(s) ---> 2Ag (s) +Cl2(g)
Silver chloride Silver Chorine

2AgBr (s) ----> 2Ag (s) + Br2(g)
Silver bromide Silver Bromine

These reactions are used in photography

3. DISPLACEMENT REACTION (A+BC —-->AC+ B)

A reaction in which a more reactive element displaces a less reactive element from its compound.

*Fe(s) + $CuSO_4$(aq) ------> $FeSO_4$(aq) + Cu
Iron Copper sulphate Iron sulphate Copper

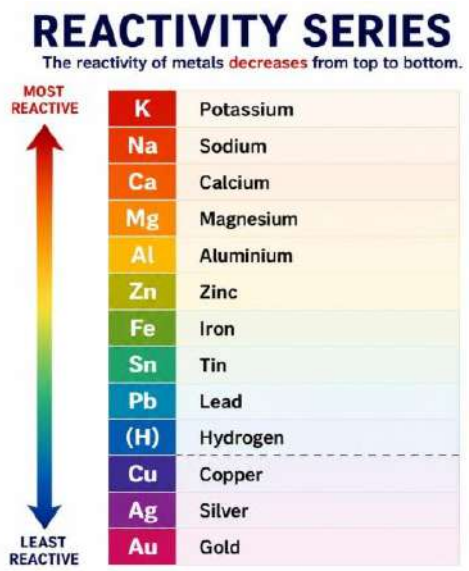
*Zn (s) + $CuSO_4$(aq) -----> $ZnSO_4$(aq) + Cu (s)
Zinc Copper sulphate. Zinc sulphate. Copper

*Zn (s) + H_2SO_4(aq) -----> $ZnSO_4$(aq) + H_2(g)

(Hydrogen gas test –it produces pop sound on bringing flame near it)

*CuO(s) + $H_{2(g)}$ --> $Cu_{(s}$ + H_2O(l)

*$PbS_{(s)}$ + $CuCl_{2(aq)}$--> $PbCl_{2\ (aq)}$ + Cu $_{(s)}$



4. DOUBLE DISPLACEMENT REACTION

(AB+CD—->AD+CB)

A reaction in which mutual exchange of ions between two compounds takes place is called double displacement reaction.

$Na_2SO_{4(aq)}$ + $BaCl_{2(aq)}$---------->$BaSO_{4(s)}$ + 2NaCl $_{(aq)}$
Sodium sulphate Barium chloride. Barium sulphate (White ppt.) Sodium chloride

KI + $Pb(NO_3)_2$—--------> KNO_3 + PbI_2
Potassium iodide Lead nitrate Potassium nitrate Lead iodide (Yellow ppt)

Precipitation reaction

*The reaction in which insoluble solid substance is produced is called Precipitation reaction.

Review question Section 2

1. "Why does the color of copper sulfate solution change when an iron nail is dipped in it?"
2. "A metal 'M' reacts with a salt solution 'NSO_4' to form 'MSO_4' and metal 'N'. Which metal is more reactive and why?

5. OXIDATION AND REDUCTION REACTION (REDOX REACTION)

*__OXIDATION__=Addition of Oxygen / Removal of Hydrogen /loss of electron
*__REDUCTION__=Addition of Hydrogen / Removal of Oxygen / gain of electron
*OXIDISING AGENT - Substance which gives oxygen / removes hydrogen. It itself gets reduced.
* REDUCING AGENT- Substance which gives hydrogen / removes oxygen. It itself gets oxidised. For example in reaction $CuO + H_2$ —-------> $Cu + H_2O$
CuO is reduced to Cu and is an oxidizing agent as it provides oxygen for oxidation of hydrogen. H_2 is oxidized to water and act as reducing agent
Other examples

$MnO_2 + 4\ HCl \rightarrow MnCl_2 + H_2O + Cl_2$

$ZnO + C \rightarrow Zn + CO$

Review question section 3

1. When aqueous solutions of potassium iodide and lead nitrate are mixed, an insoluble substance separates out. The chemical equation for the reaction involved is:

(a) $KI + PbNO_3 \rightarrow PbI + KNO_3$ (b) $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$

(c) $KI + Pb(NO_3)_2 \rightarrow PbI + KNO_3$ (d) $KI + PbNO_3 \rightarrow PbI_2 + KNO_3$

2 "Identify the reducing agent in the following reaction: MnO_2+4HCl----$\rightarrow MnCl_2+2H_2O+Cl_2$"

Corrosion:-When metals react with substances like water, oxygen or acids present in its surroundings resulting in loss of metal the process is called corrosion.
Examples - *When an iron object is left in damp air for some time ,it gets covered with a reddish-brown flaky substance called RUST.
$Fe + O_2 + H_2O$----------> $Fe_2O_3.xH_2O$ (Hydrated Ferric oxide)(Rust)
*Tarnishing / surface discoloration of silver occurs to form a black grey colour coating of silver sulphide.
$Ag_{(s)} + H_2S_{(g)} + O_{2(g)}) \rightarrow Ag_2S_{(s)} + 2H_2O_{(l)}$

*On copper, bluish green coating of copper hydroxide and copper carbonate is formed which is called patina.
Cu + H2O + CO2 +O2 —----------> $Cu(OH)2 + CuCO_3$

RANCIDITY The condition produced by aerial oxidation of fats and oils in food marked by unpleasant smell and taste is called rancidity.
Methods of prevention of rancidity

- By adding antioxidants
- By storing food in air -tight containers
- By packaging the food containing oil and fat in nitrogen gas
- By keeping the food in refrigerator

Review question section 4

1.You might have noted that when copper powder is heated in a china dish, the reddish brown surface of copper powder becomes coated with a black substance.

(a) Why has this black substance formed ?

(b) What is this black substance ?

(c) Write the chemical equation of the reaction that takes place.

(d) How can the black coating on the surface be turned reddish brown ?

Answer key review questions

Section 1

(a) Observations

The green color of the crystals changes to reddish-brown.
A characteristic smell of burning sulfur
(b) Thermal Decomposition reaction.
(c) 2 $FeSO_4$-----→Fe_2O_3 + SO_2+ SO_3Products Formed: Ferric oxide (solid), Sulfur dioxide (gas) ,Sulfur trioxide (gas)

Section 2

1. Observation: The blue color of the solution fades and turns light green. Reason: Iron is more reactive than copper.
2. More Reactive Metal: Metal 'M' is more reactive. Reason: Only a higher reactive metal can displace a lower reactive metal from its salt solution.

Section 3

1.(b) $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$

2. Oxidising agent - MnO_2 , Reducing agent - HCl

Section 4

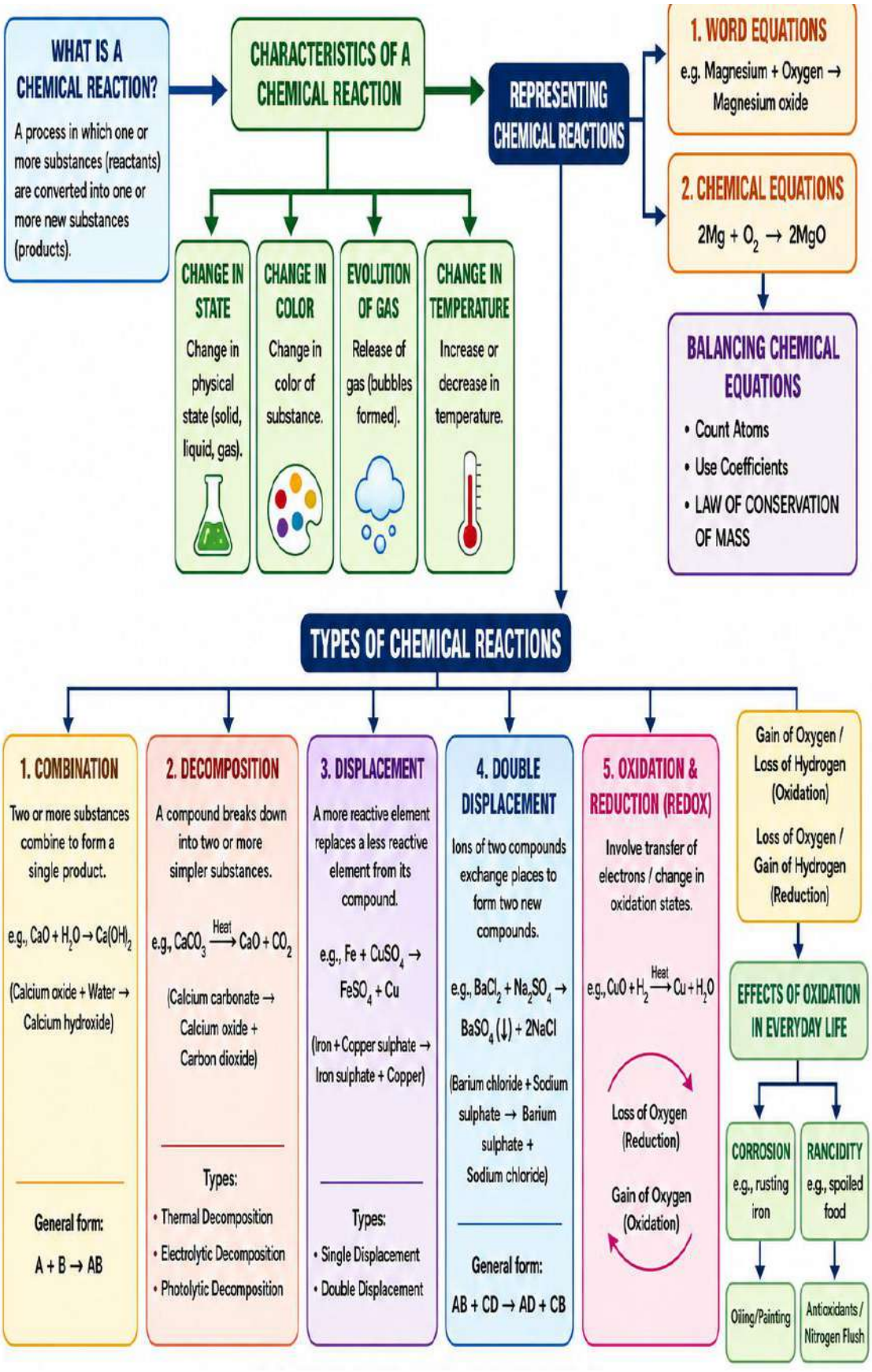
1.(a) The black substance forms because oxidation occurs. When copper is heated in the presence of air, it reacts with oxygen.

(b) The black substance is Copper(II) oxide

(c) $2Cu + O_2$----→ 2 CuO

(d) he black coating can be turned back to reddish-brown by passing Hydrogen gas over the heated black material. This is a reduction reaction.

Chapter 1 flow chart



Chapter 2 Acids, Bases And Salts

Theme: Materials
Unit I: Chemical Substances - Nature and Behaviour
Definitions in terms of furnishing of H^+ and OH^- ions, identification using indicators, chemical 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.

INDICATORS	ACID	BASE
Blue litmus paper	Red	No change
Red litmus paper	No change	Blue
China rose (Pink)	Deep Pink (Magenta)	Green
Red cabbage extract (Red)	Red	Green
Turmeric (Yellow)	Pale Yellow	Red
Phenolphthalein (Colourless)	Colourless	Pink
Methyl Orange (Orange)	Red	Yellow

CHEMICAL REACTIONS OF ACIDS AND BASES :

1.Acid + Metal —-> Salt + Hydrogen
eg. $Mg + 2HCl \text{—------>} MgCl_2 + H_2$
2.Base + Metal —-> Salt + Hydrogen
eg.2 $NaOH + Zn \text{—---->} Na_2ZnO_2$ (Sodium zincate) + H_2
3.Acid + Metal Carbonate ----> Salt + Water + Carbon Dioxide
$Na_2CO_3 + 2HCl \text{—--------->} 2NaCl + H_2O + CO_2$
$Ca(OH)_2 + CO_2 \text{—-------->} CaCO_3 + H_2O$
On passing excess CO_2 , Calcium hydrogen carbonate is formed which is soluble in water.
$CaCO_3 + H_2O + CO_2 \text{—------->} Ca(HCO_3)_2$
4.Base + Metal Carbonate/ Metal Hydrogen Carbonate —> No Reaction
5. Acid + Metal Hydrogen Carbonate —-> Salt + Water + Carbon Dioxide
eg. $HCl + NaHCO_3 \text{—-->} NaCl + H_2O + CO_2$
6. Acid + Base —-----> Salt + Water (Neutralisation Reaction)
eg. $HCl + NaOH \text{—--->} NaCl + H_2O$
$H_2SO_4 + 2NaOH \text{—-------->} Na_2SO_4 + H_2O$
7. Acid + Metal Oxide —------> Salt + Water
eg. $2HCl + CuO \text{—------>} CuCl_2 + H_2O$
(Metal oxides are basic in nature, so acids react with metal oxides)
8. Base + Non - Metal Oxide —-----> Salt + Water
$Ca(OH)_2 + CO_2 \text{—--------->} CaCO_3 + H_2O$ (Non - metallic oxides are acidic in nature, so bases react with non - metallic oxides.

Review questions Section 1

1. Consider the following reactions:

(i) Dilute hydrochloric acid reacts with sodium hydroxide (ii) Magnesium oxide reacts with dilute hydrochloric acid (iii) Carbon dioxide reacts with sodium hydroxide

It is found that in each case:

(a) Salt and water is formed (b) Neutral salts are formed

(c) Hydrogen gas is formed (d) Acidic salts are formed

2. A crystalline substance of green colour 'X' emits gases of characteristic odour when heated over a flame. It first loses water and changes colour. On further heating, it decomposes and produces a solid compound Y. (a) Identify 'X' and 'Y'

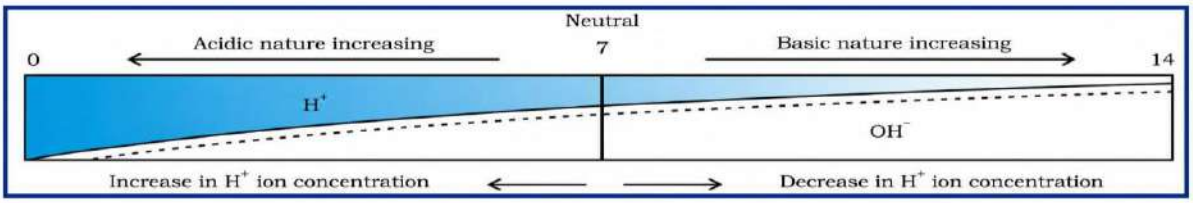
(b) State the change in colour observed when 'X' is heated.

3.Write chemical equations to show what happens when an acid reacts with a

(i) Metal (ii) Base (iii) Carbonate

How Strong is an Acid or a Base Solution ?

The strength of an acid or base can be estimated using a universal indicator.



(i) Strong Acids: An acid, which dissociates completely or almost completely in water are strong acids. Examples: HCl, H_2SO_4, and HNO_3.

(ii) Weak Acids: Acids that dissociate only partially when dissolved in water are weak acids. Examples: H_2CO_3 , CH_3COOH, Oxalic acid, and Lactic acid.

(iii) Strong Bases: Strong bases are those which ionize in water completely and produce a large number of hydroxide ions. Example: NaOH, KOH, $Ca(OH)_2$

(iv) Weak Bases: Weak bases are those bases that partially ionize in water and produce a small amount of hydroxide ions. Example: NH_4OH

(v) Alkali: These are bases that are soluble in water. Example: NaOH, KOH, $Ca(OH)_2$.

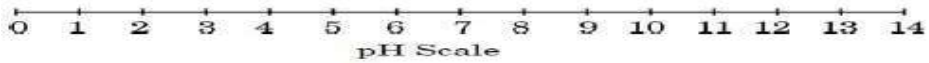
Review questions section 2

1. The warning sign shown in the given figure must invariably be displayed/pasted on the containers which contain hydroxide of:

(a) Aluminium (b) Calcium

(c) Sodium (d) Magnesium

2. The pH of a solution is measured by pH paper, which is a paper impregnated with a universal indicator.



(a) Solution P is a strong acid, while solution Q is a strong base. On the pH scale, where would you place the solutions P and Q ?(b) A solution has a pH of 7. Name a compound you would use to(i) Increase its pH (ii) Decrease its pH

*** IMPORTANCE OF pH IN EVERYDAY LIFE**

(i) When pH of rain water is less than 5.6, it is called acid rain.

(ii) Plants require a specific pH range for their healthy growth.

(iii)During indigestion people use bases called antacids. Magnesium hydroxide (Milk of magnesia), a mild base, is often used for this purpose.

(iv) Tooth decay starts when the pH of the mouth is lower than 5.5

(v) Bee-sting leaves an acid which causes pain and irritation.

Chemical from Sodium chloride (NaCl) common salt

Important Salts	**Chemical Name and Chemical formula**	**Preparation**	**Uses**
Common salt	Sodium chloride NaCl	By combination reaction of sodium hydroxide and hydrochloric acid $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(aq)$	(i) As raw material for making many chemicals such as sodium hydroxide, baking soda, washing soda, bleaching powder and many more. (ii) In edible food.
Caustic soda	Sodium hydroxide NaOH	By passing electricity through aqueous sodium chloride (brine) solution. This process is known as the chlor-alkali process. $2NaCl(aq) + 2H_2O(aq) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$	(i) In detergents and soaps (ii) In paper making (iii) In bleach manufacture (iv) In bauxite purification to extract aluminium
Bleaching powder	Calcium oxy Chloride $Ca(ClO)_2$	By passing chlorine gas over dry slaked lime $[Ca(OH)_2]$ $2Ca(OH)_2 + Cl_2 \rightarrow Ca(ClO)_2\ CaCl_2 + H_2O$	(i) For bleaching cotton and linen, wood pulp in paper factories and washing clothes in laundry. (ii) For disinfecting drinking water. (iii) As an oxidising agent in the chemical industry.
Baking soda	Sodium hydrogen carbonate $NaHCO_3$	On reacting cold concentrated sodium chloride (brine) solution with ammonia and carbon dioxide $NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$	(i) Preparing baking powder. (ii) As an antacid in medicine. (iii) In soda-acid fire extinguishers.
Washing soda	Sodium carbonate decahydrate $Na_2CO_3 \cdot 10H_2O$	By recrystallisation of sodium carbonate in water $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ $Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3 \cdot 10H_2O$	(i) In glass, soap and paper industries. (ii) Cleaning agent for domestic purposes. (iii) Softening hard water.

Water of crystallization is the fixed number of water molecules present in one formula unit of a salt. For example Chemical formula for hydrated copper Sulphate is $CuSO_4 . 5 H_2O$ this means it has 5 water molecules per formula unit of $CuSO_4$.

Review questions section 3

1. In one formula unit of salt 'X', seven molecules of water of crystallisation are present. The salt 'X' is:

(a) $CuSO_4$ (b) Na_2CO_3 (c) $FeSO_4$ (d) $CaSO_4$

2. Giving reason, state the advantage of using baking powder over baking soda for the preparation of bread or cakes.

3. State the chemical property in each case on which the following uses of baking soda are based upon:

(i) As an anti-acids(ii) as a constituent in making baking powder(iii) in soda-acid fire-extinguishers

Plaster of Paris

*Chemical name - Calcium Sulphate hemi hydrate , * Chemical formula - $CaSO4.½\ H_2O$

*Plaster of Paris is formed by heating gypsum ($CaSO_4.2H_2O$) at 373K .

CaSO4.2H2O+ Δ—--------> CaSO4.½ H2O + 1½ H2O

*Reaction of plaster of Paris with water

CaSO4.½ H2O + 1½H2O —----------> CaSO4.2H2O

Calsium sulphate hemihydrates(powder) Calsium sulphate bi hydrate(very hard)

Uses of Plaster of Paris

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

* It is used for making toys , material for decoration and for making surfaces smooth.

Answer key review questions

Section 1

1(a) Salt and water is formed

2. X: Ferrous sulphate hepta hydrate crystals Y: Ferric oxide Green to white then white to reddish brown

3.(a) Acid + Metal —-> Salt + Hydrogen (b) acid = Base --→ salt + water (C) Acid + carbonate -----→ salt + water + carbon dioxide

Section 2

1 (b) sodium

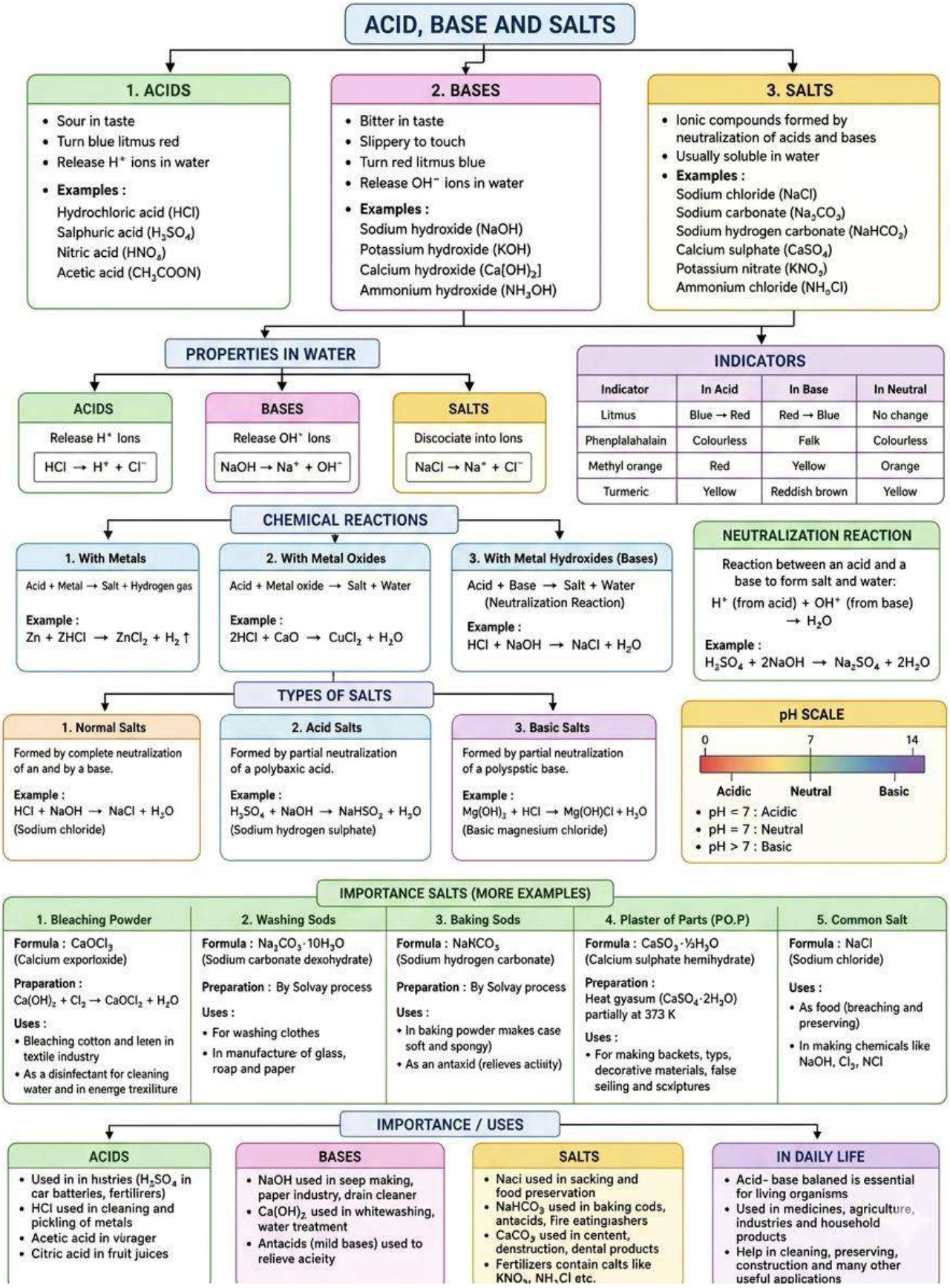
2(a) Solution P (Strong Acid): You would place it at the far left of the scale, typically in the range of 0 to 2. Solution Q (Strong Base): You would place it at the far right of the scale, typically in the range of 12 to 14. (b) (i) add base (ii) add acid

Section 3

1(c) $FeSO_4$ 2. Baking Soda: When heated, it produces Sodium Carbonate, which is very bitter.Baking Powder: It contains a mild acid (like tartaric acid). This acid neutralizes the sodium carbonate, removing the bitterness and making the cake soft and fluffy by releasing

3. **(i)** As an Antacid – mild non corrosive base to neutrilise acid (ii) When heated or mixed with acid, it releases which makes bread/cakes soft and spongy.(iii) The CO_2 gas forms a blanket over the fire, cutting off the oxygen supply**.**

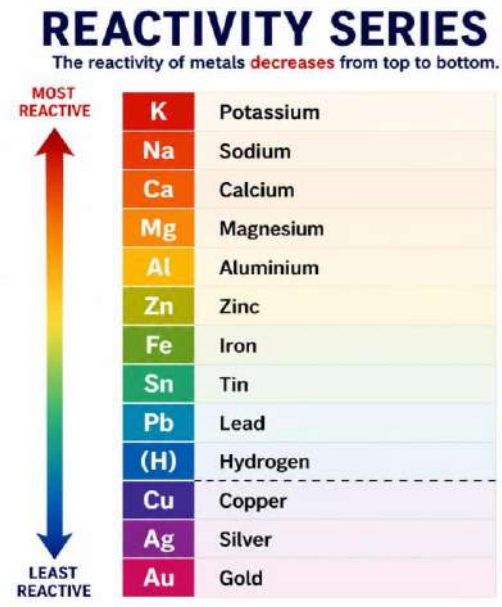
Chapter 2 Acids, Bases And Salts Flow Chart



Chapter 3 Metals And Non Metals

Theme: Materials
Unit I: Chemical Substances - Nature and Behaviour
Metals and Non-metals: Properties of metals and non-metals; Reactivity series; Formation and properties of ionic compounds; Basic metallurgical processes; Corrosion and its prevention.

PHYSICAL AND CHEMICAL PROPERTIES OF METALS

PHYSICAL PROPERTIES OF METALS	CHEMICAL PROPERTIES OF METALS
1. They are strong, hard to cut except Na, K. 2. They are malleable, (can be beaten into sheets.) 3. They are ductile, (can be drawn into wires.) 4. They are sonorous, (producing a ringing sound when struck). 5. They are lustrous (shiny). 6. They are good conductors of heat and electricity. 7. They have high melting and boiling points except Na, K. 8. They are all solids except mercury. 9. They have high density except Na, K, Li, etc. 10. They have mostly 1, 2 or 3 valence electrons. 	1. REACT WITH OXYGEN TO FORM METAL OXIDES. $4Na + O_2 \rightarrow 2Na_2O(s)$ $2Cu + O_2 \rightarrow 2CuO(s)$ $4K + O_2 \rightarrow 2K_2O(s)$ $4Al + 3O_2 \rightarrow 2Al_2O_3(s)$ Metallic oxides are mostly basic. Those metal oxides which are soluble in water are called **Alkalies**. Metals can lose electrons to form positive ions. Transition metals show variable valency, e.g. Cu^+, Cu^{2+}, Fe^{2+}, Fe^{3+} 2. Some Metals React With Cold Water, Some With Hot, Some With Steam To Form Oxides Or Hydroxide And Hydrogen Gas. Metal + Water → Metal oxide/metal hydroxide + Hydrogen $2Na + 2H_2O(cold) \rightarrow 2NaOH + H_2$ $2K + 2H_2O(cold) \rightarrow 2KOH + H_2$ $Mg + 2H_2O(hot) \rightarrow Mg(OH)_2 + H_2$ $2Al + 3H_2O(steam) \rightarrow Al_2O_3 + 3H_2$ 3. Metals React With Dilute Acids To Form Salt And Hydrogen Gas Except With Dil HNO_3, Which Is Oxidizing Agent. Metal + dilute acid → Salt + Hydrogen $Zn + 2HCl(dil.) \rightarrow ZnCl_2 + H_2$ $Mg + H_2SO_4(dil.) \rightarrow MgSO_4 + H_2$ $Mg + 2HNO_3(very\ dil.) \rightarrow Mg(NO_3)_2 + H_2$ $Mn + 2HNO_3(5\%) \rightarrow Mn(NO_3)_2 + H_2$ Metals are good reducing agents. 4. More reactive metals can displace less reactive metals from its salt solution.

Review questions section 1

1.The products formed when Aluminium and Magnesium are burnt in the presence of air respectively are:

(a) Al_3O_4 and MgO_2 (b) Al_2O_3 and MgO (c) Al_3O_4 and MgO (d) Al_2O_3 and MgO_2

2.Following is the list of some observations while performing the experiments of chemistry:

(i) burns with a dazzling white flame. (ii) A white powder is formed.

(iii) on heating it vapourises.

(iv) Aqueous solution of the white powder obtained turns blue litmus to red.

Which of the above given observations are of burning magnesium ribbon in air are

(a) (i) (ii) and (iv) (b) only (ii) (c) only (i) (d) (iii) and (iv)

3.In common practice silver is recovered from silver nitrate solution by the use of copper metal.

(a) Name the type of reaction that takes place in this process and give the chemical equation of the reaction involved.

(b) Name the method used for refining silver.

4.(i) Name two metals which react violently with cold water.

(ii) List any two observations which a student notes when these metals are dropped in a beaker containing water.

(iii) Write a test to identify the gas evolved (if any) during the reaction of these metals with water.

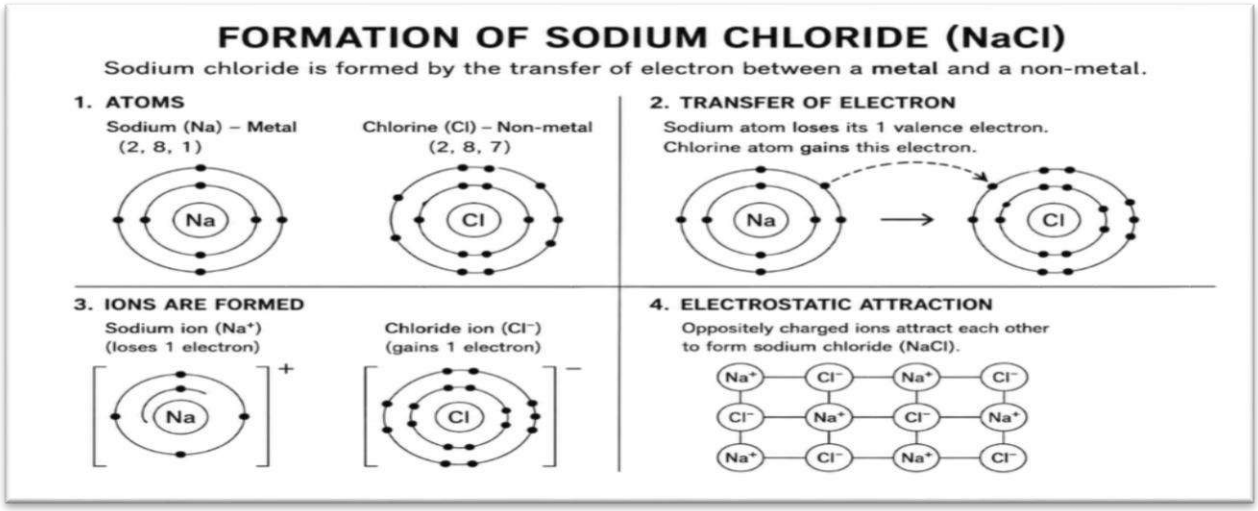
PHYSICAL AND CHEMICAL PROPERTIES OF NON - METALS

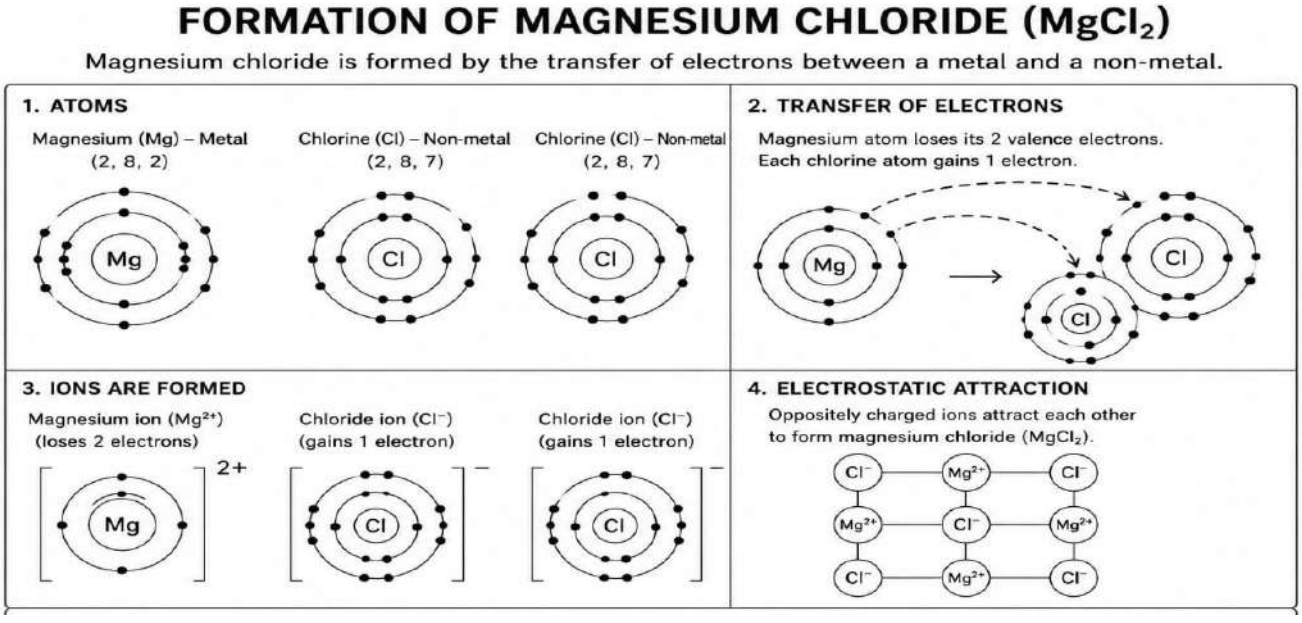
PHYSICAL PROPERTIES OF NON- METALS	CHEMICAL PROPERTIES OF NON- METALS
1. They are brittle. 2. They exist as solid, liquid and gas. 3. They are non-lustrous except diamond and iodine. 4. They are not conductors of heat and electricity except graphite. 5. Low melting and boiling point except diamond and graphite. 6. Low density. 7. They have mostly 5, 6, 7 valence electrons.	1. They react with oxygen to form acidic oxides or neutral oxides. Non-metals + Oxygen → Non-metal oxide $C + O_2 \rightarrow CO_2$ (Acidic oxide) $2H_2 + O_2 \rightarrow 2H_2O$ (Neutral oxide) 2. They gain electrons to form negative ions. 3. They are good oxidising agents. 4. Their oxides dissolve in water forming acids. Non-metallic oxide + Water → Acids $CO_2 + H_2O \rightarrow H_2CO_3$ (Carbonic acid) $SO_2 + H_2O \rightarrow H_2SO_3$ (Sulphurous acid) 5. They do not react with dilute acids because they cannot lose electrons. 6. More reactive non-metals can displace less reactive non-metals from their salt solution

HOW DO METALS AND NON-METALS REACT? Reactivity of elements is the tendency to attain a filled valence shell. Atoms of the metals lose electrons from their valence shell to form Cations. Atoms of non-metals gain electrons in the valence shell to form an **Anion**.

PROPERTIES OF IONIC COMPOUNDS

Physical nature: They are solid substances having strong attractive force between the positively and negatively charged ions.
Melting and Boiling Point: They exhibit high melting and boiling points due to the presence of strong inter-ionic attractions. Generally soluble in water but insoluble in solvents like kerosene or petrol.
Conduction of electricity: When an ionic compound is dissolved in water, the resulting solution contains ions due to which they conduct electricity.Solid ionic compounds do not conduct electricity because the ions are unable to move due to their fixed arrangement. When ionic compounds are in the molten state, they can conduct electricity because the heat overcomes the electrostatic forces holding the oppositely charged ions together.
Formation of ionic compounds



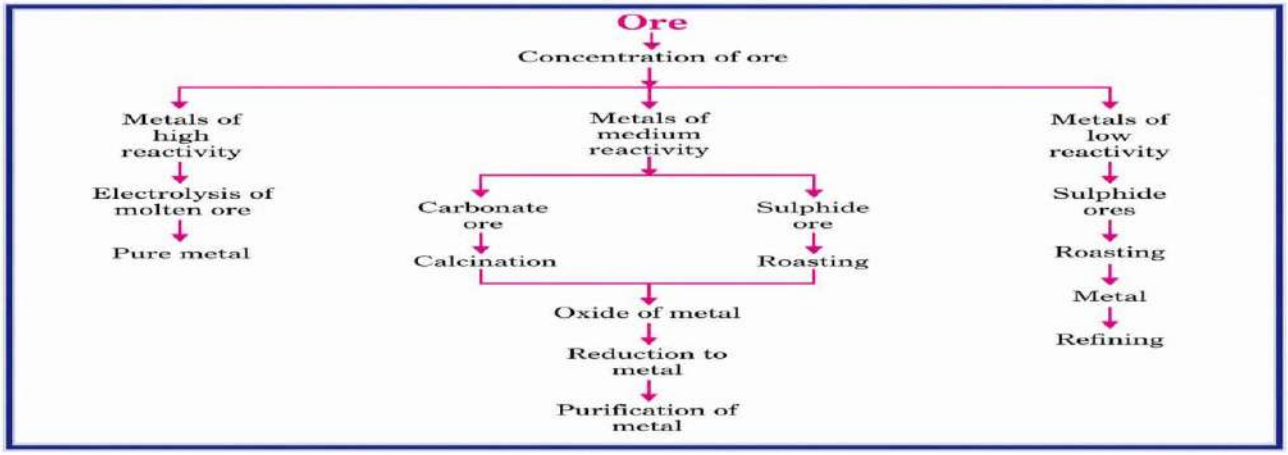


METALURGY

OCCURRENCE OF METALS

The elements or compounds which occur naturally in the earth's crust are called **minerals**. Minerals that contain a very high percentage of particular metal and the metal can be profitably extracted from it, such minerals are called **ores**.

Extraction of metals – (Basic processes involved)



EXTRACTION OF METALS FROM THEIR ORES

Step 1. Concentration of ore/Enrichment of ores.-

Concentration of ore / Enrichment of Ore It refers to the process of removing impurities, such as soil, sand, stone etc. called gangue from mined ores. The processes used are based on the differences between the physical or chemical properties of the gangue and the ore

Step 2. Conversion of concentrated ore into metal.

(i) Extraction of Highly Reactive Metals The highly reactive metals K, Na , Ca and Mg are extracted by the electrolysis of their molten chlorides. The pure metal is produced at the cathode and Cl2 gas is formed at the anode.

Electrolysis

$2NaCl\ (l) \text{ —----------> } 2Na(s) + Cl2(g)$

(Molten)

At Cathode : $Al^{3+} + 3e^- \text{ —----------> } Al$

Aluminium ions Electrons Aluminium atom

(From molten Al_2O_3) (From cathode) (Aluminium metal)

At Anode : $2O^{2-} - 4e^- \text{ —----------> } O2$

Chloride ions Electrons Oxygen gas

(From molten Al_2O_3) (Given to anode).

(ii) Extraction of Moderately Reactive Metals

The moderately reactive metals, Fe, Zn, Pb are commonly found in nature as sulphides or carbonates. Obtaining these metals from their oxides is easier compared to extracting them from sulphides and carbonates.

Roasting and **Calcination are used to obtain metal oxide.**

Reduction of metal oxide with carbon

ZnO (s) + C (s) —----------> Zn(s) + CO (g)

Reduction of metal oxide with Aluminium

3MnO2 (s) + 4Al (s) —--------> 3Mn (l) + 2Al2O3 (s) + Heat

Thermite Reaction

The reduction of a metal oxide to form metal by using Al as a reducing agent is called **Thermite reaction (or Thermite process).**

It is highly exothermic, so the metal is produced in the molten state.

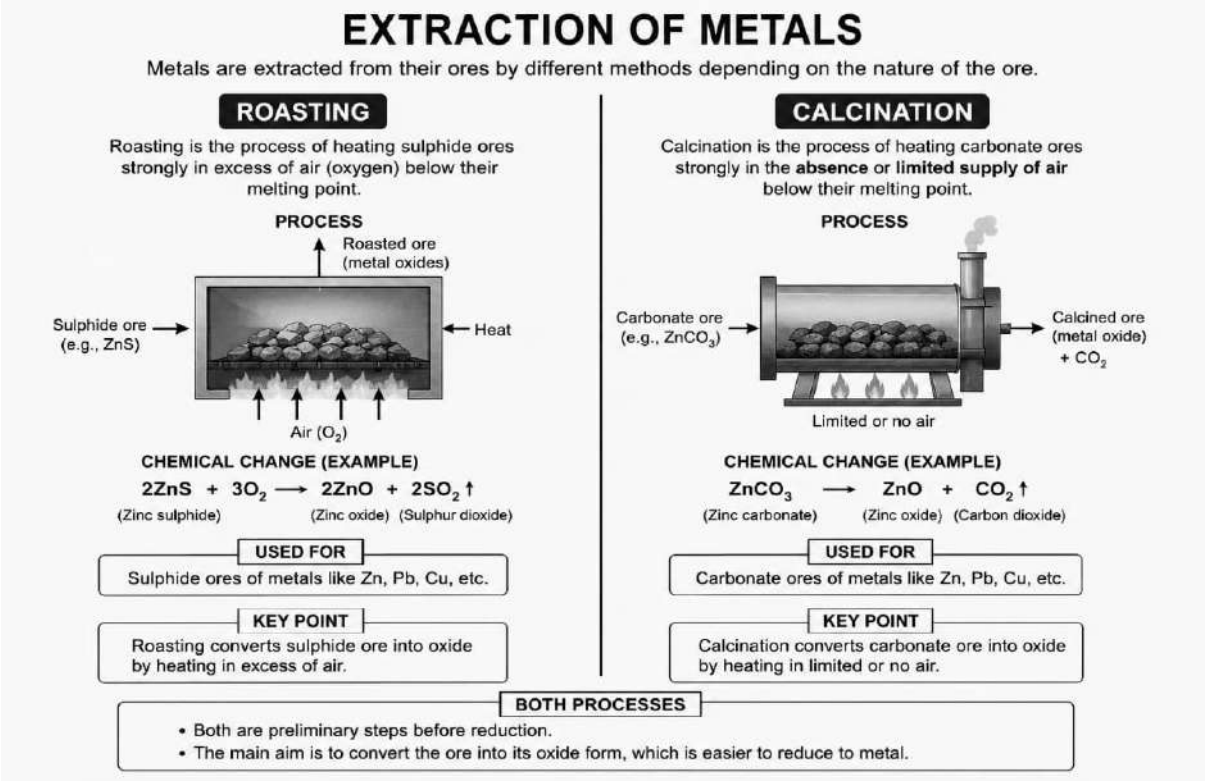
$Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe(l) + Al_2O_3(s) + Heat$

(iii) Extraction of Less Reactive Metals

Extraction of Mercury

$2HgS(Cinnabar)+3O_2(g)+heat \rightarrow 2HgO +2SO_2(g)$

[Roasting] $2HgO(s)+heat \rightarrow 2Hg(l)+O_2(g)$



Step 3. Refining (Purification) of impure metals

The process of purifying impure metals is called refining of metals.

On passing the current through the electrolyte, the impure metal from the anode dissolves into the electrolyte. An equivalent amount of pure metal from the electrolyte is deposited at the cathode. The insoluble impurities settle down at the bottom of the anode and are called anode mud.

(i) Anode: Impure copper (ii) Cathode: Strip of pure copper

(iii) Electrolyte: Solution of acidified copper Sulphate

Review questions section 2

1. The metals obtained from their molten chlorides by the process of electrolytic reduction are:

(a) Gold and silver (b) Calcium and magnesium

(c) Aluminium and silver (d) Sodium and iron

2 .The most common method of extraction of metals from their oxide ores is:

(a) Reduction with carbon (b) Reduction with hydrogen

(c) Reduction with aluminium (d) Electrolytic reduction

CORROSION

The surface of some metals gets corroded when they are exposed to moist air for a long period. This is called corrosion.

Prevention of Corrosion

The rusting of iron can be prevented by painting, oiling, greasing, galvanizing, chrome plating, anodizing or making alloys.

Galvanization: It is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc.

Alloying: Alloying is done by mixing a metal with other substances, so as to achieve the desired characteristics The electrical conductivity and melting point of an alloy is less than that of pure metals.

Name of Alloy	Composition	Use
Amalgam	Mercury and other metal	Fillings in teeth
Brass	Copper and Zinc	Electrical fittings
Bronze	Copper and Tin	Statues and medals
Solder	Tin and Lead	Welding electrical wires
Stainless steel	Iron ,Nickel and Chromium	Cooking utensils

Answer key review questions

Section 1

1. (b) Al_2O_3 and MgO 2. (a) (i) (ii) and (iv)

3 (a) displacement reaction (b) electrolysis

4 (a) sodium, potassium (b) evolution of heat and hydrogen gas formation (c) Hydrogen gas – burns with pop sound

Section 2

1. (b) Calcium and magnesium 2. (a) Reduction with carbon

Chapter 3 Metals And Non Metals Flow Chart

CHAPTER 3 : METALS AND NON-METALS

METALS AND NON-METALS

1. METALS – General Properties

- Usually hard (except Na, K which are soft)
- Malleable (can be beaten into sheets)
- Ductile (can be drawn into wires)
- Good conductors of heat and electricity
- Sonorous (produce sound on striking)
- Lustrous (shiny surface)
- High melting and boiling points (except Na, K, Hg)
- Mostly solids at room temperature (except Hg – liquid)

Examples : Iron, Copper, Aluminium, Zinc, Sodium, Magnesium etc.

2. NON-METALS – General Properties

- Generally soft (except diamond, graphite)
- Brittle (cannot be beaten into sheets)
- Non-ductile (cannot be drawn into wires)
- Poor conductors of heat and electricity (except graphite)
- Non-sonorous
- Non-lustrous (dull)
- Low melting and boiling points (many are gases at room temperature)
- Can exist as solids, liquids or gases

Examples : Carbon, Sulphur, Phosphorus, Chlorine, Oxygen etc.

3. OCCURRENCE

- Metals occur in the earth's crust either in free state or in combined state.
- Most metals are found in combined state as their oxides, sulphides, carbonates, bicarbonates, silicates etc.
- Some metals like Au, Ag, Pt are found in free state.
- Non-metals occur in free state.

Examples :
Iron – in haematite (Fe_2O_3), magnetite (Fe_3O_4)
Aluminium – in bauxite ($Al_2O_3.2H_2O$)
Copper – in copper pyrites ($CuFeS_2$)
Gold, Silver – in free state

4. PHYSICAL PROPERTIES – COMPARISON

Property	Metals	Non-metals
State (room temp.)	Mostly solids (Hg – liquid)	Solids / Liquids / Gases
Lustre	Lustrous (shiny)	Non-lustrous (dull)
Hardness	Generally hard (exceptions exist)	Generally soft (exceptions exist)
Malleability	Malleable	Non-malleable
Ductility	Ductile	Non-ductile
Conductivity	Good conductors	Poor conductors (except graphite)
Sonority	Sonorous	Non-sonorous
Melting & Boiling Points	Generally high	Generally low

5. DIFFERENCE BETWEEN METALS AND NON-METALS (CHEMICAL PROPERTIES)

Property	Metals	Non-metals
Action with O_2	Form basic oxides	Form acidic or neutral oxides
Action with water	Many react with water to give metal hydroxide and H_2	Do not react with water (except some e.g. Cl_2 forms HCl)
Action with acids	React to give salt and H_2	Do not react with dilute acids (generally)
Action with bases	Do not react with bases	Many react with bases (e.g. non-metal oxides react with bases)

6. REACTIVITY SERIES OF METALS

K Na Ca Mg Al Zn Fe Sn Pb (H) Cu Hg Ag Pt Au

Reactivity decreases →

How to use?

- A more reactive metal displaces a less reactive metal from its salt solution.
- A metal above hydrogen displaces hydrogen from dilute acids.

Examples :

- $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
- $Fe + 2HCl \rightarrow FeCl_2 + H_2 \uparrow$
- $Cu + HCl \rightarrow$ No reaction

7. CORROSION

Slow destruction of metals by reaction with substances in the environment (air, moisture, acids etc.)

Examples :

- Rusting of iron
- Tarnishing of silver
- Green coating on copper

Prevention of corrosion :

- Painting, Oiling, Greasing
- Galvanization (coating of zinc on iron)
- Alloying (e.g. Stainless steel)
- Electroplating (e.g. Tin plating, Chromium plating)

8. EXTRACTION OF METALS

(a) For Metals High in Reactivity (K, Na, Ca, Mg, Al etc.)

- Extracted by Electrolysis of molten compounds.

Example : Extraction of Aluminium

$2Al_2O_3$ (molten) $\xrightarrow{\text{electrolysis}}$ $4Al + 3O_2 \uparrow$

(b) For Metals of Medium Reactivity (Zn, Fe, Sn, Pb, Cu etc.)

- Extracted by Reduction of their oxides with carbon or carbon monoxide or by displacement method.

Examples :

$Fe_2O_3 + 3CO \xrightarrow{\Delta} 2Fe + 3CO_2$

$ZnO + C \xrightarrow{\Delta} Zn + CO$

$CuO + C \xrightarrow{\Delta} Cu + CO_2$

(c) For Metals Low in Reactivity (Cu, Ag, Hg, Au, Pt etc.)

- Found in native state and obtained by physical methods like crushing, grinding and concentration.

Example : Gold, Silver, Platinum

9. ALLOYS

- Alloys are homogeneous mixtures of two or more metals, or a metal and a non-metal.
- Properties of alloys are usually better than pure metals.

Examples :

- Brass – Cu + Zn (used in utensils, taps)
- Bronze – Cu + Sn (used in statues, medals)
- Solder – Pb + Sn (used to join wires)
- Stainless steel – Fe + Cr + Ni (used in cutlery, surgical instruments)

10. USES OF SOME IMPORTANT METALS

Metal	Uses
Iron	Construction of buildings, bridges, vehicles, machines, tools etc.
Aluminium	Aircrafts, electrical wires, utensils, foil, window frames etc.
Copper	Electrical wires, motors, coins, utensils, water pipes etc.
Zinc	Galvanization of iron, making alloys (brass), dry cells etc.
Silver	Jewellery, coins, electrical contacts, mirrors etc.
Gold	Jewellery, coins, electronic components, corrosion resistant coating etc.
Mercury	Thermometers, barometers, fluorescent lamps, batteries etc.

