CBSE Class 10 Science Complete Notes 2026-27

Full-Book Notes, Solved MCQs, Short Questions and Long Questions - Based on the NCERT Science Textbook

For CBSE Class 10 students - Science (Subject Code 086), session 2026-27

All 13 chapters of the current NCERT Class 10 Science book, covered chapter by chapter: clear revision notes with key definitions and formulas, **130 practice MCQs with answer keys, 65 solved short questions, and 26 solved long questions**, all written in simple, original language for board exam preparation and daily revision.

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CBSE Class 10 Science - paper pattern (third-party reproduced, not officially confirmed): Theory paper 80 marks + Internal Assessment 20 marks = 100 total. Exam duration 3 hours. Passing marks: 33% in theory and in internal assessment separately. Theory paper has five sections: Section A - 20 MCQs (20 marks); Section B - 6 short answers of 2 marks (12); Section C - 7 short answers of 3 marks (21); Section D - 3 long answers of 5 marks (15); Section E - 3 case-based questions of 4 marks (12). Unit-wise weightage of the 80-mark theory paper: Chemical Substances - Nature and Behaviour 25; World of Living 25; Natural Phenomena 12; Effects of Current 13; Natural Resources 5. From 2026, CBSE Class 10 is held twice a year - a compulsory first exam in February-March and an optional second exam in May. Do not rely on any 2027 date until CBSE publishes the official date sheet.

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How this book is organised: every chapter has three parts - (1) revision notes with key concepts, definitions and formulas, (2) 10 MCQs with an answer key, (3) 5 solved short questions and 2 solved long questions. Work through one chapter at a time. First read the notes, then try the short and long questions with the answers covered, then attempt the MCQs without looking at the key.

Chapter 1 - Chemical Reactions and Equations

Chemistry - Unit: Chemical Substances - Nature and Behaviour. What a chemical reaction is, how to write and balance equations, the five types of reactions, and the effects of oxidation in daily life.

A **chemical reaction** is a process in which one or more substances (reactants) change into new substances (products) with different properties. Signs that a reaction has taken place are a change in state, a change in colour, evolution of a gas, a change in temperature, or the formation of a precipitate (an insoluble solid).

Writing and balancing chemical equations

A chemical equation uses symbols and formulas to show a reaction. A **balanced equation** has the same number of atoms of each element on both sides, because atoms are neither created nor destroyed in a chemical reaction (law of conservation of mass). To balance an equation, adjust the coefficients (the numbers in front of formulas) - never change the subscripts inside a formula. Example: $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ is already balanced. State symbols are written in brackets: (s) solid, (l) liquid, (g) gas, (aq) aqueous solution.

Types of chemical reactions

- **Combination reaction:** two or more substances join to form one product. Example: $CaO + H_2O \rightarrow Ca(OH)_2$ (quicklime + water gives slaked lime, and heat is released).
- **Decomposition reaction:** one compound breaks into two or more simpler substances, usually by heat, light or electricity. Example: $CaCO_3 \rightarrow CaO + CO_2$ on heating (limestone). $2AgCl \rightarrow 2Ag + Cl_2$ in sunlight (used in black-and-white photography). Electrolysis of water: $2H_2O \rightarrow 2H_2 + O_2$.
- **Displacement reaction:** a more reactive element pushes a less reactive element out of its compound. Example: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ (blue colour fades as zinc displaces copper).
- **Double displacement reaction:** two compounds exchange ions and form two new compounds, often with a precipitate. Example: $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4$ (white precipitate) + 2NaCl.
- **Oxidation and reduction:** oxidation is gain of oxygen or loss of hydrogen; reduction is loss of oxygen or gain of hydrogen. A reaction in which oxidation and reduction happen together is a **redox reaction**. Example: $CuO + H_2 \rightarrow Cu + H_2O$ (CuO is reduced, H_2 is oxidised).

Chapter 1 - Chemical Reactions and Equations (continued)

Notes continued.

Effects of oxidation in daily life

Corrosion is the slow eating away of metals by air and moisture - iron rusts to form brown hydrated iron(III) oxide ($Fe_2O_3.xH_2O$). It is prevented by painting, oiling, galvanising (coating with zinc) or alloying. **Rancidity** is the spoiling of food containing fats and oils when they are oxidised by air; it gives a bad smell and taste. It is prevented by adding antioxidants, keeping food in air-tight containers, or flushing packets of chips with nitrogen gas.

> **Remember:** Exothermic reactions release heat (respiration, burning of fuels, slaked lime formation). Endothermic reactions absorb heat (photosynthesis, decomposition of calcium carbonate). A precipitation reaction forms an insoluble solid; a neutralisation reaction is acid + base -> salt + water.