11. USES OF SOME IMPORTANT NON-METALS

Non-metal	Uses
Carbon	As fuel (coal, coke), in pencils (graphite), diamond in jewellery, cutting tools etc.
Sulphur	Manufacture of sulphuric acid, vulcanization of rubber, fungicides etc.
Oxygen	For respiration, welding, cutting of metals in industries, medical use etc.
Nitrogen	Manufacture of ammonia, fertilizers, preservation of food etc.
Chlorine	For disinfecting drinking water, manufacture of bleaching powder, PVC etc.
Phosphorus	In matches, fertilizers, fireworks etc.

12. HYDROGEN – A SPECIAL NON-METAL

- Lightest element.
- Exists as diatomic gas (H_2).
- Colourless, odourless, tasteless.
- Combustible – burns with 'pop' sound.
- Reducing agent.

Preparation :

- By reaction of Zn with dilute HCl or H_2SO_4.
  $Zn + 2HCl \rightarrow ZnCl_2 + H_2 \uparrow$

Uses :

- In hydrogenation of vegetable oils.
- In manufacture of ammonia.
- As a fuel (in rockets).
- In welding (oxy-hydrogen flame).
- In fuel cells.

KEY POINT

Metals are generally hard, lustrous, malleable, ductile and good conductors.
Non-metals are generally soft, dull, brittle and poor conductors.
Reactivity of metals decides their extraction method and their ability to displace other metals or hydrogen.

Chapter 4 Carbon And Its Compounds

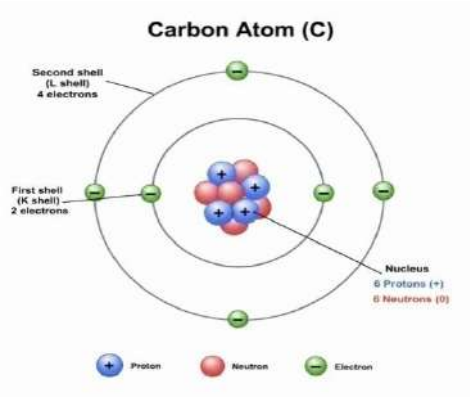
Theme: Materials

Unit I: Chemical Substances - Nature and Behaviour

Carbon and its Compounds: Covalent bonds – formation and properties of covalent compounds, Versatile nature of carbon, Hydrocarbons – saturated and unsaturated Homologous series. Nomenclature of alkanes, alkenes, alkyne and carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes). Chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction). Ethanol and Ethanoic acid (only properties and uses), soaps and detergents.

ATOMIC NO. OF CARBON = 6

ELECTRONIC CONFIGURATION= 2,4



*One carbon atom requires 4 e to attain noble gas configuration, the valency of C is 4.

(i) It could not gain 4e to form C^{4-} anion because the nucleus with 6 Protons will not be able to hold $10e^-$.(4 extra e^-)

(ii) It could not lose 4 e to form C cation because a large amount of energy is required to remove $4e^-$.

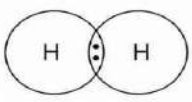
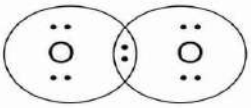
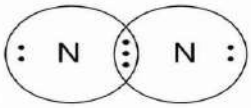
*The property of self combination of Carbon atoms to form long chains is called **CATENATION.**

*The valency of carbon is 4 , so it is called **TETRAVALENT.**

*Due to tetravalency carbon can form four strong covalent bonds and results in the formation of a large number of compounds.

A **covalent bond** is formed when two atoms **share electrons** with each other to complete their outermost shell and attain a stable electronic configuration. This type of bonding usually occurs between **non-metals**. Atoms share electrons because they cannot easily lose or gain electrons. By sharing, each atom gets the required number of electrons in its outer shell.

COVALENT BONDS IN HYDROGEN, OXYGEN AND NITROGEN

	1. HYDROGEN (H_2) (Covalent Bond)	2. OXYGEN (O_2) (Covalent Bond)	3. NITROGEN (N_2) (Covalent Bond)
Electron Dot Structure (Lewis Structure)	H : H One shared pair of electrons	:Ö::Ö: Two shared pairs of electrons	:N≡N: Three shared pairs of electrons
Structural Formula	H—H (Single Covalent Bond)	O=O (Double Covalent Bond)	N≡N (Triple Covalent Bond)
Formation	Each hydrogen atom has 1 valence electron. They share one pair of electrons to achieve a stable duplet (2 electrons in K shell).	Each oxygen atom has 6 valence electrons. They share two pairs of electrons to achieve a stable octet (8 electrons in L shell).	Each nitrogen atom has 5 valence electrons. They share three pairs of electrons to achieve a stable octet (8 electrons in L shell).
Electron Shell Diagram			

IUPAC NOMENCLATURE

IUPAC (International Union of Pure and Applied Chemistry) Nomenclature is the systematic method of naming organic compounds.

1. ALKANES (Saturated Hydrocarbons)

General formula: C_nH_{2n+2}

No. of Carbon atoms	Name	Prefix	Example
1	Methane	Meth–	CH_4
2	Ethane	Eth–	C_2H_6
3	Propane	Prop–	C_3H_8
4	Butane	But–	C_4H_{10}
5	Pentane	Pent–	C_5H_{12}
6	Hexane	Hex–	C_6H_{14}
7	Heptane	Hept–	C_7H_{16}
8	Octane	Oct–	C_8H_{18}
9	Nonane	Non–	C_9H_{20}
10	Decane	Dec–	$C_{10}H_{22}$

Rules for naming alkanes

- Choose the longest continuous chain of carbon atoms.
- Name the chain using the prefix (number of carbons) + –ane.
- Number the chain from the end nearest to the substituent (if any).
- Write the name of substituent(s) in alphabetical order.
- Use numbers to show the position of substituents.

Examples:

(i) $CH_3–CH_2–CH_3$
Propane

(ii) $CH_3–CH(CH_3)–CH_3$
2-Methylpropane

2. ALKENES (Unsaturated Hydrocarbons)

General formula: C_nH_{2n}

Rules for naming alkenes

- Choose the longest chain containing the double bond.
- Replace the ending –ane of the corresponding alkane with –ene.
- Number the chain from the end nearer to the double bond.
- Mention the position of double bond.
- Name and number substituents as in alkanes.

Examples:

(i) $CH_2=CH_2$
Ethene

(ii) $CH_3–CH=CH–CH_3$
But-2-ene

3. ALKYNES (Unsaturated Hydrocarbons)

General formula: C_nH_{2n+2}

Rules for naming alkynes

- Choose the longest chain containing the triple bond.
- Replace the ending –ane of the corresponding alkane with –yne.
- Number the chain from the end nearer to the triple bond.
- Mention the position of triple bond.
- Name and number substituents as in alkanes.

Examples:

(i) $HC\equiv CH$
Ethyne

(ii) $CH_3–C\equiv C–CH_3$
But-2-yne

4. HALOALKANES (Alkyl Halides)

General formula: R–X (X = F, Cl, Br, I)

Rules for naming haloalkanes

- Choose the longest chain.
- Name the chain as alkane.
- Number the chain from the end nearer to the halogen.
- Name the halogen as fluoro-, chloro-, bromo-, iodo- as a prefix.

Examples:

(i) $CH_3–CH_2–Cl$
Chloroethane

(ii) $CH_3–CH(Br)–CH_3$
2-Bromopropane

5. ALCOHOLS

General formula: R–OH

Rules for naming alcohols

- Choose the longest chain containing –OH group.
- Replace the ending –ane with –anol.
- Number the chain from the end nearer to –OH group.
- Mention the position of –OH group.
- Name and number substituents as in alkanes.

Examples:

(i) $CH_3–CH_2–OH$
Ethanol

(ii) $CH_3–CH(OH)–CH_3$
Propan-2-ol

6. CARBOXYLIC ACIDS

General formula: R–COOH

Rules for naming carboxylic acids

- Choose the longest chain containing –COOH group.
- Replace the ending –ane with –anoic acid.
- Number the chain starting from the carbon of –COOH group as C-1.
- Name and number substituents as in alkanes.

Examples:

(i) $CH_3–COOH$
Ethanoic acid

(ii) $CH_3–CH_2–COOH$
Propanoic acid

7. ALDEHYDES

General formula: R–CHO

Rules for naming aldehydes

- Choose the longest chain containing –CHO group.
- Replace the ending –ane with –anal.
- Number the chain starting from the carbon of –CHO group as C-1.
- Name and number substituents as in alkanes.

Examples:

(i) $CH_3–CHO$
Ethanal

(ii) $CH_3–CH_2–CHO$
Propanal

8. KETONES

General formula: R–CO–R'

Rules for naming ketones

- Choose the longest chain containing >C=O group.
- Replace the ending –ane with –anone.
- Number the chain to give the carbonyl carbon (C=O) the lowest possible number.
- Mention the position of carbonyl group.
- Name and number substituents as in alkanes.

Examples:

(i) $CH_3–CO–CH_3$
Propanone (Acetone)

(ii) $CH_3–CO–CH_2–CH_3$
Butan-2-one

IMPORTANT POINTS

- Functional group has priority in naming.
- If two functional groups are present, the group with higher priority is named as the suffix and the other as prefix.
- Common order of priority:
  –COOH > –CHO > >C=O (ketone) > –OH > –X (halogen) > C=C > C≡C
- Use commas (,) to separate numbers and hyphens (-) between numbers and letters.
  Example: 2,3-Dimethylbutane
- Write substituents in alphabetical order (di-, tri-, tetra- are not considered for alphabetizing).

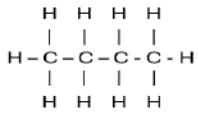
COMMON PREFIXES AND SUFFIXES

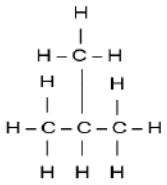
Number of carbons	1	2	3	4	5	6	7	9	10
Prefix	Meth-	Eth-	Prop-	But-	Pent-	Hex-	Hept-	Non-	Dec-
Suffix (Alkane)	-ane	-ane	-ane	-ane	-ane	-ane	-ane	-ane	-ane

Other Suffixes	Meaning
-ene	Alkene (double bond)
-yne	Alkyne (triple bond)
-anol	Alcohol
-anoic acid	Carboxylic acid
-anal	Aldehyde
-anone	Ketone

Isomerism

Isomerism is the phenomenon in which two or more compounds have the same molecular formula but different structural arrangements of atoms. Such compounds are called isomers. Because their structures are different, their properties may also differ.
Example Butane (C_4H_{10}) has two isomers:

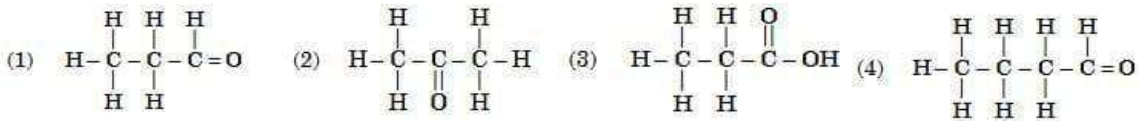




Review questions section 1

1. Which of the following hydrocarbons belongs to a **different chemical family** (homologous series) than the others?" (a) C_4H_{10} (b) C_6H_{14} (c) C_7H_{14} (d) $C_{10}H_{22}$

2. Select from the following the members of same homologous series:



Difference Between Saturated and Unsaturated Hydrocarbons

Feature	Saturated Hydrocarbons	Unsaturated Hydrocarbons
Bond Type	Contain only single bonds between carbon atoms.	Contain at least one double or triple bond.
Reactivity	Generally less reactive (stable).	Highly reactive.
Burning/Flame	Burn with a clean, blue flame (complete combustion).	Burn with a yellow, sooty flame (incomplete combustion).
Hydrogen Count	Contain the maximum possible number of hydrogen atoms.	Contain fewer hydrogen atoms than the saturated version.
Family Name	Known as Alkanes.	Known as Alkenes (double) or Alkynes (triple).

TYPES OF CHEMICAL REACTIONS OF CARBON COMPOUNDS

1. Combustion (or Burning) - The process of burning a carbon compound in air to give carbon dioxide, water, heat and light, is known as combustion.

CH4 + 2O2 —----------> CO2 + 2H2O + Heat + Light

2. Oxidation - Oxidation 'means 'controlled combustion'.

Alkaline $KMnO_4$ / Acidified $K_2Cr_2O_7$ + Heat

CH_3-CH_2OH —----------> CH_3COOH

3. Substitution - The reaction in which one (or more) hydrogen atoms of a saturated hydrocarbon are replaced by some other. atoms (like chlorine), is called a substitution

reaction.

Sunlight

$CH_4 + Cl_2$—----------> $CH_3Cl + HCl$

4. Addition - Addition reactions are given by all unsaturated hydrocarbons containing a double bond or a triple bond(alkenes and alkynes). The addition of hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation. It takes place in the presence of nickel or palladium metals as a catalyst and is used to prepare vegetable ghee (or vanaspati ghee) from vegetable oils.

Ni

>C=C< + H_2 —----------> $CH_3 - CH_3$

Comparison of Ethanol and Ethanoic Acid

Property / Reaction	Ethanol C_2H_5OH	Ethanoic Acid CH_3COOH
Nature	**Neutral**	**Acidic**
Litmus Test	No change in color	Turns **Blue litmus Red**
Reaction with Sodium (Na)	Slow reaction; releases H_2 gas	Rapid reaction; releases H_2 gas
Reaction with $NaHCO_3$	**No reaction**	Reacts to release CO_2 (effervescence)
Esterification	Acts as the **alcohol** component	Acts as the **acid** component
Oxidation	Easily oxidized to **Ethanoic Acid**	Highly **resistant** to further oxidation
Combustion	Burns with a **clean blue flame**	Burns with a **sooty/smoky flame**
Smell	Distinct **alcoholic** smell	Pungent, **vinegar-like** smell

COMPARATIVE CHEMICAL REACTIONS OF ETHANOL & ETHANOIC ACID

	PROPERTY / REACTION	ETHANOL (C_2H_5OH)	ETHANOIC ACID (CH_3COOH)	PRODUCTS & OBSERVATIONS
1	Reaction with Sodium (Na)	$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2\uparrow$ Product: Sodium ethoxide	$2CH_3COOH + 2Na \rightarrow 2CH_3COONa + H_2\uparrow$ Product: Sodium ethanoate	Product: Sodium ethanoate
2	Reaction with Sodium Bicarbonate ($NaHCO_3$)	No Reaction	Brisk Effervescence $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2\uparrow$	Observation: Brisk effervescence
3	Esterification	$CH_3COOH + C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$		Product: Ethyl ethanoate (a sweet-smelling ester)
4	Oxidation	$CH_3CH_2OH \xrightarrow[+\text{ Heat}]{\text{Alkaline } KMnO_4} CH_3COOH$ Ethanol is oxidized to Ethanoic Acid	Does not undergo further oxidation easily under these conditions	
5	Combustion	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ + Heat/Light	COMBUSTIO $CH_3COOH + 2O_2 \rightarrow 2CO_2 + 2H_2O$ + Heat/Light	

Review questions section 2

1 .A saturated organic compound 'A' with two carbon atoms belongs to the homologous series of alcohols. On oxidation, it forms an organic acid 'B' with molecular mass 60 u. On heating 'A' with excess concentrated sulphuric acid at 443 K, an unsaturated hydrocarbon 'C' is formed.

(i) Name A, B, and C. (ii) Calculate molecular mass of C.

(iii) What happens when a pinch of sodium carbonate is added to compound B? Write a chemical equation for the reaction.

(iv) Draw electron dot structure of compound B.

2 .(i) A compound 'X' having two carbon atoms in its molecule turns blue litmus red, and a 5-8% solution of 'X' in water is widely used as a preservative. Identify the compound 'X' and write its structure.

(ii) Compare its pH nature with a mineral acid.

(iii) 'X' on reacting with alcohols produces sweet smelling compounds, used in making perfumes. Name the reaction and write its chemical equation.

(iv) When sodium carbonate is added to 'X', a colourless gas is produced which turns lime water milky. Write the chemical equation for the reaction giving the name of the salt produced.

* **Denatured alcohol** is ethanol that has been made undrinkable by adding poisonous substances, such as: Methanol, Pyridine, Copper sulphate. Denaturing alcohol serves several purposes: It prevents misuse for drinking. It allows ethanol to be used in industrial applications with lower excise duty.

(**Vinegar** contains 5 to 8 percent Ethanoic acid)

The reaction of a carboxylic acid with an alcohol to form an ester is called **esterification**.

$CH_3COOH + C_2H_5OH$ ----------→ $CH_3COOC_2H_5$

The alkaline hydrolysis of esters (using alkali like sodium hydroxide)

$CH_3COOC_2H_5 + NaOH + \Delta$ —---------> $CH_3COONa + C_2H_5OH$

Ethyl ethanoate Sodium hydroxide. Sodium ethanoate Ethanol

The alkaline hydrolysis of esters of higher fatty acids (fats and oils) is known as **saponification** (soap making).

R-COO-R + NaOH + Δ —---------> R-COONa(soap) + R-OH

SOAPS AND DETERGENTS

A soap is the sodium salt (or potassium salt) of a long chain carboxylic acid (fatty acid) which has cleansing properties in water.

A soap has a large non-ionic hydrocarbon group and an ionic group, COO^-Na^+.

Examples (i) Sodium Stearate, $C_{17}H_{35}COO^-Na^+$ (ii) Sodium Palmitate, $C_{15}H_{31}COO^-Na^+$

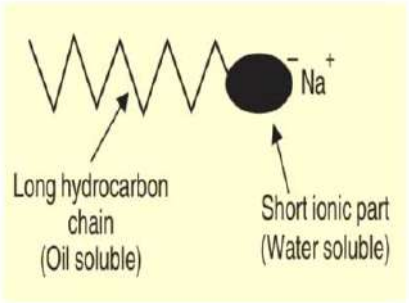
Soap is made by heating animal fat or vegetable oil with concentrated sodium hydroxide solution (caustic soda solution).

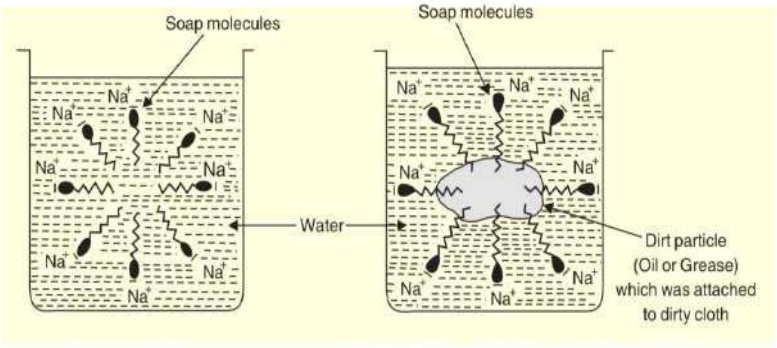
Fat or Oil + Sodium hydroxide —----------> Soap + Glycerol

(An ester) (An alkali) (Sodium salt of fatty acid) (An alcohol)

CLEANSING ACTION OF SOAP

When a dirty cloth is put in water containing dissolved soap, then the hydrocarbon ends of the soap molecules in the micelle attach to the oil or grease particles present on the surface of the dirty cloth. The ionic ends of the soap molecules in the micelles attached to water. When the dirty cloth is agitated in soap solution, the oily and greasy particles present on its surface and entrapped by soap micelles get dispersed in water due to which the soap water becomes dirty but the cloth gets cleaned.

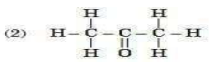
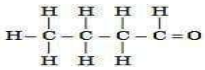




(a) Soap micelle (b) Soap micelle entraps the dirt particle

The magnesium and calcium salt present in hard water reacts with soap molecules to form an insoluble product called scum. This scum creates difficulty in a cleansing action. By use of detergent, insoluble scum is not formed with hard water and clothes get cleaned effectively.

Answer key review questions

Section 1 1. (c) C_7H_{14} 2. (2)  (4) 

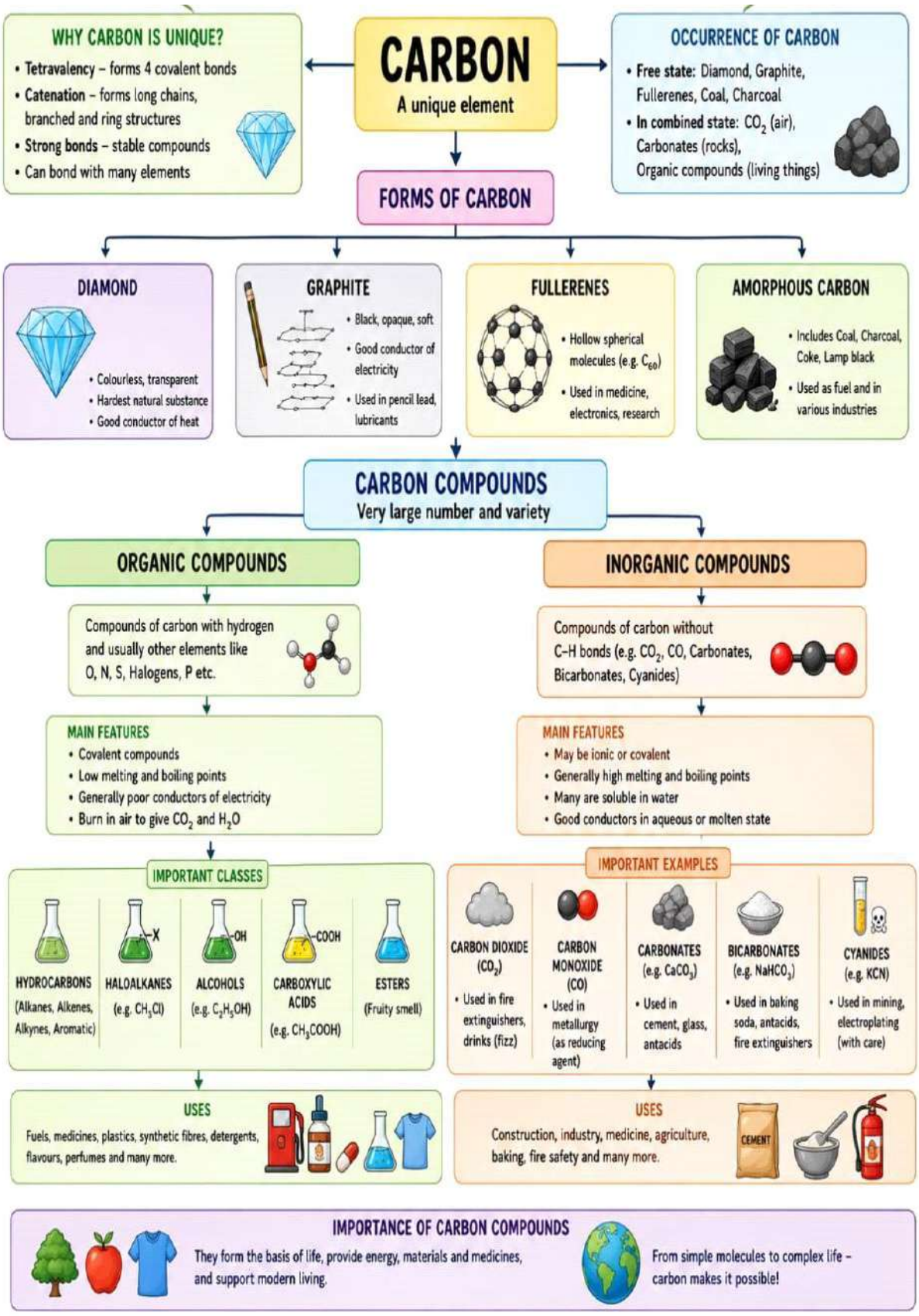
Section 2

1. Organic Compounds A, B, and C

(i) Names:A: Ethanol B: Ethanoic Acid C: Ethene C_2H_4 — Formed by dehydration of ethanol.(ii) Molecular Mass of C (Ethene): C_2H_4 = 28 u (iii) Reaction with Sodium Carbonate: When sodium carbonate is added to Ethanoic acid, brisk effervescence occurs due to the evolution of Carbon dioxide gas. (iv) Electron Dot Structure of B (Ethanoic Acid):
The structure shows Carbon sharing electrons with Hydrogen, another Carbon, and Oxygen atoms.Carbon 1 is bonded to three Hydrogens. Carbon 2 is double-bonded to one Oxygen and single-bonded to an —OH group.

2. Compound 'X' (Ethanoic Acid) (i) Ethanoic Acid (Acetic Acid). A 5-8% solution is called Vinegar.Structure: (ii) pH Comparison:Ethanoic acid is a weak acid (partially ionizes).A mineral acid (like HCl is a strong acid (completely ionizes).Result: Ethanoic acid has a higher pH value than a mineral acid of the same concentration.(iii) Reaction with Alcohol (Esterification): $CH_3COOH + C_2H_5OH \dashrightarrow CH_3COOC_2H_5$ Product: Ethyl ethanoate (the sweet-smelling ester).(iv) Reaction with Sodium Carbonate: $CH_3COOH + Na_2CO_3 \dashrightarrow CH_3COONa + CO_2 + H_2O$, The colourless gas is CO_2 Salt Produced: Sodium Ethanoate (Sodium Acetate).

Chapter 4 Carbon And Its Compounds Flow Chart



Chapter 5: Life Processes

Theme: The World of the Living
Unit II: World of Living
'Living Being'. Basic concept of nutrition, respiration, transport and excretion in plants and animals.

1. The Core of Living: Why Life Needs Constant Maintenance

Every living organism, whether it is a tiny bacterium, a large tree, or a human being, constantly performs maintenance functions to preserve its organized structure and stay alive.

Key Maintenance Processes:

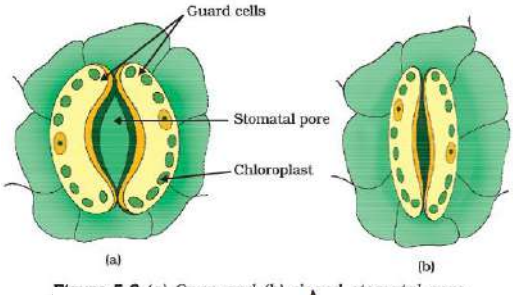
- **Nutrition –** Obtaining food as a source of energy and raw materials
- **Respiration –** Breaking down food to release usable energy
- **Transportation –** Distributing nutrients, gases, and wastes throughout the body
- **Excretion –** Removing harmful waste substances

Its Importance:

These processes work together to maintain homeostasis (internal balance), repair tissues, support growth, and keep organs functioning properly.

Example:

Even while sleeping, your heart pumps blood, lungs exchange gases, cells repair damage, and kidneys filter waste.



2. Nutrition: The Biological Fuel System

Nutrition is the process through which organisms obtain food and utilize it to produce energy, build tissues, repair damage, and regulate body functions. Without nutrition, no organism can survive because food supplies both energy and raw materials.

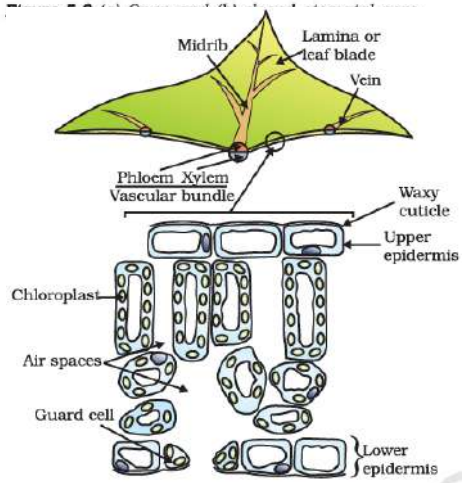


Figure 5.1
Cross-section of a leaf

Types of Nutrition:

A. Autotrophic Nutrition (Self-feeding)

Autotrophs prepare their own food from simple inorganic substances like carbon dioxide and water.

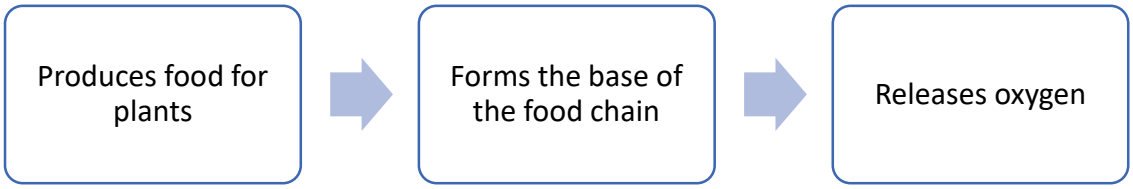
Green plants use sunlight trapped by chlorophyll to synthesize glucose.

Requirements(raw materials): Sunlight , Chlorophyll, Carbon dioxide , Water

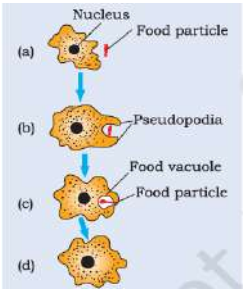
Chemical equation: Carbon Dioxide + Water → Glucose + Oxygen

$$6\,CO_2 + 12\,H_2O \xrightarrow{Chlorophyll\ \&\ Sunlight} C_6H_{12}O_6 + 6O_2 + 6\,H_2O$$

Significance:

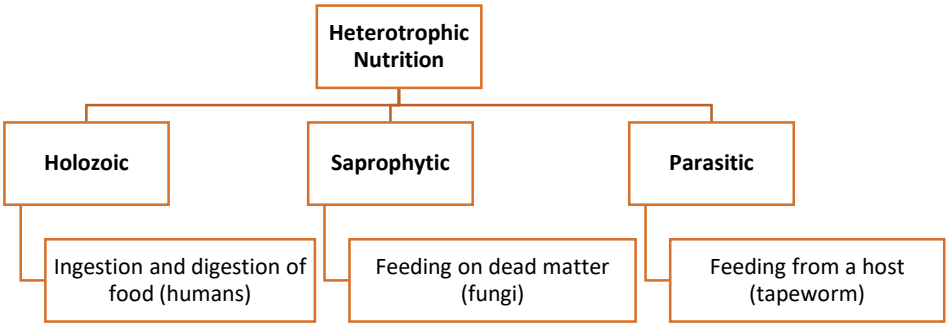


Example: Green plants, algae



B. Heterotrophic Nutrition (Dependent feeding)

Heterotrophs cannot make their own food and depend on other organisms.



Review questions- Section 1

1.Desert plants take up carbon dioxide at night and prepare an intermediate compound. Which of the following statements explains why they do not complete photosynthesis during the daytime?

2.A student passes exhaled air through a test tube filled with freshly prepared lime water. The lime water turns milky very quickly. This rapid transformation is proof of which respiratory byproduct?

Human Digestive System: Food Breakdown and Absorption

Humans consume complex food substances like carbohydrates, proteins, and fats, but body cells can only absorb simple molecules. The digestive system converts complex food into absorbable forms through mechanical digestion and chemical digestion.

Important Keyword: Alimentary Canal

A long muscular tube extending from mouth to anus.

Step-by-Step Digestion:

a. Mouth:

- Teeth mechanically break food
- Saliva contains salivary amylase, which converts starch into sugar
- Tongue mixes food and helps swallowing

b. Oesophagus:

- Food moves via peristalsis (wave-like muscular contractions)

c. Stomach:

→Gastric glands secrete:

- **Hydrochloric Acid (HCl) –** Creates acidic medium, kills germs
- **Pepsin –** Digests proteins
- **Mucus –** Protects stomach lining

d.Small Intestine:

The main site of digestion and absorption.

- Bile juice from liver emulsifies fats
- Pancreatic juice digests proteins, carbohydrates, and fats
- Villi increase surface area for absorption

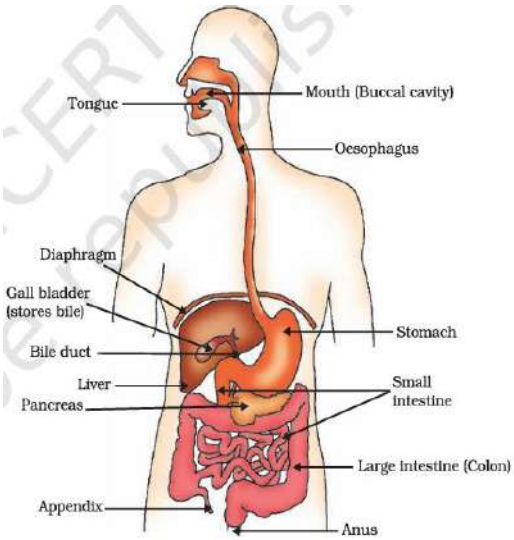


Figure 5.6 Human alimentary canal

Large Intestine:- Absorbs water , Forms feces

Importance:

Digestion ensures that nutrients reach every cell for energy, growth, and repair.

4. Respiration: Energy Release System

Respiration is the biochemical process in which food (especially glucose) is broken down to release energy in the form of ATP (Adenosine Triphosphate), the energy currency of the cell.

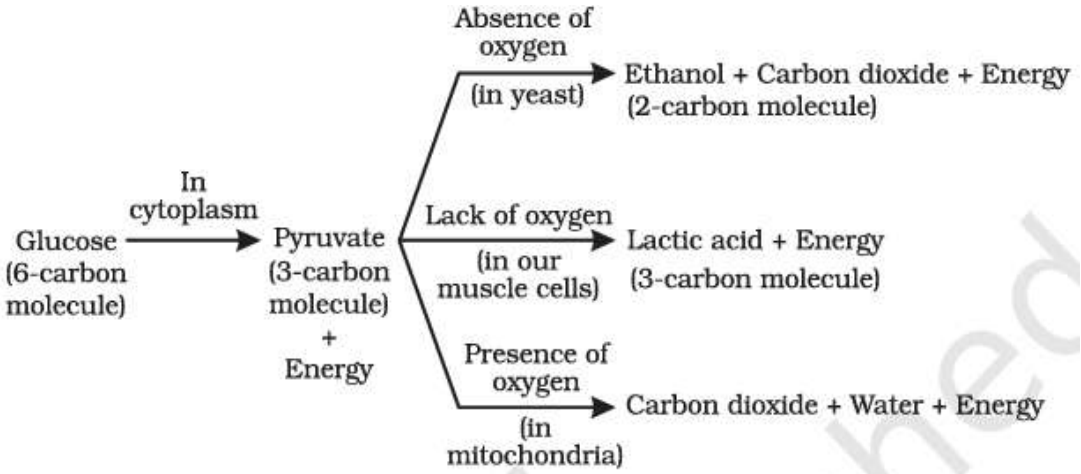


Figure 5.8 *Break-down of glucose by various pathways*

Why is ATP important?

ATP powers muscle movement, nerve impulses, cell repair, growth, and all metabolic functions.

Types of Respiration:

Aerobic Respiration

- Occurs in presence of oxygen
- Produces CO_2 + Water + Large amount of ATP
- Common in humans and most plants/animals
- Takes place mainly in mitochondria
- More efficient

. Anaerobic Respiration

- Occurs without oxygen
- Yeast → Alcohol + CO_2
- Human muscles → Lactic acid during oxygen shortage
- Takes place mainly in cytoplasm
- less efficient

Human Respiratory System:

Pathway:

- Nostrils → Nasal cavity → Trachea → Bronchi → Lungs → Alveoli

Important Keyword: Alveoli

Tiny air sacs with thin walls and rich blood supply that maximize gas exchange.

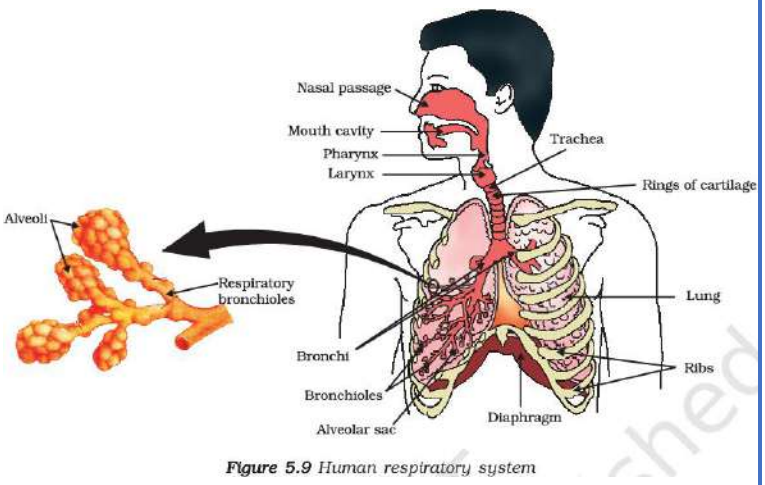


Figure 5.9 Human respiratory system

Gas Exchange:

- Oxygen enters blood
- Carbon dioxide leaves blood

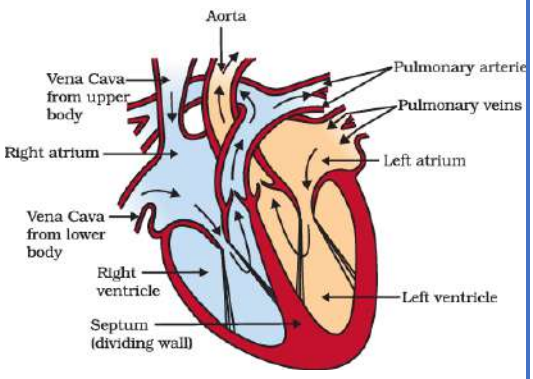
Review Questions: Section 2

1.During vigorous physical exercise, an athlete experiences severe muscle cramps. Name the substance, the accumulation of which causes this condition?

2.A student passes exhaled air through a test tube filled with freshly prepared lime water. The lime water turns milky very quickly. This rapid transformation is proof of which respiratory byproduct?

5. Transportation: The Distribution Network of Life

Transportation is one of the most essential life processes because every living cell requires a continuous supply of nutrients, oxygen, water, and hormones, while wastes must be removed efficiently. In multicellular organisms, cells are located far from the external environment, so simple diffusion is insufficient.



A. Transportation in Human Beings: The Circulatory System

In humans, transportation occurs through the circulatory system, a highly efficient closed network consisting of the heart, blood, and blood vessels.

1. The Heart: The Muscular Pumping Station

The heart is a strong, muscular organ about the size of a fist, located slightly to the left in the chest cavity. Its main function is to pump blood continuously throughout the body.

Structure of the Heart:

The human heart has four chambers:

Right Side:

- **Right Atrium –** Receives deoxygenated blood from the body
- **Right Ventricle –** Pumps deoxygenated blood to the lungs

Left Side:

- **Left Atrium –** Receives oxygenated blood from the lungs
- **Left Ventricle –** Pumps oxygen-rich blood to the entire body

Important Keyword: Double Circulation

In one complete cycle, blood passes through the heart twice:

Pulmonary Circulation:

- Heart → Lungs → Heart(For oxygenation)

Systemic Circulation:

- Heart → Body → Heart(For distribution)

Significance of Double Circulation:

- Prevents mixing of oxygenated and deoxygenated blood
- Ensures efficient oxygen supply
- Supports high energy needs of humans

2. Blood: The Fluid Transport Medium

Blood is a fluid connective tissue that acts as the main transport medium of the body.

Components of Blood:

A. Red Blood Cells (RBCs)→ Function: Carry oxygen from lungs to tissues using haemoglobin

→ **Key Feature:**Haemoglobin binds oxygen efficiently

→ **Importance:**Without enough RBCs or haemoglobin, the body may suffer from anemia and fatigue.

B. White Blood Cells (WBCs)

→ **Function:**Defend the body against infections and pathogens

→ **Importance:**They are the immune soldiers of the body.

C. Platelets→ Function: Help in blood clotting during injury

→ **Importance:**Prevent excessive blood loss.

D. Plasma

→ **Functions:**

Transports:

- Nutrients
- Hormones
- Carbon dioxide
- Waste products
- Salts

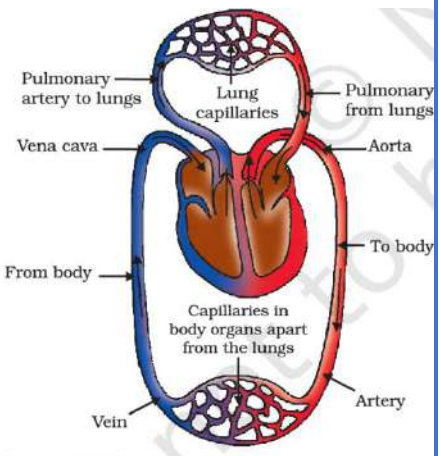


Figure 5.11
Schematic representation of transport and exchange of oxygen and carbon dioxide

3. Blood Vessels: The Transportation Channels

Blood flows through a network of specialized tubes called blood vessels.

A. Arteries

→ **Definition:**Vessels carrying blood away from the heart

→ **Key Features:**

- Thick, elastic walls
- Carry blood under high pressure
- Usually carry oxygenated blood (except pulmonary artery)

B. Veins

→ **Definition:**Vessels carrying blood back to the heart

→ **Key Features:**

- Thin walls
- Valves prevent backflow
- Usually carry deoxygenated blood (except pulmonary vein)

C. Capillaries

→ **Definition:**Microscopic blood vessels connecting arteries and veins

→ **Key Features:**

- One-cell-thick walls
- Exchange oxygen, nutrients, and wastes with tissues

4. Lymph: The Secondary Transport Fluid

Lymph is a colorless fluid formed from plasma that leaks into tissues.

→ **Functions:**

- Returns excess fluid to blood
- Transports absorbed fats from intestine
- Supports immune defense

B. Transportation in Plants: The Vascular System

Plants also require transportation because water absorbed by roots must reach leaves, and food prepared in leaves must reach all plant parts.

Unlike animals, plants use a vascular tissue system made of xylem and phloem.

1. Xylem: Water and Mineral Transport System

→ **Definition:**Xylem is a specialized vascular tissue that transports water and minerals from roots to stems and leaves.

→ **Functions:**

- Upward transport of water
- Mineral transport
- Mechanical support

Important Keyword: Transpiration Pull

Water evaporates from stomata in leaves, creating a suction force that pulls water upward.

Additional Force: Root Pressure also helps push water upward.

→ **Pathway:**Soil → Roots → Stem → Leaves

2. Phloem: Food Transport System

→ **Definition:**Phloem transports prepared food (mainly sucrose) from leaves to all parts of the plant.

Important Keyword: Translocation

→ **Function:**

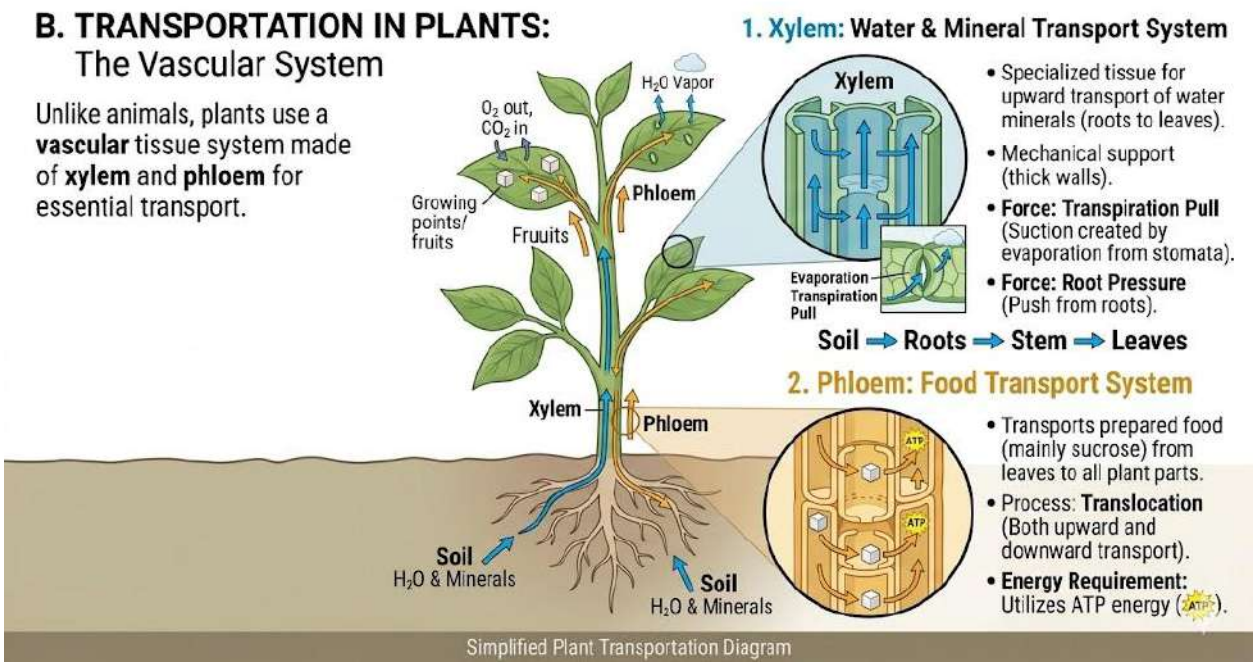
- Moves sugars from leaves to roots, fruits, seeds, and growing tissues
- Can transport food both upward and downward

→ **Energy Requirement:**Unlike xylem, phloem transport requires ATP energy.

Review questions:- Section 3

1.If the components of a mammalian heart are studied, why are the muscular walls of the left ventricle significantly thicker than the walls of the right ventricle?

2.A medical report shows that a patient has a dangerously low blood platelet count. Which immediate complication is this patient most likely to face?



6. Excretion: Waste Removal System During metabolism, harmful waste products such as urea, carbon dioxide, excess salts, and water are produced. If these wastes accumulate, they can poison the body. Excretion removes these toxic substances and maintains internal balance. **Important Keyword: Excretion Biological process** of removing metabolic wastes.

Human Excretory System:

→ Main Organs:

- Kidneys
- Ureters
- Urinary bladder
- Urethra

→ Role of Kidneys:

Kidneys filter blood and remove nitrogenous wastes in the form of urine.

Functional Unit: Nephron→ Each nephron performs:

- Ultrafiltration of blood
- Selective reabsorption of useful substances
- Urine formation

→ Waste Removed:

- Urea
- Excess salts
- Extra water

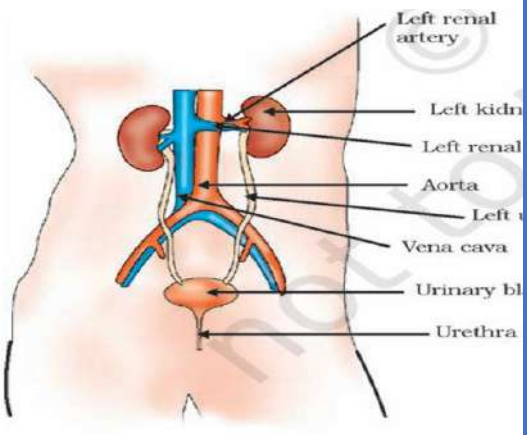


Figure 5.13
Excretory system in human beings

→ **Importance:**

- Prevents toxic buildup
- Maintains water balance (osmoregulation)
- Maintains salt balance

→ **In Plants:**

- Waste stored in vacuoles
- Removed through leaf fall
- Excess water lost by transpiration

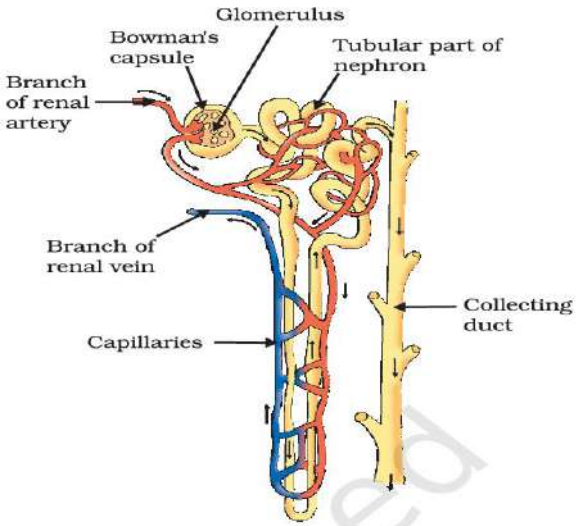
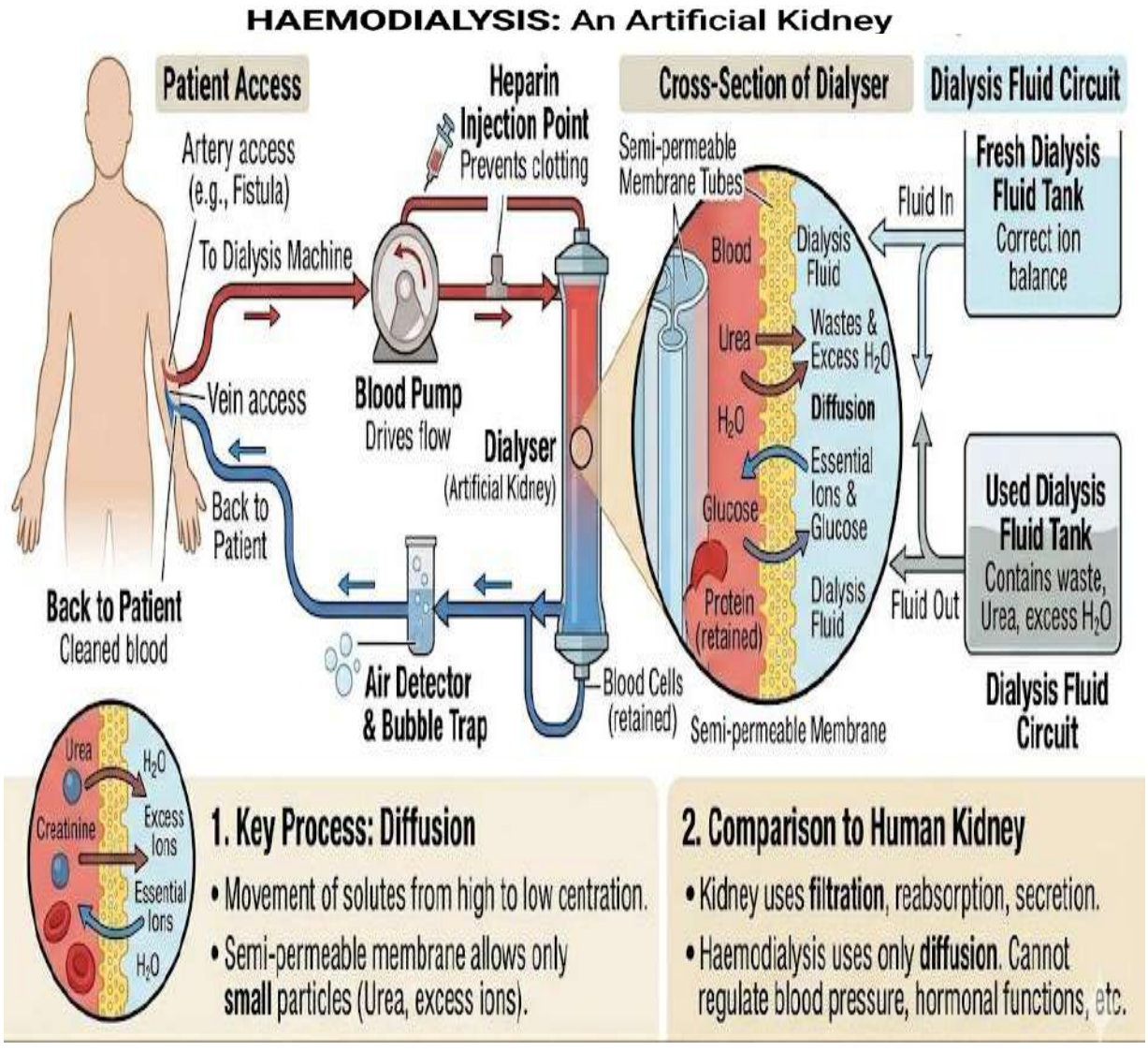


Figure 5.14
Structure of a nephron



Review questions:- Section 4

1.Name the structural and functional unit of the human kidney. State its two main components.