MCQs - Chapter 1

1. Which of these is a sign that a chemical reaction has taken place?

A) Change in colour B) Change in shape only C) Melting of ice D) Boiling of water

2. In the reaction $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$, zinc is:

A) reduced B) oxidised C) a catalyst D) precipitated

3. The reaction $CaO + H_2O \rightarrow Ca(OH)_2$ is an example of a:

A) decomposition reaction B) combination reaction C) displacement reaction D) double displacement reaction

4. Which gas is released when dilute hydrochloric acid reacts with zinc?

A) Oxygen B) Carbon dioxide C) Hydrogen D) Chlorine

5. A white precipitate of $BaSO_4$ is formed in the reaction between:

A) Na_2SO_4 and $BaCl_2$ B) NaCl and $BaSO_4$ C) $BaCl_2$ and HCl D) NaOH and $BaCl_2$

MCQs - Chapter 1 (continued)

6. Which of these is an endothermic reaction?

A) Burning of natural gas B) Respiration C) Decomposition of calcium carbonate D) Formation of slaked lime

7. Silver chloride turns grey in sunlight because of:

A) combination B) decomposition C) displacement D) neutralisation

8. Rusting of iron is prevented by galvanising, which means coating iron with:

A) copper B) tin C) zinc D) aluminium

9. In the reaction $CuO + H_2 \rightarrow Cu + H_2O$, the substance that is oxidised is:

A) CuO B) H_2 C) Cu D) H_2O

10. Rancidity in food can be prevented by:

A) adding water B) flushing packets with nitrogen gas C) heating in open air D) adding salt

Short Questions with Answers - Chapter 1

Q1. Why should a magnesium ribbon be cleaned before burning it in air?

Magnesium reacts with oxygen in air and forms a layer of magnesium oxide on its surface. This layer prevents the ribbon from burning properly. Cleaning with sandpaper removes the oxide layer so that magnesium can burn easily.

Q2. Write a balanced equation for the reaction of zinc with dilute sulphuric acid.

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$. The equation is balanced because there is one zinc atom, one sulphur atom, four oxygen atoms and two hydrogen atoms on each side.

Q3. What is a decomposition reaction? Give one example with an equation.

A decomposition reaction is one in which a single compound breaks down into two or more simpler substances. Example: on heating, calcium carbonate decomposes into calcium oxide and carbon dioxide: $CaCO_3 \rightarrow CaO + CO_2$.

Short Questions with Answers - Chapter 1 (continued)

Q4. Why does the colour of copper sulphate solution fade when an iron nail is dipped in it?
Iron is more reactive than copper, so iron displaces copper from copper sulphate solution: Fe + $CuSO_4$ -> $FeSO_4$ + Cu. The blue colour of $CuSO_4$ fades as light-green $FeSO_4$ forms, and copper is deposited on the nail.

Q5. What is oxidation? Give one example of oxidation in daily life.
Oxidation is the gain of oxygen or the loss of hydrogen by a substance. Example: iron objects rust when iron combines with oxygen and moisture in air - this is oxidation of iron in daily life.

Long Questions with Answers - Chapter 1

Q1. Explain the five types of chemical reactions with one example and equation for each.

The five types are: (1) Combination - two or more substances join to form a single product, e.g. $CaO + H_2O \rightarrow Ca(OH)_2$. (2) Decomposition - one compound breaks into simpler substances, e.g. $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$ on heating; lead nitrate gives brown nitrogen dioxide gas. (3) Displacement - a more reactive element pushes a less reactive one out of its compound, e.g. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$. (4) Double displacement - two compounds exchange ions, e.g. $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$, forming a white precipitate of barium sulphate. (5) Oxidation-reduction (redox) - oxidation and reduction occur together, e.g. $CuO + H_2 \rightarrow Cu + H_2O$, where copper oxide is reduced to copper and hydrogen is oxidised to water. Recognising the type helps in predicting products and in balancing equations correctly.

Long Questions with Answers - Chapter 1 (continued)

Q2. What is corrosion? Describe how it damages iron and three ways to prevent it. What is rancidity and how is it prevented?

Corrosion is the slow destruction of a metal by the action of air, moisture or chemicals in its surroundings. Iron corrodes to form rust, a brown flaky substance (hydrated iron(III) oxide). Rust is porous and crumbles, so it does not protect the iron below it, and the metal is gradually eaten away - this damages bridges, ships, cars and iron gates. Corrosion can be prevented in three ways: (1) painting or oiling the surface, which keeps air and moisture away from the metal; (2) galvanising, coating iron with a layer of zinc, which protects iron even if the coating is scratched because zinc is more reactive and corrodes first; (3) alloying, mixing iron with other metals (as in stainless steel) to make it resistant to corrosion. Rancidity is the spoiling of food containing fats and oils: oxygen in air oxidises the fats, producing a bad smell and taste. It is prevented by adding antioxidants (substances that slow oxidation), storing food in air-tight containers, and flushing packets of chips with nitrogen gas, which keeps oxygen out.

Answer Key - Chapter 1 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	A	B	B	C	A	C	B	C	B	B

Chapter 1 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 2 - Acids, Bases and Salts.

Chapter 2 - Acids, Bases and Salts

Chemistry - Unit: Chemical Substances - Nature and Behaviour. Indicators, the pH scale, how acids and bases react, and the salts we use every day.

Acids are substances that taste sour and turn blue litmus red; common acids are hydrochloric acid (HCl), sulphuric acid (H_2SO_4), nitric acid (HNO_3) and acetic acid (CH_3COOH, the acid in vinegar). **Bases** are substances that taste bitter, feel soapy and turn red litmus blue; common bases are sodium hydroxide (NaOH), calcium hydroxide ($Ca(OH)_2$) and ammonium hydroxide (NH_4OH). A base that dissolves in water is called an **alkali**. Acids produce hydrogen ions (H^+) in water; bases produce hydroxide ions (OH^-).

Indicators

Indicators show whether a solution is acidic or basic by changing colour. Litmus: blue litmus turns red in acid, red litmus turns blue in base. Phenolphthalein is colourless in acid and pink in base. Methyl orange is red in acid and yellow in base. **Olfactory indicators** change their smell: vanilla essence, onion and clove oil lose their smell in a basic solution but keep it in an acidic solution.

The pH scale

The **pH scale** measures how acidic or basic a solution is, from 0 to 14. A solution with pH 7 is neutral (pure water). pH below 7 is acidic (the lower the pH, the stronger the acid); pH above 7 is basic. pH is measured with universal indicator or a pH meter. Strong acids like HCl have pH near 1, while strong bases like NaOH have pH near 14.

Reactions of acids and bases

- Acid + metal -> salt + hydrogen gas. Example: $2HCl + Zn \rightarrow ZnCl_2 + H_2$.
- Acid + metal carbonate or metal hydrogencarbonate -> salt + water + carbon dioxide. Example: $2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$; $HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$.

Chapter 2 - Acids, Bases and Salts (continued)

Notes continued.

- Acid + base -> salt + water. This is a **neutralisation reaction**. Example: HCl + NaOH -> NaCl + H_2O.
- Metallic oxides are basic and non-metallic oxides are acidic in nature.

Important salts and pH in daily life

Common salt (NaCl) is obtained from sea water; it is the raw material for sodium hydroxide, baking soda, washing soda and bleaching powder. **Baking soda ($NaHCO_3$)** is used in cooking and in antacids. On heating, it gives sodium carbonate - **washing soda ($Na_2CO_3.10H_2O$)**, used for cleaning. **Bleaching powder ($CaOCl_2$)** is used to disinfect drinking water. **Plaster of Paris ($CaSO_4.1/2H_2O$)** is made by heating gypsum; mixed with water it sets into a hard mass and is used for casts and statues. Water of crystallisation is the fixed number of water molecules in a salt crystal - washing soda has 10, gypsum has 2.

> **pH in daily life:** Our body works best at pH 7 to 7.8. Tooth decay starts when the pH of the mouth falls below 5.5, because acid made by bacteria attacks tooth enamel - brushing with basic toothpaste helps. Bee stings inject methanoic (formic) acid; baking soda relieves the pain. Nettle sting injects methanoic acid too, and the dock plant leaf contains a basic substance that soothes it. Farmers treat acidic soil with slaked lime (a base) and basic soil with organic matter.

MCQs - Chapter 2

1. Which of these turns blue litmus red?

A) Sodium hydroxide B) Hydrochloric acid C) Common salt solution D) Pure water

2. Phenolphthalein in a basic solution turns:

A) colourless B) red C) pink D) yellow

3. The pH of a neutral solution is:

A) 0 B) 1 C) 7 D) 14

4. Which of these is an olfactory indicator?

A) Litmus B) Phenolphthalein C) Vanilla essence D) Methyl orange

5. The chemical formula of baking soda is:

A) Na_2CO_3 B) $NaHCO_3$ C) NaCl D) $CaOCl_2$

MCQs - Chapter 2 (continued)

6. Tooth decay starts when the pH of the mouth falls below:

A) 7.8 B) 7.0 C) 6.5 D) 5.5

7. The gas released when dilute hydrochloric acid reacts with sodium carbonate is:

A) hydrogen B) oxygen C) carbon dioxide D) chlorine

8. Plaster of Paris is made from:

A) limestone B) gypsum C) washing soda D) bleaching powder

9. Which salt is used to disinfect drinking water?

A) Common salt B) Baking soda C) Bleaching powder D) Washing soda

10. A solution with pH 2 is:

A) a strong base B) a strong acid C) neutral D) a weak base

Short Questions with Answers - Chapter 2

Q1. What is an indicator? Name two indicators and the colour change each shows in an acid.

An indicator is a substance that changes colour in acidic and basic solutions. Litmus: blue litmus turns red in an acid. Methyl orange: turns red in an acid (and yellow in a base).

Q2. Why does dry HCl gas not change the colour of dry litmus paper, but aqueous HCl does?

Acids show their acidic character only when dissolved in water, because they produce hydrogen ions (H^+) in water. Dry HCl gas has no H^+ ions, so it does not change litmus. In water, HCl gives H^+ ions and turns blue litmus red.

Q3. What is a neutralisation reaction? Give one example.

A neutralisation reaction is the reaction between an acid and a base to form a salt and water. Example: HCl + NaOH -> NaCl + H_2O.

Short Questions with Answers - Chapter 2 (continued)

Q4. Write the chemical formula of washing soda and state one use of it.

Washing soda is sodium carbonate decahydrate, $Na_2CO_3.10H_2O$. It is used for washing clothes and cleaning, and in the manufacture of glass, soap and paper.

Q5. Why is baking soda used as an antacid?

Baking soda (sodium hydrogencarbonate) is a mild base. It neutralises the excess hydrochloric acid in the stomach, so it relieves acidity and indigestion.

Long Questions with Answers - Chapter 2

Q1. Explain the pH scale and describe the importance of pH in everyday life with four examples.