2.Unlike animals, plants do not have a specialized excretory system. How do they get rid of gaseous wastes?

Review questions answer key

Review Questions:- Section 1

1. Desert plants keep their stomata closed during the day to prevent water loss through transpiration. They use the daytime sunlight energy to act upon the intermediate compound prepared at night.

2. Carbon Dioxide

Review Questions:- Section 2

1. Lactic acid. It accumulates when muscle cells break down glucose through anaerobic respiration due to a lack of sufficient oxygen during intense physical activity.

2.Carbon dioxide(CO_2). It reacts with lime water to create an insoluble white precipitate of calcium carbonate, turning the liquid milky.

Review Questions:- Section 4

1. The left ventricle must pump blood under high pressure to the entire body, whereas the right ventricle only pumps blood a short distance to the lungs.

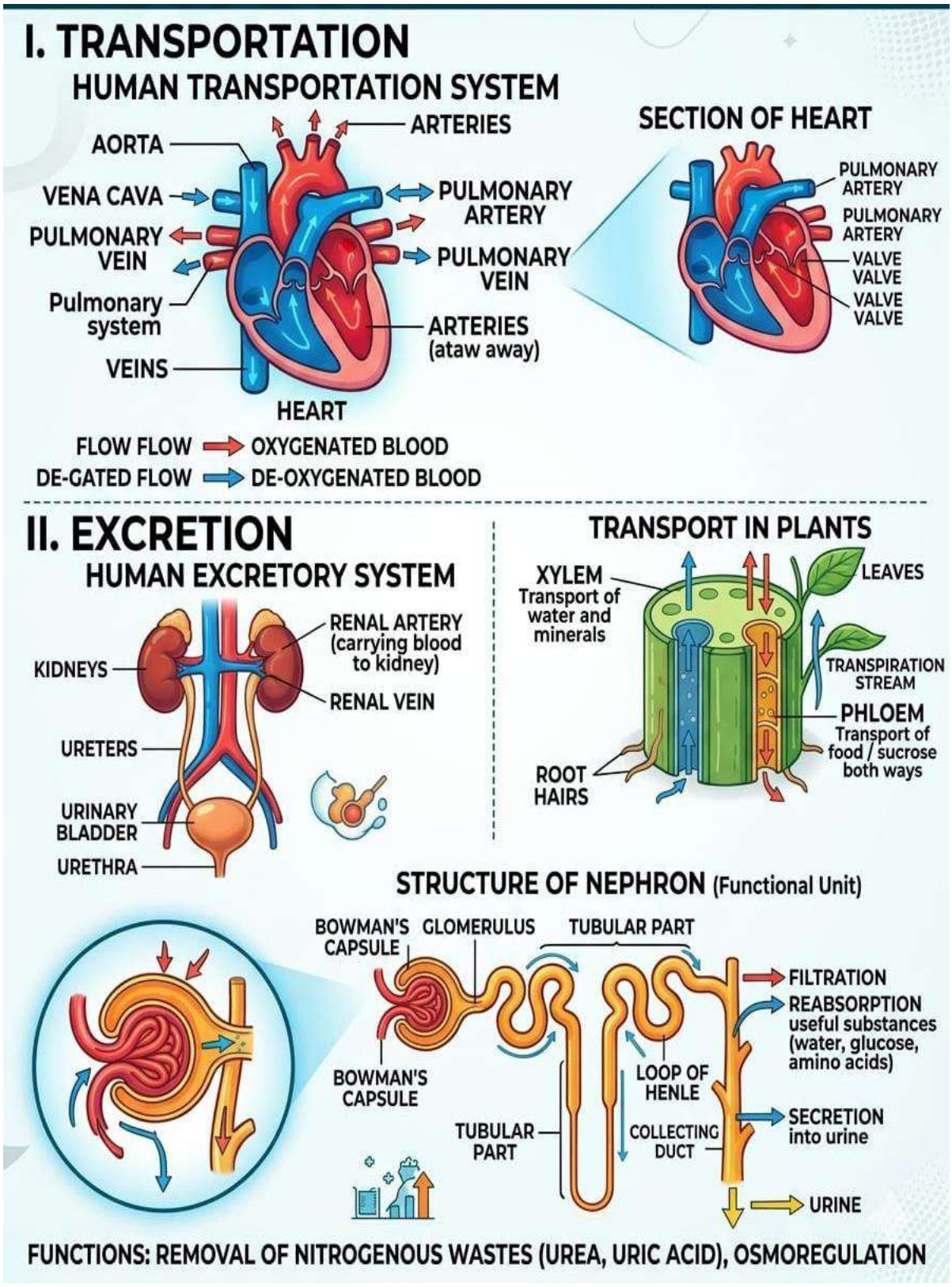
2. Severe or uncontrolled bleeding (haemorrhage), because the blood cannot clot properly.

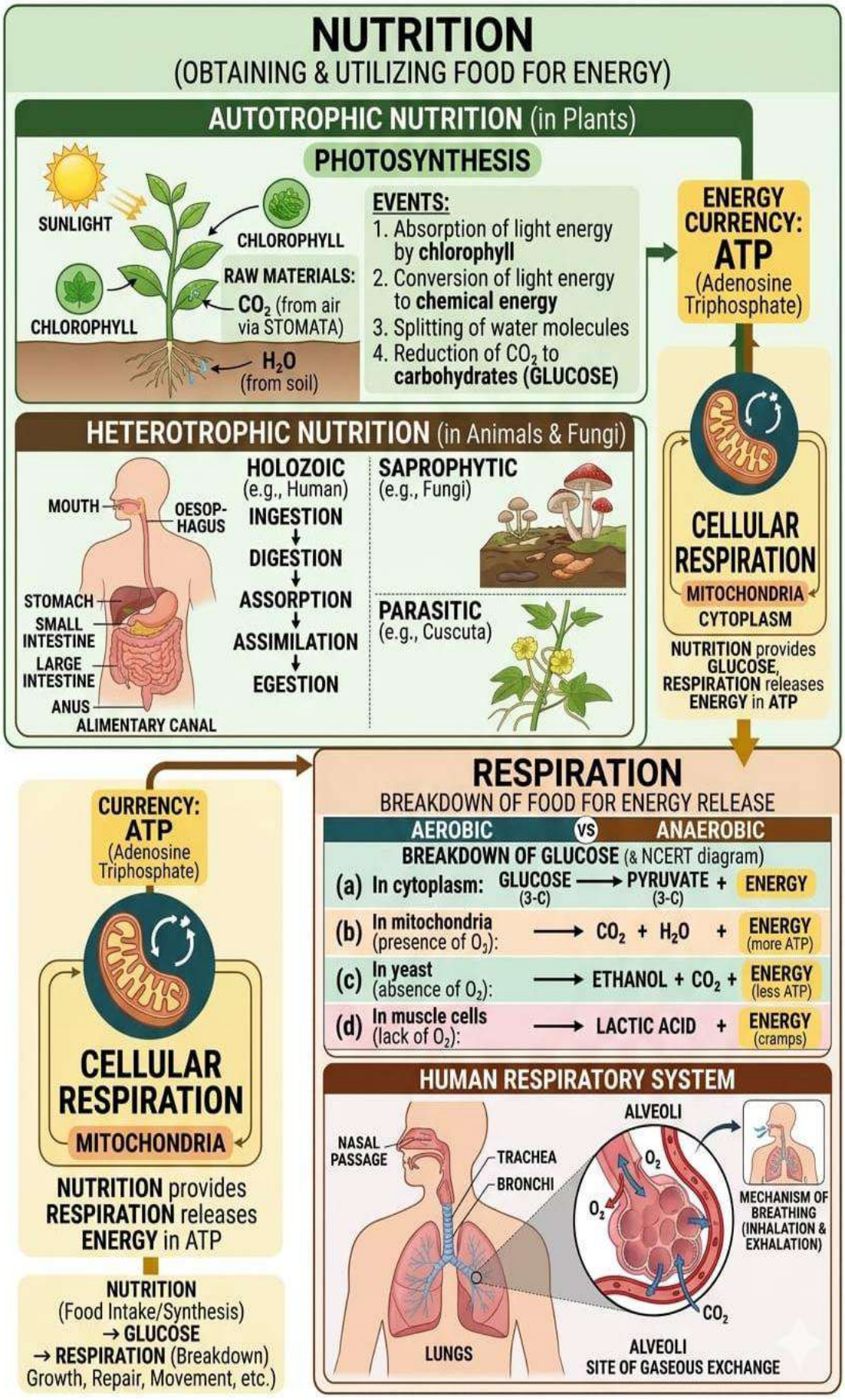
Review Questions:- Section 4

1. Nephron. Its two main components are the Bowman's capsule (which contains the glomerulus) and the renal tubule.

2. Through stomata (in leaves) and lenticels (in stems). They release excess oxygen and carbon dioxide directly into the air by simple diffusion

Chapter 5: Life Processes Flow Chart




NUTRITION
(OBTAINING & UTILIZING FOOD FOR ENERGY)
AUTOTROPHIC NUTRITION (in Plants)
PHOTOSYNTHESIS
SUNLIGHT
CHLOROPHYLL
CHLOROPHYLL
RAW MATERIALS:
CO_2 (from air via STOMATA)
H_2O (from soil)
EVENTS:
1. Absorption of light energy by chlorophyll
2. Conversion of light energy to chemical energy
3. Splitting of water molecules
4. Reduction of CO_2 to carbohydrates (GLUCOSE)
ENERGY CURRENCY: ATP (Adenosine Triphosphate)
HETEROTROPHIC NUTRITION (in Animals & Fungi)
MOUTH
OESOPHAGUS
STOMACH
SMALL INTESTINE
LARGE INTESTINE
ANUS
ALIMENTARY CANAL
HOLOZOIC (e.g., Human)
INGESTION
DIGESTION
ASSORPTION
ASSIMILATION
EGESTION
SAPROPHYTIC (e.g., Fungi)
PARASITIC (e.g., Cuscuta)
CELLULAR RESPIRATION
MITOCHONDRIA
CYTOPLASM
NUTRITION provides GLUCOSE, RESPIRATION releases ENERGY in ATP
CURRENCY: ATP (Adenosine Triphosphate)
CELLULAR RESPIRATION
MITOCHONDRIA
NUTRITION provides RESPIRATION releases ENERGY in ATP
NUTRITION (Food Intake/Synthesis) → GLUCOSE → RESPIRATION (Breakdown) Growth, Repair, Movement, etc.)
RESPIRATION
BREAKDOWN OF FOOD FOR ENERGY RELEASE
AEROBIC VS ANAEROBIC
BREAKDOWN OF GLUCOSE (& NCERT diagram)
(a) In cytoplasm: GLUCOSE (3-C) → PYRUVATE (3-C) + ENERGY
(b) In mitochondria (presence of O_2): → CO_2 + H_2O + ENERGY (more ATP)
(c) In yeast (absence of O_2): → ETHANOL + CO_2 + ENERGY (less ATP)
(d) In muscle cells (lack of O_2): → LACTIC ACID + ENERGY (cramps)
HUMAN RESPIRATORY SYSTEM
NASAL PASSAGE
TRACHEA
BRONCHI
LUNGS
ALVEOLI
O_2
O_2
CO_2
ALVEOLI
SITE OF GASEOUS EXCHANGE
MECHANISM OF BREATHING (INHALATION & EXHALATION)

Chapter 6 Control And Coordination

Theme: The World of the Living
Unit II: World of Living
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.

Stimuli :- The changes in the environment to which living organisms respond are called stimuli.

Coordination:-The working together of various organs in an organism to produce a proper response to a stimulus is called coordination.

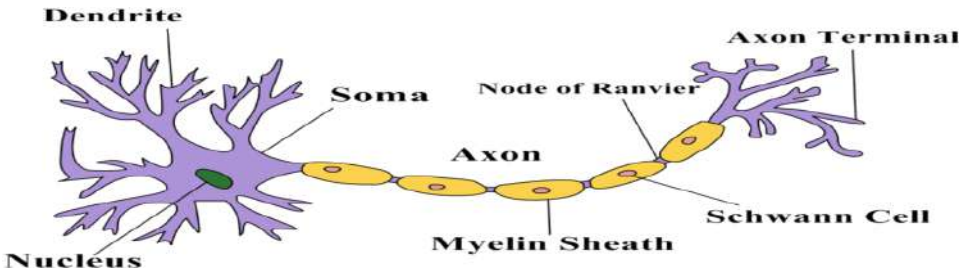
Coordination in animals: In animals control and coordination is done by the nervous system and endocrine system.

Parts of the nervous system:

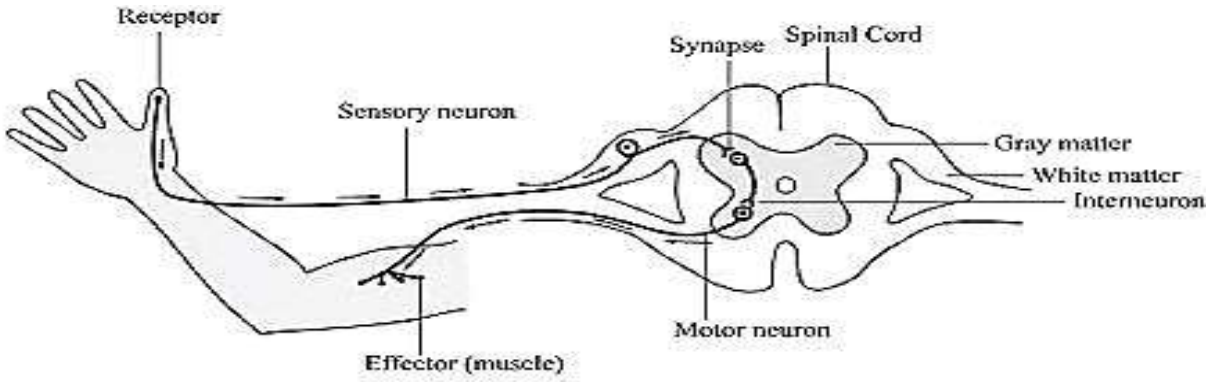
The central nervous system:-consists of the brain , and spinal cord.

The peripheral nervous system:-consists of cranial nerves arising from the brain and spinal nerves arising from the spinal cord.

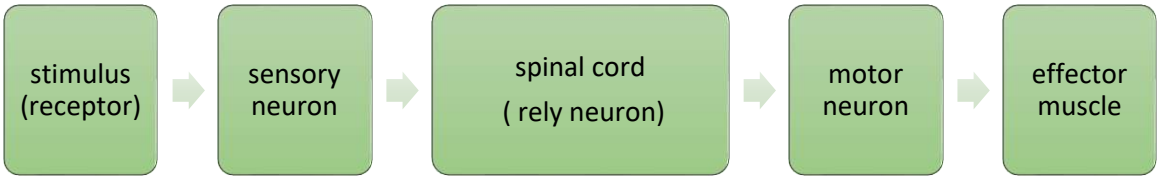
Nerve cell (Neuron): Neuron is the structural and functional unit of the nervous system. It has a cell body called **cyton** containing a nucleus and cytoplasm.It has several branched structures called **dendrites.**It has a long nerve fibre called **axon** which is covered by a protective covering called **Myelin sheath.**The junction between two neurons is called **synapse**



Reflex arc: The pathway of a reflex action is called reflex arc.



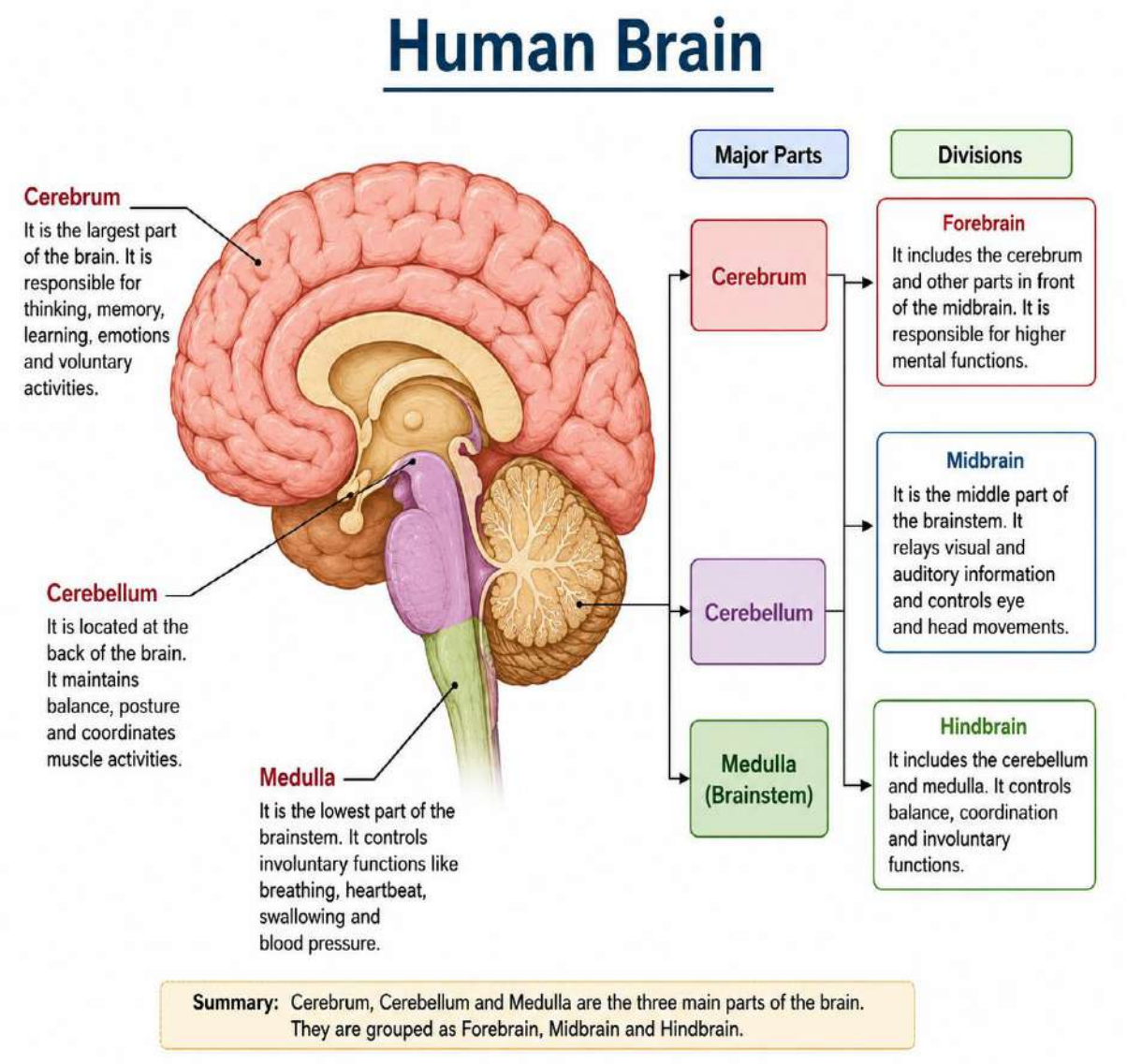
Reflex action :-Reflex action is a sudden, unconscious and involuntary response of the effectors to a stimulus. Eg:- We suddenly withdraw our hand if we suddenly touch a hot object.



Review questions Section 1

1.A student touches a hot object and quickly pulls back the hand. Which part of the neuron carries the message away from the cell body?

2.In a reflex action, neurons help in rapid transmission of impulses. Name the gap between two neurons where information passes.



Brain :-

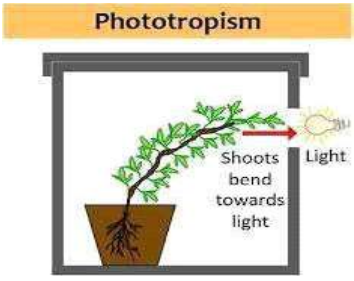
Brain is the main coordinating center in the human body. It is protected by the cranium. It is covered by three membranes called meninges filled with a fluid called cerebrospinal fluid which protects the brain from shocks. The brain has three main parts.
Fore brain :- consists of the cerebrum and olfactory lobes. It controls voluntary actions like touch, smell, hearing, taste, sight, mental activities like thinking, learning, memory, emotions.
Mid brain :- controls involuntary actions and reflex movements of head, neck, eyes etc.

Hind brain :- consists of cerebellum, pons and medulla. Cerebellum**:**- controls body movements, balance and posture.Pons**:** - controls
respiration.
Medulla :- controls heart beat, blood pressure, swallowing, coughing, sneezing, vomitingetc

Spinal cord :- The spinal cord starts from the brain and extends through the vertebral column. It carries messages to and from the brain. It also controls reflex actions.

Review questions Section 2
1.Name the part of the hindbrain that controls involuntary actions like blood pressure, salivation, and vomiting.?
2.Which part of the brain is the main thinking part?.

Co ordination in plants
In plants control and coordination is done by chemical substances called plant hormones or phytohormones.
Auxins :- help in cell division, cell elongation and growth.
Gibberillins :- help in growth of stem and branches.
Cytokinins:- help in cell division, formation of fruits and seeds.
Abscisic acid :- inhibits growth and affects wilting of leaves.
Ethylene :- helps in flowering and ripening of fruits.
Movements in plants :-Movements in plants are of two main types.
Tropic movements: are directional movements towards or away from the stimulus and it depends on growth. They are of different types like Phototropism, Geotropism, Chemotropism, Hydrotropism etc.



Nastic movements:-are non directional movements which are neither towards or away from the stimulus and it does not depend on growth. Eg: If we touch the leaves of touch me not plant, its leaves fold up and droops down immediately

Review questions Section 3
1.A potted plant kept near a window bends towards sunlight after a few days.
(a) Name the plant hormone responsible for this movement.
(b) What type of movement is shown by the plant?
2.Farmers spray a hormone on fruits to ripen them quickly during transport.
(a) Name the hormone used.
(b) State one other function of this hormone in plants.

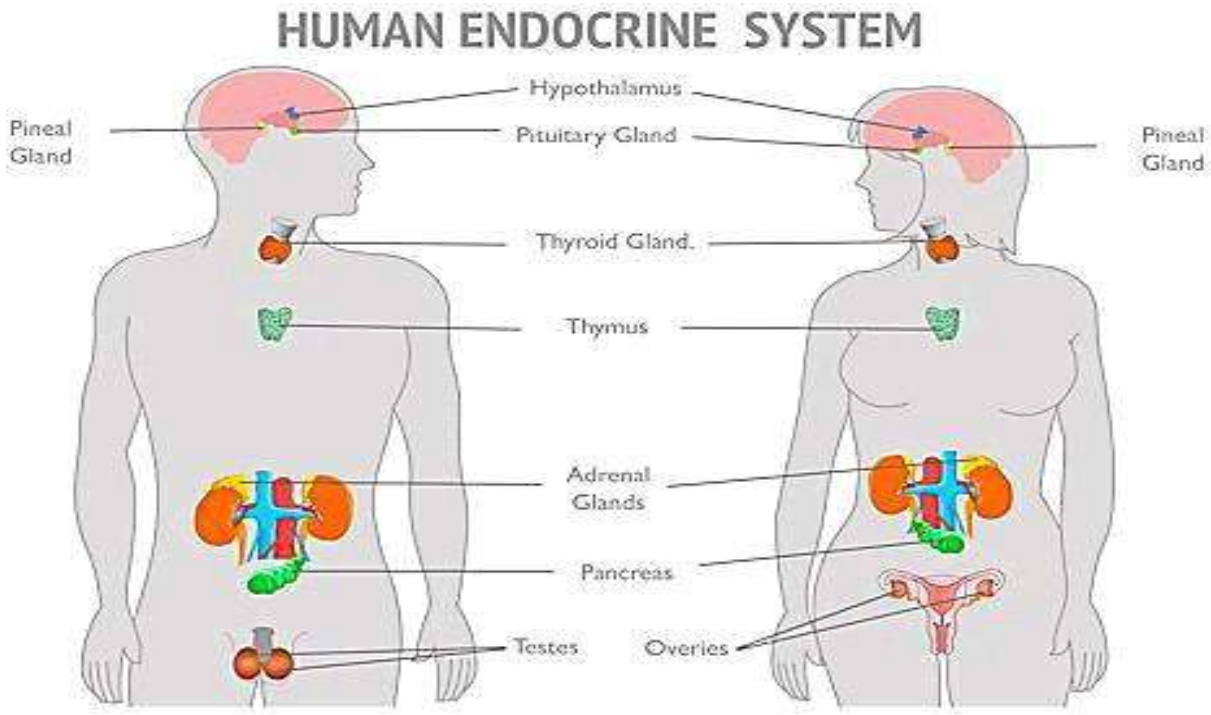
HORMONES IN ANIMALS: Hormones are chemical messengers which are secreted by the ductless endocrine gland into the blood. Hormones control the activities of certain cells and organs. Some of the main endocrine glands are the pituitary gland, adrenal gland, thyroid gland, pancreas, testes, ovary etc.

Endocrine gland	Hormone	Role
Pituitary gland	Growth Hormone	Stimulate growth and development
Adrenal gland	Adrenaline	Stress hormones (enable to deal with the Stress) Increase heartbeat & breathing
Thyroid gland	Thyroxine	Regulates metabolism for body growth
Pancreas	Insulin	Regulates blood sugar level
Ovary	Oestrogen	Changes associated with puberty in female
Testes	Testosterone	Changes associated with puberty in male

GOITRE- Iodine is necessary for the formation of thyroxine hormone. If Iodine is deficient in our diet, there is a possibility that we might suffer from goitre. One of the symptoms in this disease is a swollen neck.

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

DIABETES- Deficiency of insulin hormone causes diabetes



Review questions Section 4

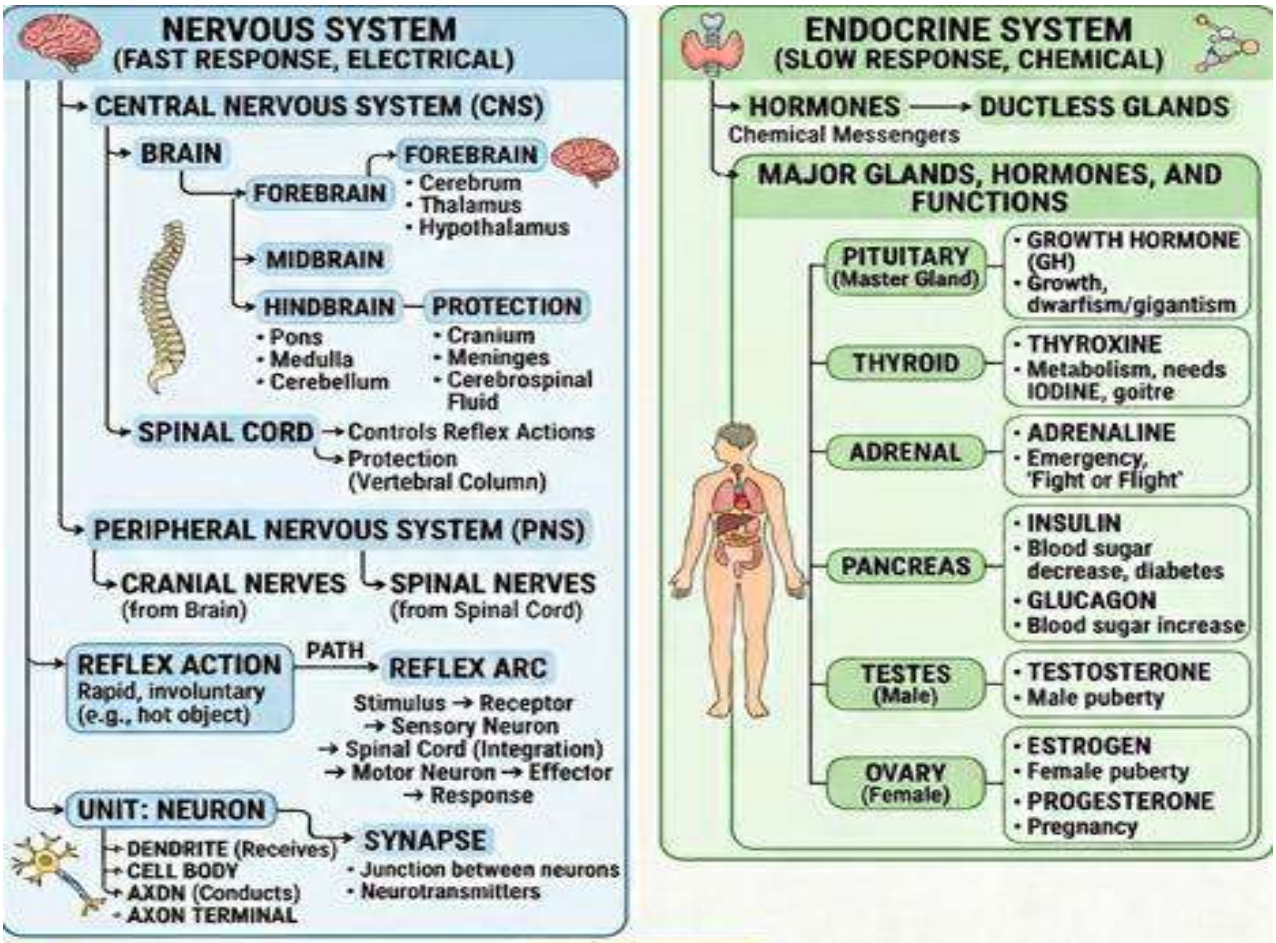
1.Which gland is known as the "master gland" in the human body?

2.Why is iodized salt recommended for our diet?

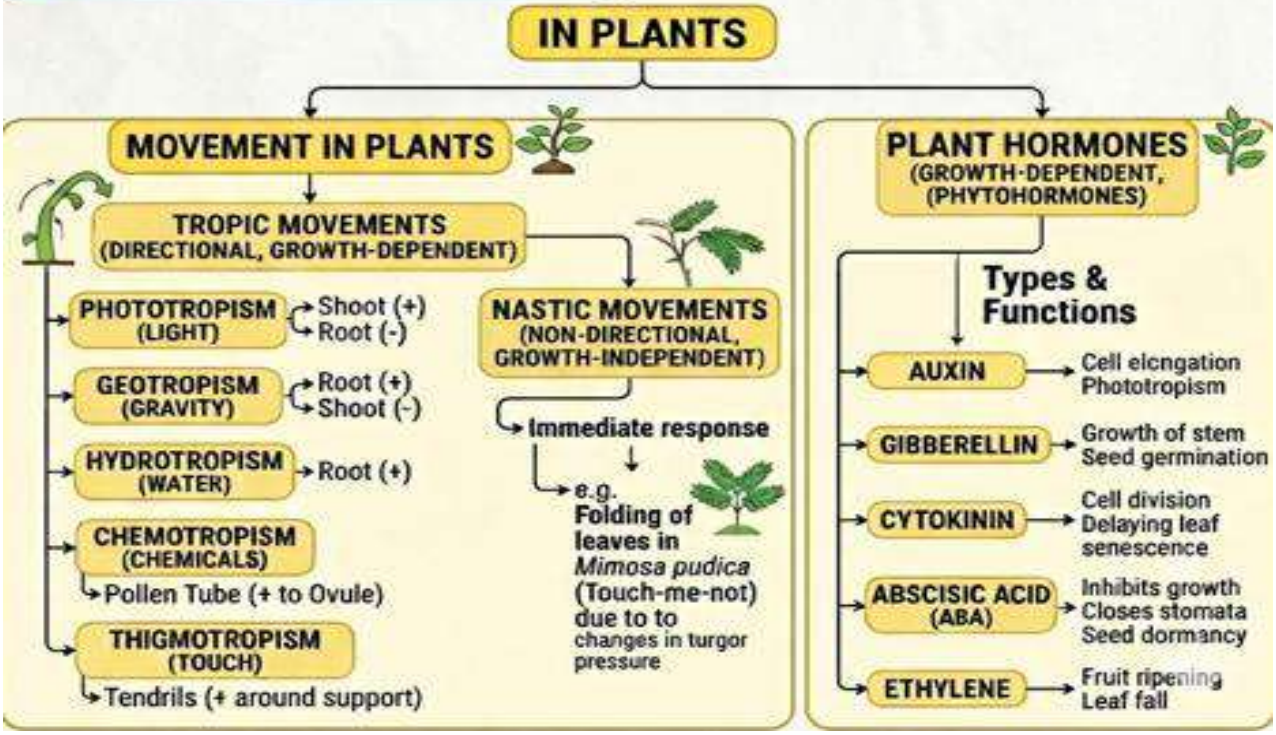
3. Write the function of the hormone “thyroxine” produced in our body.

Chapter 6 Control And Coordination Flow Chart

IN ANIMALS



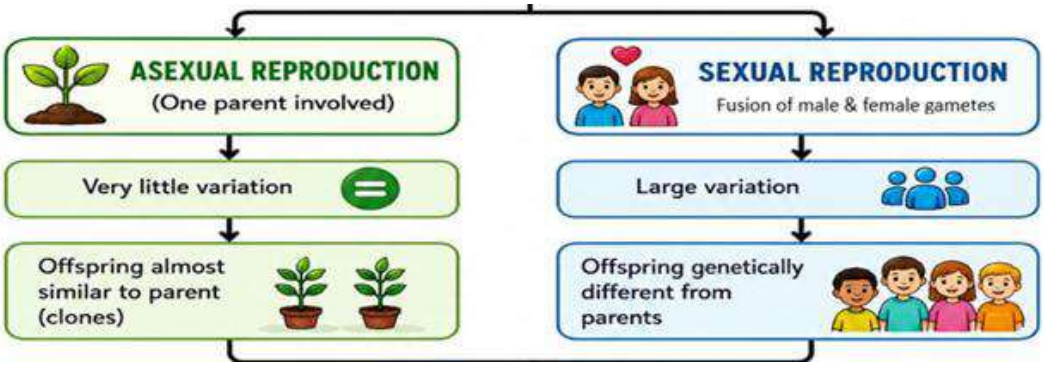
IN PLANTS



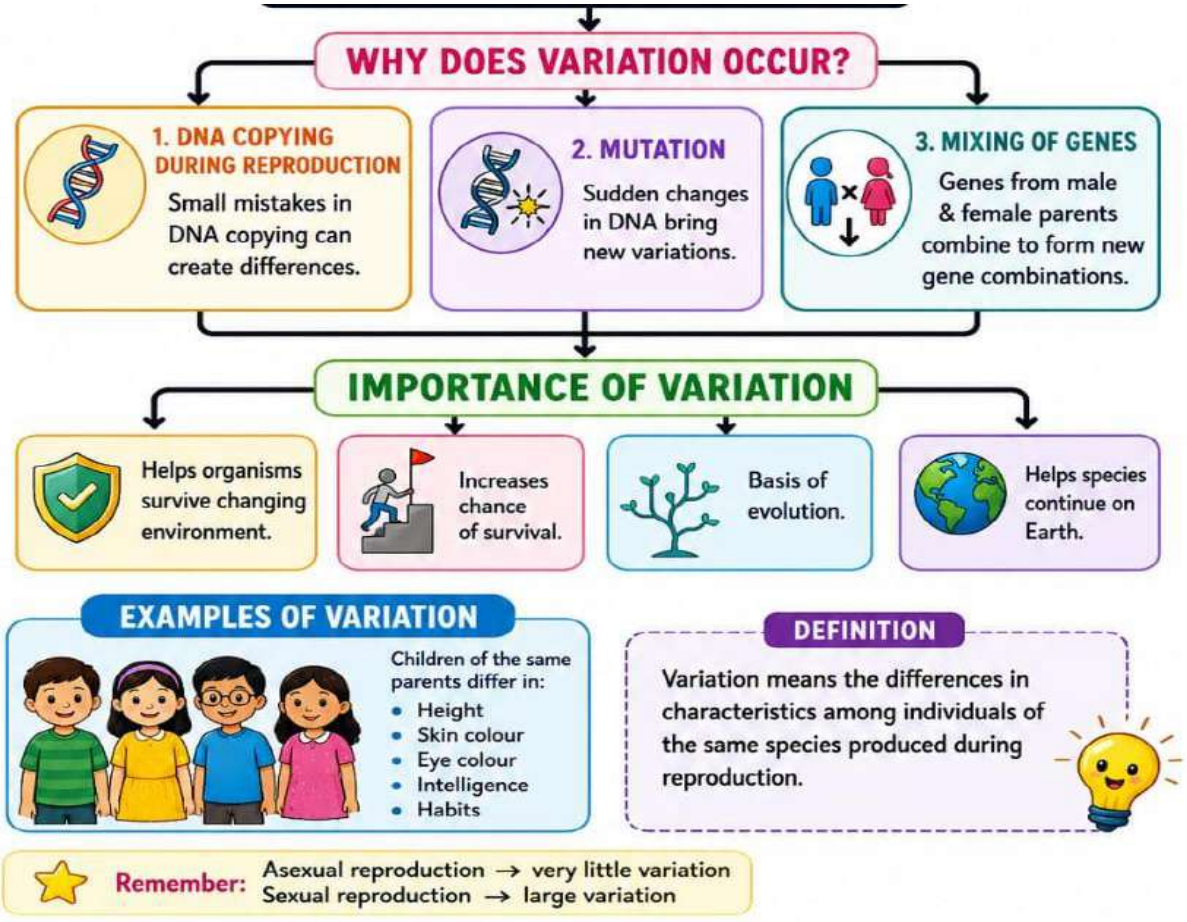
Chapter 7. HOW DO ORGANISMS REPRODUCE

Syllabus –
Theme: The World of the Living
Unit II: World of Living
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.

Reproduction- Reproduction is the biological process by which organisms produce new individuals of their own kind. There are two main modes of reproduction.



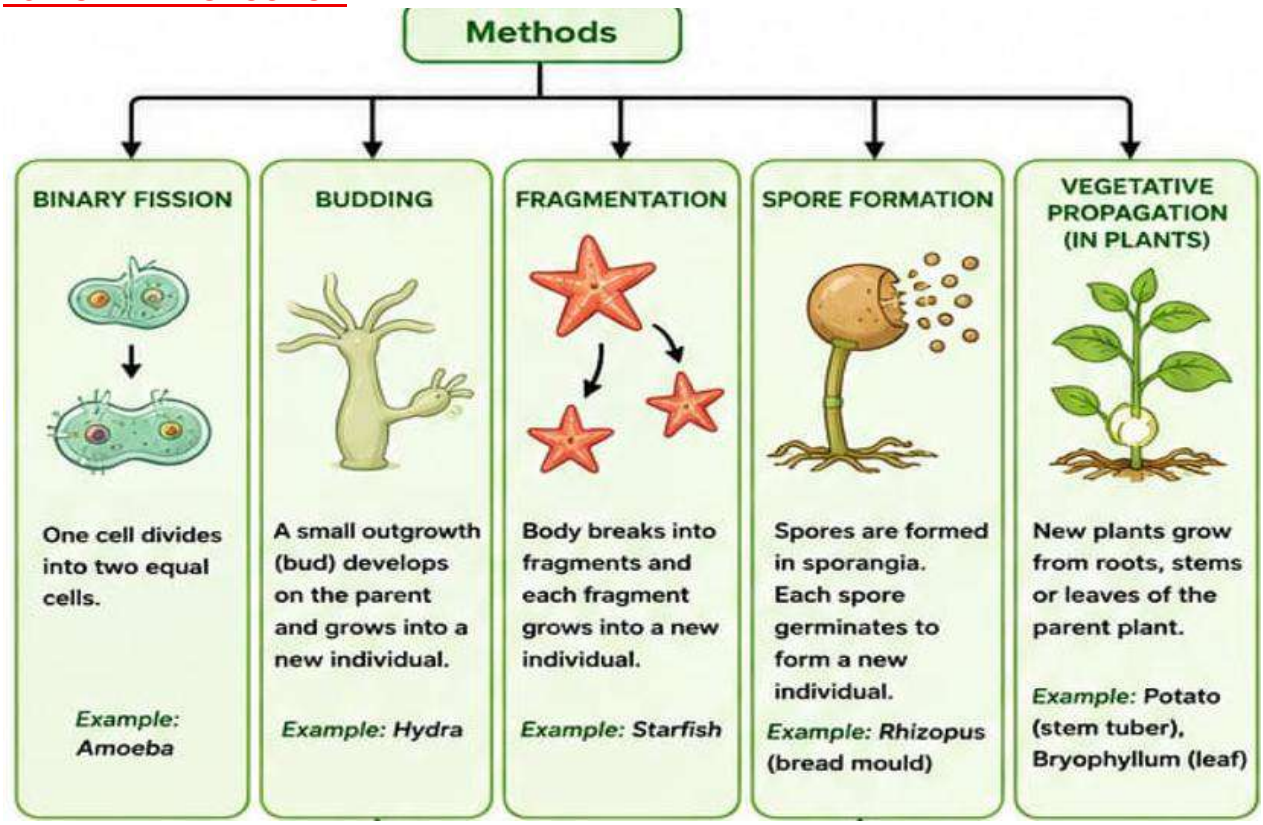
Why does variation occur during reproduction!!!!



Review questions Section- 1

1. Define reproduction. Reproduction is one of the most important characteristics of living beings. Give three reasons in support of the statement.
2. What is DNA copying? State its importance.
3. Newly formed DNA copies may not be identical at times. Give one reason.
4. What is the effect of DNA copying, which is not perfectly accurate, on the reproduction process?

ASEXUAL REPRODUCTION



Review questions section- 2

1. Puneet wanted to grow banana plants.
(i) Based on your knowledge on plant reproduction should he opt for seeds or any alternate method of reproduction. Justify your answer.
(ii) Offsprings of a banana plant usually show very little variation.
2.What causes variation and are variations good or bad? Justify.

3. What is vegetative propagation? Name two methods in which this process is used to grow many plants. List any two advantages of vegetative propagation.

4. (a) Although Amoeba and Leishmania, both show same mode of reproduction, but the process of reproduction is carried out in different ways.Identify their mode of reproduction and mention the way it is carried out in the two species.(b) What is regeneration? Explain with the help of a diagram how this process is carried out in Planaria. (c) Name the part of Rhizopus in which spores are formed. State the condition under which spores grow into a new individual.

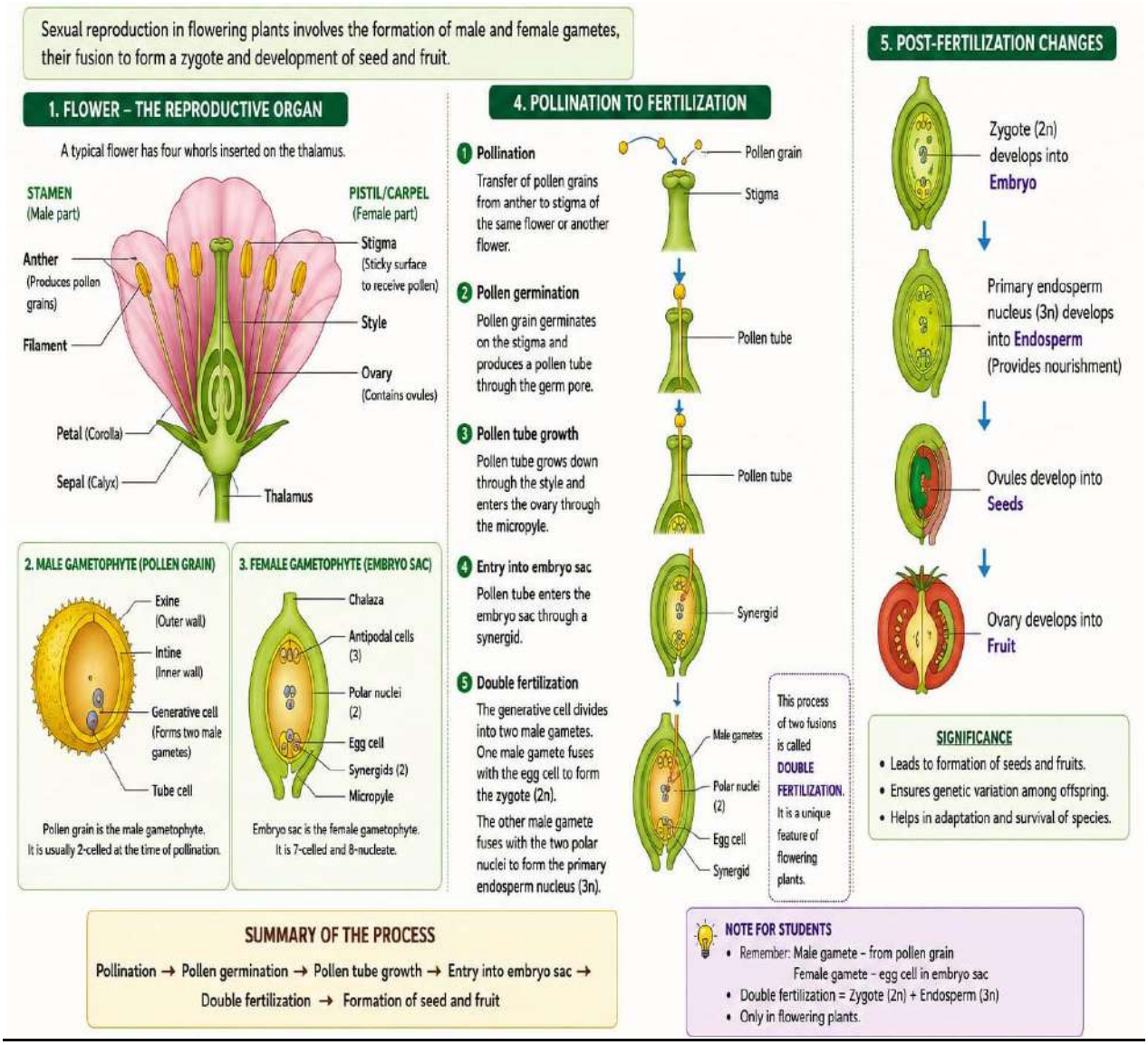
SEXUAL REPRODUCTION

It involves fusion of male and female gametes, results in the formation of a zygote.

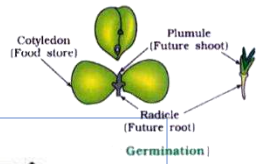
SEXUAL REPRODUCTION IN FLOWERING PLANTS (ANGIOSPERMS)

Flower is the reproductive part of the plant.
Bisexual flowers: both male and female reproductive parts i.e. stamen & carpel are present. Ex. *Hibiscus*, Mustard etc.
Unisexual flowers: either male or female reproductive part is present in a flower. Ex. Papaya, Watermelon etc. **Sepal:** Green leaflike structures which protects the bud. **Petals:** Colourful, attract insects for pollination. **Stamen:** Male reproductive part of a flower. It consists of anther and filament. Anther produces pollen, the male gametes. **Carpel:** Female reproductive part of a flower. It consists of ovary, stigma and style.
Female gamete -egg -present in ovule.

Sexual reproduction in Plants

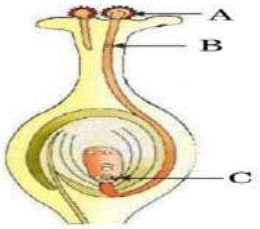


Germination - The growth of seed into seedling is germination.
Seed - The ovule develops into seed. It contains the future plant or embryo which develops into a seedling under appropriate conditions.



Review questions Section 3

1. Differentiate between self-pollination and cross-pollination.
2. Identify A, B and C in the diagram given and write one function of each

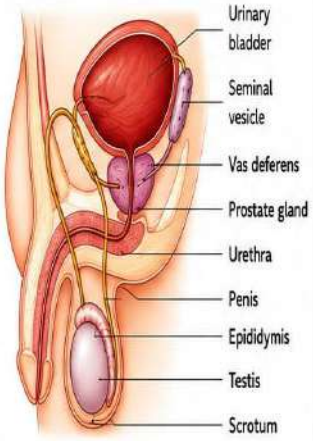


REPRODUCTION IN HUMAN BEINGS

The reproductive system in humans is the biological system responsible for reproduction, which ensures the continuity of our species.

MALE REPRODUCTIVE SYSTEM

It produces male gametes (sperms), and male sex hormones (androgens).

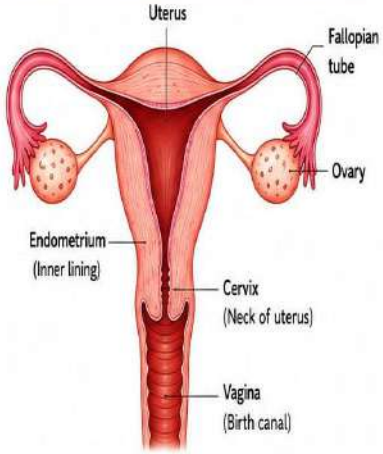


Functions

- Testes produce sperms and testosterone.
- Sperms are transported through vas deferens and released through penis.
- Testosterone brings about male secondary sexual characters.

FEMALE REPRODUCTIVE SYSTEM

It produces female gamete (ovum) and female sex hormones (estrogens and progesterone).



Functions

- Ovaries produce ova and hormones (estrogen and progesterone).
- Fallopian tubes pick up the ovum and transport it to the uterus.
- Uterus provides a suitable environment for the development of the embryo.
- Vagina receives the penis during intercourse and serves as the birth canal during childbirth.

IMPORTANCE OF REPRODUCTION

Reproduction is essential for the survival of species and has great significance for life on Earth.

1. Continuity of Species

It ensures that the species continues from generation to generation and prevents it from extinction.

2. Transfer of Traits

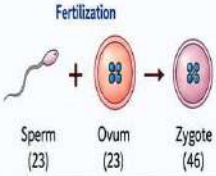
Reproduction transfers genetic characters from parents to offspring, bringing about similarities and variations.

3. Evolution and Adaptation

Reproduction with variations helps species to adapt to changing environments and evolve over time.

KEY FACTS

- Sperms are produced in millions in the testes; one sperm contains 23 chromosomes.
- Ovum is produced once in about a month; it contains 23 chromosomes.
- Fertilization (fusion of sperm and ovum) forms a zygote with 46 chromosomes.
- The zygote develops into an embryo and then into a baby in the mother's uterus.



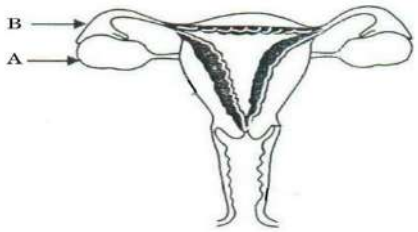
IN SHORT

Reproduction is the natural process by which new individuals are produced. It is fundamental to life and essential for the continuity, growth and evolution of all living organisms.