The pH scale runs from 0 to 14 and measures how acidic or basic a solution is. A pH of 7 is neutral; below 7 is acidic and above 7 is basic, and the further from 7, the stronger the acid or base. pH matters in everyday life in many ways. First, our body works in a narrow pH range of about 7.0 to 7.8; acids in the stomach help digestion, but excess acid causes pain and is treated with antacids. Second, tooth decay begins when the pH of the mouth falls below 5.5, because bacteria produce acid that attacks enamel - using a basic toothpaste neutralises the acid and protects the teeth. Third, plants grow well only in a certain soil pH: if soil is too acidic, farmers add slaked lime (a base); if it is too basic, they add organic matter, which releases acid. Fourth, bee stings inject methanoic acid into the skin, and rubbing baking soda (a mild base) on the sting neutralises the acid and relieves pain; similarly, the dock plant soothes a nettle sting because it contains a basic substance. So the pH scale is not only a laboratory measure - it guides health, farming and first aid in daily life.

Long Questions with Answers - Chapter 2 (continued)

Q2. Describe how common salt is the starting material for sodium hydroxide, baking soda, washing soda and bleaching powder.

Common salt (sodium chloride, NaCl) is the raw material for several important chemicals. When electricity is passed through a concentrated solution of common salt (brine), it decomposes into sodium hydroxide, chlorine gas and hydrogen gas - this is the chlor-alkali process: $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$. Sodium hydroxide is used in making soaps and detergents. The chlorine gas from this process is used to make bleaching powder: chlorine is passed over dry slaked lime to give calcium oxychloride, $CaOCl_2$, which disinfects drinking water. Baking soda is made by passing carbon dioxide and ammonia through a cold concentrated solution of sodium chloride: $NaCl + H_2O + CO_2 + NH_3 \rightarrow NaHCO_3 + NH_4Cl$. Baking soda is used in cooking and as an antacid. On heating, baking soda gives sodium carbonate ($2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$), and recrystallising sodium carbonate from water gives washing soda, $Na_2CO_3.10H_2O$, used for cleaning. Thus one simple salt from sea water supplies the starting material for a whole family of useful chemicals.

Answer Key - Chapter 2 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	C	C	C	B	D	C	B	C	B

Chapter 2 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 3 - Metals and Non-metals.

Chapter 3 - Metals and Non-metals

Chemistry - Unit: Chemical Substances - Nature and Behaviour. Physical and chemical properties of metals and non-metals, the reactivity series, ionic compounds, extraction of metals, and corrosion.

Metals are elements that are lustrous (shiny), malleable (can be hammered into sheets), ductile (can be drawn into wires), good conductors of heat and electricity, and sonorous (make a ringing sound when struck). Examples: iron, copper, aluminium, gold, silver. **Non-metals** are generally dull, brittle, poor conductors of heat and electricity, and neither malleable nor ductile. Examples: oxygen, sulphur, carbon, nitrogen. Exceptions: mercury is a liquid metal; iodine is a lustrous non-metal; graphite (a form of carbon) conducts electricity; sodium and potassium are so soft they can be cut with a knife.

Chemical properties of metals

- **With oxygen:** metals form basic oxides. $4Na + O_2 \rightarrow 2Na_2O$; $2Mg + O_2 \rightarrow 2MgO$. Some metal oxides are amphoteric (react with both acids and bases) - aluminium oxide and zinc oxide.
- **With water:** very reactive metals (K, Na) react violently with cold water; calcium reacts less violently; magnesium reacts with hot water; aluminium, zinc and iron react with steam; copper, silver and gold do not react with water at all.
- **With dilute acids:** metals above hydrogen in the reactivity series react with dilute acids to give a salt and hydrogen gas; metals below hydrogen (copper, silver, gold) do not react.
- **With salt solutions:** a more reactive metal displaces a less reactive metal from its salt solution.

Reactivity series

> **Potassium > Sodium > Calcium > Magnesium > Aluminium > Zinc > Iron > Lead > Hydrogen > Copper > Mercury > Silver > Gold**
>
> Learn the order by heart: K, Na, Ca, Mg, Al, Zn, Fe, Pb, H, Cu, Hg, Ag, Au. Metals above hydrogen react with dilute acids; metals below it do not.

Chapter 3 - Metals and Non-metals (continued)

Notes continued.

Ionic compounds

When a metal reacts with a non-metal, the metal loses electrons and the non-metal gains them, forming ions held together by strong electrostatic forces - an **ionic bond**. Example: sodium loses one electron to form Na^+ and chlorine gains it to form Cl^-, giving sodium chloride. Ionic compounds have high melting and boiling points, are generally soluble in water, and conduct electricity when molten or dissolved in water (but not as solids, because their ions are fixed in place).

Extraction of metals

Metals occur in the Earth's crust as ores. Highly reactive metals (K, Na, Ca, Mg, Al) are extracted by **electrolysis of their molten chlorides or oxides**. Metals in the middle of the reactivity series (Zn, Fe, Pb) are extracted by **reduction of their oxides with carbon** - their sulphide and carbonate ores are first converted to oxides by roasting (heating in excess air) or calcination (heating in limited air). Less reactive metals (Cu, Ag, Au) occur in the free state or are obtained by heating their ores alone.