Review questions Section 4

Q1. What are testes? List two functions performed by testes in human beings.

Q2. Write the name and one function each of the parts A and B shown in the following diagram.



SEXUALLY TRANSMITTED DISEASES (STDs)

Sexually transmitted diseases (STDs) are infections that spread from one person to another through sexual contact.

COMMON STDs

Disease	Causative Agent	Symptoms	Prevention/Treatment
Gonorrhoea 	Bacterium (*Neisseria gonorrhoeae*)	Pain during urination, discharge from reproductive organs, abdominal pain.	Use of condoms, proper hygiene, antibiotics for treatment.
Syphilis 	Bacterium (*Treponema pallidum*)	Sores on genital area, rash on body, fever, swollen lymph nodes.	Use of condoms, regular check-up, antibiotics for treatment.
HIV/AIDS 	Virus (Human Immunodeficiency Virus)	Fever, fatigue, weight loss, frequent infections. (AIDS is the advanced stage.)	Use of condoms, no sharing of needles, no blood transfusion from affected person. No cure; treatment available.
Genital Herpes 	Virus (Herpes Simplex Virus)	Painful blisters in genital area, itching, fever.	Use of condoms, avoid multiple sexual partners. No cure; medicines relieve symptoms.
Warts (Genital Warts) 	Virus (Human Papilloma Virus – HPV)	Small, soft growths or warts in genital area; may cause itching.	Use of condoms, avoid multiple sexual partners. No cure; treatment removes warts.

GENERAL PREVENTION

- Always use condoms during sexual intercourse.
- Avoid multiple sexual partners.
- Do not share needles, syringes or sharp instruments.
- Ensure safe blood transfusion.
- Maintain personal hygiene.
- Get regular health check-ups.

Methods of Contraception

Contraception refers to the methods or devices used to prevent pregnancy.

DIFFERENT METHODS OF CONTRACEPTION

1. Barrier Methods (Prevent the entry of sperms)

- **Condoms (for males):** A thin rubber sheath worn on the penis that prevents sperms from entering the female reproductive tract.
- **Diaphragm/Cervical cap (for females):** A soft cup-shaped device that covers the cervix and blocks sperms.

Condom

Diaphragm

2. Chemical Methods (Use of chemicals to kill sperms or prevent their entry)

- **Spermicidal creams, jellies,** foams, tablets or suppositories are inserted into the vagina. These chemicals kill sperms or block their entry into the uterus.

Spermicidal cream

Spermicidal suppositories

3. Intra Uterine Devices (IUDs)

Small devices inserted into the uterus by a doctor. They prevent fertilization.

Copper-T (IUD)

4. Surgical Methods (Permanent methods)

- **Vasectomy (for males):** The vas deferens are cut and tied so that sperms do not mix with semen.
- **Tubectomy (for females):** The fallopian tubes are cut and tied so that ovum cannot meet sperm.

Vasectomy

Tubectomy

Family planning allows people to attain their desired number of children and determine the spacing of pregnancies avoid unintended pregnancies and plan births, it reduces pregnancy-related health risks strengthens health systems, and promotes economic development.

Living with HIV no longer prevents a woman from having a family. Medical advancements have made safe conception and healthy childbearing highly achievable.

Review questions Section 5

1. (i) What are contraceptive devices?(ii) State briefly one contraceptive methods used by human males.
2. (a) Explain the surgical method of contraception used by (i) males, and(ii) females to prevent fertilisation.(b) Write the role of oral pills taken by women as a contraceptive.
3. (a) Name any two bacterial infections that are sexually transmitted. How can they be prevented(b) List three different ways, other than the one stated in (a) above, that help an individual to avoid unwanted pregnancies.(c) List three advantages for adopting contraceptive measures.

Review questions Answer key

Section 1

1. Definition: Reproduction is the fundamental process of creating offspring to ensure the survival and continuation of a species.
   Reasons
   a)Continuation of Species: It prevents species from going extinct by passing on genetic information to the next generation.
   b)Population Growth: It replaces dead individuals and helps in increasing the population size of a species.
   c)Evolution and Variation: It introduces genetic variations that are crucial for species to adapt to changing environments
2. Definition: DNA copying (or replication) is the process by which a cell makes a similar copy of its DNA before cell division.
   Importance: It ensures that the genetic information is transmitted from parents to offspring. Without it, newly formed cells or offspring would not receive the necessary genes to survive and function properly
3. Newly formed DNA copies may differ due to biochemical errors or mutations that occur during the DNA replication process.
4. Effect on Reproduction: Minor inaccuracies (mutations) during DNA copying lead to variations in offspring. Over time, these variations form the basis of evolution and help organisms adapt to changing environments.

   Section 2

1. i. Choice: Puneet should opt for an alternate method of reproduction (like vegetative propagation using suckers) rather than seeds.
   Justification: Most cultivated banana plants are sterile triploids and do not produce viable seeds. Vegetative propagation allows for faster growth, uniform fruit quality, and ensures the new plants are exact clones of the parent.
   ii. Offspring of banana plants show very little variation because they are produced through vegetative propagation (asexual reproduction). Because there is no fusion of gametes or exchange of genetic material, the offspring are exact genetic copies (clones) of the parent plant.

2. Variations are primarily caused by sexual reproduction due to the mixing of genes during fertilization. Mutations (spontaneous errors in DNA copying) can also cause variation in both asexual and sexual organisms. Are variations good or bad: Variations can be both.

Good: They provide an advantage in survival by allowing a population to adapt to sudden environmental changes, diseases, or extreme climates. Bad: They can sometimes lead to harmful traits, or make an organism unable to survive in a newly changed habitat

3. It is a type of asexual reproduction in plants where new individuals grow from vegetative parts of the plant (such as roots, stems, or leaves) rather than from seeds.

Two methods:

Natural methods: Using suckers (as in bananas), bulbs, tubers (potatoes), or runners.

Artificial methods: Cutting, layering, grafting, and Plant Tissue Culture.

Two advantages:

It allows for the rapid production of plants that are seedless or produce very few seeds (e.g., bananas, seedless grapes).

It helps preserve the exact, desirable traits of the parent plant across future generations

4.a) Amoeba vs. Leishmania: Both reproduce asexually through Binary Fission, but the process takes different forms:

Amoeba: The cell division can take place in any plane/direction because it has no fixed body shape.

Leishmania: The cell division occurs in a definite orientation (longitudinally), as it has a whip-like structure (flagellum) at one end.

(b) Regeneration: Regeneration is the ability of an organism to regrow lost body parts or develop an entirely new organism from fragmented pieces of its body.

In Planaria: If a Planaria is cut into multiple pieces, each individual piece is capable of growing into a completely new, independent flatworm. Cells in the cut piece multiply, grow, and differentiate to reform the lost body parts.

(c) Spore Formation in Rhizopus:

Part where spores are formed: Spores are formed inside a sac-like structure called a sporangium. Conditions for growth: Spores grow into new individuals under moist and warm conditions with an adequate food source.

Section 3

1.Self-pollination is the transfer of pollen from the anther to the stigma of the same flower or another flower on the same plant. Cross-pollination is the transfer of pollen from the anther of one flower to the stigma of a different plant of the same species.

2. A: Stigma-Function: Serves as the landing platform that catches and receives pollen grains during pollination. B: Pollen Tube-Function: Elongates and grows down through the style to act as a conduit, carrying male gametes from the pollen grain to the ovule inside the ovary.

C: Ovule / Egg Cell-Function: Contains the female gamete. After fertilization, it develops into the seed.

Section 4 1.Testes (or testicles) are a pair of primary male reproductive organs located in a pouch of skin called the scrotum, outside the abdominal cavity.

Two main functions:

a)Sperm Production: They continuously produce the male gametes, called sperms (or spermatozoa).

b)Hormone Secretion: They produce the male sex hormone, testosterone, which regulates sperm production and controls the development of male secondary sexual characteristics.

2. A. Ovary- The ovary produces female gametes (eggs) and secretes essential reproductive hormones (estrogen and progesterone).

B. Oviduct (fallopian tube) - The oviduct (fallopian tube) acts as the pathway for the egg to travel from the ovary to the uterus and serves as the primary site for fertilization

Review Questions:- Section EAnswer Key

1.Contraceptive devices and methods are tools or medical techniques used to prevent pregnancy by stopping the sperm and egg from meeting or by preventing the implantation of a fertilized egg.

Contraceptive Methods Used by Human Males: Male Condoms, They block sperms from entering the female reproductive tract.

2.a)(i) Males (Vasectomy): A minor surgical procedure where the *vas deferens* (the sperm duct) is cut and tied securely. This blocks the sperm from mixing with the semen, preventing them from being ejaculated.

(ii) Females (Tubectomy): A surgical procedure where the fallopian tubes are cut and tied (or blocked). This prevents the egg from traveling down the tube to meet the sperm, and stops the fertilized egg from reaching the uterus

(b) Role of Oral Pills - Oral contraceptive pills taken by women work by altering the body's hormonal balance. They contain synthetic female hormones (estrogen and progesterone) that inhibit ovulation (release of the egg)

3.a) Gonorrhoea, Syphilis, They can be prevented by using barrier methods (such as condoms)

b) three different ways (other than barrier protection) to avoid unwanted pregnancies are:

Hormonal Contraceptives: Utilizing birth control pills, patches, or injections that alter the hormone balance to prevent ovulation.

Intrauterine Devices (IUDs): T-shaped devices (like Copper-T) inserted into the uterus to prevent fertilization or implantation.

Surgical Sterilization: Permanent procedures such as vasectomy in males or tubectomy in females.

(c) Three advantages for adopting contraceptive measures are:

Family Planning: Allows individuals or couples to space out pregnancies and decide the exact size of their families.

Maternal Health: Prevents closely spaced, frequent pregnancies, allowing the mother's body time to recover and heal.

Population Control: Plays a vital role in curbing rapid population growth and ensuring better allocation of socioeconomic resources.

Chapter 7. How do organisms reproduce flow chart

HOW DO ORGANISMS REPRODUCE?

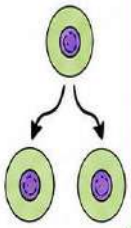
(Class 10 Science – Chapter 7)

1. WHY DO ORGANISMS REPRODUCE?

- To increase their number and continue the species.
- Variations produced during reproduction help species survive in changing environments.

2. BASIC EVENTS IN REPRODUCTION

- A cell makes a copy of its DNA.
- The cell divides to form two new cells, each with its own cellular parts.



3. ASEXUAL REPRODUCTION (SINGLE ORGANISM)

New individuals are produced from a single parent in the following ways:

- **Fission** – one cell splits into two or more (e.g., Amoeba).

- **Budding** – a small bud grows on the parent and separates (e.g., Yeast, Hydra).

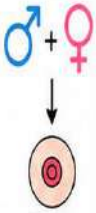
- **Fragmentation** – body breaks into pieces; each piece grows into new individual (e.g., Spirogyra, Planaria).

- **Vegetative propagation** – new plants grow from roots, stems or leaves (e.g., Potato, Bryophyllum).

- **Spore formation** – spores are formed in sporangia and grow into new individuals (e.g., Rhizopus).

4. SEXUAL REPRODUCTION

- Gametes (germ cells) from both fuse to form a zygote.
- Produces more variations by combining DNA from two parents.



5. SEXUAL REPRODUCTION IN FLOWERING PLANTS

- Pollen transfer from anther to stigma is called pollination.
- After fertilisation, ovule becomes seed and ovary becomes fruit.

6. REPRODUCTION IN HUMAN BEINGS

- Male system produces sperms; female system produces eggs. Fertilisation occurs in the fallopian tube.
- Baby develops in uterus for about 9 months and is born due to contractions.

7. REPRODUCTIVE HEALTH

- Sexually transmitted diseases can spread through sexual contact.
- Contraceptive methods help prevent unwanted pregnancy.

KEY TERMS

Fission, Budding, Fragmentation, Vegetative propagation, Spore formation, Pollination, Fertilisation, Gamete, Meiosis, Puberty, Contraception, Placenta, Foetus.

IN SHORT

Reproduction is the process by which organisms produce new individuals. It ensures the continuation of species and creates variations for survival.

Chapter 8 Heredity

Theme: The World of the Living
Unit II: World of Living
Heredity: Heredity; Mendel's contribution- Laws for inheritance of traits: Sex determination; brief introduction.

How traits inherit ?
Cellular DNA (Information source) → For synthesis of Proteins → Works efficiently → More Hormone Produced → Traits appear.
Therefore, genes control characteristics or trait
Variations-Variation refers to the structural, functional, or behavioral differences that exist between individuals of the same species. It is the core mechanism that prevents every living organism from being an exact copy of its parents, driving both individual uniqueness and the broader process of biological evolution.

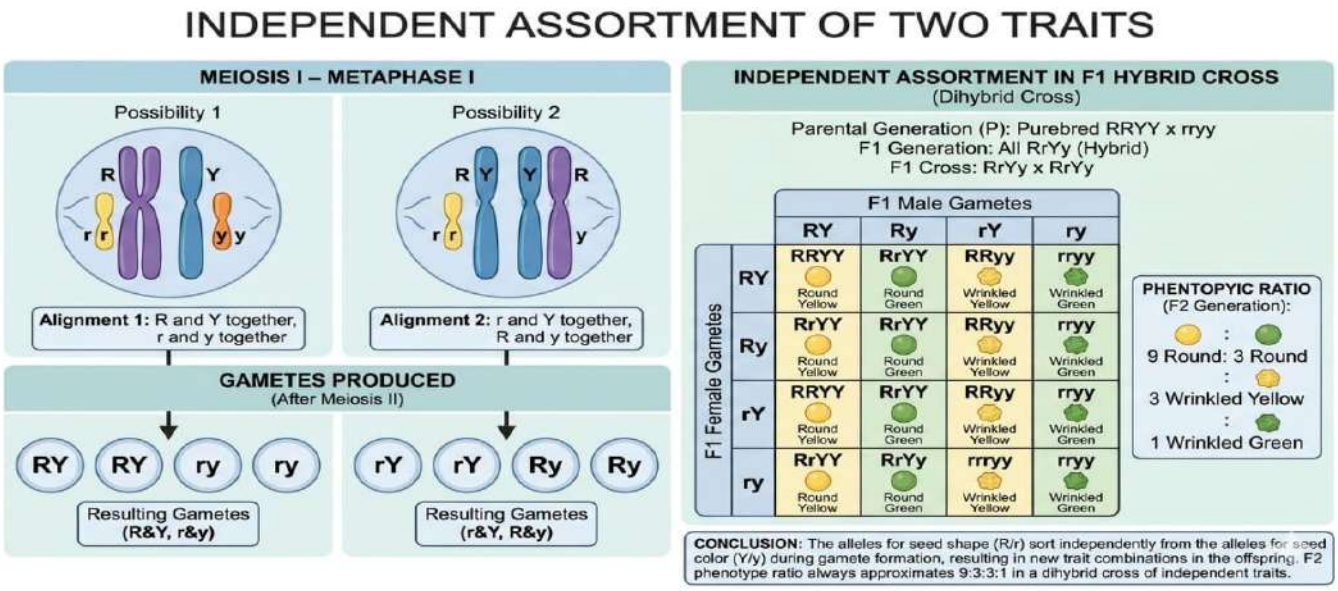
Types of Variation
*Genetic Variation: Caused by differences in DNA sequences. It is heritable and passed down to future generations through mechanisms like mutations, crossing over during meiosis, and random fertilization.
*Environmental Variation: Caused by external surroundings, lifestyle, or climate (e.g., skin tanning from the sun, or a plant growing larger due to better soil). It is not passed down to offspring.

Important of variations-
*It helps in survival of individuals.
*It helps in the creation of new species.
*It leads to mutation

Review question section 1
1.Why is variation important for a species?
2. Differentiate between inherited variation and acquired variation.

Laws of inheritance
*Fundamental genetic principles that explain how traits are passed from parents to their offspring, originally discovered by the 19th-century monk Gregor Mendel, who is known as the "Father of Genetics". Through his seven-year research on garden pea plants (*Pisum sativum*.
*Mendel selected pea plants for his experimental material because
- Many pair of contrasting characters - Easy to grow - Short life span.

***Mendel's law of inheritance**
-Law of dominance - Dominant traits expressed while recessive can't.
-Law of segregation (purity of gametes) -- Traits get separated during the formation of gamete
-Law of independent assortments



Preview question section 2

1.A trait may be inherited but may not be expressed. justify statement.

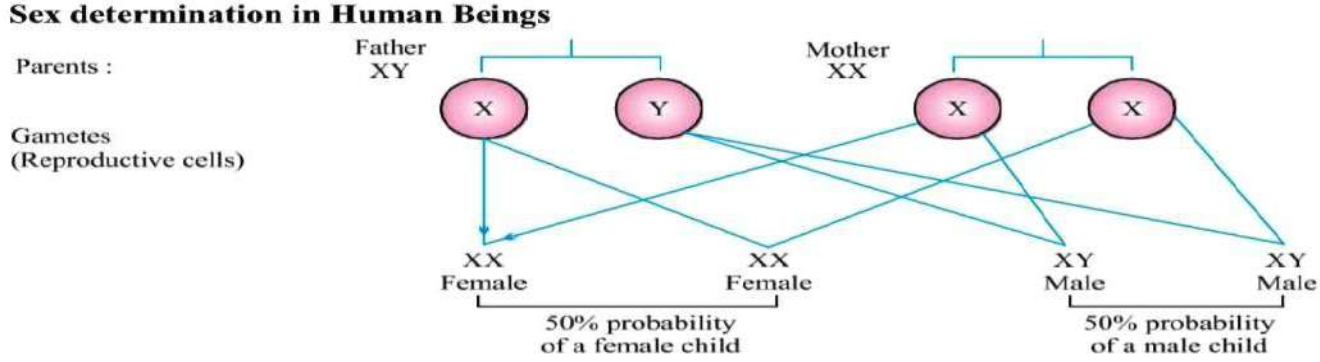
2. A pea plant with tall height (TT) is crossed with a dwarf plant (tt). All the plants in F_1 generation are tall. What does this show about the tall trait?

3. A farmer crossed round-seeded pea plants with wrinkled-seeded plants and obtained all round seeds in the first generation. Predict the result if F_1 plants are self-crossed.

Sex Chromosomes : In human beings, there are 23 pairs of chromosomes. Out of these 22 chromosome pairs are called autosomes and the last pair of chromosomes that help in deciding gender of that individual is called sex chromosome.

This shows that half the children will be male and half will be female. All children will inherit an X chromosome from their mother regardless whether they are boys or girls. Thus, sex of children will be determined by what they inherit from their father, and not from their mother.

In some species, determination of sex is dependent on external factors like. Food (honey bees.)Temperature (reptiles) etc.



Review questions section 3

1.In humans, a mother always contributes an X chromosome to the child, while the father may contribute either X or Y chromosome. Based on this information, who determines the sex of the child?

2.A sperm carrying Y chromosome fertilises an egg. What will be the chromosome combination in the child and what will be the sex?

Review questions Answer key

Section 1

1.environmental changes.

2.Key Differences: Inherited Variation: DNA-based; passed to offspring.Acquired Variation: Life-experience based; not passed to offspring.

Section 2

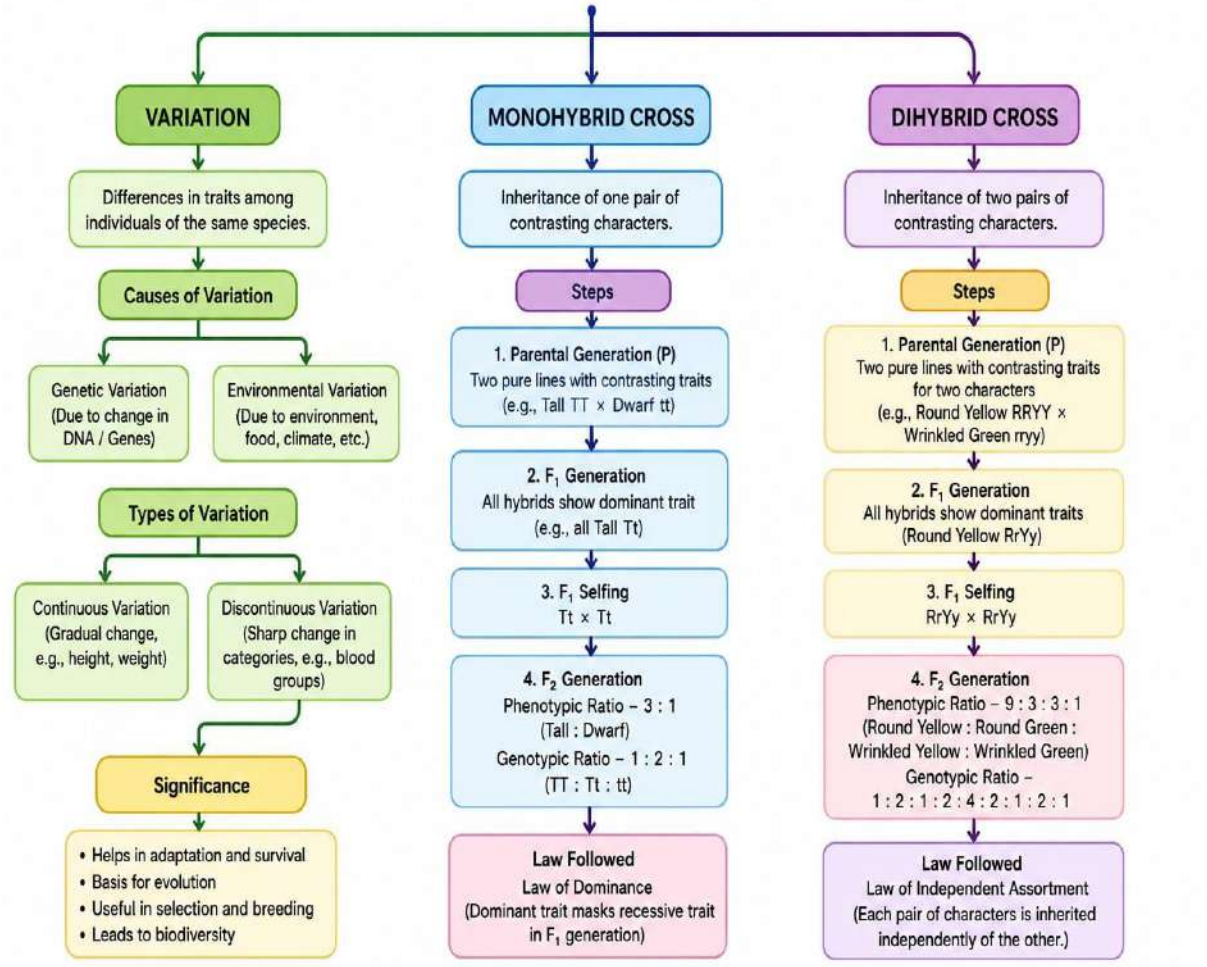
1.Recessiveness: The trait is masked by a dominant allele in heterozygous conditions.

2.Dominance: The tall trait is a dominant trait.

3. 3:1 Ratio: 75% round-seeded plants and 25% wrinkled-seeded plants.

Section 3 1.The father. 2.XY combination; Male (Boy).

Chapter 8 Heredity Flow Chart



9 Light – Reflection and Refraction

Theme: Natural Phenomena
Unit III: Natural Phenomena
Light – Reflection and Refraction: Reflection of light by curved surfaces; Images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula (Derivation not required), magnification. Refraction; Laws of refraction, refractive index.
Refraction of light by spherical lens; Image formed by spherical lenses; Lens formula (Derivation not required); Magnification. Power of a lens.

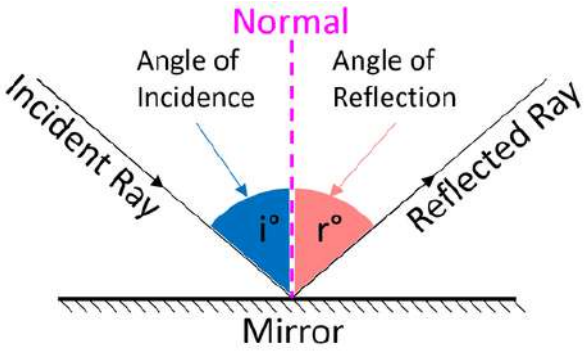
Reflection of Light

A highly polished surface like a mirror reflects most of the light falling on it.

Reflection of light follows two laws:

1.Angle of incidence = Angle of reflection

2.Incident ray, reflected ray and normal at the point of incidence lie in the same plane



These laws are applicable to all reflecting surfaces, including spherical mirrors.

Image Formed by a Plane Mirror

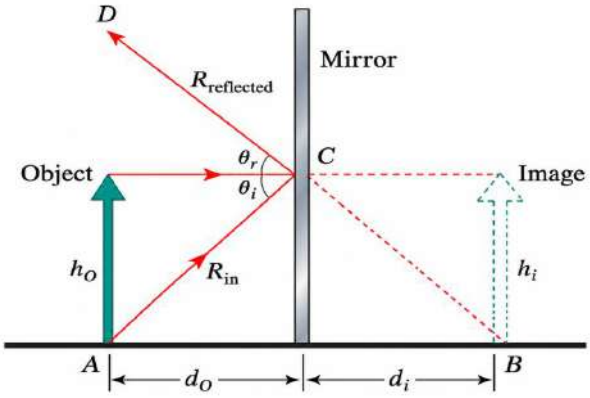
The image formed by a plane mirror is:

Virtual and erect

Same size as the object

Formed as far behind the mirror as the object is in front of it

Laterally inverted



Review questions section 1
1.State laws of reflection.
2. State any four characteristics of the image of the objects formed by a plane mirror.

Spherical Mirrors

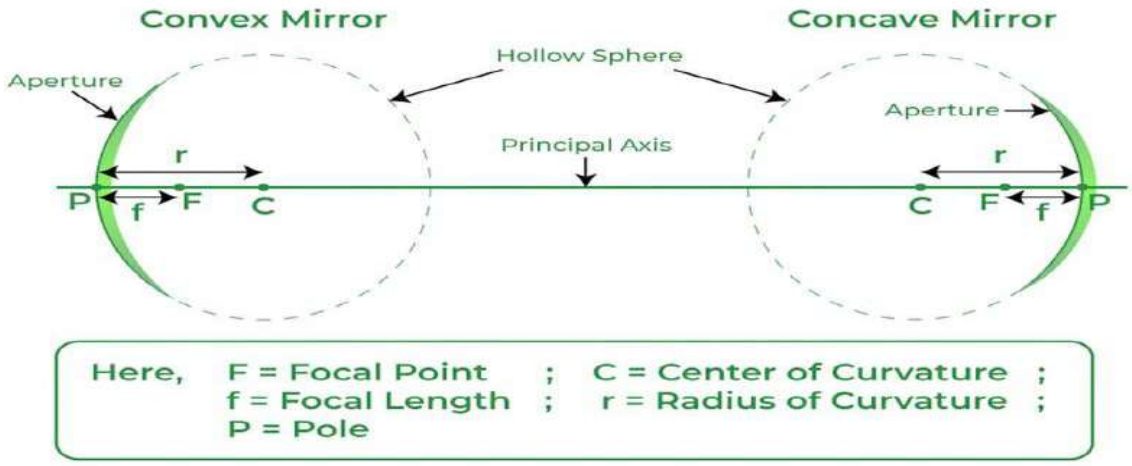
Mirrors whose reflecting surfaces form a part of a sphere are called **spherical mirrors**. The reflecting surface may curve inward or outward.

Types of Spherical Mirrors

Concave Mirror- Reflecting surface curves inward. Reflecting surface faces towards the centre of the sphere. Also called a **converging mirror**.

Convex Mirror - Reflecting surface bulges outward. Also called a **diverging mirror**.

Important Terms Related to Spherical Mirrors



1. Pole (P) - The centre point of the reflecting surface of the mirror. Lies on the surface of the mirror.

3. Radius of Curvature (R)

Radius of the sphere of which the mirror is a part. Distance between pole and centre of curvature.

[R = PC]

2. Centre of Curvature (C)

The centre of the sphere of which the mirror is a part. Lies outside the mirror.

Position of C - For a concave mirror → in front of the mirror

For a convex mirror → behind the mirror

4. Principal Axis - Imaginary straight line passing through pole (P) and centre of curvature (C).Normal to the mirror at the pole.

5. Principal Focus (F)

Principal focus lies midway between pole and centre of curvature.

Concave Mirror

Rays parallel to the principal axis meet at a point after reflection. This point is called the principal focus.

Convex Mirror

Reflected rays appear to come from a point behind the mirror. This point is the principal focus.

6. Focal Length (f)

Distance between pole (P) and principal focus (F). [f = PF]

7. Aperture

Diameter of the reflecting surface of the

Relation Between Radius of Curvature and Focal Length

(For spherical mirrors of small aperture)

Radius of curvature R = 2 x focal length

R = 2 f or f = R / 2

Image Formation by Spherical Mirrors

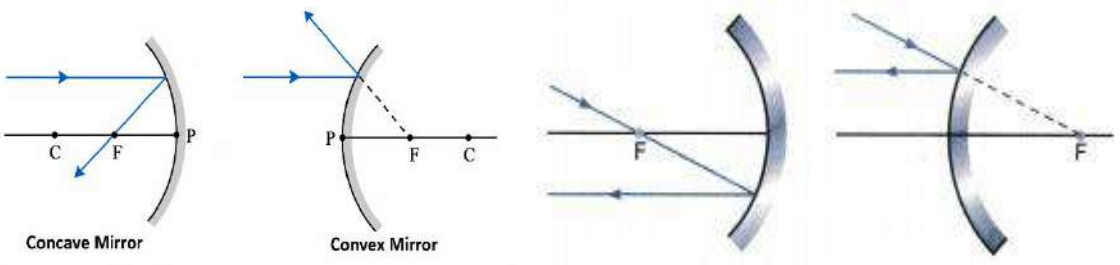
Nature, size and position of image depend on the position of the object.

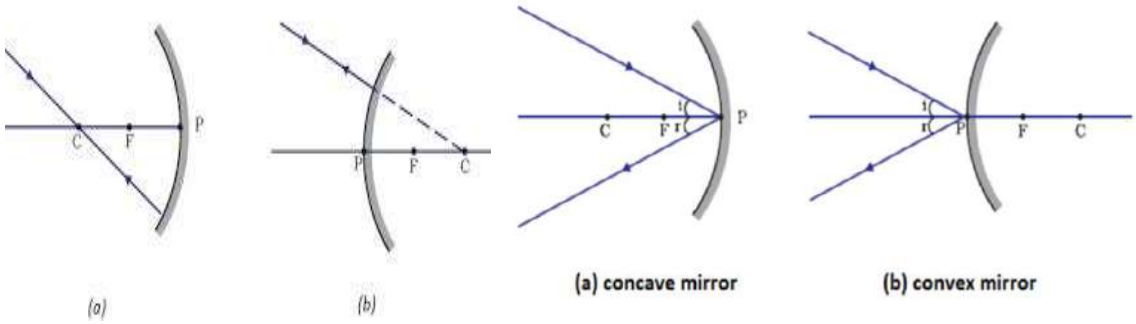
Images formed by spherical mirrors may be:

- Real or virtual
- Erect or inverted
- Enlarged, diminished or same size

Path of incident and reflected rays (spherical mirrors)

Path of Incident Ray	Concave Mirror – Path of Reflected Ray	Convex Mirror – Path of Reflected Ray
1. Ray parallel to the principal axis	Reflected ray passes through the principal focus (F)	Reflected ray appears to come from the principal focus (F) behind the mirror
2. Ray passing through or directed towards the principal focus (F)	Reflected ray becomes parallel to the principal axis	Reflected ray parallel to the principal axis
3. Ray passing through the Centre of curvature (C)	Reflected back along the same path	reflected back along the same path
4. Ray incident at the pole (P)	Reflected ray obeys the laws of reflection; angle of incidence = angle of reflection	Reflected ray obeys the laws of reflection; angle of incidence = angle of reflection





Review questions section 2

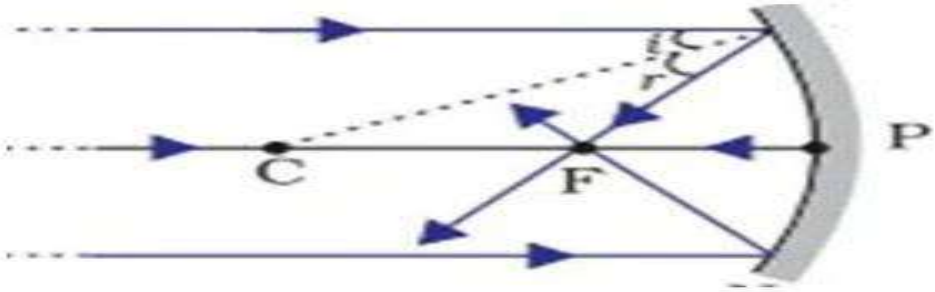
1.Explain why a ray of light passing through the centre of curvature of a concave mirror gets reflected along the same path.

2.Draw a ray diagram to show the path of the reflected ray corresponding to an incident ray of light parallel to the principal axis of a convex mirror and show the angle of incidence and angle of reflection on it.

3.What is the minimum number of rays required for locating the image formed by a concave mirror for an object?

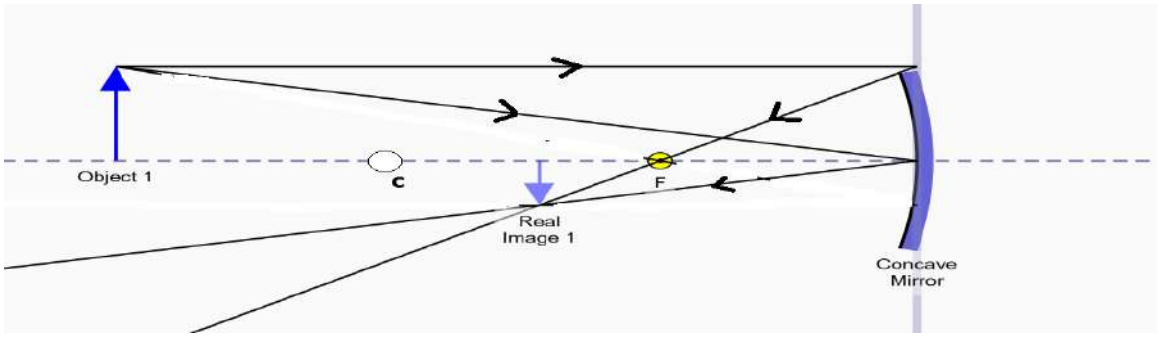
Image formation by spherical mirror

CASE I object at infinity



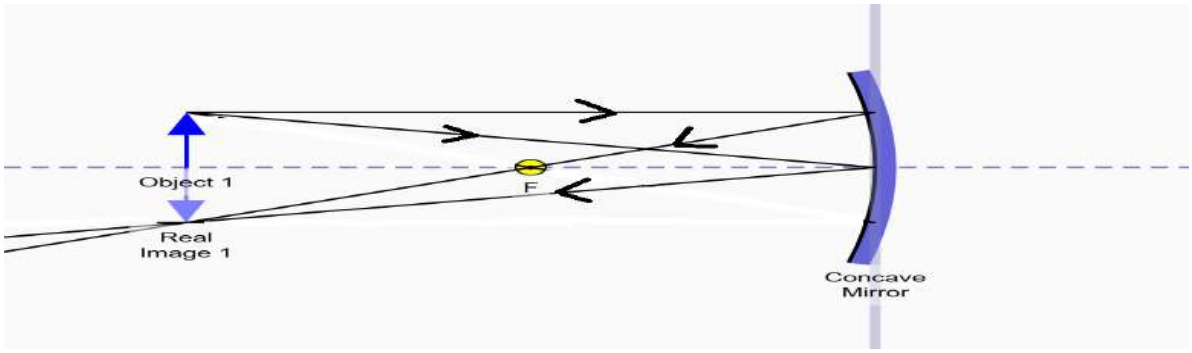
Position of the Object	Position of the Image	Relative Size of Image	Nature of Image
At infinity	At the focus F	Highly diminished, point-sized	Real and Inverted

CASE II object beyond C



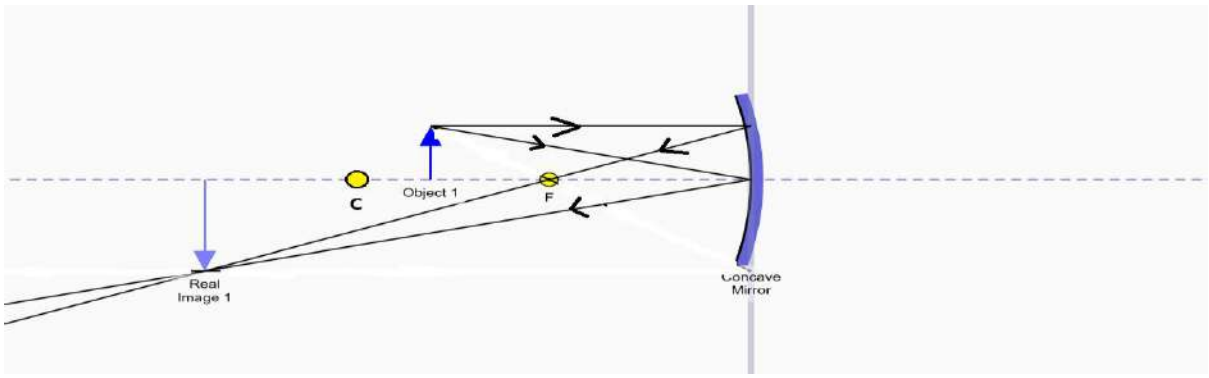
Position of the Object	Position of the Image	Relative Size of Image	Nature of Image
Beyond C	Between F and C	Diminished	Real and Inverted

CASE III object at C



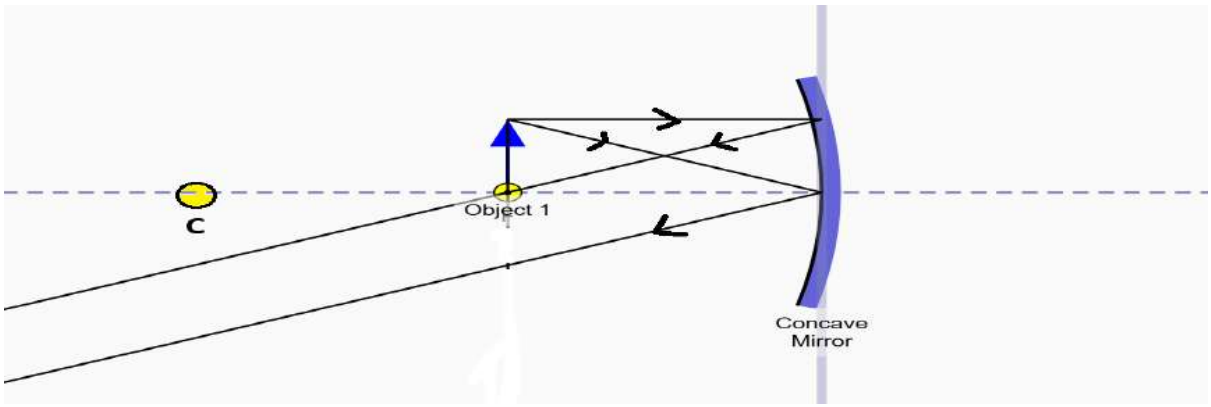
Position of the Object	Position of the Image	Relative Size of Image	Nature of Image
At C	At C	Same size	Real and Inverted

CASE IV object Between C and F



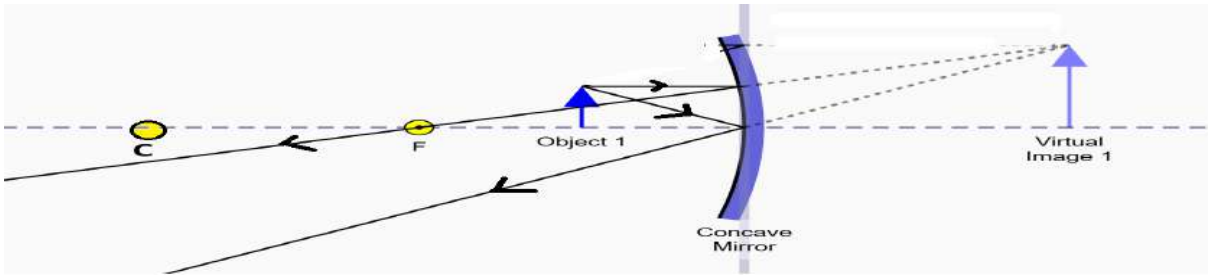
Position of the Object	Position of the Image	Relative Size of Image	Nature of Image
Between C and F	Beyond C	Enlarged	Real and Inverted

CASE V object at F



Position of the Object	Position of the Image	Relative Size of Image	Nature of Image
At F	At infinity	Highly enlarged	Real and Inverted*

CASE VI object between F and P



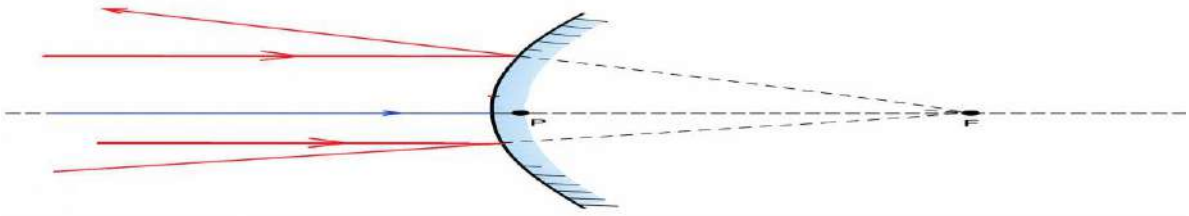
Position of the Object	Position of the Image	Relative Size of Image	Nature of Image
Between P and F	Behind the mirror	Enlarged	Virtual and Erect

Uses of Concave Mirrors

1. In torches, searchlights and vehicle headlights to obtain parallel beams
2. As shaving mirrors to get enlarged image
3. By dentists to see enlarged images of teeth
4. In solar furnaces to concentrate sunlight and produce heat

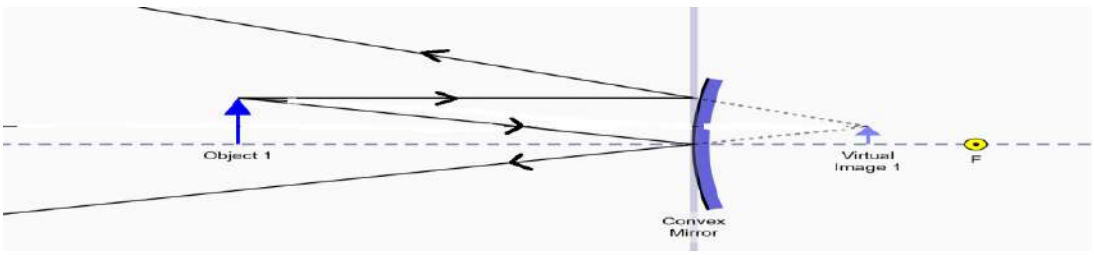
Image Formation by Convex Mirror

Case I Object at infinity



Position of Object	Position of Image	Size of Image	Nature of Image
1. Object at Infinity	Image formed at focus (F) behind the mirror	Highly diminished and point-sized	Virtual and erect

Case II object between infinity and pole P



Position of Object	Position of Image	Size of Image	Nature of Image
Object Between Infinity and Pole (P)	Image formed between P and F behind the mirror	Diminished	Virtual and erect

Characteristics of Images Formed by Convex Mirrors

- Always virtual
- Always erect
- Always diminished
- Formed behind the mirror
- Provide wider field of view

Uses of Convex Mirrors

1. Used as rear-view (wing) mirrors in vehicles
2. Help drivers see traffic behind safely
3. Provide wider field of view
4. Form erect and diminished images

Comparison Between Concave and Convex Mirrors

Concave Mirror	Convex Mirror
Curved inward	Curved outward
Converging mirror	Diverging mirror
Can form real or virtual images	Forms only virtual images
May form enlarged images	Always forms diminished images
Narrow field of view	Wide field of view
Used in shaving mirrors and headlights	Used in rear-view mirrors

Mirror Formula and Magnification

Object Distance (u) - Distance between object and pole of mirror.

Image Distance (v) - Distance between image and pole of mirror.

Focal Length (f) - Distance between principal focus and pole.

Mirror Formula

The relation between object distance, image distance and focal length is called the **mirror formula**.

Magnification

Magnification tells how much larger or smaller the image is compared to the object.

Represented by the letter **m**.

Mirror Formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

Magnification (m): It can be expressed as ratio of the height of the image (h') to the height of the object (h).

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

Important Points

Applicable to all spherical mirrors.

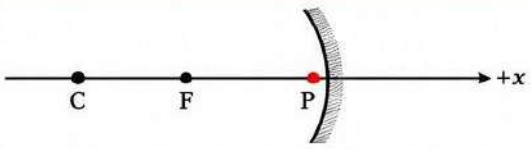
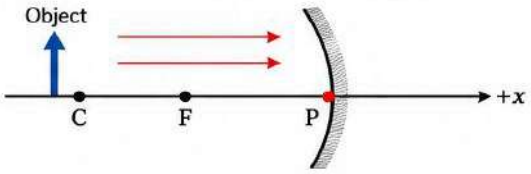
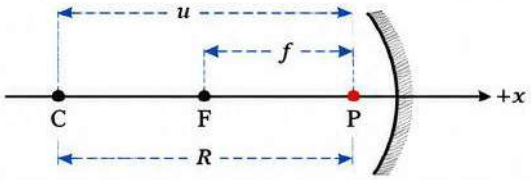
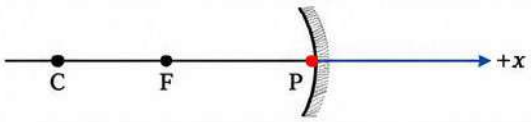
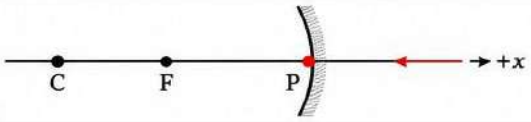
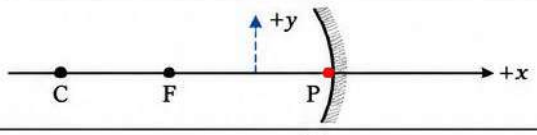
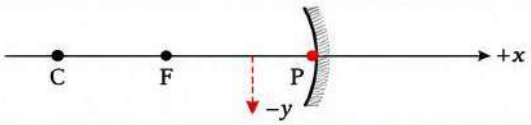
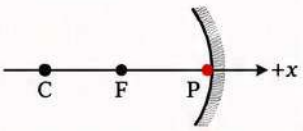
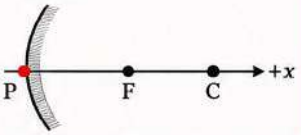
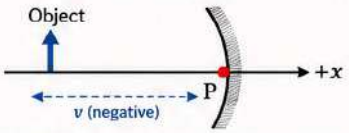
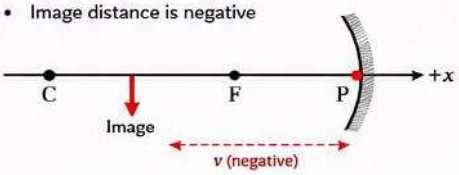
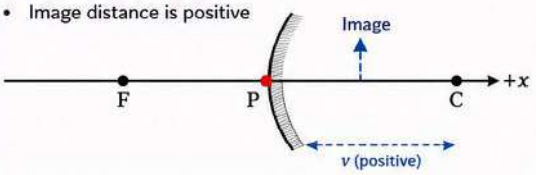
Valid for all positions of the object.

Sign convention must always be followed while substituting values

Formula for Magnification

Where: (h') = height of image (h) = height of object (v) = image distance (u) = object distance

New cartesian sign convention for mirrors

Rule/Topic	Explanation	Diagram / Illustration
Basic Idea of Sign Convention	• The pole (P) of the mirror is taken as the origin. • The principal axis acts as the x-axis. • All distances are measured from the pole (P).	
1. Position of Object	• The object is always placed to the left of the mirror. • Light rays are assumed to fall on the mirror from the left side.	
2. Measurement of Distances	• All distances are measured from the pole (P) of the mirror. • Distances are measured parallel to the principal axis.	
3. Distances Along Principal Axis	**Positive Distances** • Distances measured towards the right side of the pole • Along the $+x$-axis	
	Negative Distances • Distances measured towards the left side of the pole • Along the $-x$-axis	
Vertical Distances	**Positive Vertical Distances** • Distances measured upward from the principal axis • Along the $+y$-axis	
	Negative Vertical Distances • Distances measured downward from the principal axis • Along the $-y$-axis	
Important Sign Rules for Mirrors	**Concave Mirror** • Focal length (f) is negative • Radius of curvature (R) is negative	
	Convex Mirror • Focal length (f) is positive • Radius of curvature (R) is positive	
	Object Distance (u) • Always negative • Because object is placed on the left side of the mirror	
Image Distance (v)	**Real Image** • Formed in front of mirror • Image distance is negative	
	Virtual Image • Formed behind mirror • Image distance is positive	

Review questions section 3

1.What is the nature of the image formed by a concave mirror if the magnification produced by the mirror is +3?

2.Draw a ray diagram to show the formation of image of an object placed between infinity and the optical centre of a concave lens.

3.Draw a ray diagram to show the formation of a virtual image by a concave mirror.

Refraction of Light

Light travels in straight lines in a transparent medium. When light passes from one transparent medium to another, its direction may change. This change in direction of light is called **refraction of light**.

Cause of Refraction - Light changes direction because its speed changes when it enters another medium. Different media allow light to travel at different speeds.

Definition of Refraction - The bending of light when it travels obliquely from one transparent medium to another is called refraction of light.

Laws of Refraction

First Law - Incident ray, refracted ray and normal at the point of incidence lie in the same plane.

Second Law (Snell's Law) For a given pair of media: $\frac{\sin i}{\sin r}$ = constant Where: (i) = angle of incidence, (r) = angle of refraction

Refractive Index - The constant in Snell's law is called the **refractive index (n)**. It measures how much light bends in a medium. Different media have different refractive indices. Greater refractive index means greater bending of light.

Speed of Light in Different Media

Light travels fastest in vacuum. Speed of light in vacuum C = 3 x 10^8 m/s Speed decreases in water, glass and other media.

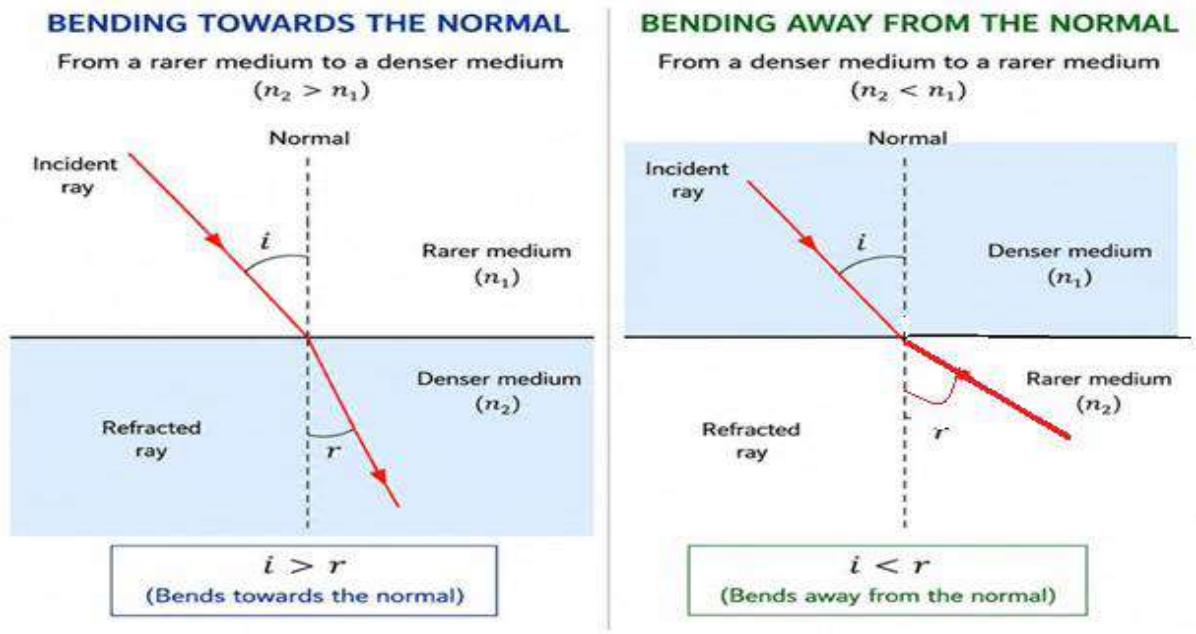
Absolute Refractive Index - Refractive index of a medium with respect to air or vacuum **(**When vacuum or air is the first medium)

Refractive Index of Medium 2 with Respect to Medium 1(air or vacuum) $n_{21} = \frac{c}{v}$

Refractive Index of Medium 2 with Respect to Medium 1 $n_{21} = \frac{v1}{v2}$

Refractive Index of Medium 1 with Respect to Medium 2 $n_{21} = \frac{v2}{v1}$

Where: C = speed of light in vacuum , v = speed of light in air or any other medium , v_1 = speed of light in medium 1 , v_2 = speed of light in medium 2



Optical Density - Optical density tells how strongly a medium refracts light. It is different from mass density.

Optically Denser Medium - Has higher refractive index. Light travels slower.

Optically Rarer Medium - Has lower refractive index. Light travels faster.

Behaviour of Light

From Rarer to Denser Medium Light slows down. Bends towards the normal.

From Denser to Rarer Medium Light speeds up. Bends away from the normal.

Everyday Examples of Refraction

1.Bottom of Water Tank Appears Raised - Due to bending of light rays while coming from water to air. **2. Letters Under a Glass Slab Appear Raised - Refraction** causes apparent upward shift. **3. Pencil Partly Immersed in Water Appears Bent - Light** from underwater part changes direction at water-air interface. **4. Lemon in Water Appears Bigger -** Refraction causes magnification effect.

Review question section 4

Why does a ray of light bend when it travels from one medium into another?

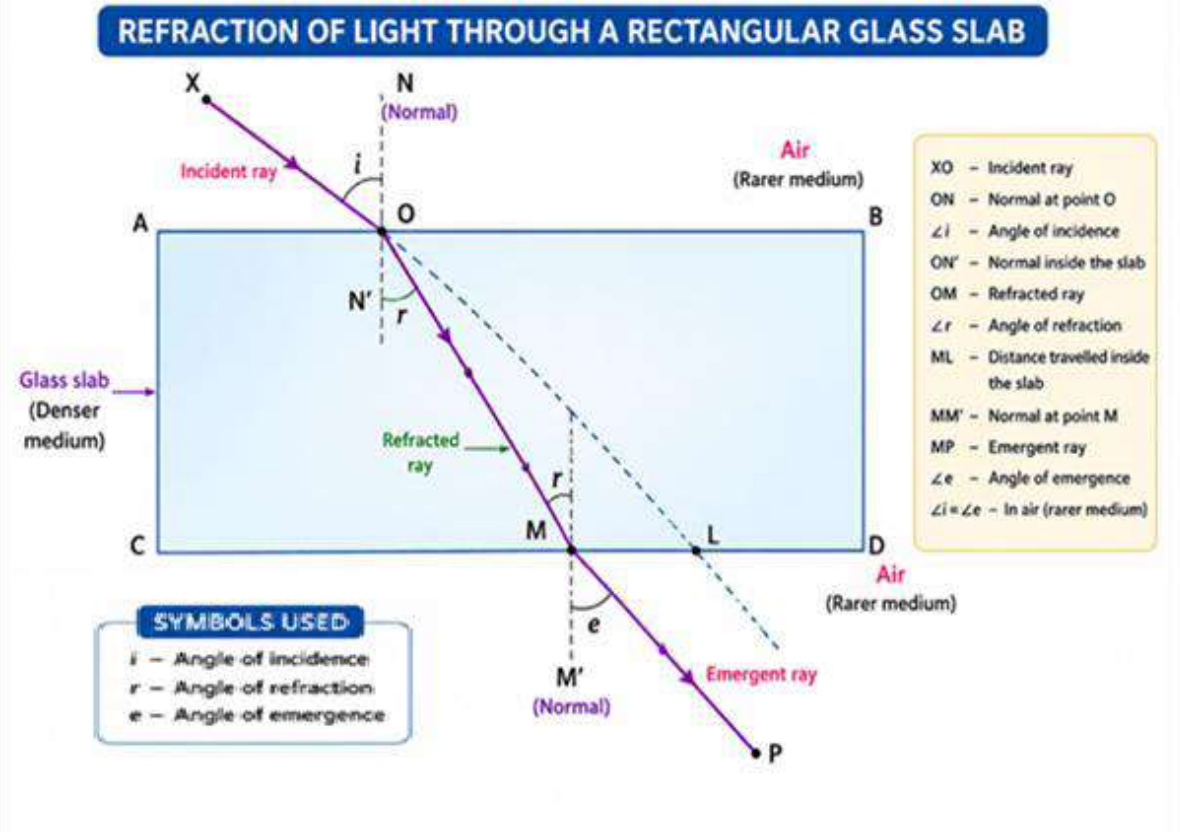
Refraction Through a Rectangular Glass Slab

Important Rays - Incident Ray - Ray falling on the surface. **Refracted Ray -** Ray travelling inside the second medium after bending. **Emergent Ray -** Ray coming out from the second surface.

Important Observations - From Air to Glass - Light bends towards the normal. (Because glass is optically denser than air.) **From Glass to Air -** Light bends away from the normal. (Because air is optically rarer than glass.)

Emergent Ray - Emergent ray becomes parallel to the incident ray. This happens because opposite bending at two parallel surfaces cancels out. However, the ray gets slightly shifted sideways. This is called **lateral displacement**.

Refraction at Normal Incidence - When light falls normally on the surface (perpendicular to the surface It passes straight without bending.



Review Questions section -5

1. What is refraction of light? Why does a ray of light bend when it travels from one medium to another?
2. State the two laws of refraction of light.
3. Define refractive index. Write its mathematical expression in terms of the speed of light in vacuum and in a medium.

Refraction by Spherical Lenses

Lens - A transparent material bounded by two surfaces, at least one of which is spherical.

Types of Lenses

1. Convex Lens - Thicker at the middle and thinner at edges. Converges parallel rays of light. Also called a **converging lens**.

2. Concave Lens - Thinner at the middle and thicker at edges. Diverges parallel rays of light. Also called a **diverging lens**.

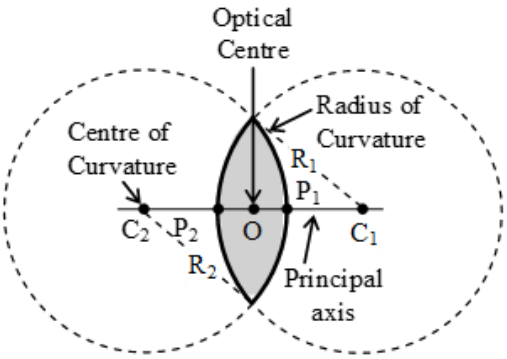
Important Terms Related to Lenses

1. Centre of Curvature (C_1 and C_2) - Centres of spheres forming the lens surfaces.

2. Principal Axis - Imaginary straight line joining centres of curvature.

3. Optical Centre (O) - Central point of the lens. A ray passing through it goes undeviated.

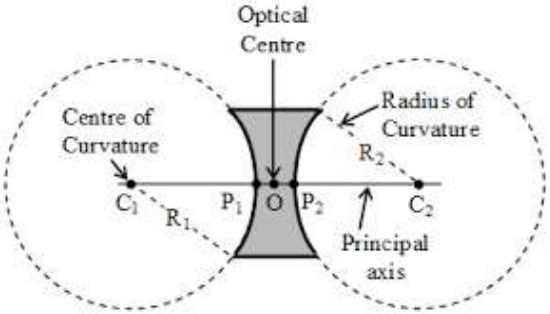
4. Aperture - Effective diameter of the lens.



Principal Focus of Lenses

Convex Lens – A point at which rays parallel to principal axis converge is called principal focus.

Concave Lens - A point at which rays parallel to principal axis appear to diverge is called Principal focus.

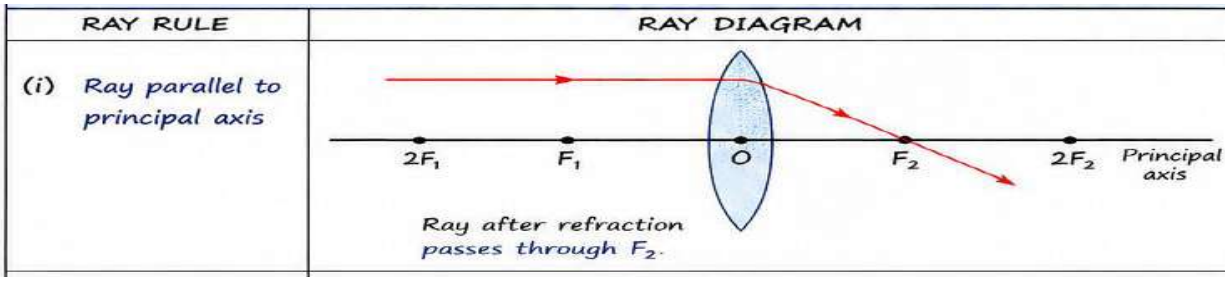


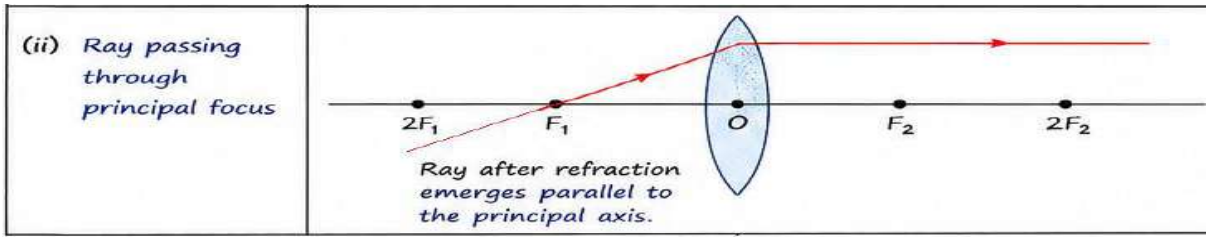
Principal Foci A lens has two principal foci: (F1), (F2)

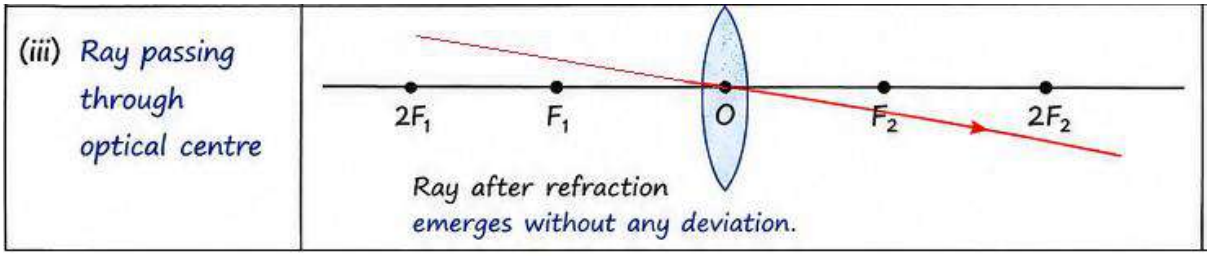
Focal Length - Distance between optical centre and principal focus. [f = OF]

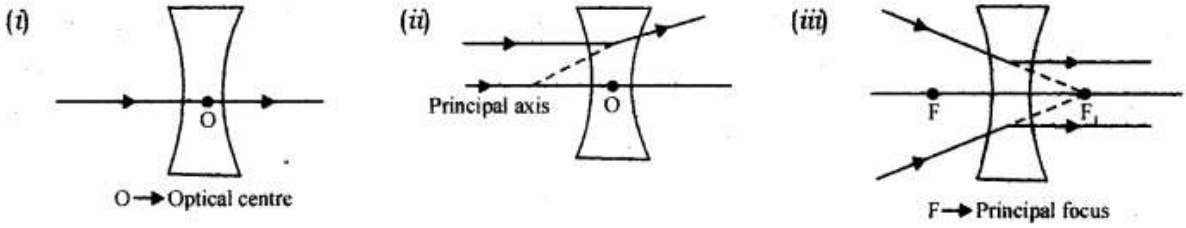
Path of incident and refracted rays (convex lens)

Ray Type	Convex Lens (Converging Lens)	Concave Lens (Diverging Lens)
(i) Ray parallel to principal axis	After refraction, passes through the principal focus on the **other side** of the lens.	After refraction, appears to diverge from the principal focus on the **same side** of the lens.
(ii) Ray through principal focus	A ray passing through the principal focus emerges **parallel to the principal axis** after refraction.	A ray directed towards the principal focus emerges **parallel to the principal axis** after refraction.
(iii) Ray through optical centre	Passes through the lens **without deviation** (straight line).	Passes through the lens **without deviation** (straight line).

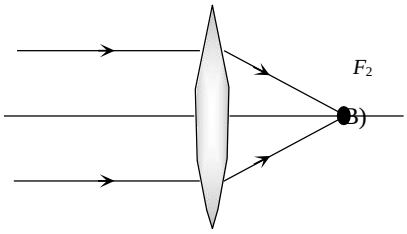








Convex lens – conversing nature



Concave lens – Diversing nature

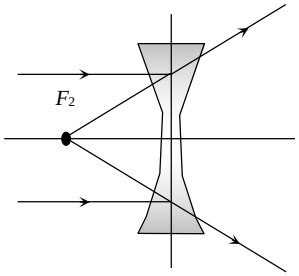
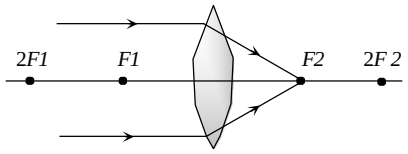
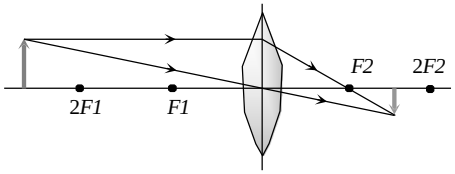


Image Formation by Convex Lens

Object at Infinity - Image at F_2, highly diminished, Real and inverted	
Object Beyond $2F_1$ - Image between F_2 and $2F_2$ Diminished Real and inverted	

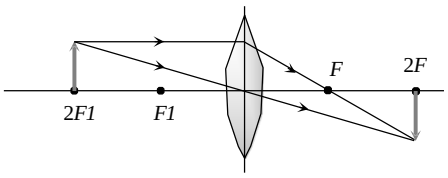
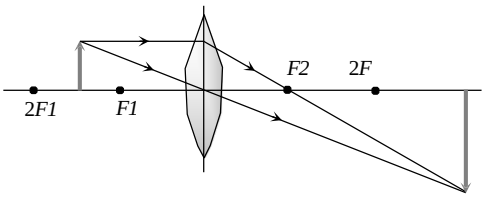
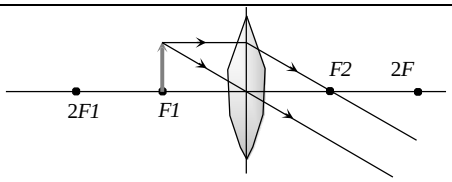
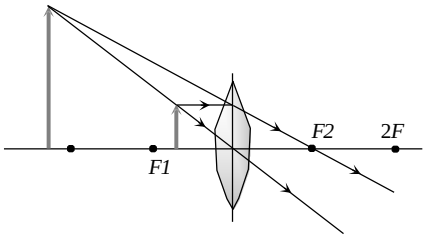
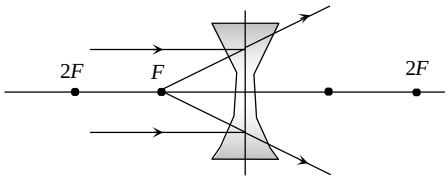
Object at $2F_1$ - Image at $2F_2$ Same size Real and inverted	
Object Between F_1 and $2F_1$ - Image beyond $2F_2$ Enlarged Real and inverted	
Object at F_1 - Image at infinity, Enlarged Real and inverted	
Object Between F_1 and O - Image on same side of lens, Enlarged, Virtual and erect	

Image Formation by Concave Lens

Characteristics - Image is always: Virtual, Erect, Diminished

Object at Infinity - Image at F_1, highly diminished, virtual, erect



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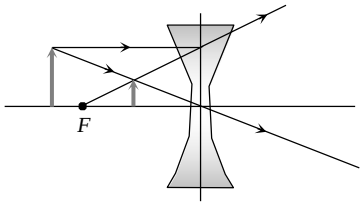
Object Between Infinity and Optical Centre - Image between F_1 and O, Diminished



Topic	Rule / Formula	Explanation
Sign Convention for Lenses	Same sign convention as mirrors	The same Cartesian sign convention used for mirrors is followed for lenses.
	Distances measured from optical centre	All distances are measured from the optical centre of the lens.
Convex Lens	Focal length positive	(f) is taken as positive.
Concave Lens	Focal length negative	(f) is taken as negative.
Object Distance (u)	Always negative	Object is always placed on the left side of the lens.
Real Image	Image distance positive	Real image forms on the right side of lens.
Virtual Image	Image distance negative	Virtual image forms on the same side as object.
Lens Formula	$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$	(v) = image distance, (u) = object distance, (f) = focal length
Magnification Formula	M = $\frac{h'}{h}$	(h') = image height, (h) = object height
Relation Between Magnification and Distances	M = $\frac{v}{u}$	Magnification is equal to ratio of image distance to object distance.
Positive Magnification	(m > 0)	Image formed is virtual and erect.
Negative Magnification	(m < 0)	Image formed is real and inverted.

Power of a Lens - Power of a lens measures its ability to converge or diverge light. Its unit is Dioptre (D) It is reciprocal of focal length of lens in metre

$$P = \frac{1}{f(metre)} = \frac{100}{f\ (cm)}$$ (Diopter (D) (1D = 1 m^{-1})

Where: (P) = power of lens , (f) = focal length in metre

Sign of Power **Convex Lens** Positive power **Concave Lens** Negative power

Combination of Lenses

Total power of lenses in contact: P=P1+P2+P3+…….

Uses of lens: Spectacles, magnifying glass, cameras, microscopes.

Review questions section 6

1.An object of height 10 cm is placed 25 cm away from the optical centre of a converging lens of focal length 15 cm. Calculate the image-distance and height of the image formed.

2.Draw ray diagrams to represent the nature, position and relative size of the image formed by a convex lens for the object placed: (a) at 2F1 (b) Between F1, and the optical centre O of lens

Review questions Answer key

section 1

1.Laws of Reflection 1. Angle of incidence = Angle of reflection. 2. Incident ray, reflected ray and normal lie in the same plane. 2.Characteristics of Image Formed by Plane Mirror - image is virtual, erect, same size as object, laterally inverted.

section 2

1. A ray passing through the centre of curvature strikes the mirror normally, so the angle of incidence is $0°$. Hence, it gets reflected back along the same path. 2.In a convex mirror, a ray parallel to the principal axis gets reflected and appears to diverge from the principal focus behind the mirror. Angle of incidence and angle of reflection are equal. 3.Minimum two rays are required to locate the image formed by a concave mirror.

section 3

1.If magnification of a concave mirror is +3, the image formed is virtual, erect and magnified. 2.Concave Lens Image Formation - Object placed anywhere between infinity and optical centre forms: a virtual erect diminished image between focus (F) and optical centre (O) on the same side of the lens. 3.Virtual Image by Concave Mirror -When the object is placed between pole (P) and focus (F) of a concave mirror, the image formed is: virtual erect magnified behind the mirror.

section 4

1. A ray of light bends when it travels from one medium to another because its speed changes in different media. This bending of light is called refraction.

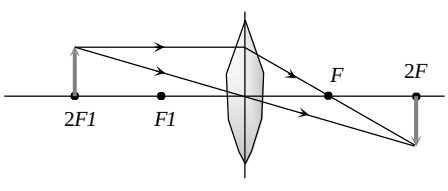
section 5

1.Refraction is the bending of light when it passes from one transparent medium to another due to change in its speed. 2.Laws of Refraction (i) The incident ray, refracted ray and normal at the point of incidence lie in the same plane. (ii) For a given pair of media, the ratio $\frac{\sin i}{\sin r}$is constant. 3.Refractive Index - Refractive index is the ratio of speed of light in vacuum to the speed of light in a medium. Mathematical expression: $n = \frac{c}{v}$

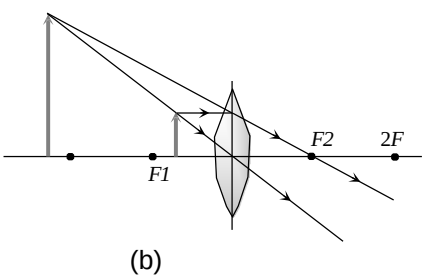
section 6

1. Given: Object height, $h = 10$ cm Object distance, $u = -25$ cm Focal length of convex lens, $f = +15$ cm Using lens formula: $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ Substituting values: $\frac{1}{v} - \frac{1}{(-25)} = \frac{1}{15}$ $\frac{1}{v} + \frac{1}{25} = \frac{1}{15}$ $\frac{1}{v} = \frac{1}{15} - \frac{1}{25}$ $\frac{1}{v} = \frac{5-3}{75} = \frac{2}{75}$ $v = 37.5$ cm So, the image distance is: $\boxed{v = 37.5 \text{ cm}}$ magnification: $m = \frac{v}{u} = \frac{h'}{h}$ $m = \frac{37.5}{-25} = -1.5$ $\frac{h'}{10} = -1.5$ $h' = -15$ cm

image height is: $\boxed{h' = -15 \text{ cm}}$



2.(a)



(b)

chapter **9 Light – Reflection and Refraction Flow Chart**

LIGHT: REFLECTION AND REFRACTION

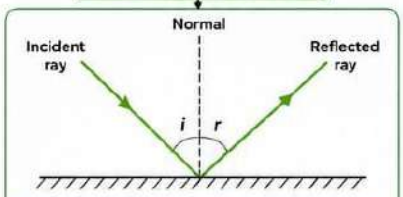
Light is a form of energy that travels in straight lines. When light falls on a surface or passes from one medium to another, it shows two important phenomena.

TWO PHENOMENA OF LIGHT

1. REFLECTION OF LIGHT

The bouncing back of light into the same medium when it strikes a surface.

LAWS OF REFLECTION

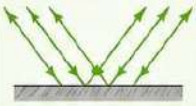


1. The angle of incidence (i) is equal to the angle of reflection (r).
2. The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.

TYPES OF REFLECTION

REGULAR (SPECULAR) REFLECTION

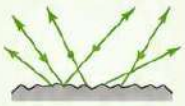
Occurs on smooth, polished surfaces. Reflected rays are parallel.



Example: Plane mirror, calm water surface

DIFFUSE (IRREGULAR) REFLECTION

Occurs on rough surfaces. Reflected rays scatter in different directions.



Example: Wall, paper, wooden surface

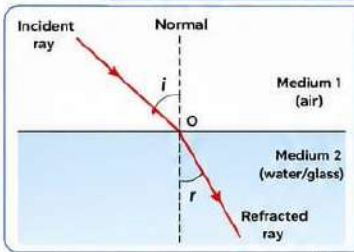
2. REFRACTION OF LIGHT

The bending of light when it passes from one medium to another.

WHY DOES REFRACTION OCCUR?

Light changes its speed when it enters a different medium. This change in speed causes a change in direction.

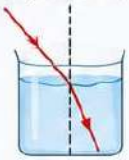
LAWS OF REFRACTION (Snell's Law)



1. $\frac{\sin i}{\sin r}$ = constant (Snell's Law)
2. The incident ray, the refracted ray and the normal at the point of incidence, all lie in the same plane.

EFFECT OF REFRACTION

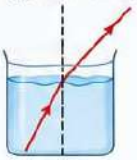
Rarer to Denser (e.g., air to water)



$r < i$

Bends towards the normal

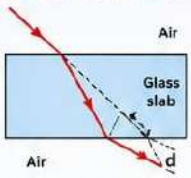
Denser to Rarer (e.g., water to air)



$r > i$

Bends away from the normal

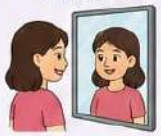
Lateral Displacement



Ray emerges parallel to the incident ray but shifted sideways.

IMPORTANT EXAMPLES

Plane Mirror



Uses regular reflection to form image.

Rear-view Mirror

Uses convex mirror (reflection) to get a wide field of view.

Twinkling of Stars

Due to atmospheric refraction of starlight.

Rising of Sun

Sun appears higher than its actual position due to refraction.

Pencil in Water

Pencil appears bent due to refraction at the water surface.

Rainbow

Caused by refraction, dispersion and internal reflection of sunlight in water droplets.

APPLICATIONS IN DAILY LIFE

Mirrors

Used in looking glasses, dressing mirrors, periscopes.

Lenses

Used in spectacles, cameras, microscopes, telescopes.

Optical Fibres

Use total internal reflection to transmit data and light.

Periscope

Uses reflection to see objects not in direct line of sight.

Mirage

Caused by atmospheric refraction; water appears on hot roads.

Prism

Used to split white light into its constituent colours.

SUMMARY

Reflection is the bouncing back of light in the same medium obeying the laws of reflection.
Refraction is the bending of light when it passes from one medium to another obeying Snell's Law.

Chapter 10 The Human Eye and the Colourful World

Theme: Natural Phenomena Unit III: Natural Phenomena 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 daily life (excluding colour of the sun at sunrise and sunset).

Parts of the Human Eye and Their Functions

The **cornea** is the transparent front part of the eye that refracts or bends the incoming light rays.

The **pupil** is a small opening in the eye that regulates and controls the amount of light entering the eye.

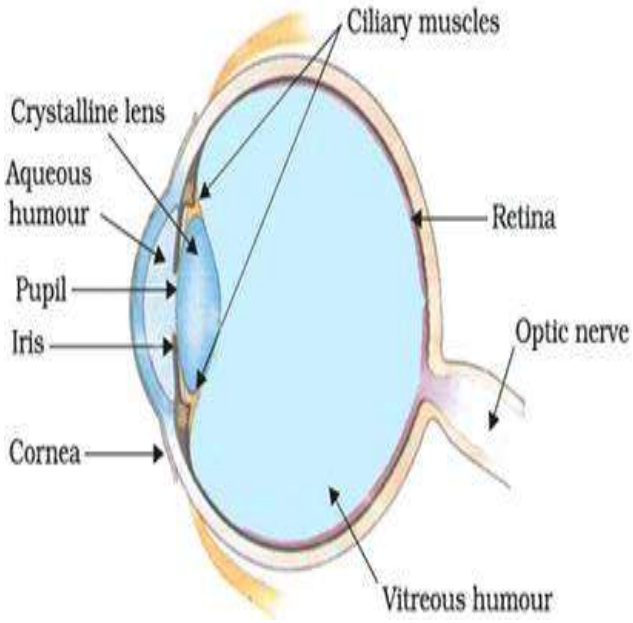
The **iris** is the coloured part of the eye which controls the size of the pupil.

The **ciliary muscles** control the thickness or curvature of the lens and help in the process of accommodation.

The **crystalline lens** makes fine adjustments in focal length so that objects at different distances can be seen clearly.

The **retina** contains light-sensitive sensory receptors where the image is formed.

The **optic nerve** carries electrical impulses from the retina to the brain for interpretation.



The ability of the eye lens to adjust its focal length is called **power of accommodation**.

Far point and near point of eye: The farthest point that a normal eye can see any object clearly is infinity and the nearest point is 25cm (Least Distance of Distinct Vision or LDDV)

Review questions section 1

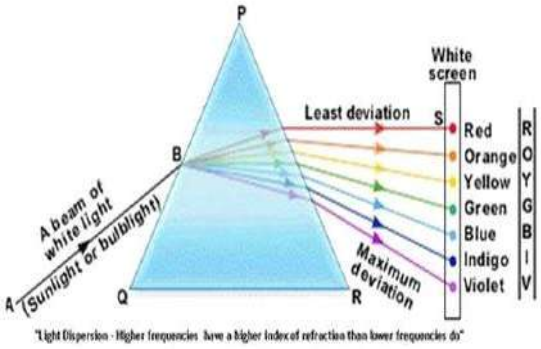
1.Name the part of the eye that controls the amount of light entering it.

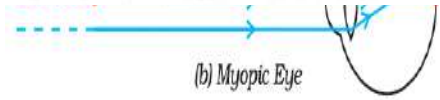
2.What is the function of the retina?

3.Why is the image formed on the retina inverted?

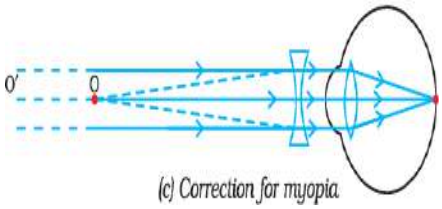
Defects of vision and their correction

Myopia (short-sightedness): A person can see nearby object clearly but can't see distant object clearly.
Causes:(i) Excessive curvature of lens or decreased focal length.(ii) elongation of eye ball
The image is formed in front of the retina.
It can be corrected by using a concave lens.

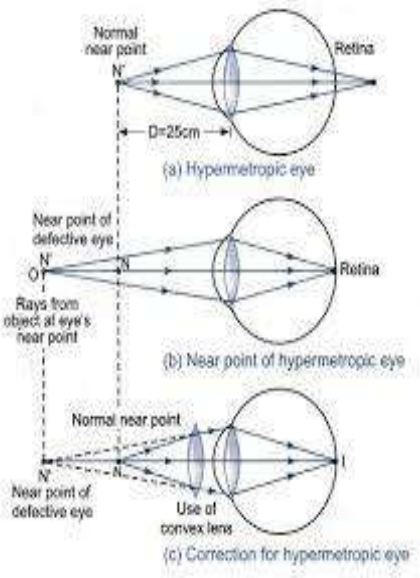




Hypermetropia (far-sightedness): -A person can see distan to objects clearly but can't see nearby objects clearly.
Cause: (i) Shortening of eyeball. (ii) increase in focal length of lens or decreasepower of lens.
The image is formed behind the lens. This defect can be corrected by using a convex lens.



(iii) **Presbyopia** : -This defect is caused during old age. In this defect the ciliary muscles weakens and decreases the power of accommodation and unable to see nearby objects clearly.
--Sometime old people are unable to see nearby as well as distantobjects clearly.
--The defect can be corrected by **bifocal lens**.

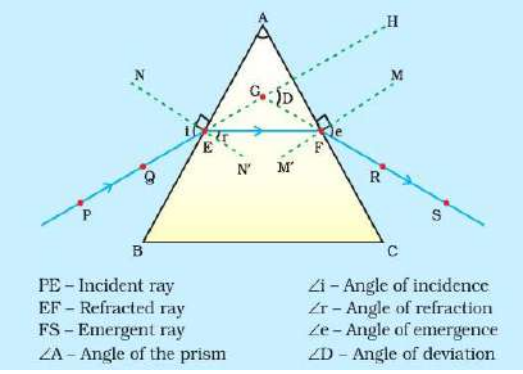


Review questions section 2
1.Rohan can see nearby objects clearly but cannot see the blackboard from the last bench. Identify the defect of vision.
Which type of lens is used to correct it?

2.Sia can see distant objects clearly but faces difficulty while reading a book kept close to her eyes.

3.Name the defect of vision. Suggest the corrective lens required.

Refraction through Prism:
When a ray of white light passes through a glass prism then it refract twice and deviates from its normal path'
The angle to which it enters the prism is called angle of incidence ( ) The angle to which it deviates from its normal path is called angle of deviation (D).



Dispersion of white light by a glass prism
When a beam of white light passes through a prism it get refracted twice and finally the white light split into a band of seven colour or visible spectrum. This splitting of light into Seven colour is called dispersion of light.
Different colours of light bend through different angles with respect to the incident ray, as

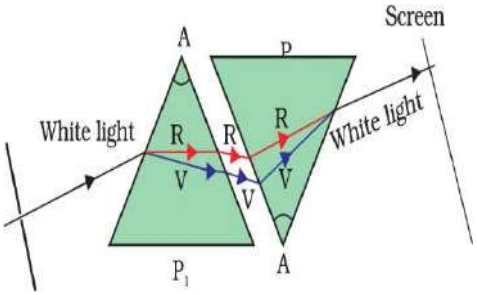
they pass through a prism.
The red light bends the least while the violet the most.

Review question section 3

1. White light passes through a prism and forms different colours on a screen. Name this phenomenon.

Recombination of the spectrum of white light

Sir Issac Newton tried to find out that whether the spectrum obtained by prism are further split into more colour he kept one prism upright and other inverted and passed white light but he failed to split further instead he found that the seven colour unite to form white light again, which suggest that white light consist of seven colors.

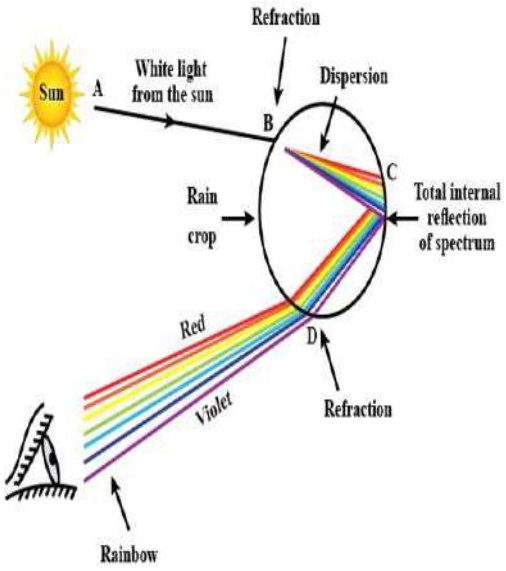


Formation of rainbow

➢Rainbow is a band of seven colours or natural visible spectrum which is formed just after the rain shower.

➢The suspended tiny water droplets in air act as prism, when light passes through these tiny droplets then it **refracted** and **dispersed** and finally suffers **total internal reflection** results in formation of band of seven colours called rainbow

➢Essential condition for observing a rainbow is that observer must stand with his back towards the sun

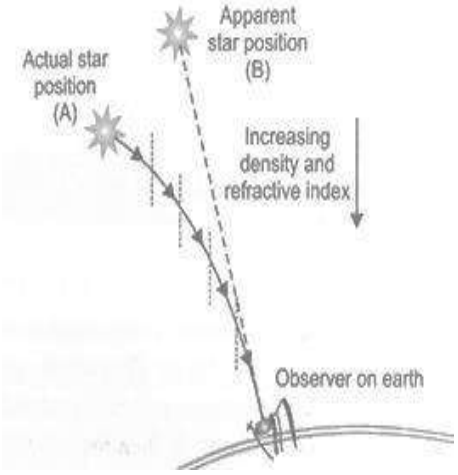


Review questions section 4

1. During rain, Rahul saw a rainbow in the sky after sunlight appeared. Which phenomenon is responsible for the formation of rainbow?

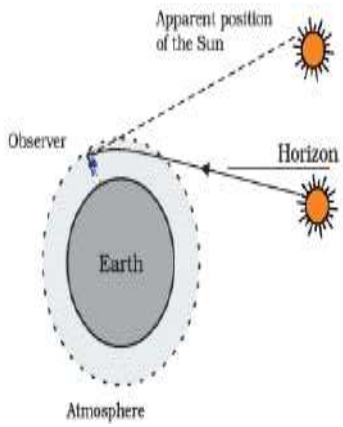
2.A rainbow always forms opposite to the Sun. What does this indicate about the path of sunlight?

Atmospheric refraction (stars seen higher than they are, advance sunrise and delayed sunset, the sun appears flattened during sunrise and sunset, stars twinkle but planets do not.)



Stars seen higher than they are: Stars are very far away the light coming from space (vacuum, a rare medium) enters into the earth's atmosphere (denser medium) after several refraction the stars appear backward

Advance sunrise and delayed sunset



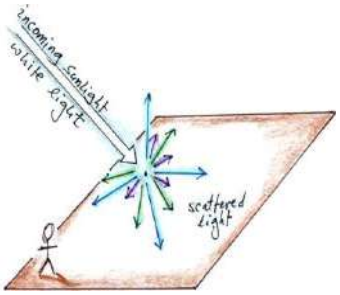
During sunrise and sunset sunlight comes from lower atmospheric density to higher density due to which refraction takes place and light appears to be coming from above the horizon level than the actual position of the sun. **Sun appears flattened during sunrise and sunset:** Due to unequal bending of light from lower and upper part of sun during sunrise or sunset, it appears oval.

Stars twinkle but planets do not: Stars are very far away from the earth and act as a point source of light. The light coming from the star reaching our eyes increases and decreases continuously due to earth's atmospheric refraction hence appears twinkling. Whereas planets are closer to the earth and act as a large number of point sources. The total variation in the amount of light entering our eye from all the point sized sources will average out to zero.

Review question section 5

1. Stars appear to twinkle while planets usually do not. What causes the twinkling of stars?

<u>Scattering of light:</u> When a beam of light encounter any suitable size of particle then the particle redirects the direction of light in different direction, which illuminates the surrounding.



The phenomenon of scattering of light by the colloidal particles like smoke, tiny water droplets, suspended particles of dust and molecules of air of atmosphere gives rise to the Tyndall **effect.** Ex: Light passing through canopy, dark room with dust, light through colloids.

Why is the colour of the clear Sky Blue?: When sunlight passes through the atmosphere, the fine particles in air scatter the blue colour (shorter wavelengths) more strongly than red. The scattered blue light in the atmosphere enters our eyes and the sky looks blue.

Why space looks dark for astronauts: The sky appears dark to passengers flying at very high altitudes, due to absence of atmosphere, scattering is not prominent at such heights.

Reddish appearance of the Sun at the sunrise or sunset: Near the horizon light has to travel a longer distance and most of the blue light and shorter wavelengths are scattered away by the particles. Therefore, the light that reaches our eyes is of red colour having longer wavelengths which do not scatter completely. This gives rise to the reddish appearance of the Sun during sunrise and sunset.

Review questions section 6

1.Red colour is used in danger signals and stop signs. Why is red colour preferred?

2. The sky appears blue during daytime. Which phenomenon causes this effect?

3.During sunset, the Sun appears reddish in colour. Explain the reason briefly.

Review questions Answer key

Section 1

1.The iris controls the amount of light entering the eye.

2. The retina acts as a screen on which the image is formed and sends visual signals to the brain through the optic nerve.

3. The image formed on the retina is inverted because the eye lens is a convex lens, which forms a real and inverted image.

Section 2

1. The defect is myopia (short-sightedness). It is corrected using a concave lens.
2. The defect is hypermetropia (long-sightedness). It is corrected using a convex lens.

Section 3

1. The phenomenon is called dispersion of light.

Section 4

1. Rainbow formation is caused by dispersion, refraction and total internal reflection of sunlight in water droplets.
2. It indicates that sunlight is refracted and reflected inside raindrops before reaching the observer.

Section 5

1. Twinkling of stars is caused by atmospheric refraction of starlight.

Section 6

1. Red colour is preferred because it scatters the least in air and can be seen from far away.
2. The sky appears blue due to scattering of light.
3. During sunset, most colours scatter away and mainly red light reaches our eyes, so the Sun appears reddish.

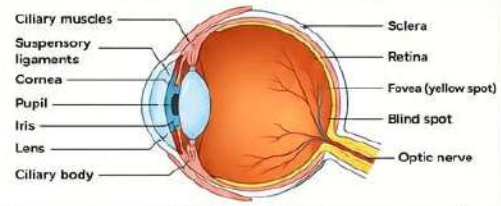
Chapter 10 The Human Eye and the Colourful World Flow chart

THE HUMAN EYE AND THE COLOURFUL WORLD

We see the world because light enters our eyes and our brain interprets it. The human eye is a wonderful natural instrument and light is responsible for colours around us.

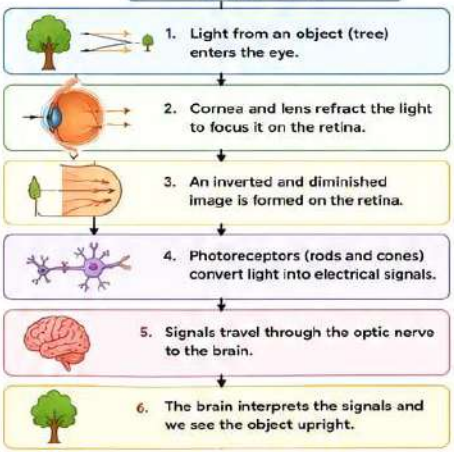
1. THE HUMAN EYE – THE NATURAL CAMERA

STRUCTURE OF THE HUMAN EYE



FUNCTIONS OF PARTS		
Cornea	:	Transparent layer that protects the eye and refracts incoming light.
Iris	:	Coloured part that controls the size of pupil and the amount of light entering the eye.
Pupil	:	Opening through which light enters.
Lens	:	Transparent, flexible structure that changes its shape to focus light.
Ciliary muscles	:	Change the shape of the lens for focusing.
Retina	:	Light-sensitive layer having millions of photoreceptors (rods and cones).
Fovea (yellow spot)	:	Region of sharpest vision.
Optic nerve	:	Carries electrical signals from retina to brain.

HOW WE SEE



1. Light from an object (tree) enters the eye.
2. Cornea and lens refract the light to focus it on the retina.
3. An inverted and diminished image is formed on the retina.
4. Photoreceptors (rods and cones) convert light into electrical signals.
5. Signals travel through the optic nerve to the brain.
6. The brain interprets the signals and we see the object upright.

(The brain does the final processing of the image.)

2. DEFECTS OF VISION AND THEIR CORRECTION

(A) MYOPIA (Short-sightedness)

Distant objects appear blurry.

Cause

Elongated eyeball or excessive curvature of the eye lens.

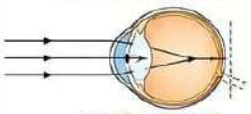
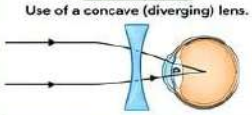


Image formed in front of the retina.

Correction

Use of a concave (diverging) lens.



(B) HYPERMETROPIA (Long-sightedness)

Near objects appear blurry.

Cause

Shortened eyeball or decreased curvature of the eye lens.

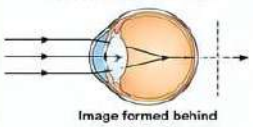
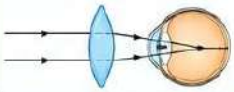


Image formed behind the retina.

Correction

Use of a convex (converging) lens.



(C) PRESBYOPIA

Difficulty in seeing near objects with age.

Cause

Loss of elasticity of lens and weakening of ciliary muscles.

Correction

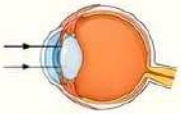
Use of bifocals (upper part for distance, lower part for near vision).

(D) CATARACT

Lens becomes cloudy and vision becomes blurred.

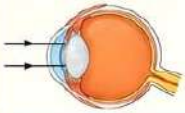
Cause

Clouding of the eye lens.



Correction

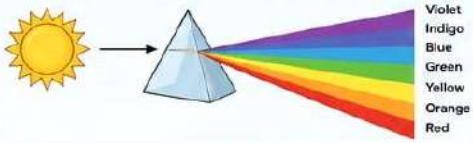
Surgical removal of the cloudy lens and implantation of an artificial lens.



3. THE COLOURFUL WORLD

WHITE LIGHT AND COLOURS

White light from the Sun contains seven colours (VIBGYOR).



WHY DO WE SEE COLOURS?

When light falls on an object:

- Some colours (wavelengths) are absorbed.
- The remaining colour is reflected to our eyes.
- We see the reflected colours.

Examples:

Apple looks red (only red light is reflected)	Leaf looks green (only green light is reflected)	Shirt looks blue (only blue light is reflected)	Black objects absorb almost all colours. No colour is reflected.	White objects reflect almost all colours.

IMPORTANCE

- Helps us to see and enjoy the beautiful world.
- Essential for reading, learning, driving, and recognising objects.
- Helps in many fields like photography, space exploration, medicine and more.

SUMMARY

- ✓ The eye forms an image on the retina.
- ✓ Brain interprets the image.
- ✓ Defects of vision can be corrected with suitable lenses or surgery.
- ✓ White light contains seven colours.
- ✓ We see colours due to reflection of light.

CARE OF EYES

- Read in proper light.
- Do not read very close to the book or screen.
- Take regular breaks while using screens.
- Eat a balanced diet rich in Vitamin A.
- Get eyes checked regularly.

The human eye and light together make the world colourful and beautiful!

Chapter 11: Electricity

How Things Work
Unit IV: Effects of Current

Electricity :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.

1. Electric Current and Circuit

Electric current is the rate of flow of electric charges through a conductor. In metallic wires, electrons are the charge carriers.

If 'q' (unit- coulomb, C) charge flows through a conductor in time 't' then current 'i' (unit- ampere, A) is calculated as

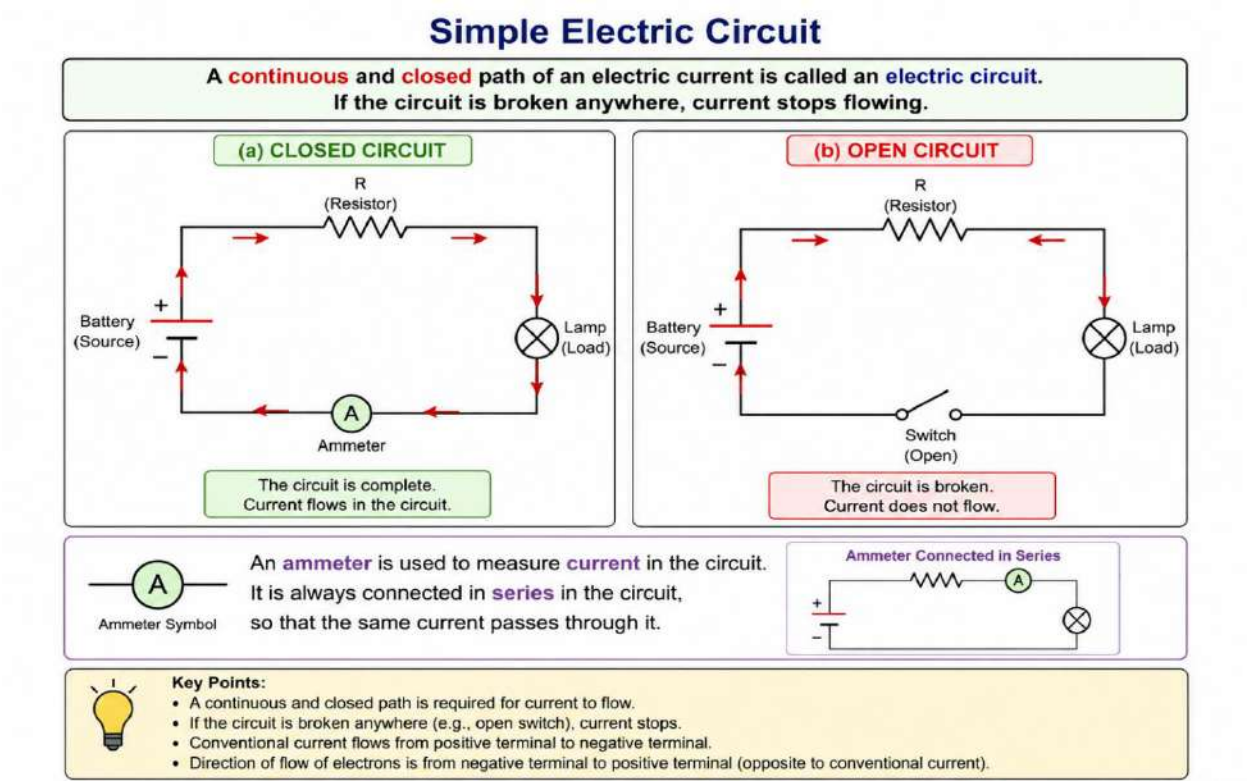
$$i = \frac{q}{t}\ , \quad 1A = \frac{C}{s}$$

Small units: 1 mA = 10^{-3} A 1 μA = 10^{-6} A

A continuous and closed path of an electric current is called an electric circuit. If the circuit is broken anywhere, current stops flowing.

Conventionally, the direction of electric current is taken as opposite to the direction of flow of electrons (i.e., from positive terminal to negative terminal of the cell).

Ammeter is a device, which measures electric current and it is always connected in series in the circuit.



Review Questions -1

1. What is an electric circuit? What happens when the circuit is broken?
2. Define the unit of electric current (Ampere).
3. Calculate the number of electrons constituting one coulomb of charge.
4. A current of 2 A flows through a wire for 5 minutes. Find the total charge that flows.
5. What is the difference between conventional current direction and the actual direction of electron flow?