> **Corrosion and alloys:** Iron rusts, silver tarnishes (black coating of silver sulphide) and copper gets a green coating of basic copper carbonate. An **alloy** is a mixture of a metal with other metals or non-metals. Brass is copper + zinc; bronze is copper + tin; steel is iron + carbon; stainless steel is iron + chromium + nickel. Alloys are harder and more resistant to corrosion than pure metals. Solder (lead + tin) has a low melting point and is used to join wires.

MCQs - Chapter 3

1. Which metal is liquid at room temperature?

A) Sodium B) Mercury C) Aluminium D) Iron

2. Which non-metal is a good conductor of electricity?

A) Sulphur B) Diamond C) Graphite D) Phosphorus

3. In the reactivity series, the most reactive metal is:

A) gold B) iron C) potassium D) zinc

4. Which metal does NOT react with dilute hydrochloric acid?

A) Zinc B) Iron C) Magnesium D) Copper

5. Aluminium oxide is called amphoteric because it reacts with:

A) acids only B) bases only C) both acids and bases D) neither acids nor bases

MCQs - Chapter 3 (continued)

6. Ionic compounds conduct electricity when they are:

A) solid B) molten or in solution C) in powder form D) frozen

7. Which metal is extracted by electrolysis of its molten chloride?

A) Iron B) Zinc C) Sodium D) Copper

8. Brass is an alloy of copper and:

A) tin B) zinc C) nickel D) lead

9. The green coating on old copper vessels is:

A) copper oxide B) basic copper carbonate C) copper sulphate D) copper chloride

10. Which of these metals is found in the free (native) state?

A) Sodium B) Aluminium C) Gold D) Magnesium

Short Questions with Answers - Chapter 3

Q1. Why are metals good conductors of electricity while non-metals are generally not?

Metals have free electrons that can move through the metal and carry electric current. Non-metals do not have free electrons (except graphite), so they cannot conduct electricity well.

Q2. What is meant by the reactivity series? Arrange Zn, Cu, Mg and Fe in order of reactivity.

The reactivity series is the list of metals arranged in decreasing order of their reactivity. The order is: Magnesium > Zinc > Iron > Copper.

Q3. Why does calcium react with water while copper does not?

Calcium is high in the reactivity series, so it reacts with cold water to give calcium hydroxide and hydrogen. Copper is below hydrogen in the series and is unreactive, so it does not react with water at all.

Short Questions with Answers - Chapter 3 (continued)

Q4. Define an alloy and give two examples with their composition.

An alloy is a homogeneous mixture of a metal with other metals or non-metals, made to improve properties. Brass: copper + zinc. Bronze: copper + tin.

Q5. What is roasting? How is it different from calcination?

Roasting is heating a sulphide ore strongly in the presence of excess air to convert it into its oxide. Calcination is heating a carbonate ore in the absence or limited supply of air to convert it into its oxide.

Long Questions with Answers - Chapter 3

Q1. Describe the chemical properties of metals: reaction with oxygen, water and dilute acids, with examples.

Metals show four main chemical behaviours. (1) With oxygen: most metals burn in air to form metal oxides, which are basic. Sodium burns vigorously to give sodium oxide ($4Na + O_2 \rightarrow 2Na_2O$), magnesium burns with a dazzling white flame to give magnesium oxide ($2Mg + O_2 \rightarrow 2MgO$), while iron burns only on strong heating and copper does not burn but forms a black coating of copper oxide on heating. Some oxides, like aluminium oxide and zinc oxide, are amphoteric and react with both acids and bases. (2) With water: potassium and sodium react violently with cold water, giving hydrogen gas and heat that can catch fire; calcium reacts less violently; magnesium reacts only with hot water; aluminium, zinc and iron react with steam ($3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$); lead, copper, silver and gold do not react with water at all. (3) With dilute acids: metals above hydrogen in the reactivity series react with dilute hydrochloric or sulphuric acid to give a salt and hydrogen gas - for example, $Zn + 2HCl \rightarrow ZnCl_2 + H_2$. The reaction is faster for more reactive metals. Metals below hydrogen, such as copper, silver and gold, do not react with dilute acids. (4) With salt solutions of other metals: a more reactive metal displaces a less reactive metal from its salt solution, as zinc displaces copper from copper sulphate, but copper cannot displace zinc from zinc sulphate. Together these reactions place metals in the reactivity series and explain why different metals need different methods of extraction.

Long Questions with Answers - Chapter 3 (continued)

Q2. Explain how metals are extracted from their ores according to their position in the reactivity series.

The method of extraction depends on how reactive the metal is. Metals at the top of the reactivity series - potassium, sodium, calcium, magnesium and aluminium - are very reactive and cannot be reduced by carbon, so they are extracted by electrolysis of their molten compounds. For example, sodium is obtained by electrolysing molten sodium chloride, and aluminium by electrolysing molten aluminium oxide (bauxite) mixed with cryolite, which lowers the melting point. Metals in the middle - zinc, iron, lead and copper - are moderately reactive. Their sulphide ores are first converted to oxides by roasting (heating in excess air), and their carbonate ores by calcination (heating in limited air); the oxide is then reduced by heating with carbon. For example, zinc oxide is reduced by carbon: ZnO + C -> Zn + CO. Iron is extracted in a blast furnace from haematite ore using coke as the reducing agent. Metals low in the series - copper, silver and gold - are least reactive and are found partly in the free state; copper can also be obtained by simply heating its sulphide ore in air ($2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$, then $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$). After extraction, metals are refined to remove impurities. So the rule is: the more reactive the metal, the stronger the method needed to extract it.