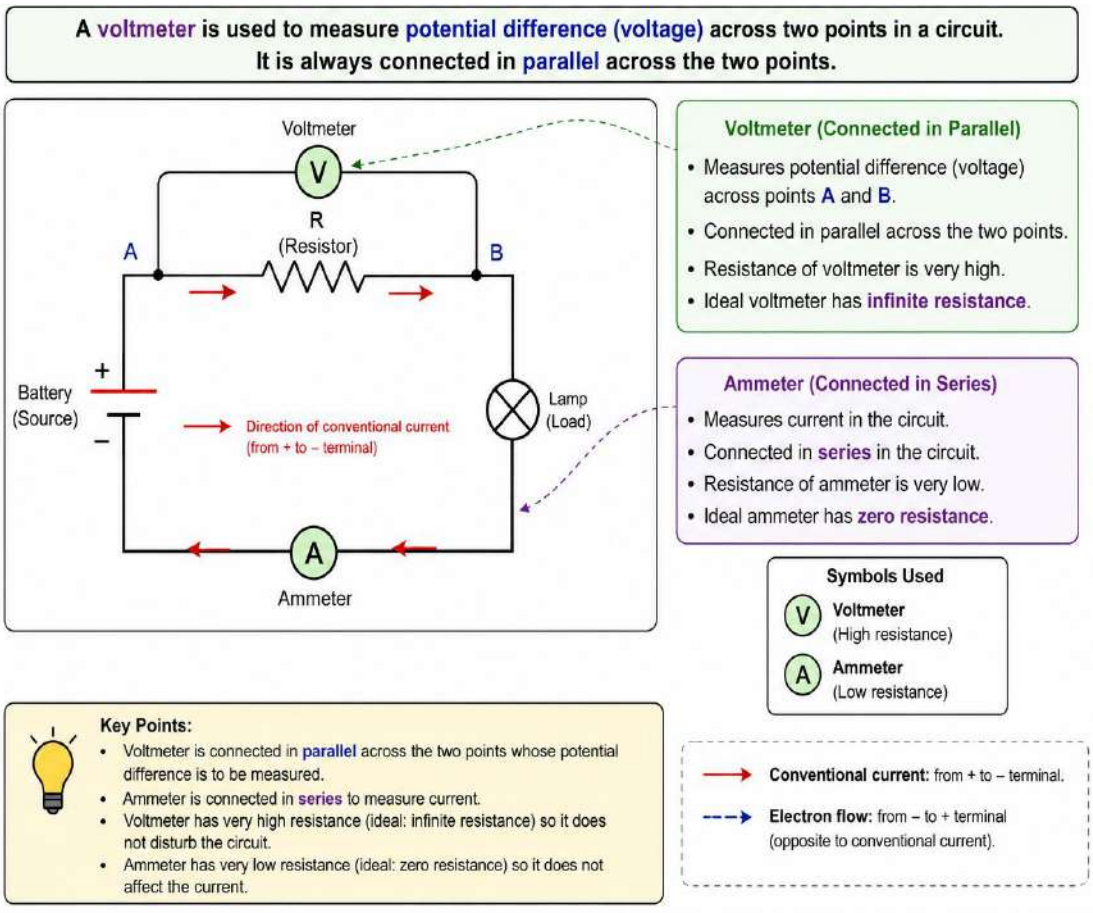
2. Electric Potential and Potential Difference

Charges do not flow on their own in a conductor. They need a difference of electric pressure called potential difference to move. A cell or battery creates this potential difference through chemical reactions, which drives the current in the circuit. Electric potential difference between two points is defined as the work done per unit charge to move a positive charge from one point to the other.

$V = \frac{W}{Q}$, here V = potential difference (volt, V), W = work done (joule, J), Q = charge (coulomb, C)

SI unit: Volt (V). 1 V = 1 J / 1 C

Voltmeter measures potential difference. It is always connected in PARALLEL across the two points.

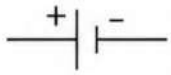
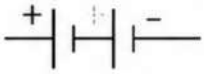
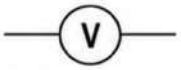
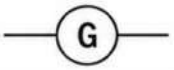
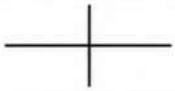
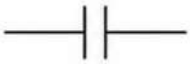
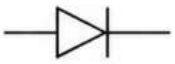
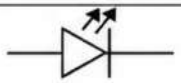
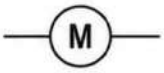


Review Questions 2

1. Name the device that maintains a potential difference across a conductor.
2. What is meant by saying the potential difference between two points is 1 V?
3. How much energy is given to each coulomb of charge passing through a 6 V battery?
4. How much work is done in moving a charge of 3 C across two points having a potential difference of 10 V?
5. What is the role of a voltmeter in a circuit and how is it connected?

3. Circuit Diagram and Symbols

Symbols of some commonly used components in circuit diagrams

S.No.	Component	Symbol	S.No.	Component	Symbol
1.	Electric Cell		11.	Ammeter	
2.	Battery		12.	Voltmeter	
3.	Connecting Wire		13.	Galvanometer	
4.	Wires Joined		14.	Fuse	
5.	Wires Not Joined		15.	Key	
6.	Switch (Open)		16.	Capacitor	
7.	Switch (Closed)		17.	Earth Wire	
8.	Electric Bulb		18.	Diode	
9.	Resistor		19.	LED	
10.	Variable Resistor (Rheostat)		20.	Motor	

Review Questions - 3

1. What is the symbol for an open switch and a closed switch?
2. How is an ammeter different from a voltmeter in a circuit (in terms of connection)?
3. What does a zigzag line with an arrow represent in a circuit diagram?
4. Draw the symbols for a cell, a battery, and a resistor.
5. Why do we use circuit diagrams instead of drawing actual components?

4. Ohm's Law

Ohm's Law states that, if the physical conditions (such as temperature, dimensions, etc.) of a conductor remain unchanged, then the **current** flowing through it is **directly proportional** to the **potential difference** across its ends.

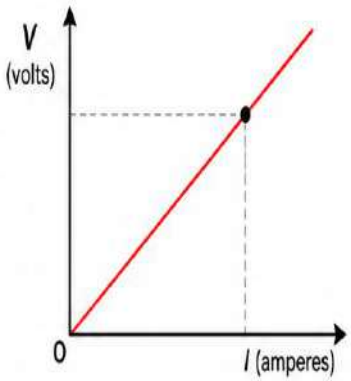
MATHEMATICAL FORMULATION

If V is the potential difference (in volts),
I is the current (in amperes) and
R is the resistance (in ohms) of a conductor,
then according to Ohm's Law,

$$V \propto I \quad \text{or} \quad V = IR$$

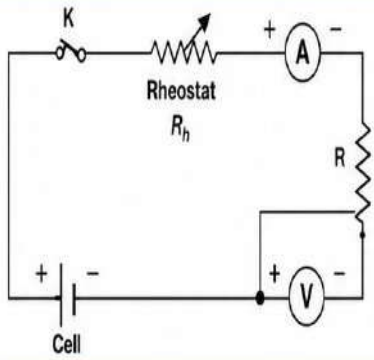
where R is the constant of proportionality and is called the resistance of the conductor.

GRAPHICAL REPRESENTATION



The V–I graph for a conductor is a straight line passing through the origin.

CIRCUIT DIAGRAM TO VERIFY OHM'S LAW



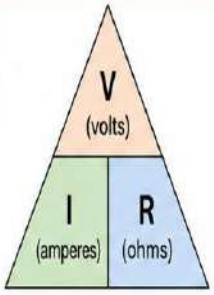
Ammeter is connected in **series**. Voltmeter is connected in **parallel**.

OHM'S LAW IN TERMS OF RESISTANCE

$$R = \frac{V}{I}$$

SI unit of resistance is ohm (Ω).
1 ohm is the resistance of a conductor when a potential difference of **1 volt** across its ends produces a current of **1 ampere** through it.

OHM'S LAW TRIANGLE



$V = IR$

$I = \frac{V}{R}$

$R = \frac{V}{I}$

Cover the required quantity to find the remaining one.

KEY POINTS

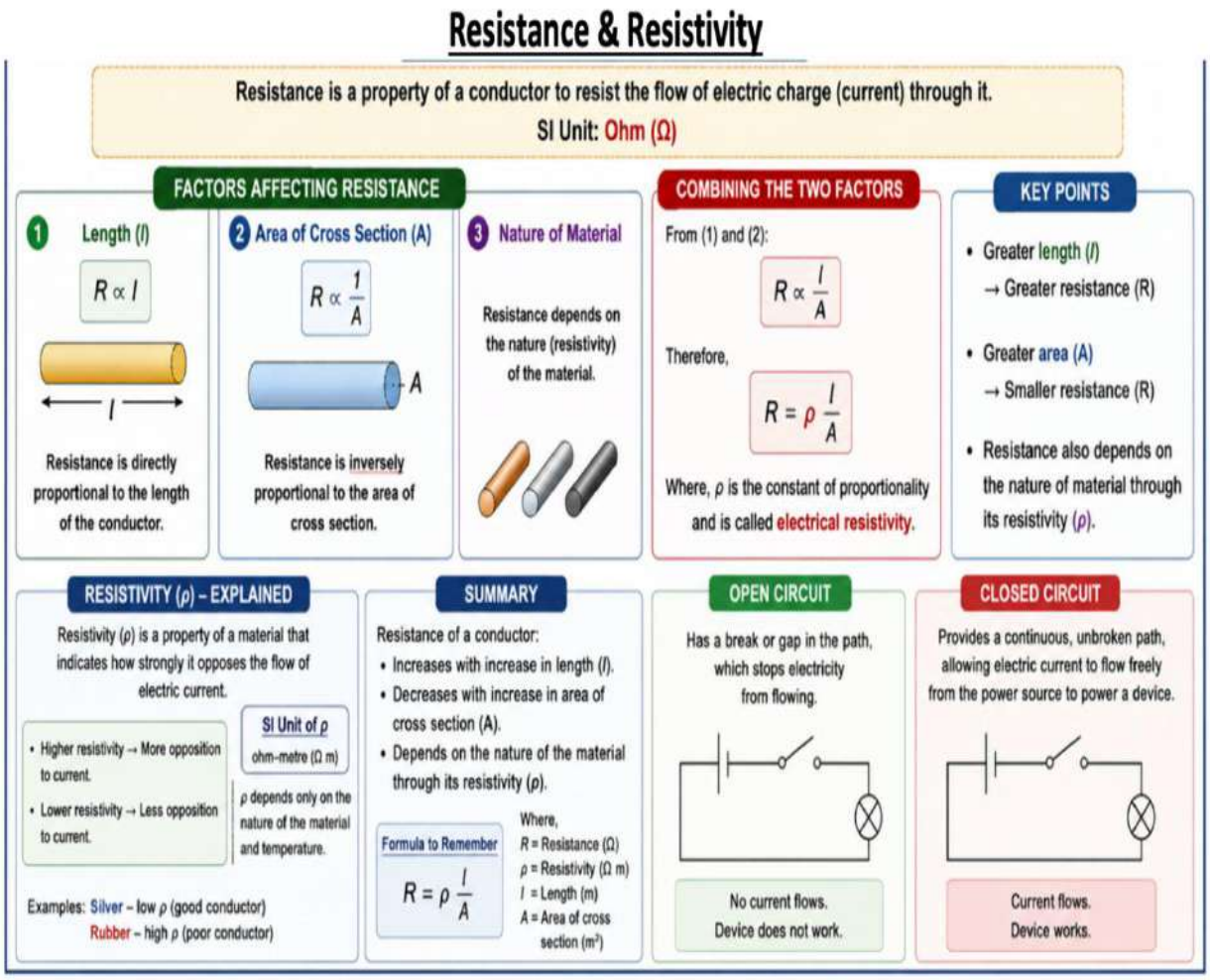
- Ohm's Law is valid only when **physical conditions** like temperature, dimensions, etc., remain **unchanged**.
- The resistance of a conductor is **constant** for a given conductor if its physical conditions remain unchanged.
- **Metals** obey Ohm's Law.

V : Potential difference (volts)
I : Current (amperes)
R : Resistance (ohms)

Review Questions - 4

1. State Ohm's law. Write its mathematical expression.
2. What does a straight-line V-I graph passing through the origin indicate?
3. The resistance of an electric component is 5 Ω. If a potential difference of 10 V is applied across it, find the current.
4. What is a rheostat and what is its use in a circuit?
5. If the resistance of a conductor is doubled while voltage remains the same, what happens to the current?

5. Factors on Which Resistance of a Conductor Depends



Resistivity Values (Approx.)

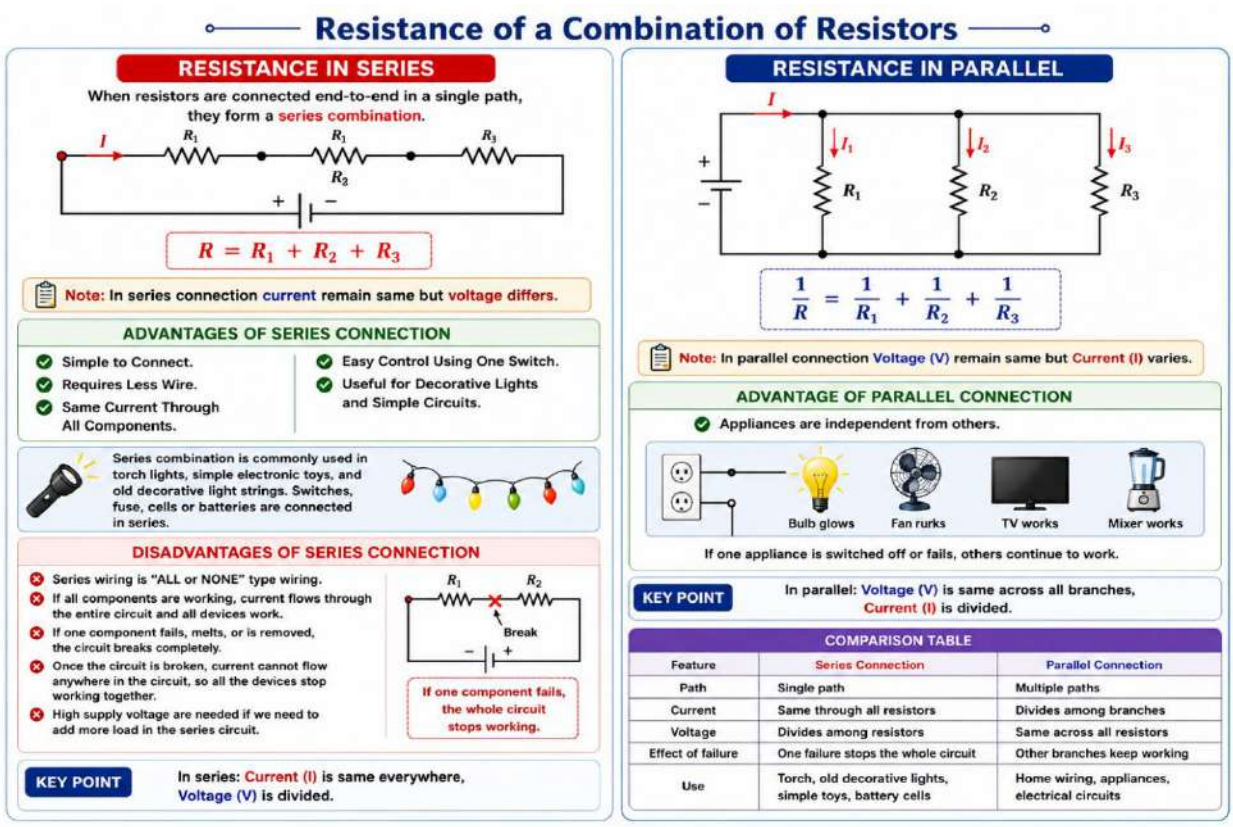
- Conductors (metals): 10^{-8} to 10^{-6} Ω·m (e.g., Silver, Copper, Aluminium)
- Alloys: Higher than constituent metals (e.g., Nichrome: 100×10^{-6} Ω·m)
- Insulators (rubber, glass): 10^{12} to 10^{17} Ω·m

Alloys are used in heating devices (iron, toaster) because they have high resistivity and do not oxidise easily at high temperatures. Tungsten (melting point 3380°C) is used for bulb filaments.

Review Questions - 5

1. On what factors does the resistance of a conductor depend?
2. Will current flow more easily through a thick wire or a thin wire of the same material? Why?
3. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?
4. Which has lower resistivity - iron or silver? Which is a better conductor?
5. A wire of length 2 m and cross-sectional area 2×10^{-6} m² has a resistance of 4 Ω. Find its resistivity.

6. Resistance of a System of Resistors



Review Questions - 6

1. In a series circuit, what is the relationship between current through each resistor?
2. Three resistors of 3 Ω, 4 Ω, and 6 Ω are connected in series to a 12 V battery. Find total resistance and current.
3. Three resistors of 4 Ω, 6 Ω, and 12 Ω are connected in parallel. Find equivalent resistance.
4. What are the advantages of connecting household appliances in parallel rather than in series?
5. How does the equivalent resistance in series compare to that in parallel for the same set of resistors?

7. Heating Effect of Electric Current

When current flows through a resistor, electrical energy is converted into heat energy. This is called the heating effect of electric current or Joule heating.

In a purely resistive circuit, all electrical energy supplied by the source is dissipated as heat.

$$H = VIt = I^2Rt$$

where H = heat produced (J), I = current (A), R = resistance (Ω), t = time (s)

This is Joule's Law of Heating. It states that heat produced is:

- Directly proportional to the square of current (I^2)
- Directly proportional to resistance (R)
- Directly proportional to time (t)

Applications of Heating Effect

- Electric iron, toaster, oven, kettle, heater — based on Joule heating
- Electric bulb — tungsten filament heats up and emits light (melting point 3380°C)
- Electric fuse — protects circuit; melts when current exceeds safe value; connected in series

Fuse wire is made of materials with low melting points (aluminium, copper, iron, lead alloys). Common domestic fuse ratings: 1 A, 2 A, 3 A, 5 A, 10 A.

Review Questions - 7

1. State Joule's law of heating and write its formula.
2. Why does the cord of an electric heater not glow while the heating element does?
3. Why is tungsten used exclusively for filaments of electric bulbs?
4. An electric iron has resistance 20 Ω and takes 5 A. Calculate heat developed in 30 seconds.
5. Compute the heat generated while transferring 96000 C of charge in one hour through a potential difference of 50 V.

8. Electric Power

Electric power is the rate at which electrical energy is consumed or dissipated in a circuit.

$$P = VI = I^2R = V^2/R$$

SI unit of power: Watt (W). 1 W = 1 V × 1 A

Practical unit: kilowatt (kW). 1 kW = 1000 W

Commercial unit of electrical energy: kilowatt hour (kWh), commonly called 'unit'.

$$1\ kWh = 1000\ W \times 3600\ s = 3.6 \times 10^6\ J$$

Note: We do not pay for current or voltage, but for energy consumed (kWh).

Review Questions - 8

1. What determines the rate at which energy is delivered by a current?
2. An electric bulb is connected to a 220 V supply and draws 0.5 A. What is its power?
3. An electric motor takes 5 A from a 220 V line. Find the power and energy consumed in 2 hours.
4. A refrigerator rated 400 W operates 8 hours/day. Find the cost for 30 days at Rs 3 per kWh.
5. What is a kilowatt hour and why is it used as the commercial unit of energy?

ANSWERS TO REVIEW QUESTIONS

Section 1: Electric Current and Circuit

1. An electric circuit is a continuous and closed path through which electric current flows. If the circuit is broken anywhere (e.g., switch off), the current stops because there is no complete path for electrons to flow.

2. One Ampere is the unit of current. 1 ampere is defined as the flow of 1 coulomb of charge per second through a cross-section of a conductor. (1 A = 1 C / 1 s)

3. Charge on one electron = 1.6×10^{-19} C. Number of electrons in 1 C = $1 / (1.6 \times 10^{-19}) = 6.25 \times 10^{18}$ electrons.

4. Q = I × t = 2 A × (5 × 60) s = 2 × 300 = 600 C.

5. Electrons (negative charges) actually flow from the negative terminal to the positive terminal of a cell. However, conventional current direction is taken as the direction of flow of positive charges, i.e., from the positive terminal to the negative terminal, which is opposite to the actual electron flow.

Section 2: Electric Potential and Potential Difference

1. A cell or battery maintains a potential difference across a conductor. The chemical action within the cell generates this potential difference.

2. A potential difference of 1 V between two points means that 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

3. Energy given to each coulomb = V × Q = 6 V × 1 C = 6 J. Each coulomb of charge is given 6 J of energy.

4. W = V × Q = 10 V × 3 C = 30 J.

5. A voltmeter measures the potential difference between two points. It is always connected in parallel across the two points between which the potential difference is to be measured. It has very high resistance so it does not disturb the circuit.

Section 3: Circuit Diagram and Symbols

1. Open switch symbol: two small circles (or lines) with a gap between them [—( )—]. Closed switch symbol: two circles with a dot in the middle [—(•)—].

2. Ammeter is connected in series in the circuit so that the same current flows through it. Voltmeter is connected in parallel across the component so that it measures the potential difference across it.

3. A zigzag line with an arrow represents a variable resistance or rheostat, used to vary current in a circuit.

4. Cell: short and long parallel lines. Battery: multiple cells. Resistor: zigzag line (/\/\/).

5. Circuit diagrams use standard symbols to represent components in a simple, clear, and universally understood way. Actual drawings would be complex, hard to interpret, and would differ between individuals.

Section 4: Ohm's Law

1. Ohm's Law: At constant temperature, the potential difference (V) across the ends of a conductor is directly proportional to the current (I) flowing through it. Mathematically: V = IR, where R is the resistance.

2. A straight-line V-I graph passing through the origin indicates that V and I are directly proportional, confirming that the conductor obeys Ohm's law and has a constant resistance at the given temperature.

3. I = V / R = 10 / 5 = 2 A.

4. A rheostat is a variable resistance used in a circuit to regulate (increase or decrease) the current without changing the voltage source. It works by varying the effective length of the resistance wire in the circuit.

5. By Ohm's law, I = V/R. If R is doubled (2R), then I = V/(2R), which is half the original current. So the current is halved.

Section 5: Factors Affecting Resistance

1. Resistance depends on: (i) Length of the conductor — directly proportional; (ii) Area of cross-section — inversely proportional; (iii) Nature of the material (resistivity); (iv) Temperature of the conductor.

2. Current flows more easily through a thick wire. A thicker wire has a larger area of cross-section, so resistance R = ρl/A is smaller (since A is larger). Lower resistance means greater current for the same voltage.

3. Alloys are used because: (a) their resistivity is higher than that of pure metals, so they produce more heat; (b) they do not oxidise (burn) easily at high temperatures; (c) they are more durable.

4. From Table 11.2: Silver has resistivity 1.60×10^{-8} Ω·m, which is lower than iron (10.0×10^{-8} Ω·m). Silver is the best conductor (lowest resistivity).

5. $\rho = RA/l = (4 \times 2 \times 10^{-6}) / 2 = 4 \times 10^{-6}$ Ω·m.

Section 6: Resistors in Series and Parallel

1. In a series circuit, the same current flows through each resistor. The current does not divide; it is constant throughout the entire circuit.

2. Rs = 3 + 4 + 6 = 13 Ω. Current I = V / Rs = 12 / 13 ≈ 0.92 A.

3. 1/Rp = 1/4 + 1/6 + 1/12 = 3/12 + 2/12 + 1/12 = 6/12 = 1/2. Therefore Rp = 2 Ω.

4. Advantages: (a) Each appliance gets the full supply voltage; (b) Each appliance can be switched on/off independently; (c) If one fails, others keep working; (d) Different appliances needing different currents can all function correctly.

5. For the same set of resistors, the equivalent resistance in series ($R_s = R_1 + R_2 + ...$) is always greater than any individual resistance, while the equivalent resistance in parallel ($1/R_p = 1/R_1 + 1/R_2 + ...$) is always less than the smallest individual resistance.

Section 7: Heating Effect of Electric Current

1. Joule's Law of Heating: The heat produced (H) in a conductor is directly proportional to (i) the square of the current (I^2), (ii) the resistance (R), and (iii) the time (t) for which current flows. Formula: $H = I^2Rt$.

2. The cord has much lower resistance than the heating element. Since $H = I^2Rt$ and the same current flows through both (series connection), the heating element with much higher resistance dissipates far more heat and glows, while the cord barely warms up.

3. Tungsten is used because: (a) it has a very high melting point (3380°C) so it does not melt even at the high operating temperature; (b) it has high resistivity; (c) it emits bright white light when heated to high temperatures.

4. $H = I^2Rt = (5)^2 \times 20 \times 30 = 25 \times 20 \times 30 = 15000$ J = 15 kJ.

5. $H = VQt = V \times Q$ (since work done = VQ). Here Q = 96000 C, V = 50 V. $H = 50 \times 96000 = 4800000$ J $= 4.8 \times 10^6$ J. (Note: time = 1 hour is already accounted for since Q is the total charge over 1 hour.)

Section 8: Electric Power

1. The rate at which energy is delivered by a current is determined by both the current (I) and the potential difference (V). Power $P = VI = I^2R = V^2/R$. A higher voltage or higher current results in more power delivered.

2. $P = VI = 220$ V × 0.5 A = 110 W.

3. Power $P = VI = 220 \times 5 = 1100$ W = 1.1 kW. Energy consumed in 2 h = $P \times t = 1100$ W × 2 × 3600 s = 7,920,000 J $= 7.92 \times 10^6$ J (or 2.2 kWh).

4. Energy consumed = 400 W × 8 h/day × 30 days = 96000 Wh = 96 kWh. Cost = 96 × Rs 3 = Rs 288.

5. One kilowatt hour (kWh) is the amount of electrical energy consumed when a device of power 1 kW (1000 W) is used for 1 hour. 1 kWh $= 3.6 \times 10^6$ J. It is used commercially because the joule is too small a unit for practical billing purposes.

CHAPTER 11 : ELECTRICITY

HOW THINGS WORK

Unit IV: Effects of Current

Electricity is a form of energy used to run various electric appliances like fan, television, bulb, heater, motor etc.

1 ELECTRIC CURRENT

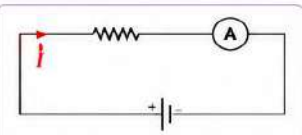
The rate of flow of electric charge through any cross-section is called 'electric current'.

$$i = \frac{q}{t}$$

where q = charge that flows (Coulomb)
t = time (second)

- SI Unit : ampere (A), also $1\ A = 1\ C/s$
- 1 A of current is equivalent to flow of 1 Coulomb charge through a cross section for 1 second.
- Smaller units : $1\ mA = 10^{-3}\ A$ & $1\ \mu A = 10^{-6}\ A$

AMMETER :
A device used to measure current.
It is always connected in series in the circuit.
An ideal ammeter has zero resistance.



2 ELECTRIC POTENTIAL AND POTENTIAL DIFFERENCE

ELECTRIC POTENTIAL : The amount of work required to move a positive unit charge from infinity to a specific point in an electric field.
If W is the work done in bringing a positive charge 'q' from ∞ to a certain point, then potential (V) of that point is defined as

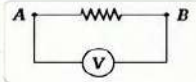
$$V = \frac{W}{q}$$

Unit : Volt (V) or $\frac{J}{C}$ Hence $1\ V = 1\ \frac{J}{C}$

ELECTRIC POTENTIAL DIFFERENCE (ΔV) between two points in an electric circuit carrying some current is the work done to move a unit charge from one point to the other.
If W is the work done in taking a positive charge 'q' from one point to another, then potential difference (ΔV) between those points is defined as

$$\Delta V = \frac{\Delta W}{q}$$

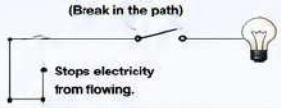
VOLTMETER : The potential difference is measured by a voltmeter.
It is always connected in parallel across the points between which the potential difference is to be measured.



3 ELECTRIC CIRCUIT AND COMPONENTS

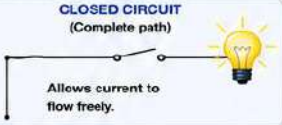
Electric circuit : The path of electric charges / current.
The symbolic representation of any electric circuit is called a circuit diagram.

OPEN CIRCUIT
(Break in the path)



Stops electricity from flowing.

CLOSED CIRCUIT
(Complete path)



Allows current to flow freely.

SYMBOLS OF COMMONLY USED COMPONENTS

S.No.	Component	Symbol	S.No.	Component	Symbol
1.	Electric Cell		11.	Ammeter	A
2.	Battery		12.	Voltmeter	V
3.	Connecting Wire		13.	Galvanometer	G
4.	Wires Joined		14.	Fuse	
5.	Wires Not Joined		15.	Key	
6.	Switch (Open)		16.	Capacitor	
7.	Switch (Closed)		17.	Earth Wire	
8.	Electric Bulb		18.	Diode	
9.	Resistor		19.	LED	
10.	Variable Resistor (Rheostat)		20.	Motor	M

4 OHM'S LAW

Ohm's Law states that, if the physical conditions (such as temperature, dimensions, etc.) of a conductor remain unchanged, then the current flowing through it is directly proportional to the potential difference across its ends.

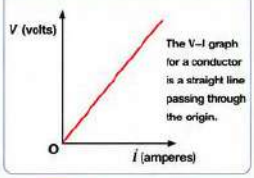
MATHEMATICAL FORMULATION

If V is the potential difference (in volts), I is the current (in amperes) and R is the resistance (in ohms) of a conductor, then according to Ohm's Law,

$$V \propto i \quad \text{or} \quad V = iR$$

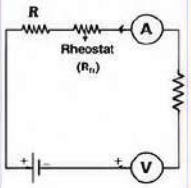
where R is the constant of proportionality and is called the resistance of the conductor.

GRAPHICAL REPRESENTATION



The V–I graph for a conductor is a straight line passing through the origin.

CIRCUIT DIAGRAM TO VERIFY OHM'S LAW

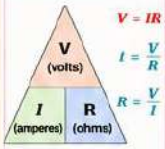


OHM'S LAW IN TERMS OF RESISTANCE

$$R = \frac{V}{I}$$

SI unit of resistance is ohm (Ω).
1 ohm is the resistance of a conductor when a potential difference of 1 volt across its ends produces a current of 1 ampere through it.

OHM'S LAW TRIANGLE



Cover the required quantity to find the remaining one.

5 RESISTANCE & RESISTIVITY

FACTORS AFFECTING RESISTANCE (R)

1. Length (l) $R \propto l$
2. Area of Cross Section (A) $R \propto \frac{1}{A}$
3. Nature of Material
   Resistance depends on the nature (resistivity) of the material.

COMBINING THE TWO FACTORS

From (1) and (2):

$$R \propto \frac{l}{A}$$

Therefore,

$$R = \rho \frac{l}{A}$$

where ρ is the constant of proportionality and is called electrical resistivity.

KEY POINTS

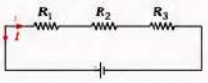
- Greater length (l) → Greater resistance (R)
- Greater area (A) → Smaller resistance (R)
- Resistance also depends on the nature of material through its resistivity (ρ).

DIFFERENCE BETWEEN RESISTANCE AND RESISTIVITY

Feature	Resistance (R)	Resistivity (ρ)
Definition	Resistance is the opposition offered by a conductor to the flow of electric current.	Resistivity is the property of a material that opposes the flow of electric current.
Depends on	Length, area of cross-section and material of conductor.	Only on the nature of material and temperature.
Changes with dimensions	It changes when dimensions of conductor change.	It remains same for a given material at constant temperature.
Symbol	R	ρ
SI Unit	Ohm (Ω)	Ohm-metre (Ω m)
Relation	$R = \rho \frac{l}{A}$	$\rho = \frac{RA}{l}$

6 RESISTANCE OF A COMBINATION OF RESISTORS

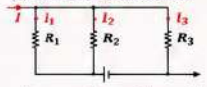
(A) SERIES COMBINATION



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

- Current is same through all resistors.
- Potential difference divides among resistors.

(B) PARALLEL COMBINATION



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

- Potential difference is same across all resistors.
- Current divides among branches.

7 ELECTRIC POWER

Electric power is the rate at which electrical energy is consumed or converted into useful forms of energy in an electric circuit.

$$P = \frac{W}{t}$$

SI Unit : Watt (W) or J/s
1 watt = power consumed when 1 joule of energy is used in 1 second.

IMPORTANT RELATIONS

$$P = VI$$
$$P = I^2R$$
$$P = \frac{V^2}{R}$$

Also $V = IR \rightarrow I = \frac{V}{R}$
$R = \frac{V}{I}$ $R = \frac{V^2}{P}$

APPLICATIONS

Torch, simple toys, old decorative light strings, switches, fuse, cells or batteries.

NOTE

In series combination, if one appliance fails, the whole circuit breaks. In parallel combination, others continue to work.

8 HEATING EFFECT OF ELECTRIC CURRENT

Heat is caused due to collision of electrons in any current carrying conductor.
More current → more electrons → more collision → more heat
More resistance → more collision → more heat.

JOULE'S LAW OF HEATING : Heat produced (H) in a circuit is directly proportional to the square of current (I), resistance (R) of the conductor and time (t) for which current flows.

$$H = I^2Rt$$

Where, H = Heat produced (Joule)
I = Current (ampere)
R = Resistance (ohm)
t = Time (second)

KEY TAKEAWAY Electricity helps us in daily life. Understanding current, potential difference, resistance, power and heating effect is the key to many useful devices.

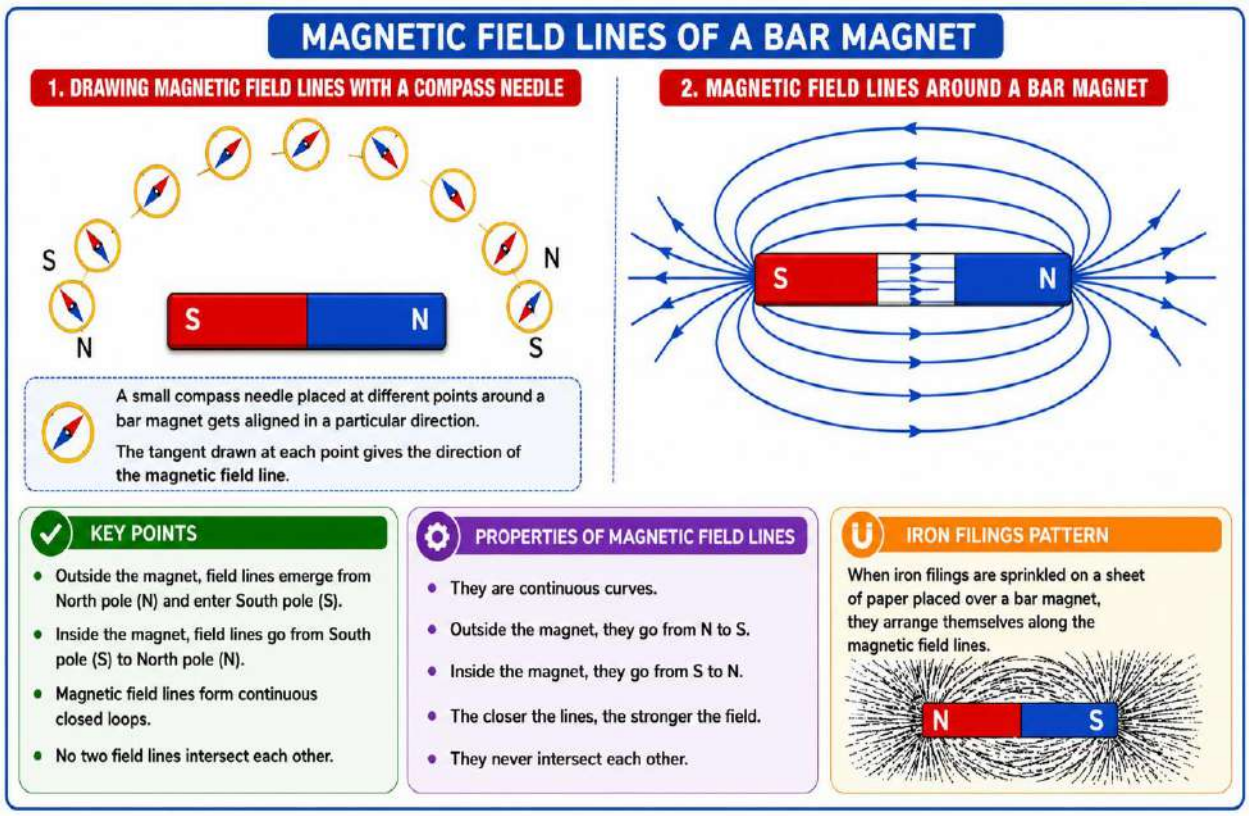
How Things Work
Unit IV: Effects of Current
Magnetic effects of currents: Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming's Left Hand Rule, Direct current. Alternating current: frequency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

1. Magnetic Field and Field Lines

A magnetic field is the region surrounding a magnet where its force can be detected. A compass needle, which is itself a small bar magnet, gets deflected when brought near a bar magnet. This shows that the magnet exerts influence in the space around it.

Properties of Magnetic Field Lines

- They emerge from the North pole and merge into the South pole outside the magnet; inside the magnet they go from South to North.
- They are closed, continuous curves.
- The direction of the field at any point is given by the tangent to the field line at that point.
- Where field lines are closer together, the magnetic field is stronger.
- No two field lines ever cross each other. If they did, the compass needle at that point would point in two directions simultaneously, which is impossible.



Review Questions – Section 1

1. Why does a compass needle get deflected when brought near a bar magnet?
2. State two properties of magnetic field lines.
3. Why do two magnetic field lines never intersect each other?
4. What do closely spaced magnetic field lines indicate?
5. In which direction do field lines run inside a bar magnet?

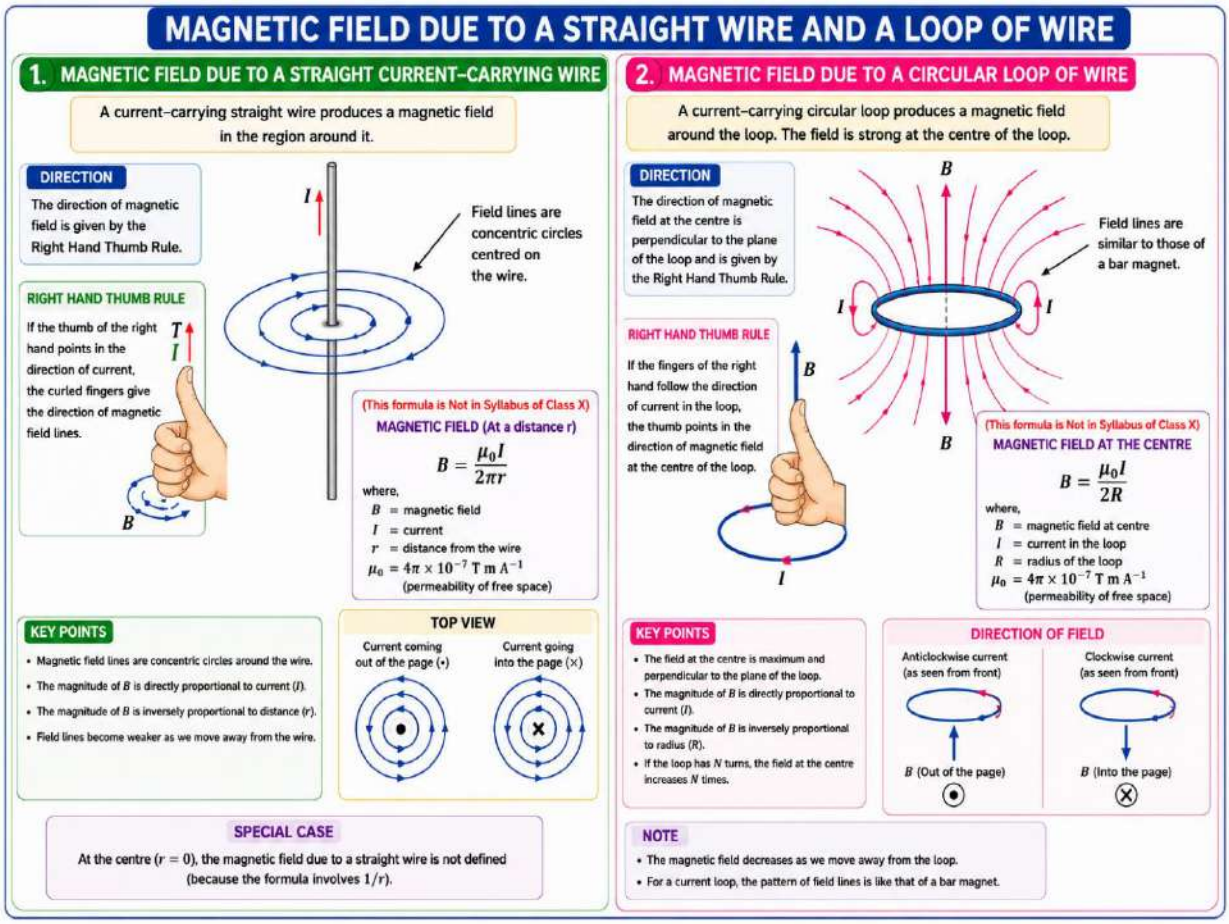
2. Magnetic Field Due to a Current-Carrying Conductor

Hans Christian Oersted (1820) discovered that a compass needle placed near a current-carrying wire gets deflected, proving that an electric current produces a magnetic field around it. Reversing the current reverses the direction of the magnetic field.

2A. Magnetic Field Due to a Straight Conductor

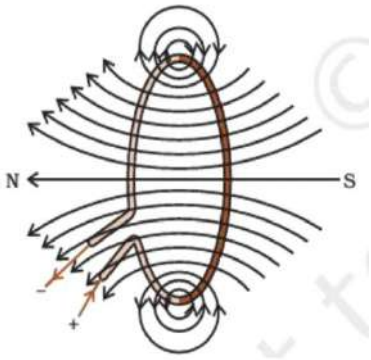
When current flows through a long straight wire, the magnetic field lines form concentric circles around the wire. Key observations:

- Increasing current increases the magnetic field (greater deflection of compass).
- Moving farther from the wire decreases the magnetic field (field decreases with distance).
- Concentric circles become larger as we move away from the wire.



2B. Right-Hand Thumb Rule

Imagine holding the current-carrying conductor in your right hand such that the thumb points in the direction of the current. Your curled fingers then point in the direction of the magnetic field lines around the conductor.



(Also called Maxwell's Corkscrew Rule: if a corkscrew is driven in the direction of current, the direction of rotation gives the direction of the magnetic field.)

2C. Magnetic Field Due to a Current Through a Circular Loop

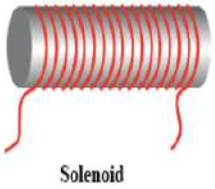
When a straight wire is bent into a circular loop and current is passed:

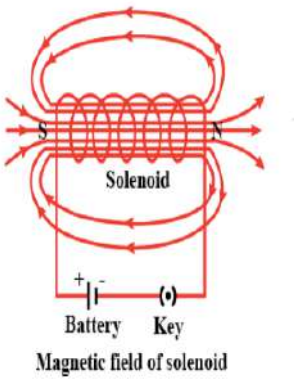
- Each small section of the loop produces concentric magnetic field lines.
- At the centre of the loop, these arcs appear as parallel straight lines.
- Each section of the loop adds field in the same direction at the centre (verified by the right-hand rule).
- For a coil of n turns, the field is n times that of a single turn, because all turns carry current in the same direction.

2D. Magnetic Field Due to a Current in a Solenoid

A solenoid is a coil of many circular turns of insulated copper wire wound closely in the shape of a cylinder.

- The field inside a solenoid consists of parallel straight lines — indicating a uniform magnetic field.
- One end behaves as a North pole, the other as a South pole — similar to a bar magnet.
- Placing a soft iron rod inside a current-carrying solenoid magnetises it — this is called an electromagnet.





Magnetic field of solenoid

Review Questions – Section 2

Q1. State the right-hand thumb rule.
Q2. How does the magnetic field produced by a straight wire change as (i) current increases, (ii) distance from wire increases?
Q3. Why is the magnetic field at the centre of a circular loop in the form of straight lines?
Q4. How is the magnetic field of a solenoid similar to that of a bar magnet?
Q5. What is an electromagnet? How is it formed?

3. Force on a Current-Carrying Conductor in a Magnetic Field

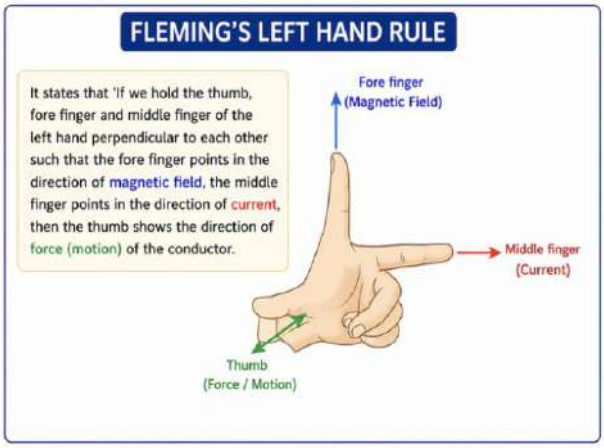
Andre Marie Ampere proposed that if a current-carrying conductor produces a magnetic field that exerts force on a magnet, then a magnet must also exert an equal and opposite force on the conductor.

The force on the conductor depends on:

i. The direction of the current.
ii. The direction of the magnetic field.
iii. The magnitude of the current.
iii. The length of the conductor.

The force is maximum when the current and the magnetic field are perpendicular to each other.

Fleming's Left-Hand Rule



Stretch the thumb, the forefinger, and the middle finger of your left hand mutually perpendicular to each other:

- Forefinger (first finger): direction of the Magnetic Field (B)
- Middle finger (second finger): direction of Current (I)
- Thumb: direction of Force (motion) on the conductor

Devices based on this principle: Electric motor, electric generator, loudspeakers, microphones, and measuring instruments.

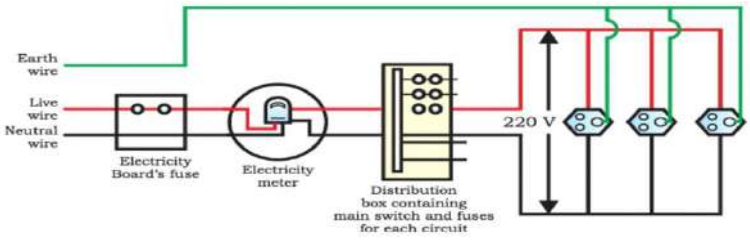
Review Questions – Section 3

1. State Fleming's left-hand rule.
2. When is the force on a current-carrying conductor in a magnetic field the largest?
3. How does the displacement of the rod change if (i) current increases, (ii) a stronger magnet is used, (iii) the length of the rod increases?
4. An electron moves towards the front wall and is deflected to the right by a magnetic field. What is the direction of the magnetic field?
5. Name two devices that use the principle of force on a current-carrying conductor in a magnetic field.

4. Domestic Electric Circuits

Electric power is supplied to homes through two wires from the main supply:

- Live wire: red insulation (positive), potential = 220 V
- Neutral wire: black insulation (negative), potential = 0 V
- Earth wire: green insulation, connected to a metal plate buried deep in the earth



The potential difference between the live and neutral wires is 220 V.

Circuit Details

- The wires pass through a main fuse and electricity meter at the meter board.
- Two separate circuits are used: 15 A rating for high-power appliances (geysers, air coolers); 5 A rating for bulbs, fans, etc.

- All appliances are connected in parallel so each gets the same potential difference (220 V) and has an independent switch.

Earth Wire – Purpose

The earth wire connects the metallic body of appliances to the earth. If current leaks into the metallic body, it flows safely to earth instead of passing through the user, preventing severe electric shock.

Overloading and Short Circuit

Short circuit: occurs when the live wire and the neutral wire come into direct contact (due to damaged insulation or appliance fault). This causes an abrupt, very large increase in current.

Overloading: occurs when too many appliances are connected to a single socket, or when supply voltage rises accidentally. It can also cause excessive current.

Fuse: the most important safety device. It is a thin wire of high resistance and low melting point. When current exceeds the rated value, Joule heating melts the fuse wire, breaking the circuit and protecting appliances.

Review Questions – Section 4

1. Name two safety measures commonly used in electric circuits and appliances.
2. An electric oven of 2 kW operates on a 220 V supply. What current does it draw? Can it be used on a 5 A circuit?
3. What precautions should be taken to avoid overloading of domestic electric circuits?
4. Why are domestic appliances connected in parallel and not in series?
5. What is the function of an earth wire? Why is it necessary to earth metallic appliances?

Answers to All Review Questions

Section 1 – Magnetic Field and Field Lines

A1. A compass needle is a small bar magnet. A bar magnet exerts a magnetic force on it. The force makes the compass needle align along the field lines of the bar magnet, causing it to deflect.

A2. (i) Magnetic field lines are closed curves that emerge from the North pole and enter the South pole. (ii) Two field lines never cross each other.

A3. If two field lines crossed, the compass needle at that point would simultaneously point in two different directions, which is physically impossible. Hence they never intersect.

A4. Closely spaced (crowded) field lines indicate a stronger magnetic field in that region.

A5. Inside a bar magnet, field lines run from the South pole to the North pole.

Section 2 – Magnetic Field Due to Current

A1. Right-Hand Thumb Rule: If the current-carrying conductor is held in the right hand with the thumb pointing in the direction of current, the curled fingers indicate the direction of the magnetic field lines around the conductor.

A2. (i) As current increases, the magnetic field at a given point increases (stronger deflection). (ii) As distance from the wire increases, the magnetic field decreases (weaker deflection; concentric circles become larger and more spread out).

A3. As we move toward the centre of the loop, the concentric magnetic field circles around each element of the wire become larger and larger. By the time we reach the centre, the arcs of these large circles appear as straight parallel lines.

A4. The field lines outside a solenoid are similar to those of a bar magnet. One end of the solenoid behaves as a North pole and the other as a South pole. The field inside is uniform (parallel straight lines), just like the uniform field inside a bar magnet.

A5. An electromagnet is formed by placing a soft iron core inside a current-carrying solenoid. The strong magnetic field produced inside the solenoid magnetises the soft iron core. When current is switched off, the iron loses its magnetism.

Section 3 – Force on a Current-Carrying Conductor

A1. Fleming's Left-Hand Rule: Stretch the thumb, forefinger, and middle finger of the left hand mutually perpendicular to each other. If the forefinger points in the direction of the magnetic field and the middle finger in the direction of the current, then the thumb points in the direction of the force (motion) on the conductor.

A2. The force is largest when the direction of current is perpendicular (at right angles) to the direction of the magnetic field.

A3. (i) Increasing current increases the displacement (larger force). (ii) A stronger magnet increases the displacement (larger force). (iii) Increasing the length of the rod increases the displacement (larger force).

A4. The electron moves toward the front wall. By Fleming's left-hand rule (current direction is opposite to electron motion, i.e., away from the front wall), the magnetic field that causes deflection to the right is directed vertically downward.

A5. Electric motor and loudspeakers.

Section 4 – Domestic Electric Circuits

A1. (i) Electric fuse – melts and breaks the circuit during short circuit or overloading. (ii) Earth wire (earthing) – connects the metallic body of appliances to the earth to prevent electric shock.

A2. Current drawn = Power / Voltage = 2000 / 220 ≈ 9.1 A. Since the circuit has a rating of only 5 A, the oven will draw far more current than the circuit can handle. The fuse will blow (or the circuit may be damaged) and the oven cannot be safely operated on a 5 A circuit.

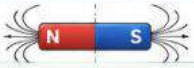
A3. Precautions: (i) Do not connect too many appliances to a single socket. (ii) Do not use appliances with power ratings beyond the circuit's current limit. (iii) Ensure wiring insulation is in good condition to prevent accidental short circuits.

A4. When connected in parallel, each appliance gets the same potential difference (220 V) independently, has its own switch, and the failure of one appliance does not affect others. In series, the voltage would be shared and all appliances would fail if one breaks.

A5. The earth wire connects the metallic body of an appliance to the earth. If current leaks into the metallic body due to a fault, it flows safely through the earth wire to the ground instead of passing through the user. This prevents the user from getting a severe electric shock. It is essential for appliances with metallic bodies such as iron, refrigerator, and toaster.

CHAPTER 12 : MAGNETIC EFFECTS OF ELECTRIC CURRENT

UNIT IV: EFFECTS OF CURRENT | **THEME: NATURAL RESOURCES**



KEY CONCEPTS

- ★ Electric current produces magnetic effects.
- ★ A current carrying conductor produces a magnetic field around it.
- ★ The direction of magnetic field or force is given by **Right Hand Thumb Rule and Fleming's Left Hand Rule.**
- ★ Solenoid with current behaves like a bar magnet.
- ★ AC changes direction periodically and is preferred over DC.
- ★ Electricity at homes is supplied through domestic circuits.

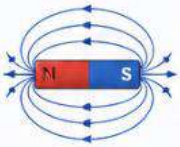
COMPASS NEEDLE

- A compass needle aligns in the North–South direction.
- End pointing to north = **North seeking pole.**
- End pointing to south = **South seeking pole.**

Like poles repel.
Unlike poles attract.

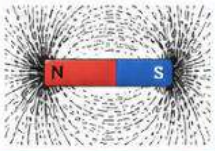
1. MAGNETIC FIELD AND FIELD LINES

- Magnetic field: Region around a magnet where its force can be experienced.
- Represented by B. SI unit: Tesla (T).
- Magnetic field lines emerge from North pole and merge at South pole outside the magnet.
- Inside the magnet, they go from South to North.
- Field lines never intersect.
- Closer the lines, stronger is the field.



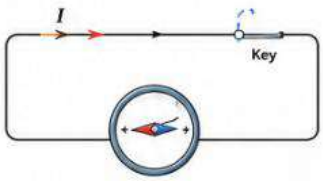
PROPERTIES OF MAGNETIC FIELD LINES

1. Closed curves.
2. Emerge from North and merge into South.
3. Inside the magnet: South to North.
4. Never intersect.
5. Closer lines show stronger field.



2. MAGNETIC EFFECT OF CURRENT (OERSTED'S EXPERIMENT)

- A compass placed near a current carrying wire gets deflected.
- **Conclusion:** A current carrying conductor produces a magnetic field around it.



REVIEW QUESTIONS – 1

1. What conclusion can be drawn when a compass near a current carrying wire gets deflected?
2. Which observation from Oersted's experiment proves that electricity and magnetism are related?

3. MAGNETIC FIELD DUE TO A STRAIGHT CURRENT CARRYING CONDUCTOR

- Magnetic field around a straight conductor is in concentric circles.

RIGHT HAND THUMB RULE

Hold the conductor in right hand such that the thumb points in the direction of current, the curled fingers show the direction of magnetic field.

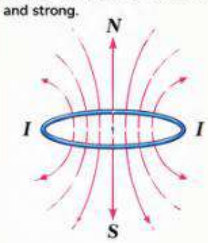
REVIEW QUESTIONS – 2

1. What happens to compass deflection if current direction in the wire is reversed?
2. Why does the magnetic field become weaker as we move away from a straight conductor?

4. MAGNETIC FIELD DUE TO CURRENT

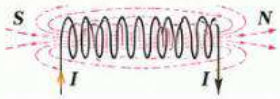
(a) CIRCULAR LOOP

- When current flows in a circular loop, magnetic field lines are concentric circles around the loop.
- At the centre, they become straight and strong.



(b) SOLENOID

- A solenoid is a cylindrical coil of wire (spring shape).
- When current flows, it behaves like a bar magnet.
- Ends act as North and South poles.

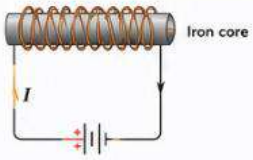


STRENGTH OF SOLENOID DEPENDS ON:

1. Strength of current
2. Number of turns of the coil
3. Radius of the coil
4. Material of the core

5. ELECTROMAGNET

- A soft iron core inside a solenoid with current becomes a strong magnet.
- This is called an electromagnet.



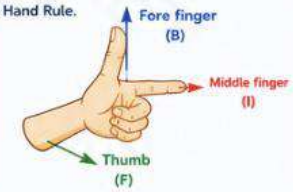
6. FORCE ON A CURRENT CARRYING CONDUCTOR

A current carrying conductor placed in a magnetic field experiences a force. Direction is given by Fleming's Left Hand Rule.

FLEMING'S LEFT HAND RULE

Hold the thumb, fore finger and middle finger of left hand perpendicular to each other such that:

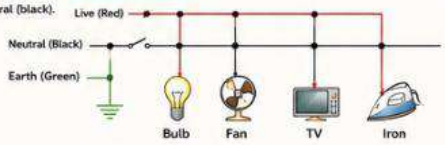
- Fore finger → Magnetic field (B)
- Middle finger → Current (I)
- Thumb → Force/Motion (F)



7. DOMESTIC ELECTRIC CIRCUITS

- Electric power is supplied through two mains: Live (red) and Neutral (black).
- Potential difference between them is 220 V.
- Appliances are connected in parallel so each gets same voltage.
- If one appliance is switched off, others work normally.

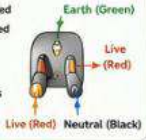
PARALLEL CONNECTION



SAFETY FEATURE (EARTHING)

Metallic body of appliances is connected to earth wire (green) which is connected to a metal plate in the ground.

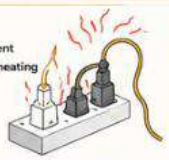
If live wire touches the body, extra current flows to the earth and prevents electric shock.



8. OVERLOADING

Too many appliances or excess current (rated value) in a circuit causes overheating of wires.

It may damage appliances and can cause fire.



9. SHORT CIRCUIT

When live wire and neutral wire come in contact.

Current increases suddenly.

It causes spark, fire and serious damage.

10. AC AND DC

DIRECT CURRENT (DC)

- Flows in one direction only.
- Provided by cells and batteries.
- Symbol: ⎓

ALTERNATING CURRENT (AC)

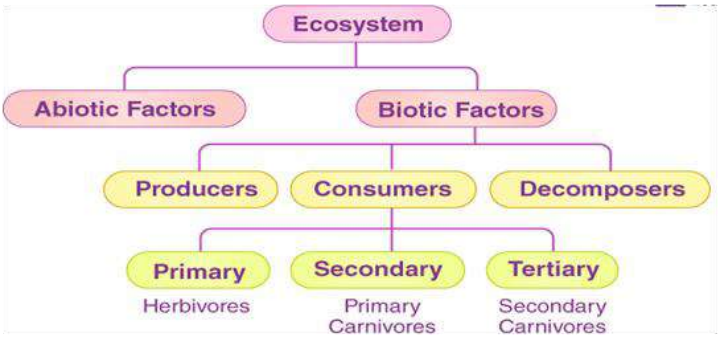
- Changes direction periodically.
- Provided by mains.
- Frequency of AC in India = 50 Hz.
- Symbol: ∿

Electricity and magnetism together make our world work better and safer!

Chapter 13 Our Environment

Theme –Unit V: Natural Resources
Syllabus: Eco-system, Environmental problems, Trophic levels, 10 % energy transfer rule, food chain and food web, Ozone depletion, waste production and their solutions. Biodegradable and non-biodegradable substances.

ECOSYSTEM-is a system consisting of biotic (Living) and abiotic (Non-living like water, Light, Soil etc) components that function together as a self-sustaining unit.
E.g.- Natural ecosystem – forest, pond, lake Man-made(artificial ecosystem)-crop,fields, garden
Ecosystem :The ecosystem comprises all the biotic and abiotic factors interacting with one another in any given area.
Biotic components include all living organisms such as plants, animals, microorganisms and humans, etc.
Abiotic components include sunlight, temperature, air, wind, rainfall, soil and minerals,etc.
E.g. pond ecosystem, grassland ecosystem, etc.
Mode of nutrition in animals and plants Autotrophic and Heterotrophic are the two modes of nutrition in living organisms. Plants and some bacteria are autotrophic as they make their own food. Animals, fungi and some bacteria are heterotrophic as they derive their food from other organisms.
Saprophytes and decomposers
Saprophytes feed on dead and decaying material, For example, fungi and microorganisms, bacteria, worms, slugs, and snails
Functions of Saprophytes: They absorb nutrients from dead and decaying plants and animal parts.



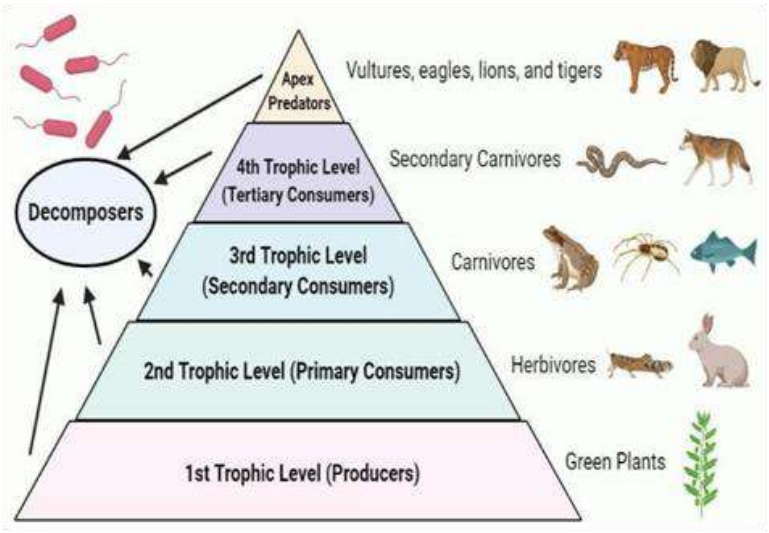
Functions of Decomposers break down the organic matter or waste material and release nutrients into the soil. They break down the complex organic matter into simpler substances. **Abiotic components :**Non-living chemical and physical components of the environment like the soil, air, water, temperature, etc.
Biotic components Living organisms of the environment like plants, animals, microbes and fungi.

Review question section 1

1. What will happen if all decomposers disappear from an ecosystem?

Trophic levels :It refers to the various levels in a food web as per the flow of energy. The different trophic levels are –
PYRAMID OF TROPHIC LEVELS:
➢ Is a graphical representation.
➢ Can be the pyramid of numbers, the pyramid of biomass or the pyramid of energy.
➢ All the pyramids start with producers.

a) **Pyramid of numbers**: gives the number of organisms present at each trophic level. It can be upright or inverted.
b) **Pyramid of biomass:** gives the biomass of each trophic level and could be upright or inverted.
c) **Pyramid of energy:** is always upright as it shows the flow of energy from one trophic level to the next trophic level.



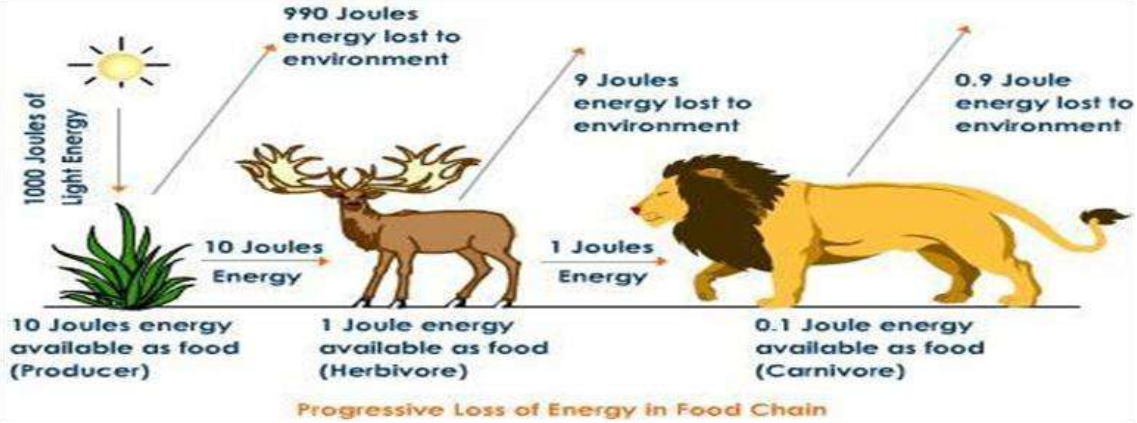
Law of conservation of energy :Energy can neither be created nor destroyed; rather, it transforms from one form to another.

In biological systems, it gets passed from one organism to another across trophic levels.

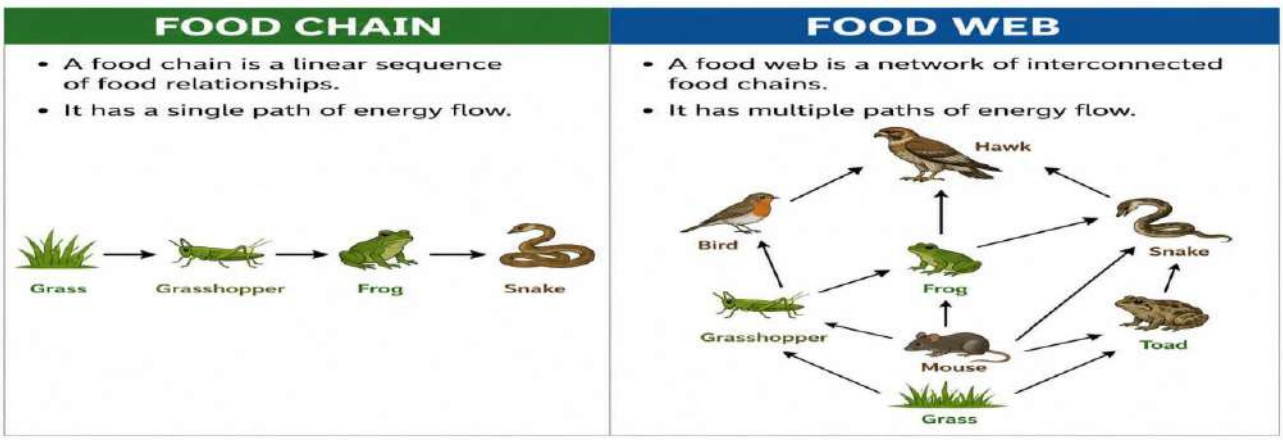
Energy flow

Transfer of energy from one trophic level to another depicting its direction and amount.

• Can be represented by the pyramid of energy.



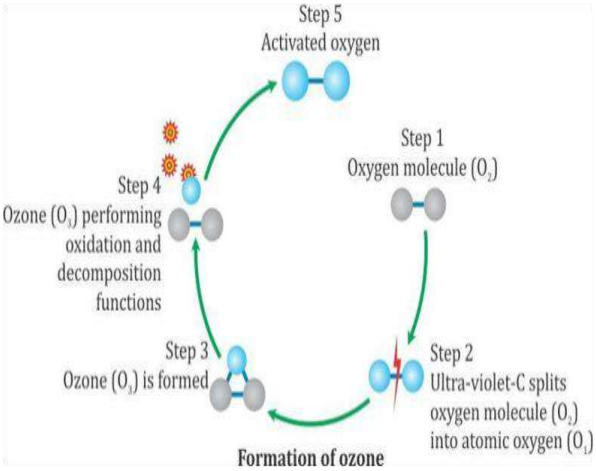
In any food chain, only 10% of the energy is transferred from one trophic level to another.



Review questions section 2

1. In a food chain, the maximum amount of energy is available at which level?
2. The 10% law of energy transfer was proposed by whom?
3. In a food chain, if 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?

Ozone layer: Ozone(O_3) is a deadly toxic gas present as ultraviolet shield in the stratosphere at about 25 km above the surface of theEarth. The ozone layer protects the earth from the sun's ultraviolet (UV) radiation.



Formation:-

$O_2 \rightarrow O + O$ (free oxygen)

$O_2 + O \rightarrow O_3$

Cause of Ozone layer depletion: *Chlorofluorocarbons(CFC's) used in refrigerants, aerosol sprays and foam blowing agents** Halogens used in fire extinguishers * Nitrogen oxide from industrial emissions.

<u>Harms caused by UV rays</u> :- skin cancers, skin ageing, sunburn, tanning, eye damage.

<u>Prevention of depletion</u> :-* Reduce use of CFC's and HFC's * Limiting nitrogen oxide emission from vehicles and industries * Minimizing pesticide usage * Traditional ways of cooling and refrigeration

Bio degradable waste	Non bio degradable waste
1. The wastes decompose naturally in the environment.	The wastes do not decompose naturally.
2. They are safe for the environment.	They are harmful to the environment and create pollution.
3. The wastes are made up of natural ingredients.	The wastes are made up of synthetic materials.
4. They can be constantly reused.	They cannot be recycled.
5.Biodegradable substances persist for small time interval in the environment.	Non biodegradable substances persist for longer time in the environment.
6. Example – waste papers, wood crumbles.	Example – plastic bags, cans, disposable bottles.

Garbage management: Involves all the activities and actions required to manage waste from its inception to its final disposal.

Ensures environmental best practices are followed along with proper monitoring and regulation. Steps involved:

1. Segregation of waste
2. Collection
3. Transport
4. Treatment
5. Processing & Recycling
6. Disposal

Biomagnification: It is the increase in the concentration of contaminants as they move up each trophic level in a food chain.

Review question section 3
1.Which organism of this food chain will have the highest concentration of non-biodegradable chemicals?

Review questions answer key

Section 1

1.Nutrient recycling stops.Dead matter accumulates.Ecosystems collapse.

Section 2

1Producer level (First trophic level)

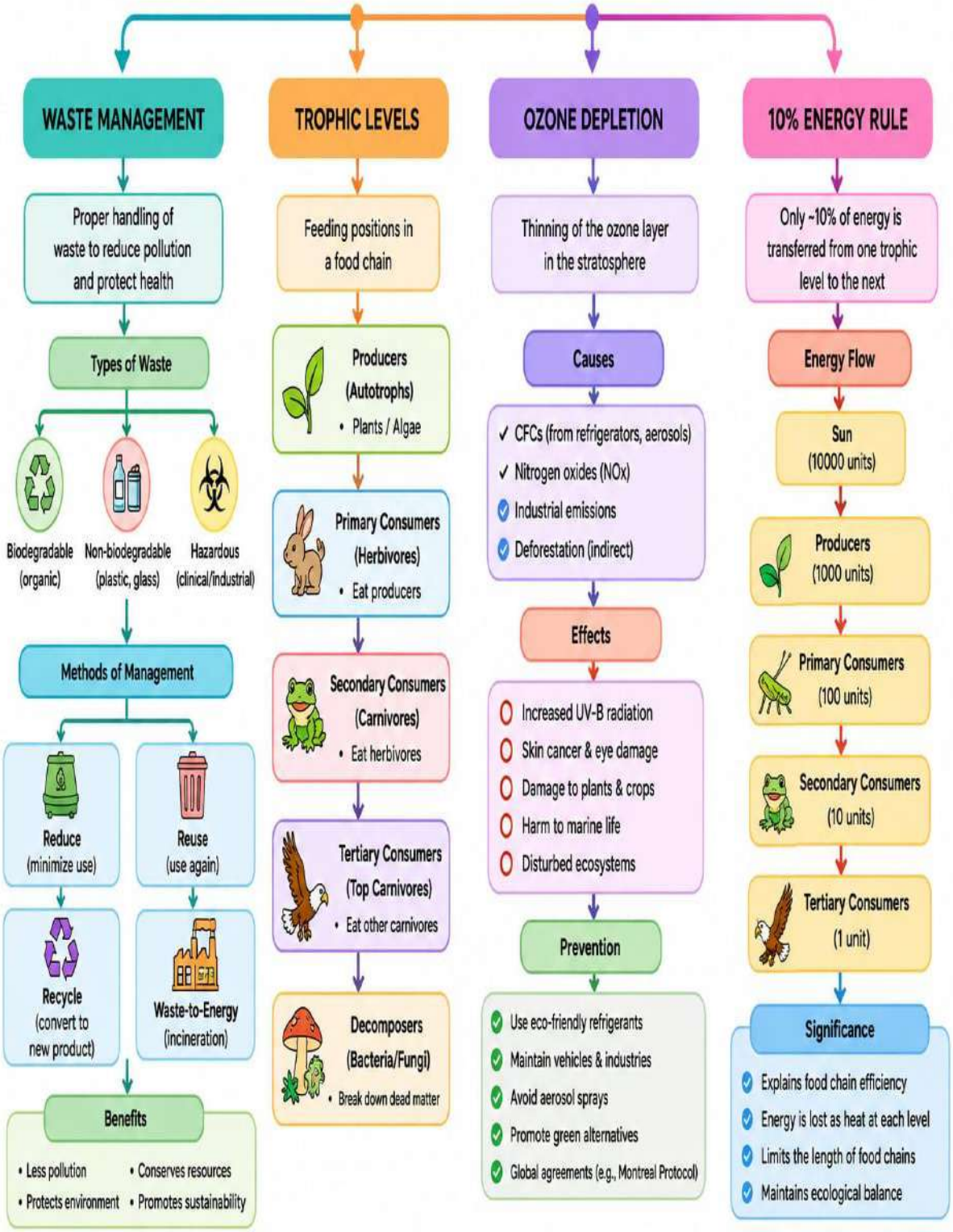
2.Raymond Lindeman

3.100 Joules(Explanation: Producers have 10,000 J , Primary Consumers get 1,000 J , Secondary Consumers get 100 J to pass along.)

Section 3

1.Top predator

Chapter 13 Our Environment Flow Chart



Chapter wise QR Codes for Quiz and Question bank

Chapter	Quiz	Question Bank
1. CHEMICAL REACTIONS AND EQUATIONS		
2.ACIDS, BASES AND SALTS		
3.METALS AND NON METALS		
4.CARBON AND ITS COMPOUNDS		
5. LIFE PROCESSES		
6. CONTROL AND COORDINATION		

7. HOW DO ORGANISMS REPRODUCE?		
8. HEREDITY		
9. LIGHT – REFLECTION AND REFRACTION		
10. THE HUMAN EYE AND THE COLOURFUL WORLD	Scan me!	Scan me!
11. ELECTRICITY	Scan me!	
12. MAGNETIC EFFECTS OF ELECTRIC CURRENT		Scan me!
13. OUR ENVIRONMENT	Scan me!	Scan me!

(CBSE Class 10 Science Board Examination Paper)

GENERAL INSTRUCTIONS : Read the following instructions carefully and follow them:

1. This question paper contains 39 questions. All questions are compulsory.
2. Question paper is divided into THREE sections — A, B and C.
   - Section A : Biology (30 Marks)
   - Section B : Chemistry (25 Marks)
   - Section C : Physics (25 Marks)
3. The question paper has MCQs, VSAs, SAs, LAs and C/S-BQs. Marks are given against each question.
4. There are case based questions (CBQs) with three sub-questions and are of 4 marks each.
5. Divide your answer sheet into three sections as per question paper – Section A (Biology), Section B (Chemistry) and Section C (Physics). It is compulsory to answer each question in its respective section. Do not mix answers of one section into the other section.
6. Instructions are given with each section and question, wherever necessary.
7. Kindly note that a separate question paper has been provided for visually impaired candidates.
8. There is no overall choice in the question paper. However, an internal choice has been provided in few questions. Only one of the choices in such questions must be attempted.

SECTION – A: Biology (Questions 1 to 16)

1. Which structure in a leaf is mainly responsible for gaseous exchange? (A) Xylem (B) Stomata (C) Phloem (D) Cuticle

2. Identify the type of reproduction shown in the diagram given below:

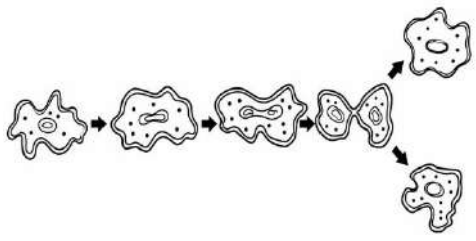


diagram shows a sequence of stages of a single-celled organism (Amoeba) undergoing binary fission: the parent cell nucleus elongates, the cytoplasm begins to constrict at the center, and the cell eventually divides into two identical daughter cells.) (A) Budding (B) Fragmentation (C) Spore Formation (D) Binary Fission

3. Identify the correct statement for *spirogyra*, *leishmania* and *hydra*: (A) they reproduce sexually. (B) they are unicellular. (C) they are multicellular. (D) they reproduce asexually.

4. Human brain has various parts or regions that help in different actions, responses and coordination. From the following, identify the part responsible for precision of voluntary actions: (A) Cerebrum (B) Cerebellum (C) Medulla (D) Pons

5. Pancreas secretes pancreatic juice which contain certain enzyme that helps in digestion of food. Choose the correct option from the following: (A) Trypsin digests emulsified fats and lipase digests proteins. (B) Trypsin digests proteins and lipase digests emulsified fats. (C) Trypsin and lipase both digests fats. (D) Trypsin digests proteins and lipase digests carbohydrates.

6. Sex is determined by different factors in various species. However, in human beings, it is determined genetically. Which amongst the following option(s) is/are correct for human beings? (i) Gamete carrying X chromosome from female parent. (ii) Gamete carrying X chromosome from male parent. (iii) Gamete carrying Y chromosome from male parent. Options: (A) (ii) and (iii) (B) (i) only (C) (i) and (iii) (D) (iii) only

7. Which of the following group is not 'biodegradable'? (A) Vegetable peels, dead leaves, paper (B) Cow dung, leather bag, water (C) Polythene bag, rubber band, ball pen (D) Paper, fruits, bones

Directions: Question numbers 8 and 9 are Assertion and Reason based questions. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below : (A) Both, Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both, Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

8. Assertion (A): Reflex actions do not involve thinking. Reason (R): Most reflex actions are controlled by the spinal cord.

9. Assertion (A): In human beings, the respiratory pigment is haemoglobin present in red blood cells. Reason (R): Haemoglobin has a very high affinity for carbon dioxide.

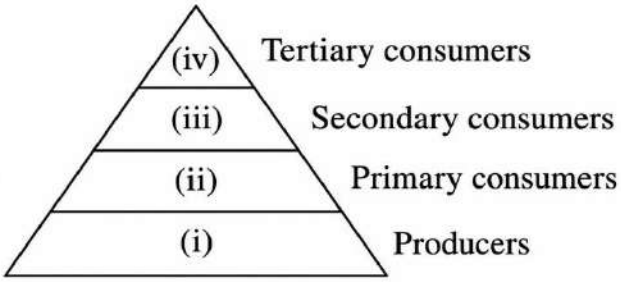
10. What is the function of diaphragm in human respiratory system? Where is it present in human body?

11. (a) State two differences between the act of chewing food and salivation on sight of food.

(b) State two differences between pollination and fertilization.

12. Draw a neat diagram to show germination of pollen on the female reproductive part of the flower. Name and label only the following parts: 3 (a) The part that receives the pollen grain. (b) The structure that carries the male germ cell to reach the female germ cell.

13. Given below is a pyramid showing various trophic levels in an ecosystem:



A textual representation of the provided diagram: a triangle divided into four horizontal layers. Layer (iv) at the apex represents Tertiary consumers; Layer (iii) represents Secondary consumers; Layer (ii) represents Primary consumers; and Layer (i) at the broad base represents Producers.)

(a) From the organisms listed below, identify which one is to be placed at which trophic level? Deer, Grass, Lion, Snake, Rabbit

(b) Discuss the reason why primary consumers will have more energy as compared to secondary consumers?

(c) Why is the base of the pyramid broad?

14. Give differences between the following: (a) Nephron and neuron (b) Sensory nerve and motor nerve (c) Consumers and decomposers

15. Mendel took garden pea plants with different characteristics, such as height to study the inheritance pattern of factors (genes). He crossed tall pea plant with short pea plant and obtained all the tall plants in the F_1 generation. Answer the following questions: (a) Why only tall pea plants were observed in F_1 progeny? (b) By which method did Mendel obtain F_2 progeny? (c) (i) Write one difference between dominant and recessive trait.

(c) (ii) Write two observations made by Mendel about F_1 progeny.

16. (a) Given below are certain situations. Analyse each and describe its possible impact: (i) A population of bacteria living in temperate waters whose temperature increased by global warming. (ii) The sperm encounters the egg when it reaches the oviduct in human females. (iii) Self pollination does not occur in a flower that contains only pistil. (iv) Egg does not get fertilised in a human female. (v) When the seed is placed under appropriate condition of water and air in the soil?

(b) Given below are certain situations. Analyse and describe what would happen when: (i) Spores are liberated from blob-like structures of the bread mould? (ii) Leaves of bryophyllum fall on wet soil? (iii) A pollen from different species land on the stigma of totally unrelated species? (iv) Copper-T is placed in the uterus of a human female? (v) *Spirogyra* breaks into smaller fragments upon maturation?

SECTION – B: Chemistry (Questions 17 to 29)

17. (i) $AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$ (ii) $K_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2KCl$ Which of the following options clearly describes both the reactions? 1 (A) (i) is double displacement, (ii) is displacement reaction. (B) Both, (i) and (ii) are displacement reactions and precipitation reactions. (C) Both, (i) and (ii) are double displacement reactions and precipitation reactions. (D) (i) is displacement, (ii) is double displacement reaction.

18. Which one of the following can be used as an acid-base indicator by a visually impaired (blind) student? (A) Turmeric (B) Vanilla essence (C) Methyl orange (D) Litmus

19. The gases evolved on heating lead (II) nitrate crystals are: (A) NO and O_2 (B) N_2 and NO_2 (C) NO_2 and H_2 (D) NO_2 and O_2

20. The formula of functional group for aldehyde is: (A) —COOH (B) —CHO (C) >C=O (D) —OH

21. Which of the following is a poor conductor of electricity? (A) Pb (B) Cu (C) Ag (D) Al

22. The natural sources of oxalic acid, lactic acid and methanoic acid respectively are:
(A) tomato, curd, ant-sting (B) tomato, orange, nettle-sting (C) orange, milk, ant-sting (D) orange, sour milk, nettle-sting

23. When an element 'X' reacts with water, it starts floating. Identify the element 'X':
(A) Potassium (B) Calcium (C) Sodium (D) Iron

Directions : For question number 24, two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to this question from the codes (A), (B), (C) and (D) as given below : (A) Both, Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both, Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

24. Assertion (A): Carbon shares its valence electrons with other atoms of carbon or with atoms of other elements. Reason (R): The shared electrons belong to the outermost shells of both the atoms and lead to both atoms attaining the noble gas configuration.

25. (a) What are amphoteric oxides? (b) Categorise the following based on their nature: ZnO, Na_2O, CO_2

26. (a) Name the substance oxidised and reduced in the following reaction: $ZnO + C \rightarrow Zn + CO$ (b) Balance the following chemical reaction: $Pb(NO_3)_2 + KI \rightarrow PbI_2 + KNO_3$ (c) Give one example each of electrolytic decomposition and decomposition by sunlight.

27. (a) Explain chlor-alkali process with chemical equation. Name the products formed at anode and cathode.

(b) Write the preparation of following compounds with balanced chemical equation: (i) Baking soda (ii) Bleaching powder (iii) Plaster of Paris

28. Read the following passage and answer the questions given below : Most of metals occur in combined state in form of ores. Carbonate ores are converted into oxides by calcination and sulphide ores by roasting. Oxides are reduced with suitable reducing agent like carbon to get free metal. Highly reactive metals like Al, Mg are also used as reducing agents to obtain metal from their oxides. Most reactive metals are obtained by electrolytic reduction of their molten ores. Alloying is a very good method of improving the properties of a metal. We can get desired properties by this method. The electrical conductivity and melting point of an alloy is less than that of pure metals. (a) Why carbonate or sulphide ores are converted to oxides before extraction of metal from it? (b) Write a reaction in which Aluminium is used as a reducing agent to obtain metal from its oxide. (c) (i) How is copper obtained from its ore (Cu_2S)? Give equations of the reactions.

(c) (ii) (I) Why highly reactive metals cannot be obtained from their oxides by using carbon as a reducing agent? (II) Why solder, an alloy of lead and tin, is used for welding electrical wires together?

29. (a) (i) Give reasons for the following: (I) Covalent compounds are poor conductor of electricity. (II) Soap does not form lather in hard water. (III) Carbon shows catenation but silicon does not. (ii) Write chemical equations for the following: (I) Oxidation of ethanol by acidified $K_2Cr_2O_7$. (II) Hydrogenation of ethene.

(b) Mohan heated ethanol with a compound 'X' in the presence of a few drops of conc. H_2SO_4 and observed a sweet smelling compound 'Y' is formed. When 'Y' is treated with sodium hydroxide it gives back ethanol and a compound 'Z'. (i) Identify 'X', 'Y' and 'Z'. (ii) Write the role of conc. H_2SO_4 in the reaction. (iii) Write the chemical equations involved and name the reactions.

SECTION – C: Physics (Questions 30 to 39)

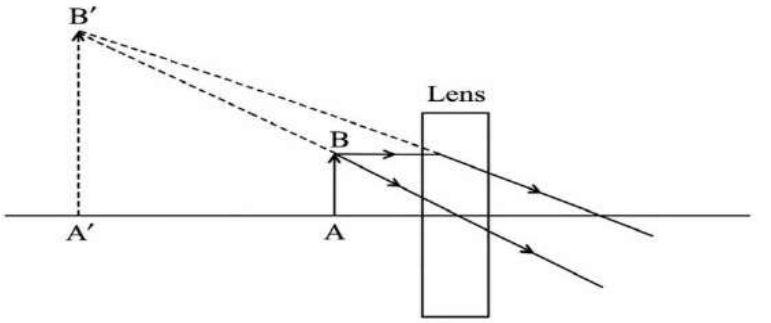
30. A convex lens of focal length 15 cm, is forming a real image. If the size of image is same as the size of object, then position of object and position of image will be, respectively: (A) - 15 cm and - 15 cm from lens (B) - 15 cm and + 15 cm from lens (C) - 30 cm and + 30 cm from lens (D) - 30 cm and - 30 cm from lens

31. When you look at an object very close to your eyes, the: (A) Ciliary muscles of your eye contract and the eye lens becomes thick. (B) Ciliary muscles of your eye get relaxed and the eye lens becomes thick. (C) Ciliary muscles of your eye contract and the eye lens becomes thin. (D) Ciliary muscles of your eye get relaxed and the eye lens becomes thin.

Directions : For question number 32, two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to this question from the codes (A), (B), (C) and (D) as given below : (A) Both, Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both, Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

32. Assertion (A): When rays of white light pass through a prism, on emerging they give spectrum of seven colours. Reason (R): It is due to the dispersion of light that red light bends minimum and violet light bends the maximum.

33. The given figure shows image formation by a lens. Analyse the figure and answer the following questions:



(A ray diagram depicts a convex lens. An object AB is positioned between the focal point F and 2F. Light rays originate from point B, pass through the lens, and converge to form a real, inverted, and magnified image A'B' on the opposite side of the lens, beyond 2F.) (a) What is the type of lens used for image formation in the given ray diagram? (b) If the real image is formed at a distance of 30 cm from the lens and the size of image is twice the size of the object, then where was the object placed?

34. (a) The resistance of a wire of 0.01 cm radius and 1.0 cm length is 7 Ω. Calculate its resistivity.

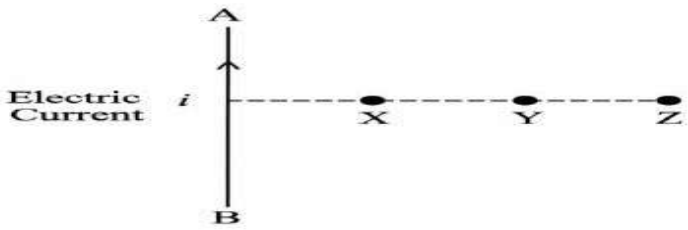
(b) An electric heater is rated 220 V; 11 A. Calculate the power consumed if the heater is operated at 200 V.

35. A person is unable to read a book placed closer than 1 meter from his eyes. Identify the defect of vision in his eyes. Draw the ray diagrams to show the defect of vision and its correction.

36. (a) Describe an activity to show that a current carrying conductor, placed in an external magnetic field experiences a force. (b) Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally towards the front wall from the back wall, is deflected by a strong magnetic field to your right side. Find the direction of the magnetic field.

37. (a) The pattern of magnetic field due to a current carrying wire depends upon the shape made by that wire. Justify.

(b) A current carrying straight wire AB is shown in the given diagram. Out of X, Y and Z on which point will the strength of magnetic field be maximum and why? *(The diagram illustrates a straight vertical wire labeled AB, with a current 'i' flowing upward from B to A. Three points—X, Y, and Z—are positioned at increasing horizontal distances to the right of the wire, with X being the closest and Z being the farthest.)*



38. Read the following passage and answer the questions given below : Lenses can form different types of images depending upon their focal length and position of object. A convex lens can create real, inverted or virtual, erect images, while a concave lens forms only virtual and diminished images. The focal length determines the power of lens. Convex lenses have positive focal length while concave lenses have negative focal length by convention. When lenses are placed together, their combined power is determined by the sum of their individual powers. Ray diagrams help to visualize how light converges or diverges through lens to form an image. (a) A convex lens of focal length 20 cm is used to form an image. If an object is placed at 40 cm from the lens, what will be the position and nature of image? (b) Illustrate the formation of image with the help of ray diagram, when the object is placed between the optical centre and principal focus of concave lens. (c) (i) A lens combination consists of a convex lens of focal length 30 cm and a concave lens of focal length 15 cm placed together. Find the equivalent focal length and power of this lens combination.

(c) (ii) Two lenses are placed in contact. One is a concave lens with focal length 2 m and the other is a convex lens with focal length 1.5 m. What type of lens will the combination behave as (convex or concave)? Give reason.

39. (a) (i) Due to change in length and area of cross-section of a conductor, resistance of conductor changes while resistivity does not change. Why? (ii) Conductors of electric toasters and electric iron are made of an alloy rather than a pure metal. Why? (iii) Define the S.I. unit of electric current.

(b) (i) How many bulbs of resistance 8 Ω each should be connected in parallel combination to draw a current of 2 A from a battery of 4 V? (ii) Name the device used for measuring electric current. How is it connected in a circuit? (iii) State Joule's law of heating.

CBSE Class 10 Science Board Examination Paper Solution

Q1. Which structure in a leaf is mainly responsible for gaseous exchange?
Answer: (B) Stomata

Q2. Identify the type of reproduction shown in the diagram.
Answer: (D) Binary Fission

Q3. Identify the correct statement for spirogyra, leishmania and hydra.
Answer: (D) They reproduce asexually.

Q4. Part responsible for precision of voluntary actions.
Answer: (B) Cerebellum

Q5. Function of trypsin and lipase.
Answer: (B) Trypsin digests proteins and lipase digests emulsified fats.

Q6. Human sex determination.
Answer: (C) (i) and (iii)

Q7. Which group is not biodegradable?
Answer: (C) Polythene bag, rubber band, ball pen

Q8. Assertion-Reason on reflex action.
Answer: (A) Both are true and Reason is correct explanation.

Q9. Assertion-Reason on haemoglobin.
Answer: (C) Assertion true, Reason false.

Q10. Function and location of diaphragm.
Diaphragm helps in breathing by expanding and contracting the chest cavity. It is present below the lungs separating chest cavity from abdominal cavity.

Q11(a). Differences between chewing and salivation.
Chewing is mechanical breakdown of food by teeth; salivation mixes saliva and starts digestion of starch.

Q11(b). Differences between pollination and fertilization.
Pollination is transfer of pollen grains to stigma; fertilization is fusion of male and female gametes.

Q12. Label the flower parts.
a) Stigma b) Pollen tube

Q13. Trophic levels.
Grass–Producer, Deer/Rabbit–Primary consumers, Snake–Secondary consumer, Lion–Tertiary consumer. Primary consumers get more energy due to 10% law. Base is broad because producers are maximum.

Q14(a). Difference between nephron and neuron.
Nephron is structural unit of kidney; neuron is structural unit of nervous system.

Q15. Mendel experiment.
F1 plants were tall because tallness is dominant. F2 obtained by self-pollination of F1 plants.

Q16. Situation based questions.
Answers include effects like fertilization, germination, reproduction and environmental impacts.

Q17. Type of reactions.
Answer: (C) Both are double displacement and precipitation reactions.

Q18. Indicator for visually impaired student.
Answer: (B) Vanilla essence

Q19. Gases evolved on heating lead nitrate.
Answer: (D) NO_2 and O_2

Q20. Functional group of aldehyde.
Answer: (B) –CHO

Q21. Poor conductor of electricity.
Answer: (A) Pb

Q22. Sources of acids.
Answer: (A) Tomato, curd, ant-sting

Q23. Element floating on water.
Answer: (B) Calcium

Q24. Assertion-Reason on carbon bonding.
Answer: (A) Both are true and Reason is correct explanation.

Q25. Amphoteric oxides.
Amphoteric oxides react with both acids and bases. ZnO is amphoteric, Na_2O basic, CO_2 acidic.

Q26. Oxidation and reduction.
ZnO is reduced and carbon is oxidised.

Q27. Chlor-alkali process.
Electrolysis of brine gives chlorine at anode, hydrogen at cathode and sodium hydroxide in solution.

Q28. Extraction of metals.
Carbonate/sulphide ores converted to oxides for easy reduction. Aluminium used in thermite reaction.

Q29. Covalent compounds and soap.
Covalent compounds lack free ions. Soap forms scum in hard water. Carbon shows catenation due to strong C-C bonds.

Q30. Convex lens focal length 15 cm.
Answer: (C) –30 cm and +30 cm

Q31. Object very close to eyes.
Answer: (A) Ciliary muscles contract and eye lens becomes thick.

Q32. Assertion-Reason on prism.
Answer: (C) Assertion true, Reason false.

Q33. Lens diagram.
The lens is convex lens. Using magnification m=v/u, object distance = 15 cm.

Q34. Resistance and power.
Use formulas $R=\rho l/A$ and $P=VI$.

Q35. Defect of vision.
The person suffers from hypermetropia. Corrected using convex lens.

Q36. Magnetic force on conductor.
A current carrying conductor experiences force in magnetic field according to Fleming's left hand rule.

Q37. Magnetic field around straight conductor.
Magnetic field is maximum at point X because it is nearest to the wire.

Q38. Lens based questions.
Convex lens forms real or virtual images. Combined power of lenses is sum of individual powers.

Q39. Electricity questions.
Resistance changes with dimensions but resistivity depends only on material and temperature. Ammeter is connected in series. Joule's law: $H = I^2Rt$.

Practice paper 1 (unsolved)

SCIENCE (086) CLASS – X

Time Allowed: 3 hours Maximum marks : 80

General Instructions:

(i) This question paper consists of 39 questions in 3 sections.
(ii) Section A is Biology, Section B is Chemistry, and Section C is Physics.
(iii) All questions are compulsory. However, an internal choice is provided in some questions.
(iv) Assertion-reason type instructions:
a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A.
b) Both Assertion (A) and Reason (R) are true, but R is not the correct explanation of A.
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

SECTION A (Biology)

1. Diagram of stomata of green leaf with guard cells is given below. Which one of the following conditions is true about stomata?
   a) Large amount of water flows into the guard cell
   b) Gaseous exchange is occurring in large amount
   c) Large amount of water flows out from guard cells
   d) Large amounts of sugars collect in guard cell
2. The force that blood exerts against the wall of a vessel is known as (1). This pressure is greater in arteries than veins. The pressure of blood inside the artery during contraction is called (2) and the pressure in artery during relaxation is called (3). Identify 1, 2 & 3.
   a) Systolic, diastolic & BP
   b) BP, Diastolic & Systolic
   c) BP, Systolic & Diastolic
   d) Diastolic, BP & Systolic
3. The regulation of blood sugar levels is a classic example of a hormonal feedback mechanism. Which hormones are responsible for lowering and raising blood sugar levels, respectively?
   a) Glucagon and Insulin
   b) Insulin and Glucagon
   c) Adrenaline and Thyroxine
   d) Thyroxine and Adrenaline
4. If the vas deferens in humans is blocked, which function is affected?
   a) Urine formation
   b) Production of sperm
   c) Transport of sperm
   d) Production of testosterone

5. A heterozygous light blue flower is crossed with a heterozygous light blue flower. Based on the Punnett square given, what is the expected phenotype ratio in F2 generation?
   a) 3 blue & 1 white
   b) 3 white & 1 light blue
   c) 1 blue, 2 white & 1 light blue
   d) 1 blue, 2 light blue & 1 White
6. Which of these is an example of a pollutant accumulating in the food chain?
   a) Ozone depletion
   b) Increase in DDT concentration
   c) Nitrogen fixation
   d) CO_2 pollution
7. Which of the following is not the growth dependent movement in plant?
   a) Movement of roots towards water.
   b) Movement of shoot towards sunlight.
   c) Movement in sunflower.
   d) The fold up and droop movement in leaves of 'touch-me-not' plant.
8. **Assertion (A):** Reflex actions occur involuntarily.
   Reason (R): Reflex actions are controlled by the spinal cord.
9. **Assertion (A):** In humans, the father's genetic contribution determines the sex of the offspring.
   Reason (R): The mother's genetic contribution determines the sex of the offspring, as she has X and Y chromosomes.
10. a) How is ozone formed? Illustrate with an equation.
    b) It has been observed that the ozone layer is getting depleted. Name the compound responsible for ozone depletion.
11. An athlete experiences sudden muscle cramps during an intense race. Explain how both aerobic and anaerobic respiration are involved in this situation.
    OR
    Differentiate between nephron and alveoli on the basis of function and the system that it is associated with.
12. What are decomposers? Define Biodegradable waste with an example.
13. The following images are showing different movements in the plant. Write the names of any three movements with examples.
14. A pure tall pea plant (TT) is crossed with a pure dwarf pea plant (tt).
    a) What is the appearance (phenotype) ratio of the offspring produced in the F1 generation?
    b) When the plants from the F1 generation are self-pollinated, what percentage of the F2 generation plants will be dwarf?
    c) Write the percentage of homozygous (pure) tall plants in the F1 generation.
15. Two potted plants are kept in two different conditions:
    Plant A – In bright sunlight with dry air.
    Plant B – In a shady room with high humidity.
    After a few hours, plant A shows more wilting compared to plant B. Based on the above situation, answer the following:
    a) Identify the plant in which transpiration rate is high and give reason.
    b) How does increased transpiration affect translocation of food and water inside the

plant?
c) Mention one adaptation in plants that helps to reduce transpiration in dry conditions.

16. **A.** 1. During the rainy season, Priya notices black powder-like substances on bread slices. Her teacher explains that these are spores.
a) Name the mode of asexual reproduction mentioned here.
b) Describe how this method helps fungi survive in unfavorable conditions.
2. a) Name the modes of asexual reproduction shown by Planaria and Plasmodium.
b) Give one example each of an organism that shows: (i) Fragmentation, (ii) Budding.
OR
B. Observe the female reproductive system diagram and answer:
a) Identify the ovaries, fallopian tube, uterus, and cervix.
b) Fertilization in humans is internal; identify the site where it occurs.
c) What happens to the egg and the uterine lining if fertilization does not take place? [7, 8]

SECTION B (Chemistry)

17. What type of chemical reaction is this?
Heat: 2FeSO4(s) → Fe2O3(s) + SO2(g) + SO3(g)
a) Combination reaction
b) Photo decomposition reaction
c) Thermal decomposition reaction
d) Exothermic reaction
18. In the reaction: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$, Zinc is acting as a:
a) Reducing agent
b) Oxidising agent
c) Catalyst
d) Precipitate
19. Which of the following is a precipitation reaction?
a) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
b) $AgNO_3 + NaCl \rightarrow AgCl \downarrow + NaNO_3$
c) $2H_2 + O_2 \rightarrow 2H_2O$
d) $CaCO_3 \rightarrow CaO + CO_2$
20. Which of the following is an olfactory indicator?
a) Turmeric
b) Onion
c) Litmus
d) Methyl orange
21. Which gas is released when an acid reacts with a metal carbonate?
a) Hydrogen
b) Oxygen
c) Carbon monoxide
d) Carbon dioxide
22. Turmeric is a natural acid-base indicator. What is the colour change observed when it is exposed to a basic solution?

a) Turns red
b) Turns blue
c) Turns pink
d) Turns brown

23. Which of the following is an amphoteric oxide?
    a) Al_2O_3
    b) MgO
    c) Na_2O
    d) CO_2
24. **Assertion:** Alkanes are less reactive than alkenes.
    Reason: Alkanes are unsaturated hydrocarbons while alkenes are saturated hydrocarbons.
25. Shivani mixed the solutions of sodium sulphate in the solution of barium chloride.
    (a) Write the chemical equation of the above chemical reaction.
    (b) What is the name of this chemical reaction?
26. **A.** When ferrous sulphate crystals are heated in a dry test tube, initially colour changes from green to white and finally to brown.
    a) Name the brown substance formed.
    b) Write the balanced equation.
    c) Why was crystals' colour changed to white?
    OR
    B. a) Show the formation of calcium chloride by transfer of electrons.
    b) Pure gold is alloyed with two metals to increase hardness. Name those two metals.
    c) Differentiate between roasting and calcination with examples.
27. **A.** Regarding Electrolytic Refining:
    a) Write the name of this process.
    b) Identify the Anode, Cathode, Electrolyte, and Impurities.
    c) Write the names of the materials used for the Anode and Cathode.
    OR
    B. A teacher gave: Lemon juice (pH 2), Soap (pH 12), Milk (pH 6.5), Distilled water (pH 7).
    a) Which substance is the strongest acid? Why?
    b) Which two substances when mixed may give a neutral solution?
    c) Why does a milkman sometimes add a pinch of baking soda to milk?
28. a) What is the pH of the acid used in the formation of common salt in the lab?
    b) Write the balanced chemical equation for the chlor-alkali process.
    c) Write the formation of Bleaching powder and its two uses.
    OR
    Write the formation of Plaster of Paris and its two uses.
29. **A.** Substance 'A' reacts with 'B' in the presence of conc. sulphuric acid to produce sweet-smelling 'C'. 'B' is the active ingredient in alcoholic drinks.
    a) Write the names of substances 'A' and 'B'.
    b) What is the name of this reaction?
    OR
    B. Define the following: (a) Homologous series (b) Esterification (c) Saponification. [9]

SECTION C (Physics)

30. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image.
    a) 6 cm, real and inverted
    b) 6 cm, virtual and erect
    c) 30 cm, real and inverted
    d) 30 cm, virtual and erect
31. The refractive index of glass is 1.50. What is the speed of light in glass? (Speed of light in vacuum is 3.0×10^8 m/s).
    a) 2.0×10^8 m/s
    b) 2.5×10^8 m/s
    c) 1.8×10^8 m/s
    d) 3.0×10^8 m/s
32. A person cannot see objects distinctly kept beyond 2 meters. This defect can be corrected by using a lens of power:
    a) +0.5 D
    b) -0.5 D
    c) +0.2 D
    d) -0.2 D
33. Which of the following phenomena of light are involved in the formation of a rainbow?
    a) Reflection, refraction and dispersion
    b) Refraction, dispersion and total internal reflection
    c) Refraction, dispersion and internal reflection
    d) Dispersion, scattering and total internal reflection
34. The resistance of a conductor depends on:
    a) Its length
    b) Its area of cross-section
    c) Nature of its material
    d) All of the above
35. **Assertion (A):** The magnetic field lines around a current-carrying straight wire are concentric circles.
    Reason (R): The direction of the magnetic field can be found using the Right-Hand Thumb Rule.
36. a) Define Power of a lens. What is its S.I. unit?
    b) A lens has a focal length of -20 cm. What is the power and type of this lens?
37. a) State Ohm's Law.
    b) Draw a circuit diagram to verify Ohm's Law.
    c) Three resistors of 2 Ω, 3 Ω, and 6 Ω are connected in parallel. Calculate the equivalent resistance of the combination.
    OR
    a) What is Joule's heating effect? Write its mathematical expression.
    b) Why are the coils of electric toasters and electric irons made of an alloy rather than a pure metal?