Answer Key - Chapter 3 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	C	C	D	C	B	C	B	B	C

Chapter 3 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 4 - Carbon and its Compounds.

Chapter 4 - Carbon and its Compounds

Chemistry - Unit: Chemical Substances - Nature and Behaviour. Covalent bonding, the versatile nature of carbon, hydrocarbons, functional groups, ethanol, ethanoic acid, and soaps.

Carbon is a non-metal with atomic number 6 and four electrons in its outermost shell. It cannot lose four electrons easily or gain four electrons easily, so it shares electrons with other atoms and forms **covalent bonds**. Carbon is **tetravalent** - it forms four covalent bonds. Its two special properties are: **catenation** (carbon atoms join with each other to form long chains, branched chains and rings) and the ability to form strong bonds with many other elements. These properties give carbon millions of compounds - more than any other element.

Allotropes of carbon

Diamond is a form of carbon in which each atom is bonded to four others in a rigid three-dimensional structure. It is the hardest natural substance, a poor conductor of electricity, and is used in cutting tools and jewellery. **Graphite** has carbon atoms arranged in flat layers (hexagonal rings); each atom is bonded to three others, and one electron per atom is free to move, so graphite conducts electricity. It is soft and slippery and is used in pencils and as a lubricant. **Fullerene** (C_{60}, buckminsterfullerene) is a cage-like molecule of 60 carbon atoms shaped like a football.

Hydrocarbons and functional groups

Compounds of carbon and hydrogen only are called **hydrocarbons**. **Saturated hydrocarbons** (alkanes) have only single bonds between carbon atoms - methane (CH_4), ethane (C_2H_6). **Unsaturated hydrocarbons** have double bonds (alkenes, e.g. ethene C_2H_4) or triple bonds (alkynes, e.g. ethyne C_2H_2). A **homologous series** is a family of compounds with the same functional group, differing by a $-CH_2-$ unit, with a gradual change in physical properties. A **functional group** is the atom or group of atoms that gives a compound its characteristic properties: -OH is the alcohol group, -COOH the carboxylic acid group, -CHO the aldehyde group, -CO- the ketone group. Naming: the suffix -ol is used for alcohols (ethanol), -oic acid for carboxylic acids (ethanoic acid), -al for aldehydes, -one for ketones.

Chapter 4 - Carbon and its Compounds (continued)

Notes continued.

Chemical properties of carbon compounds

- **Combustion:** carbon compounds burn in oxygen to give carbon dioxide, water, heat and light. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. Saturated hydrocarbons burn with a clean blue flame; unsaturated hydrocarbons burn with a yellow, sooty flame.
- **Oxidation:** ethanol is oxidised to ethanoic acid by alkaline potassium permanganate or acidified potassium dichromate.
- **Addition reaction:** unsaturated hydrocarbons add hydrogen across the double bond (hydrogenation) in the presence of a nickel or palladium catalyst - used to make vanaspati ghee from vegetable oils.
- **Substitution reaction:** in sunlight, chlorine replaces hydrogen atoms in saturated hydrocarbons ($CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$).

Ethanol, ethanoic acid, soaps and detergents

Ethanol (C_2H_5OH) is a liquid at room temperature, soluble in water, and used as a solvent, in medicines and as a fuel. It reacts with sodium to give sodium ethoxide and hydrogen, and on heating with concentrated sulphuric acid at 443 K it dehydrates to ethene. **Ethanoic acid (CH_3COOH)** is a weak acid; 5-8% ethanoic acid in water is vinegar. It reacts with ethanol to form an ester (sweet-smelling) - **esterification**: $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$ - and with sodium hydrogencarbonate to give carbon dioxide. **Soaps** are sodium or potassium salts of long-chain carboxylic acids, made by saponification (heating fats with NaOH). A soap molecule has a hydrophilic (water-loving) ionic head and a hydrophobic (water-hating) hydrocarbon tail; it forms micelles that trap dirt and oil. Soaps do not work well in hard water because calcium and magnesium ions form insoluble scum. **Detergents** are generally ammonium or sulphonate salts; they work in hard water too, but some are not biodegradable.

MCQs - Chapter 4

1. Carbon forms four covalent bonds because it has:

A) 2 valence electrons B) 4 valence electrons C) 6 valence electrons D) 8 valence electrons

2. Which allotrope of carbon is the hardest natural substance?

A) Graphite B) Fullerene C) Diamond D) Charcoal

3. The functional group in ethanol is:

A) -COOH B) -CHO C) -OH D) -CO-

4. Ethene (C_2H_4) is an example of a:

A) saturated hydrocarbon B) unsaturated hydrocarbon C) alcohol D) carboxylic acid

5. The molecular formula of the third member of the alkane homologous series is:

A) C_2H_6 B) C_3H_8 C) C_3H_6 D) C_4H_{10}

MCQs - Chapter 4 (continued)

6. Vinegar is a dilute solution of:

A) ethanol B) ethanoic acid C) methanoic acid D) citric acid

7. Hydrogenation of vegetable oils is carried out in the presence of:

A) iron B) copper C) nickel D) zinc

8. The sweet-smelling substance formed when ethanoic acid reacts with ethanol is called:

A) a soap B) an ester C) an aldehyde D) a ketone

9. Soaps do not clean well in hard water because they form:

A) micelles B) foam C) insoluble scum with calcium and magnesium ions D) lather

10. Which of these is a property of graphite?

A) Hardest substance B) Good conductor of electricity C) Insoluble in everything D) Forms four bonds per atom

Short Questions with Answers - Chapter 4

Q1. Why does carbon form covalent bonds instead of ionic bonds?