38. a) State the principle of an electric motor.

b) What is the function of split rings (commutator) in an electric motor?

c) Draw a labeled diagram of a magnetic field produced around a current-carrying circular loop.

OR

a) Define a magnetic field line. List two properties of magnetic field lines.

b) Explain why two magnetic field lines never intersect each other.

c) What is a solenoid? Draw the magnetic field pattern around a current-carrying solenoid.

Practice paper 2 (unsolved)

SCIENCE (086) CLASS – X

Time Allowed: 3 hours Maximum marks : 80

General Instructions:

(i) This question paper consists of 39 questions in 3 sections.
(ii) Section A is Biology, Section B is Chemistry, and Section C is Physics.
(iii) All questions are compulsory. However, an internal choice is provided in some questions.
(iv) Assertion-reason type instructions:
a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A.
b) Both Assertion (A) and Reason (R) are true, but R is not the correct explanation of A.
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

Section – A (Biology)

1. Select the group in which all organisms have the same mode of nutrition.
   A. Cuscuta, yeast, legumes, leeches and tapeworm
   B. Cactus, ticks, lice, leeches and cow
   C. Cuscuta, ticks, lice, leeches and tapeworm
   D. Cactus, grass, lice, lion and tapeworm
2. Which of the following options indicates the products formed after breakdown of glucose in our muscle cells when there is lack of oxygen?
   A. Ethanol + carbon dioxide + Energy
   B. Lactic acid + Energy
   C. Lactic acid + carbon monoxide + Energy
   D. Carbon dioxide + Water + Energy
3. Which of the following is a correct combination of function and part of the brain?
   A. Posture and balance: Cerebrum
   B. Salivation: Medulla in midbrain
   C. Hunger: Pons in hindbrain
   D. Blood pressure: Medulla in hindbrain
4. The blood glucose level in a patient was very high. It may be due to inadequate secretion of:
   A. Growth hormone from pituitary gland
   B. Oestrogen from ovary
   C. Insulin from pituitary gland
   D. Insulin from pancreas
5. In a cross between black furred rabbit (B) and white furred rabbit (b), all offspring were found to have black fur. What can be inferred about the genetic makeup of the parent rabbits?
   A. BB × bb
   B. Bb × Bb
   C. Bb × bb
   D. bb × bb

6. Which are the correct statements related to ozone?
(i) Ozone layer helps in increasing the UV radiations reaching earth.
(ii) Ozone is a deadly poison.
(iii) Ozone layer shields the earth from UV radiations.
(iv) Ozone layer prevents UV rays which cause skin cancer.
(v) Ozone is formed with the help of Chlorofluorocarbons.

A. (i), (ii), (iii)
B. (ii), (iii), (iv)
C. (iii), (iv), (v)
D. (i), (iv), (v)

7. Which of the following human activities has resulted in an increase of non-biodegradable substances?
A. Organic farming
B. Increase in tree plantation
C. Use of plastic as packaging material
D. Composting of kitchen waste

Questions 8 and 9 are Assertion–Reason based questions.

A. Both A and R are true, and R is the correct explanation of A.
B. Both A and R are true, and R is not the correct explanation of A.
C. A is true but R is false.
D. A is false but R is true.

8. Assertion (A): Tallness of a pea plant is controlled by an enzyme.
Reason (R): The gene for that enzyme makes proteins which help the plant to be tall.
9. Assertion (A): Vulture will always have the least amount of pesticides in a food chain.
Reason (R): Vulture occupies the last trophic level and it gets only 10% of energy of the previous trophic level.
10. Unlike animals, plants do not have any excretory products as they do not eat food. Comment upon the statement with justification.
11. Students to attempt either Option A or B.

A. How many chambers are there in the heart of the following organisms? How is mixing of oxygenated and deoxygenated blood prevented in their body?
(i) Fishes
(ii) Humans

OR

B. Explain the mechanism by which water is transported in plants.

12. About 100 acres of forest land was declared as Natural Reserve Park. The following organisms were predominant in the Natural Reserve Park:

Rabbit, frog, grass, fish, fox, water insects, zebra, peacock, snake, trees, bird, owl, insects, tiger, vulture, duck.

Create a food web comprising two separate food chains with different producers by using the above data.

13. Draw and explain how the nerve cells help in transmission of impulses.
14. In a genetic experiment, plants with pure round green seeds (RRyy) were crossed with plants with wrinkled yellow seeds (rrYY).

(i) Show the gametes formed when F1 was self-pollinated.

(ii) A total of 144 seeds were produced which developed into saplings. Show the ratio in which these traits are independently inherited in these 144 saplings.

15. Neha consumed boiled sweet potatoes and boiled eggs for breakfast. Help her to understand some steps in the process of digestion of the food taken by her by answering the questions given below. Attempt either subpart A or B.

A. Which of these food items is rich in proteins? In which part of the alimentary canal is the digestion of this component initiated? Name the enzymes, conditions required and the glands associated with the digestion here.

OR

B. Which of these food items contains fats? How is it digested?

C. Which of these food items is rich in starch? How is its digestion initiated?

D. The figure given below represents parts of the human alimentary canal. Which of these parts will have the maximum amount of digested food as soon as the process of digestion is completed?

For visually impaired students:
How will the digested food be taken up by the alimentary canal?

16. Attempt either Option A or B.

A. Puneet wanted to grow banana plants.

(i) Based on your knowledge on plant reproduction should he opt for seeds or any alternate method of reproduction? Justify your answer.

(ii) Offsprings of a banana plant usually show very little variation. What causes variation and are variations good or bad? Justify.

OR

B. Annie was conducting research on the number of fruits produced by watermelon under different conditions. She grew 25 watermelon plants each in both glass house A and B. She introduced pollinators in glass house A only.

(i) What difference will she observe in the number of fruits produced in the two glass houses? Explain with reason.

(ii) List three changes that will occur in a flower once it gets fertilized.

Section – B (Chemistry)

17. Which of the following equations represent redox reactions and what are the values for 'p' and 'q' in these equations?

    Equation 1: $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + pFe + heat$

    Equation 2: $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + qH_2O$

    A. Only equation 1 is a redox reaction, p = 1 and q = 3
    B. Both equations 1 and 2 are redox reactions, p = 2 and q = 4
    C. Only equation 2 is a redox reaction, p = 2 and q = 10
    D. Both equations 1 and 2 are redox reactions, p = 2 and q = 10

18. Four statements about the reactions of oxides with dilute hydrochloric acid and aqueous sodium hydroxide are listed.

    I. Aluminium oxide reacts with both dilute hydrochloric acid and aqueous sodium hydroxide.
    II. Calcium oxide reacts with dilute hydrochloric acid and aqueous sodium hydroxide.
    III. Zinc oxide reacts with both dilute hydrochloric acid and aqueous sodium hydroxide.
    IV. Sulphur dioxide does not react with either dilute hydrochloric acid or aqueous sodium hydroxide.

    Which statements are correct?
    A. I and II
    B. I and III
    C. II and IV
    D. III and IV

19. An iron nail is added to each of the two test tubes 'P' and 'Q' containing aqueous copper sulphate and aqueous silver nitrate respectively. Which of the following observation is correct?

    A. In test tube 'P' iron nail is coated with a blue coating and in test tube 'Q' there is no reaction.
    B. Iron nail is coated with a brown coating in test tube 'P' and silver coating in test tube 'Q'.

C. There is no reaction in either of the test tubes ‘P’ or ‘Q’.
D. There is no reaction in test tube ‘P’ but a silver coating on iron nail is seen in test tube ‘Q’.

20. Methyl orange is added to dilute hydrochloric acid and to aqueous sodium hydroxide. What is the colour of methyl orange in each solution?

    A. Orange, Red
    B. Red, Yellow
    C. Red, Orange
    D. Yellow, Red

21. Which of the following substances when dissolved in equal volume of water, will have the highest pH value?
    A. Sulphuric acid
    B. Acetic acid
    C. Magnesium hydroxide
    D. Sodium hydroxide
22. When excess carbon dioxide is passed through lime water, the milkiness disappears because:
    A. Water soluble calcium carbonate converts to water soluble calcium bicarbonate.
    B. Insoluble calcium carbonate converts to water soluble calcium bicarbonate.
    C. Water soluble calcium carbonate converts to insoluble calcium bicarbonate.
    D. Insoluble calcium carbonate converts to insoluble calcium bicarbonate.
23. In the reaction of aqueous solution of barium chloride with aqueous solution of sodium sulphate, the aqueous solution formed will be:
    A. $BaCl_2$
    B. $BaSO_4$
    C. Na_2SO_4
    D. NaCl

    Questions 24 are Assertion–Reason based questions.

    A. Both A and R are true, and R is the correct explanation of A.
    B. Both A and R are true, and R is not the correct explanation of A.
    C. A is true but R is false.
    D. A is false but R is true.

24. Assertion (A): C_4H_8, C_4H_6 and C_4H_{10} are members of the same homologous series.
    Reason (R): C_4H_8, C_4H_6, C_3H_4, C_3H_6, C_2H_4, C_2H_2 are unsaturated hydrocarbons.
25. The following activity is set-up in the science lab by the teacher. He clamped an aluminium wire on a stand and fixed a pin to the free end of the wire using wax. Then he heated the wire with a burner from the end where the wire is clamped. Students observed the pin fall off.

    A. If the teacher replaces aluminium wire by silver wire, will the students’ observation change? Justify your answer.

B. Will the aluminium wire melt? Give reason for your answer.

26. Attempt either Option A or B.

A. An element 'X' is stored in kerosene, and cannot be extracted from its ore using a reducing agent. 'X' forms an ionic compound on reaction with chlorine.

(i) Can we store 'X' in water? Give reason.

(ii) Identify element 'X'. Name the process used and write the equation for extraction of 'X' from its ore.

OR

B. The domes of many buildings in Europe are made of copper. These domes now appear greenish in colour.

(i) Why do the domes appear greenish though copper is orange-red in colour?

(ii) Should the copper domes be replaced by iron domes to overcome the problem of colour change?

(iii) Why did ancient architects use copper to make domes?

27. Amrita electrolysed distilled water using a circuit setup. Suddenly she realised that the bulb in the circuit did not glow when she used distilled water. After this realization, she added a substance to the distilled water for electrolysis to take place.

Answer the following questions:

A. Which gas was she expecting at the anode and which at the cathode?

B. Why did the bulb not glow when electricity was passed through distilled water?

C. Which substance was added by Amrita to distilled water to get the expected result?

For visually impaired students:
Identify the type of reaction:

A. $ZnO + C \rightarrow Zn + CO$
B. $ZnCO_3 \rightarrow ZnO + CO_2$
C. $2Mg + O_2 \rightarrow 2MgO + heat$

28. Sara took 2 mL of dilute NaOH solution in a test tube and added two drops of phenolphthalein solution to it. The solution turned pink. She added dilute H_2SO_4 drop by drop until the solution became colourless.

Answer the following questions:

A. If concentrated H_2SO_4 is used instead of dilute H_2SO_4, how many drops will be required?
(a) 40
(b) < 40
(c) > 40

Justify your answer.

B. Sara measured 20 drops of dilute H_2SO_4 and found its volume to be 1 mL. If Sara observed a change in colour of NaOH solution by using 3 mL of H_2SO_4, how many mL of NaOH did she add initially?

OR

Sara takes 10 drops of dilute H_2SO_4 in a test tube and adds two drops of phenolphthalein solution to it. Then she adds NaOH dropwise. What colour change would she observe and why?

C. Write a balanced chemical equation for the reaction taking place. Which of the following is true and why?
(a) Neutralisation and double displacement reaction
(b) Neutralisation and precipitation reaction
(c) Precipitation and double displacement reaction
(d) Neutralisation, double displacement as well as precipitation reaction

29. Attempt either Option A or B.

A. A hydrocarbon with the formula CxHy undergoes complete combustion as shown below:

$2CxHy + 9O_2 \rightarrow 6CO_2 + 6H_2O$

(a) What are the values of x and y?
(b) Give the IUPAC name of the hydrocarbon.
(c) Draw its electron dot structure.
(d) Name the alcohol which on heating with concentrated H_2SO_4 will produce the above hydrocarbon.
(e) Write a balanced chemical equation for the reaction of CxHy with hydrogen gas in presence of nickel.

OR

B. The electronic structures of atoms P and Q are shown.

(a) If P and Q combine to form a compound, what type of bond is formed?
(b) Give the chemical formula of the compound formed.
(c) Is the solution formed acidic or basic when the compound is dissolved in water? Justify.
(d) Write the chemical equation for the reaction between Q and ethanol.
(e) What will be the formula of the compound formed when P bonds with carbon?

Section – C (Physics)

30. Arnav wrote the following statements from his understanding of reflection from curved surfaces.

    I. Concave mirrors can produce both real and virtual images depending on the object position.
    II. Convex mirrors always produce real, inverted images regardless of object position.
    III. In both concave and convex mirrors, image location can be determined using the mirror formula.

    Choose the correct option.
    A. I and II
    B. I, II and III
    C. II and III
    D. I and III

31. Choose the correct option which explains why the sky appears blue during daytime.

    A. Shorter wavelengths such as blue are scattered more than other colours.
    B. All colours are scattered equally but blue is stronger.
    C. Longer wavelengths scatter more making blue stand out.
    D. Atmosphere contains blue-coloured particles.

32. Assertion (A): A point object is placed at a distance of 26 cm from a convex mirror of focal length 26 cm. The image will not form at infinity.

    Reason (R): For the above system the mirror formula gives $v = \infty$.

    A. Both A and R are true, and R is the correct explanation of A.
    B. Both A and R are true, and R is not the correct explanation of A.
    C. A is true but R is false.
    D. A is false but R is true.

33. The figure shows image formation with an optical instrument.

    A. Identify the optical instrument.

    B. What type of image is formed?

    C. Calculate the focal length of the instrument using the measurements given.

    For visually impaired students:

    A. Under what conditions can a convex lens form a virtual image?

B. Why does a piece of paper catch fire if sunlight is passed through a convex lens onto it?

34. Attempt either Option A or B.

A. Find the following in the given electric circuit:
(i) Effective resistance of two 8 Ω resistors in the combination
(ii) Current flowing through the 4 Ω resistor

OR

B. Study the circuit and find:
(i) Current in 12 Ω resistor
(ii) Difference in the readings of ammeter A_1 and A_2, if any

For visually impaired students:

A. Four resistors each having resistance R ohm are given. Find the maximum and minimum resistance that can be made using all four resistors.

OR

B. A copper wire has length 2 m, cross-sectional area 0.5 mm^2 and resistivity 1.7×10^{-8} Ωm. Calculate the resistance of another wire made of the same material whose length is doubled but cross-sectional area remains same.

35. The figure shows correction of a particular defect of vision.

(i) Identify the defect of vision and the lens used to correct it.

(ii) Draw and label a ray diagram showing the defect before correction.

For visually impaired students:

(i) What is dispersion of light?

(ii) Explain the condition under which dispersion occurs.

(iii) Give one reason that causes presbyopia.

36. A student needs to make a 0.12 Ω resistor using copper wire of diameter 0.80 mm. Resistivity of copper is 1.8×10^{-8} Ωm.

(i) Determine the cross-sectional area of the wire.

(ii) Calculate the length of wire required.

37. Magnetic field lines are shown in a diagram. A student says that the magnetic field at X is stronger than at Y.

(i) Explain whether the statement is correct with reason.

(ii) Redraw the diagram and mark the direction of magnetic field lines.

38. The figure shows a DSLR camera and schematic diagram of image formation on its sensor.

A. What type of lens is used in the DSLR camera?

B. What type of image is formed on the sensor?

Attempt either subpart C or D.

C. A DSLR camera has a lens of focal length 50 mm. The image is formed 60 mm behind the lens. Calculate the object distance.

OR

D. A flower is placed 150 mm away from the camera lens. The actual height of the flower is 80 mm and the image height is 20 mm. Calculate the focal length of the lens.

39. Attempt either Option A or B.

A. The arrangement of resistors is connected to a battery. The power dissipation in the 100 Ω resistor is 81 W. Calculate:

(i) Current in the circuit
(ii) Reading of voltmeter V_2
(iii) Reading of voltmeter V_1

OR

B. An electric heater consists of three similar heating elements A, B and C connected as shown. Each heating element is rated 1.2 kW, 240 V.

(i) Calculate the resistance of one heating element.

(ii) Calculate the current in each resistor when only S_1 and S_3 are closed.

(iii) Calculate the power dissipated across A when S_1, S_2 and S_3 are closed.

Practice paper 3 (unsolved)

SCIENCE (086) CLASS – X

Time Allowed: 3 hours Maximum marks : 80

General Instructions:

(i) This question paper consists of 39 questions in 3 sections.
(ii) Section A is Biology, Section B is Chemistry, and Section C is Physics.
(iii) All questions are compulsory. However, an internal choice is provided in some questions.
(iv) Assertion-reason type instructions:
a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A.
b) Both Assertion (A) and Reason (R) are true, but R is not the correct explanation of A.
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

Section – A (Biology)

1. Which of the following organisms shows saprophytic nutrition?
   A. Cuscuta
   B. Mushroom
   C. Lice
   D. Leech
2. During aerobic respiration, glucose breaks down into:
   A. Lactic acid and energy
   B. Ethanol and carbon dioxide
   C. Carbon dioxide, water and energy
   D. Carbon monoxide and water
3. Which part of the human brain controls voluntary actions?
   A. Cerebellum
   B. Medulla
   C. Cerebrum
   D. Pons
4. Which hormone regulates the sugar level in blood?
   A. Thyroxine
   B. Insulin
   C. Adrenaline
   D. Testosterone
5. A tall pea plant crossed with a dwarf pea plant produced all tall offspring. The genotype of the tall parent is:
   A. Tt
   B. tt
   C. TT
   D. TTT
6. Which of the following statements about biodegradable substances is correct?
   A. They remain unchanged for years

B. They can be decomposed by microorganisms
C. They increase biomagnification
D. They cannot be recycled

7. Which of the following is an example of a decomposer?
   A. Grasshopper
   B. Eagle
   C. Mushroom
   D. Deer

Questions 8 and 9 are Assertion–Reason based questions.

A. Both A and R are true, and R is the correct explanation of A.
B. Both A and R are true, and R is not the correct explanation of A.
C. A is true but R is false.
D. A is false but R is true.

8. Assertion (A): The movement of food in the alimentary canal occurs by peristalsis.
   Reason (R): Peristalsis involves rhythmic contraction and relaxation of muscles.
9. Assertion (A): Energy available at each trophic level decreases.
   Reason (R): Only about 10% of energy is transferred to the next trophic level.
10. Explain why the process of transpiration is important for plants.
11. Students to attempt either Option A or B.

A. Differentiate between arteries and veins on the basis of structure and function.

OR

B. Explain the role of stomata in plants.

12. Construct a food chain using the following organisms:
    Grass, snake, frog, insect, eagle.
13. Draw a labelled diagram of the human nephron and explain its function.
14. In pea plants, yellow seed colour (Y) is dominant over green seed colour (y).

(i) Write the genotype of heterozygous yellow seeded plant.

(ii) What will be the phenotypic ratio obtained in F_2 generation when two heterozygous plants are crossed?

15. Rohan ate rice, dal and butter for lunch. Answer the following questions. Attempt either subpart A or B.

A. Which nutrient is mainly present in dal? Explain its digestion in humans.

OR

B. Which food item contains fats? How are fats digested in the body?

C. Which food item contains starch? Name the enzyme that digests it.

D. Name the part of alimentary canal where maximum absorption of digested food occurs.

For visually impaired students:
How does absorption of digested food take place in the small intestine?

16. Attempt either Option A or B.

A. Explain vegetative propagation in plants with one example. State one advantage of this method.

OR

B. Explain the role of pollination in sexual reproduction of flowering plants. Mention two agents of pollination.

Section – B (Chemistry)

17. Which of the following represents a combination reaction?
    A. $CaCO_3 \rightarrow CaO + CO_2$
    B. $2Mg + O_2 \rightarrow 2MgO$
    C. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
    D. $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
18. Which of the following oxides is amphoteric in nature?
    A. Na_2O
    B. MgO
    C. Al_2O_3
    D. CO_2
19. Iron reacts with copper sulphate solution because:
    A. Iron is less reactive than copper
    B. Copper is more reactive than iron
    C. Iron is more reactive than copper
    D. Both have equal reactivity
20. Phenolphthalein gives pink colour in:
    A. Acidic solution
    B. Neutral solution
    C. Basic solution
    D. Salt solution
21. Which of the following has the lowest pH value?
    A. Sodium hydroxide
    B. Water
    C. Hydrochloric acid
    D. Soap solution

22. What happens when zinc reacts with dilute hydrochloric acid?
    A. Oxygen gas is released
    B. Chlorine gas is released
    C. Hydrogen gas is released
    D. Nitrogen gas is released
23. Which of the following is a double displacement reaction?
    A. $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
    B. $CaCO_3 \rightarrow CaO + CO_2$
    C. $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$
    D. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

    Question 24 is Assertion–Reason based.

    A. Both A and R are true, and R is the correct explanation of A.
    B. Both A and R are true, and R is not the correct explanation of A.
    C. A is true but R is false.
    D. A is false but R is true.

24. Assertion (A): Diamond is a good conductor of electricity.
    Reason (R): Diamond contains free electrons.
25. A copper wire and an iron wire of same length and thickness are heated from one end.

    A. Which wire will conduct heat faster? Give reason.

    B. Why are cooking utensils generally made of metals?

26. Attempt either Option A or B.

    A. Sodium is kept immersed in kerosene oil.

    (i) Why is sodium stored in kerosene?

    (ii) Write the equation when sodium reacts with water.

    OR

    B. Why do silver articles become black after some time?

    (i) Name the compound formed.

    (ii) Write one method to prevent corrosion of metals.

27. A student performed electrolysis of water using acidified water.

    A. Which gases are collected at cathode and anode?

    B. Why is acid added to water during electrolysis?

C. Write the balanced chemical equation for electrolysis of water.

For visually impaired students:
Classify the following reactions:

A. $2KClO_3 \rightarrow 2KCl + 3O_2$
B. $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
C. $CaO + H_2O \rightarrow Ca(OH)_2$

28. A student added sodium hydroxide solution to dilute hydrochloric acid using an indicator.

A. What colour change is observed using phenolphthalein?

B. Name the type of reaction taking place.

OR

What happens when methyl orange is added to a basic solution?

C. Write the balanced chemical equation for the reaction.

29. Attempt either Option A or B.

A. Ethene burns in oxygen according to the equation:

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

(a) Name the hydrocarbon.
(b) Is it saturated or unsaturated?
(c) Draw its electron dot structure.
(d) Write the reaction of ethene with hydrogen in presence of nickel.
(e) Name one alcohol that produces ethene on dehydration.

OR

B. An element X has electronic configuration 2,8,1 and element Y has configuration 2,8,7.

(a) Identify X and Y.
(b) What type of bond will be formed between them?
(c) Write the formula of the compound formed.
(d) State whether the compound will conduct electricity in molten state.
(e) Write one property of ionic compounds.

Section – C (Physics)

30. Which of the following statements is correct for a concave mirror?
    A. It always forms virtual image
    B. It always forms diminished image
    C. It can form both real and virtual images
    D. It always forms erect image
31. Why does the sun appear reddish during sunrise and sunset?
    A. Red light travels fastest
    B. Blue light is scattered more
    C. Red light is scattered more
    D. Atmosphere reflects red light
32. Assertion (A): A convex lens can form a magnified virtual image.

    Reason (R): When the object is placed between optical centre and focus, image formed is virtual and enlarged.

    A. Both A and R are true, and R is the correct explanation of A.
    B. Both A and R are true, and R is not the correct explanation of A.
    C. A is true but R is false.
    D. A is false but R is true.

33. A convex lens forms a real image of an object placed beyond 2F.

    A. State the position of image formed.

    B. State two characteristics of the image formed.

    C. Draw a ray diagram for image formation.

    For visually impaired students:

    A. What is meant by principal focus of a convex lens?

    B. Why is convex lens called converging lens?

34. Attempt either Option A or B.

    A. Two resistors of 6 Ω and 3 Ω are connected in parallel. Calculate:

    (i) Effective resistance
    (ii) Current drawn from a 12 V battery

    OR

    B. A 10 Ω resistor carries a current of 2 A. Calculate:

(i) Potential difference across the resistor
(ii) Heat produced in 5 minutes

For visually impaired students:

A. Define resistivity. State its SI unit.

OR

B. State Ohm's law and draw its graph.

35. A person cannot see nearby objects clearly.

    (i) Name the defect of vision.

    (ii) Which lens is used to correct it?

    (iii) State one cause of this defect.

    For visually impaired students:

    (i) What is scattering of light?

    (ii) Why do stars twinkle?

36. A wire has resistance 5 Ω. If its length is doubled and area of cross section remains same, calculate the new resistance.
37. Explain magnetic field lines around a bar magnet. State any two properties of magnetic field lines.
38. A camera uses a convex lens to form image on a screen.

    A. What type of image is formed by the lens?

    B. State two characteristics of the image.

    Attempt either subpart C or D.

    C. An object is placed 30 cm from a convex lens of focal length 15 cm. Calculate image distance.

    OR

    D. A lens forms an image twice the size of the object. If object distance is 20 cm, calculate image distance.

39. Attempt either Option A or B.

    A. A resistor of 20 Ω is connected to a 220 V supply. Calculate:

(i) Current through the resistor
(ii) Power consumed
(iii) Electrical energy consumed in 2 hours

OR

B. Three resistors each of resistance 10 Ω are connected in parallel to a 12 V battery. Calculate:

(i) Effective resistance
(ii) Total current in the circuit
(iii) Power consumed by the combination

Practice paper 4 (unsolved)

SCIENCE (086) CLASS – X

Time Allowed: 3 hours Maximum marks : 80

General Instructions:

(i) This question paper consists of 39 questions in 3 sections.
(ii) Section A is Biology, Section B is Chemistry, and Section C is Physics.
(iii) All questions are compulsory. However, an internal choice is provided in some questions.
(iv) Assertion-reason type instructions:
a) Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A.
b) Both Assertion (A) and Reason (R) are true, but R is not the correct explanation of A.
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

SECTION – A (Biology)

1.Identify the correct sequence through which inhaled air travels in the human respiratory system.

a) Nostrils → Pharynx → Larynx → Trachea → Alveoli

b) Nostrils → Trachea → Pharynx → Larynx → Alveoli

c) Nostrils → Larynx → Pharynx → Trachea → Alveoli

d) Nostrils → Pharynx → Trachea → Larynx → Alveoli

2.Which one of the following plants obtains nutrition from another living plant?

a) Rose

b) Cuscuta

c) Mango

d) Bryophyllum

3. Choose the correct statements related to the human brain.

i) Cerebrum is responsible for thinking and intelligence.

ii) Cerebellum helps in maintaining posture and balance.

iii) Medulla controls involuntary activities like heartbeat and breathing.

iv) Forebrain controls digestion and blood pressure.

a) (i) and (ii)

b) (i), (ii) and (iii)

c) (ii), (iii) and (iv)

d) (i) and (iv)

4.At which part of a neuron is the electrical signal converted into a chemical signal?

a) Dendrite

b) Synapse

c) Cell body

d) Nucleus

5. A pure tall pea plant is crossed with a pure short pea plant. What percentage of tall plants will appear in F_2 generation?

a) 25%

b) 50%

c) 75%

d) 100%

6. Read the following statements related to ozone layer.

i) Ozone protects Earth from harmful ultraviolet radiations.

ii) Ozone depletion can increase chances of skin cancer.

iii) Ozone is beneficial at ground level.

iv) Chlorofluorocarbons damage ozone layer.

Choose the correct option.

a) (i), (ii) and (iv)

b) (i), (iii) and (iv)

c) (ii) and (iii) only

d) (i) and (iii) only

7.Which component is essential for recycling nutrients in an ecosystem?

a) Herbivores

b) Carnivores

c) Producers

d) Decomposers

Questions 8 and 9 are Assertion–Reason based questions.

a) Both A and R are true, and R is the correct explanation of A.

b) Both A and R are true, but R is not the correct explanation of A.

c) A is true, but R is false.

d) A is false, but R is true.

8.Assertion: In some reptiles, environmental conditions determine the sex of offspring.

Reason: Genetic factors alone do not decide sex in all organisms.

9.Assertion: Only a small fraction of energy passes from one trophic level to the next.

Reason: Most energy is lost during biological activities as heat.

10.State any two methods by which plants remove waste materials through leaves.

11.Attempt either Option A or Option B.

A.Name the chamber of the human heart that pumps oxygenated blood to the body. Also name the artery connected to it.

OR

B.What will happen in the following situations?

i) Phloem tissue is removed from a plant stem.

ii) Platelets are absent in human blood.

12.A grassland ecosystem receives 50000 J of energy at producer level. Calculate the amount of energy available to primary consumers and secondary consumers.

13.What is meant by reflex action? Draw a flow chart showing the pathway involved in withdrawing hand from a hot object.

14.A plant with red flowers (RR) is crossed with a plant having white flowers (rr).

i) What will be the flower colour in F_1 generation?

ii) Find the percentage of white flowered plants in F_2 generation.

iii) Write the genotypic ratio of F_2 generation.

15.The kidneys continuously filter blood and remove harmful wastes from the body. Failure of kidneys may require dialysis for survival.

i) Name the blood vessel that carries filtered blood away from kidney.

ii) Name the cup-shaped structure of nephron involved in filtration.

iii) Explain any two steps involved in urine formation.

OR

iii) Mention the site of selective reabsorption in nephron. State two factors affecting reabsorption of water.

16.i) Name the reproductive parts of a flower.

ii) Differentiate between self-pollination and cross-pollination.

iii) Explain the changes that occur in ovary and ovule after fertilisation.

OR

i) Why are testes located outside the abdominal cavity in males?

ii) Mention two functions of testes.

iii) What changes occur in female reproductive system when fertilisation does not occur?

SECTION – B (Chemistry)

17.Identify the reaction which is both displacement and oxidation-reduction reaction.

a) $CuO + H_2 \rightarrow Cu + H_2O$

b) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

c) $CaCO_3 \rightarrow CaO + CO_2$

d) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

18.Which of the following metallic oxides are amphoteric in nature?

i) Zinc oxide

ii) Aluminium oxide

iii) Sodium oxide

iv) Magnesium oxide

a) (i) and (ii)

b) (ii) and (iii)

c) (iii) and (iv)

d) (i) and (iv)

19.Why can copper vessels not be used for storing iron sulphate solution?

a) Copper is more reactive than iron

b) Iron displaces copper from solution

c) Copper cannot displace iron from iron sulphate

d) Iron reacts with water

20.What colour does methyl orange show in acidic and basic medium respectively?

a) Yellow and red

b) Red and yellow

c) Pink and colourless

d) Orange and red

21.Hydrochloric acid shows lower pH value than acetic acid because:

a) Acetic acid is stronger than HCl

b) HCl ionises completely in water

c) HCl is weak acid

d) Acetic acid ionises completely

22.When potassium iodide solution is mixed with lead nitrate solution, what is observed?

a) White precipitate

b) Brown gas

c) Yellow precipitate

d) Blue solution

23.What is formed when sodium sulphate reacts with barium chloride solution?

a) White precipitate of $BaSO_4$

b) Blue precipitate of $BaSO_4$

c) Pink precipitate of $BaCl_2$

d) Yellow precipitate of NaCl

Question 24 is Assertion–Reason based.

a) Both A and R are true, and R is the correct explanation of A.

b) Both A and R are true, but R is not the correct explanation of A.

c) A is true, but R is false.

d) A is false, but R is true.

24.Assertion: Unsaturated hydrocarbons are more reactive than saturated hydrocarbons.

Reason: Unsaturated hydrocarbons contain double or triple bonds.

25.How are displacement reactions useful in extraction of metals? Explain with two examples.

26.Match the extraction method with the suitable metal.

Extraction Method	**Metals**
Electrolysis	Na, Al

Extraction Method Metals

Reduction with carbon Fe, Zn

i) Name the suitable method used for extraction of each metal.

ii) Draw electron dot structure of NaCl.

OR

i) Which concentration method is used for sulphide ores?

ii) Explain roasting and reduction processes briefly.

27.A student performed an experiment by reacting zinc with dilute sulphuric acid. Predict the observations in following cases:

a) Zinc powder is used instead of zinc granules.

b) Copper turnings are used instead of zinc.

c) Nitric acid is used instead of dilute sulphuric acid.

28.A student accidentally spilled acid in laboratory. The teacher used baking soda to neutralise it.

a) Why is baking soda used for acid spills?

b) Name the gas evolved during the reaction. How can it be tested?

OR

b) Mention two precautions while handling acids in laboratory.

c) Write balanced chemical equation for reaction between hydrochloric acid and baking soda.

29.Compound 'A' with molecular formula $C_2H_4O_2$ is used in vinegar. It reacts with ethanol to form a fruity smelling compound 'B'.

i) Identify compounds A and B.

ii) Write the chemical equation for the reaction.

iii) Name the process involved.

iv) How can compound A be prepared from ethanol?

v) Name the gas evolved when compound A reacts with sodium carbonate.

OR

i) Name an alcohol used as fuel and sanitizer.

ii) Write chemical equations for its reaction with:

a) Sodium

b) Concentrated sulphuric acid

c) Ethanoic acid

d) Acidified potassium dichromate

SECTION – C (Physics)

30.What type of image is always formed by a convex mirror?

a) Real and inverted

b) Virtual and enlarged

c) Virtual and diminished

d) Real and diminished

31.Stars appear to twinkle due to:

a) Reflection of light

b) Atmospheric refraction

c) Dispersion of light

d) Scattering by dust particles

Question 32 is Assertion–Reason based.

a) Both A and R are true, and R is the correct explanation of A.

b) Both A and R are true, but R is not the correct explanation of A.

c) A is true, but R is false.

d) A is false, but R is true.

32.Assertion: Light travels slower in glass than in air.

Reason: Glass has higher refractive index than air.

33.An object is placed 24 cm in front of a concave lens having focal length 12 cm.

i) Calculate image distance.

ii) Find magnification produced by the lens.

iii) State nature of image formed.

34.Three resistors of 2 Ω, 4 Ω and 6 Ω are connected in series with a 12 V battery. Calculate:

i) Total resistance

ii) Current flowing in the circuit

OR

Three resistors of 6 Ω each are connected in parallel to a 12 V battery. Find:

i) Effective resistance

ii) Total current drawn

35.

A student is unable to see distant objects clearly.

i) Name the defect of vision.

ii) State two causes of this defect.

iii) Which lens is used for correction?

iv) Draw labelled ray diagram showing correction of the defect.

36.An electric heater of power 2000 W operates on 220 V supply. Calculate:

i) Current drawn by heater

ii) Energy consumed in 3 hours

iii) Cost of energy if rate is ₹6 per unit

37.State the following rules:

i) Right hand thumb rule

ii) Fleming's left hand rule

iii) Fleming's right hand rule

38.Refraction takes place when light travels from one transparent medium to another.

i) Which quantity remains unchanged during refraction?

ii) What happens to light ray when it passes from air to glass?

OR

State Snell's law of refraction.

iii) Calculate speed of light in a medium having refractive index 1.5.
(Speed of light in vacuum = 3×10^8 m/s)

39.

a) Why are domestic appliances connected in parallel combination? Give two reasons.

b) Calculate equivalent resistance of two resistors 4 Ω and 6 Ω connected in parallel.

OR

a) Calculate power consumed by a 100 Ω resistor connected to 220 V supply.

b) Compare heat produced in 2 Ω resistor in the following circuits:

i) Connected in series with 4 Ω resistor across 12 V battery

ii) Connected alone across 12 V battery

Practice paper 5 (unsolved)

SCIENCE (086) CLASS – X

Time Allowed: 3 hours Maximum marks : 80

General Instructions:

(i) This question paper consists of 39 questions in 3 sections.
(ii) Section A is Biology, Section B is Chemistry, and Section C is Physics.
(iii) All questions are compulsory. However, an internal choice is provided in some questions.
(iv) Assertion-reason type instructions:
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b) Both Assertion (A) and Reason (R) are true, but R is not the correct explanation of A.
c) Assertion (A) is true, but Reason (R) is false.
d) Assertion (A) is false, but Reason (R) is true.

Section A – Biology (26 Marks)

Q1. Which of the following statements is TRUE about the uptake of water in plants?

(a) It occurs all the time due to diffusion.
(b) Water enters the roots due to osmosis.
(c) At night when transpiration is low, roots do not take up water.
(d) The movement of water from roots to leaves is bidirectional.

Q2. Which of the following method/s are useful to prevent fertilisation even when ovulation occurs?

P) Surgical blocking of the fallopian tube
Q) Copper-T
R) Oral pills
S) Condom

(a) Only P
(b) Only Q and R
(c) Only P, Q and S
(d) Only Q, R and S

Q3. In cattle, having horns is a recessive trait (h) to not having horns (H). When cattle with horns are crossed with cattle that do not have horns, the number of offspring having horns was equal to those not having horns. Which of the following is MOST LIKELY to be true?

(a) Both parents are homozygous dominant.
(b) One parent is homozygous dominant.
(c) Both parents are heterozygous.
(d) One parent is heterozygous.

Q4. Patient X was suffering from a pancreatic condition due to which the pancreas was not functioning adequately. Which of the following is a doctor likely to suggest to such an individual?

(a) Including a large amount of protein in the diet
(b) Eating a diet with low-fat content
(c) Eating only carbohydrates
(d) Including only liquid foods

Q5. Plants receive energy from the Sun which they utilise for several processes. The energy utilized for which of the following plant processes gets transferred to the next trophic level that consumes plants?

(a) Only growth
(b) Only respiration
(c) Only transport of substances and reproduction
(d) All – growth, photosynthesis, respiration and transport of substances

Q6. The action of which among the following is crucial to the formation of ozone?

(a) Humans
(b) Sunlight
(c) Carbon dioxide
(d) Chlorofluorocarbons

Q7. Assertion (A): Variations always provide a survival advantage to an organism.

Reason (R): Variations can be caused due to incorrect DNA copying.

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

Q8. Assertion (A): Omnivores receive 10% of their energy from the trophic level below them.

Reason (R): An omnivore is always in the trophic level just above herbivores.

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

Q9.

Ravi cultivated mustard, a plant with bisexual flowers, on his farm. His plants were diseased due to a gene defect and therefore had reduced yield. Ravi removed the stamens from the diseased plants and also planted fresh disease-free mustard plants where he removed the pistils.

How will Ravi's strategy help in improving the yield of mustard?

Q10.

A plant X was enclosed in a glass jar with some lizards. A similar plant Y was enclosed in another glass jar but without lizards. Both the jars are kept under the same light conditions for a few hours.

Which plant is likely to photosynthesize more and why?

OR

Proteinuria is a condition in which significant amounts of protein can be detected in urine. Which process in the nephron is likely to be affected causing proteinuria? Justify.

Q11.

Shown below are two food pyramids.

(a) Which level is likely to have the most amount of energy in such an aquatic ecosystem? Give a reason to support your answer.
(b) Such aquatic ecosystems are not considered to be sustainable. Justify this statement.

Q12.

In animals, hormones can be secreted by one organ and can act on multiple organs. Justify this statement by explaining the effect of a single animal hormone on three organs.

Q13.

If two pea plants having round and green seeds (RRGg) are crossed, identify the percentage of the following with respect to the F1 generation:

(a) Gametes having both the round and yellow seed traits
(b) Offspring having the same genotype as the parents
(c) Offspring having the same phenotype as the parents

Q14.

(a) Certain specialised cells in animals called stem cells have the ability to divide and differentiate into different cell types. This helps in the replacement of a damaged organ.

Name and explain two methods of asexual reproduction that are similar to stem cells and occur mostly in multicellular organisms.

(b) Identify TWO pairs of reproductive organs in males and females that are functionally similar to each other. Justify.

OR

(a) Sagar saw a beautiful rose and smelled it. As he was smelling it, he happened to touch a thorn and pull his hand away.

State TWO differences and similarities each in the way the nervous system performs the two actions.

(b) Are all involuntary actions reflex actions? Justify.

Q15.

Ram and Asha were a married couple. They had four children — one of these children had sickle cell anaemia whereas the other children did not show symptoms. Ram and Asha did not show symptoms of sickle cell anaemia. The trait for sickle cell anaemia is not linked to the sex chromosomes.

(a) Is this disease caused by a dominant or recessive trait? Why?

(b) If the child that had sickle cell anaemia got married to a person without a mutation in the sickle cell anaemia gene, what percentage of their children would have sickle cell anaemia? Show the cross.

OR

Identify the genetic composition of the sickle cell anaemia trait in Asha and Ram and use that to predict the genetic composition in the other children who did not show symptoms.

Section B – Chemistry (27 Marks)

Q16. A single displacement reaction is represented below.

$PQ + R \rightarrow PR + Q$

Which of the following is true about the reactants and products?

Option	Type of ion of R in product	Stability of PR as compared to PQ
A	cation	more stable
B	cation	less stable
C	anion	more stable
D	anion	less stable

(a) A
(b) B
(c) C
(d) D

Q17. Some types of chemical reactions are listed below:

- decomposition
- combination

- displacement
- double displacement

Which two of the following chemical reactions are of the SAME type?

P) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
Q) $Mg + 2HCl \rightarrow MgCl_2 + H_2$
R) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
S) $2KOH + H_2SO_4 \rightarrow K_2SO_4 + H_2O$

(a) P and Q
(b) Q and R
(c) R and S
(d) P and S

Q18. Neetu has two test tubes containing dilute hydrochloric acid and dilute sodium hydroxide solution, but they are not labeled.

Adding which of the following solutions to the test tubes will help her visually identify the acidic and basic solution?

(a) Only vinegar
(b) Only baking soda
(c) Only sodium chloride
(d) Either vinegar or sodium chloride

Q19. Sonia has aqueous solutions of three salts, sodium acetate, sodium chloride and ammonium chloride in three test tubes. The test tubes are not labeled. On checking, she finds the pH of the solutions to be 4.6, 7.0 and 8.9.

Which of the following correctly matches the salts with their respective pH?

	pH 4.6	pH 7.0	pH 8.9
A	sodium acetate	sodium chloride	
B	sodium chloride	ammonium chloride	
C	ammonium chloride	sodium acetate	
D	ammonium chloride	sodium chloride	

(a) A
(b) B
(c) C
(d) D

Q20. Galvanisation is a process of coating iron articles with a layer of zinc to prevent the iron from rusting.

Which of the following is true about how zinc prevents the rusting of iron?

P) A galvanised iron article does not undergo oxidation.
Q) The zinc coating prevents contact of iron with air.
R) Zinc undergoes corrosion more easily than iron.

(a) Only P
(b) Only Q
(c) Only P and Q
(d) Only Q and R

Q21. During purification of a metal by electrolysis, what happens at the negative electrode?

(a) Metal ions lose electrons to become neutral atoms.
(b) Neutral metal atoms gain electrons to become ions.
(c) Neutral metal atoms lose electrons to become ions.
(d) Metal ions gain electrons to become neutral metal atoms.

Q22. Metals are lustrous and shine especially when their freshly cut surfaces are exposed.

The freshly cut surface of which of these metals is likely to lose its lustre first on exposure to air?

(a) Aluminium
(b) Sodium
(c) Copper
(d) Iron

Q23. Assertion (A): Zinc oxide can be reduced to zinc metal on heating with carbon.

Reason (R): Carbon is less reactive than zinc.

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

Q24.

(a) Write the balanced chemical equation for the reaction that is prevented by storing potassium metal under kerosene.

(b) Identify the type of chemical reaction that is prevented.

Q25.

Equal sized bars of aluminium and iron are exposed to the environment.

Which of them is likely to corrode till the level marked by the line FIRST? Justify your answer.

Q26.

The electronic configuration of some elements is given below:

Element	Electronic Configuration
P	2, 8, 8
Q	2, 8, 8, 1
R	2, 6
S	2, 5
T	2, 8, 2
U	2, 8, 7

(a) Identify any two pairs of elements that will react to form compounds by transfer of electrons.

(b) Write the molecular formula of the compounds formed.

OR

A metal X is obtained from its chloride salt by exposure to sunlight.

(a) In which section of the reactivity series of metals — top, middle or bottom — is it likely to be placed? Justify your answer.

(b) Identify the type of reaction the chloride salt of metal X undergoes on exposure to sunlight.

Q27.

A carbon compound P has six carbon atoms and twelve hydrogen atoms.

(a) Is P a saturated or unsaturated carbon compound? Justify your answer by drawing the structural formula.

(b) Describe a test that can be used to determine if compound P is saturated or unsaturated.

(c) Name the products that are formed on burning compound P in excess of air.

OR

A carbon compound P is found to be neutral when tested with red and blue litmus. A gas that burns with a 'pop' sound is produced when a metal reacts with carbon compound P.

(a) Write the chemical equation for the reaction.

(b) The carbon compound P is heated with concentrated sulphuric acid to produce carbon compound Q.

(i) Write the chemical equation for the reaction.
(ii) Describe the type of flame that Q produces on combustion.

(c) What is likely to be observed on heating compound P with ethanoic acid with an acid as catalyst?

Write the chemical equation for the reaction.

Q28.

Given below is a four-carbon skeleton of a hydrocarbon compound.

(a) Fill in the hydrogen atoms/bonds to form:
(i) a saturated hydrocarbon
(ii) an unsaturated hydrocarbon

(b) If the four-carbon skeleton is of a straight chained alkene, draw the structures of all the possible compounds.

OR

If the four-carbon skeleton is of a straight chained alkyne:

(i) How many carbon atoms may NOT be bonded to any hydrogen atoms?
(ii) How many hydrogen atoms will there be in the compound?

Section C – Physics (27 Marks)

Q29. When an object was kept at position X in front of a concave mirror, an enlarged and virtual image was formed.

Which among the following identifies X correctly?

(a) Anywhere between the centre of curvature and principal focus
(b) Anywhere between the pole and principal focus
(c) Exactly at the centre of curvature
(d) Exactly at the principal focus

Q30. The face of the moon that is visible to us is called the near side and the face of the moon which is invisible to us is called the far side.

What colour would the sky appear to an astronaut standing on the far side of the Moon and why?

(a) Blue, as the Moon's atmosphere scatters sunlight just like Earth
(b) White, as the Moon's surface reflects all the light that falls on it

(c) Black, as there is no atmosphere on Moon to scatter sunlight
(d) Black, as sunlight does not fall on the far side of the Moon

Q31. Assertion (A): Iron filings scattered around a straight current carrying conductor in a plane perpendicular to the length of the conductor arrange themselves in concentric circles.

Reason (R): Magnetic field has both magnitude and direction.

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

Q32.

Search mirrors are mirrors that are used to look for hidden objects underneath cars.

(a) What type of mirrors are generally used to make search mirrors?

(b) With the help of a ray diagram describe the nature of image formed by the type of mirror identified in part (a).

Q33.

Ramya wants to measure the current flowing through the circuit shown below.

Which among the four ammeters can she use for the same? Show your calculations.

Ammeter	Minimum Range	Maximum Range
P	0 mA	1 mA
Q	0 mA	10 mA
R	0 A	1 A
S	0 A	10 A

OR

A helical coil whose length is greater than its diameter is connected to a battery.

(a) How does the magnetic field at point P compare with the magnetic field at point Q? Justify your answer.

(b) State one way in which the strength of the magnetic field inside a current carrying helical coil can be changed.

Q34.

Absolute refractive indices of two media P and Q are 1.33 and 2.52 respectively. The speed of light in medium P is 2×10^8m/s.

(a) What would be the speed of light in medium Q?

(b) If the angle of incidence for a ray of light travelling from medium P to Q is 0°, then what will be the path of light in medium Q?

Q35.

Kaveri conducted an experiment to study the energy efficiency of different bulbs. She connected a bulb A having a resistance of 100 ohms to a 240 V power supply.

(a) How much energy will be consumed by the bulb if it is kept ON for 4 hours each day for a week? Express your answer in kJ.

(b) Kaveri connects another similar bulb B in series with bulb A and connects the combination to a 240 V supply. Will there be any change in the brightness with which bulb A glows now? Explain mathematically.

Q36.

(a) Vijaya connects three bulbs P, Q and R in series with a battery in two different ways using identical conducting wires. She notices that in case I all three bulbs glow but in case II only bulbs P and R continue to glow.

What could be the reason for bulb Q to not glow in case II? Explain.

(b) Two resistances when connected in parallel give a combined resistance of $10/3$ohms. When the same two resistors are connected in series, the combined resistance becomes 15 ohms.

Calculate the individual resistance of each resistor.

Q37.

Savera passed a beam of white light through a series of equilateral prisms.

(a) What colour(s) will be seen on the screen?

(b) Copy the diagram and draw the beam entering Prism 1 and emerging from Prism 3 and falling on the screen.

(c) Name all the processes that take place when the beam of light enters Prism 1 and emerges from Prism 3.

OR

(a) Rupal suffers from myopia. Where would the image form in her eye?

(b) Name the type of lens generally used to correct myopia.

(c) Rupal underwent cataract surgery and her eye lens was replaced with an artificial lens with a fixed focal length made of silicone. State one likely visual disadvantage that Rupal is likely to experience as compared to a person with normal eyesight.

(d) Identify the parts of the eye from the descriptions given below:

(i) It helps in changing the focal length of the lens.
(ii) It causes most of the refraction of the light entering the eye.
(iii) It controls the amount of light entering the eye.
(iv) It acts as a screen on which the image is formed.

Q38.

Four resistors, a voltmeter and a battery are connected in a circuit.

(a) What is the net resistance in the circuit?

(b) How much potential difference will the voltmeter connected across resistor R4 measure?

OR

What is the power dissipated by resistor R1?

(c) If R3 is removed, will the net current in the circuit increase, decrease or remain the same? Justify your answer.

Q39.

Given below is a four-carbon skeleton of a hydrocarbon compound.

(a) Fill in the hydrogen atoms/bonds to form:
(i) a saturated hydrocarbon
(ii) an unsaturated hydrocarbon

(b) If the four-carbon skeleton is of a straight chained alkene, draw the structures of all the possible compounds.

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