Carbon has four electrons in its outer shell. Losing four electrons or gaining four electrons would need a large amount of energy and is not possible in practice, so carbon shares its electrons with other atoms and forms covalent bonds.

Q2. What is catenation? Name one element other than carbon that shows it.

Catenation is the property of an element to form bonds with atoms of the same element, making long chains, branched chains and rings. Sulphur also shows catenation (in chains of up to eight atoms).

Q3. How can you distinguish between a saturated and an unsaturated hydrocarbon by burning?

Saturated hydrocarbons burn with a clean blue flame, while unsaturated hydrocarbons burn with a yellow flame and produce a lot of black smoke (soot) because of incomplete combustion.

Short Questions with Answers - Chapter 4 (continued)

Q4. What is a homologous series? Give one example.

A homologous series is a family of organic compounds with the same functional group and similar chemical properties, where each member differs from the next by a $-CH_2-$ unit. Example: alkanes - methane (CH_4), ethane (C_2H_6), propane (C_3H_8).

Q5. Why are detergents better than soaps in hard water?

Soaps react with calcium and magnesium ions in hard water to form insoluble scum, so they clean poorly. Detergents do not form scum with these ions, so they clean well even in hard water.

Long Questions with Answers - Chapter 4

Q1. Explain the versatile nature of carbon. Describe the structures and uses of diamond and graphite.

Carbon is versatile because of two properties: tetravalency and catenation. Tetravalency means each carbon atom can form four covalent bonds, so it can join with hydrogen, oxygen, nitrogen, halogens and other carbon atoms in many ways. Catenation means carbon atoms can bond with each other to form long straight chains, branched chains and rings of any size, giving millions of different compounds - far more than any other element. This is why carbon is the basis of all living things and of fuels, plastics, medicines and dyes. Diamond and graphite are two allotropes of carbon - same element, different structures. In diamond, each carbon atom is bonded to four others in a rigid three-dimensional network. There are no free electrons, so diamond is the hardest natural substance and does not conduct electricity; it is used for cutting glass and rock, in drills, and as a gemstone. In graphite, each carbon atom is bonded to three others in flat hexagonal layers, and the fourth electron of each atom is free to move between layers. The layers slide over each other, so graphite is soft and slippery, and the free electrons make it a good conductor of electricity. Graphite is used in pencils (mixed with clay), as a lubricant, and as electrodes in batteries and electrolysis.

Long Questions with Answers - Chapter 4 (continued)

Q2. Describe the properties and uses of ethanol and ethanoic acid, and explain how soaps clean dirt.

Ethanol (C_2H_5OH) is a colourless liquid, soluble in water, with a characteristic smell. It is used as a solvent in medicines and tinctures, in alcoholic drinks, and as a fuel additive. It burns with a clean flame, reacts with sodium to give hydrogen gas ($2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$), and on heating with concentrated sulphuric acid at 443 K it loses water to form ethene. Ethanoic acid (CH_3COOH) is a colourless liquid with a vinegar-like smell; its 5-8% solution is vinegar, used in cooking and preserving food. It is a weak acid that turns blue litmus red, reacts with metals, carbonates and bases like other acids, and reacts with ethanol in the presence of concentrated sulphuric acid to form the sweet-smelling ester ethyl ethanoate (esterification). It also reacts with sodium hydrogencarbonate to release carbon dioxide gas, which is used as a test for carboxylic acids. Soaps are sodium or potassium salts of long-chain fatty acids. A soap molecule has two ends: a hydrophilic ionic head that dissolves in water and a hydrophobic hydrocarbon tail that dissolves in oil and grease. When soap is added to dirty water, the tails attach to the oil and dirt while the heads stay in the water, forming clusters called micelles with the dirt trapped inside. Rinsing washes the micelles away, so the dirt is removed. Soaps are made by heating fats or oils with sodium hydroxide (saponification), and they are biodegradable, but they form scum in hard water, where detergents are used instead.

Answer Key - Chapter 4 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	C	C	B	B	B	C	B	C	B

Chapter 4 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 5 - Life Processes.

Chapter 5 - Life Processes

Biology - Unit: World of Living. The processes that keep living things alive: nutrition, respiration, transportation and excretion in plants and animals.

Life processes are the activities that living organisms must carry out to stay alive: nutrition (taking in food), respiration (releasing energy from food), transportation (moving materials inside the body) and excretion (removing waste). Organisms need energy for growth, repair and movement, and they get it from food.

Nutrition

Autotrophic nutrition: green plants make their own food by **photosynthesis** - using sunlight, chlorophyll, carbon dioxide and water to make glucose and oxygen: $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$. Photosynthesis takes place in leaves, in chloroplasts; stomata (tiny pores) let gases in and out. **Heterotrophic nutrition:** organisms depend on other organisms for food. Types: holozoic (animals eat and digest food inside the body - humans), saprophytic (fungi feed on dead matter), parasitic (a parasite, like Cuscuta or a tapeworm, takes food from a living host). **Human digestion:** food is broken down step by step - in the mouth by teeth and saliva (salivary amylase breaks starch), in the stomach by hydrochloric acid and pepsin (protein digestion), and in the small intestine by bile (from the liver, emulsifies fats) and pancreatic juice (enzymes for carbohydrates, proteins and fats). Digested food is absorbed through **villi**, finger-like projections in the small intestine, into the blood. Undigested food passes to the large intestine, where water is absorbed, and the rest is removed as faeces.

Respiration

Respiration is the process of breaking down glucose to release energy. **Aerobic respiration** uses oxygen: glucose + oxygen -> carbon dioxide + water + energy (38 ATP). **Anaerobic respiration** happens without oxygen: in yeast, glucose -> ethanol + carbon dioxide + energy; in our muscle cells during heavy exercise, glucose -> lactic acid + energy, which causes cramps. Breathing brings air in and out: when we breathe in, the ribs move up and out and the diaphragm flattens, so air rushes into the lungs; when we breathe out, the ribs move down and the diaphragm relaxes. In the lungs, oxygen passes from the **alveoli** (tiny air sacs) into the blood, and carbon dioxide passes from the blood into the alveoli.

Chapter 5 - Life Processes (continued)

Notes continued.

Transportation

In humans, blood carries oxygen, food, hormones and waste. The **heart** is a four-chambered pump (two atria, two ventricles) with **double circulation**: blood goes to the lungs to get oxygen, returns to the heart, and is then pumped to the rest of the body. Arteries carry blood away from the heart (usually oxygenated), veins carry blood towards the heart (usually deoxygenated), and capillaries are the thinnest vessels where exchange happens. Blood has plasma, red blood cells (carry oxygen, contain haemoglobin), white blood cells (fight infection) and platelets (clot blood). Blood pressure is measured as systolic/diastolic; normal is about 120/80 mm Hg. In plants, **xylem** carries water and minerals from roots to leaves (by transpiration pull), and **phloem** carries food made in leaves to all parts (translocation).

Excretion

In humans, the **kidneys** filter waste (mainly urea) from the blood. Each kidney contains about a million filtering units called **nephrons**; useful substances are reabsorbed and the remaining liquid becomes urine, which passes through the ureters to the urinary bladder and out through the urethra. Plants get rid of waste by storing it in bark, old leaves, resin and gum, or by shedding leaves.

MCQs - Chapter 5

1. The raw materials for photosynthesis are:

A) oxygen and glucose B) carbon dioxide and water C) nitrogen and water D) oxygen and water

2. In the human digestive system, protein digestion begins in the:

A) mouth B) stomach C) small intestine D) large intestine

3. The finger-like projections that absorb digested food in the small intestine are called:

A) alveoli B) villi C) nephrons D) stomata

4. Anaerobic respiration in human muscle cells produces:

A) ethanol and carbon dioxide B) lactic acid C) water only D) glucose

5. The exchange of gases in the lungs takes place in the:

A) bronchi B) trachea C) alveoli D) diaphragm

MCQs - Chapter 5 (continued)

6. The human heart has how many chambers?

A) 2 B) 3 C) 4 D) 5

7. In plants, water and minerals are transported by the:

A) phloem B) xylem C) stomata D) cambium

8. The filtering units of the human kidney are called:

A) alveoli B) neurons C) nephrons D) villi

9. Which blood cells carry oxygen in the human body?

A) White blood cells B) Platelets C) Plasma cells D) Red blood cells

10. Normal human blood pressure is about:

A) 80/120 mm Hg B) 120/80 mm Hg C) 140/90 mm Hg D) 100/60 mm Hg

Short Questions with Answers - Chapter 5

Q1. Why are the walls of the alveoli thin and surrounded by blood capillaries?

The thin walls and the network of capillaries allow oxygen to pass quickly from the air in the alveoli into the blood, and carbon dioxide to pass from the blood into the alveoli. A short distance and a large surface area make gas exchange efficient.

Q2. What is the role of bile in digestion?

Bile is made by the liver and stored in the gall bladder. It emulsifies fats, breaking large fat globules into tiny droplets, which increases the surface area for fat-digesting enzymes to act. Bile also makes the acidic food from the stomach alkaline so that pancreatic enzymes can work.

Q3. How does the diaphragm help in breathing?

When we breathe in, the diaphragm flattens and the ribs move up and out, increasing the volume of the chest cavity, so air rushes into the lungs. When we breathe out, the diaphragm relaxes and moves up, the chest volume decreases, and air is pushed out.

Short Questions with Answers - Chapter 5 (continued)

Q4. What is double circulation? Why is it important?

Double circulation means blood passes through the heart twice in one complete circuit: once on its way to the lungs to get oxygen, and once on its way to the body. It keeps oxygenated and deoxygenated blood separate, so the body gets a rich supply of oxygen for high energy needs.

Q5. How do plants get rid of their waste products?

Plants store waste in the bark, in old leaves that fall off, in resin and gum, and in the vacuoles of cells. Some waste, like excess water, is removed by transpiration.

Long Questions with Answers - Chapter 5

Q1. Describe the process of digestion in the human body from mouth to small intestine.

Digestion begins in the mouth, where teeth crush the food and the tongue mixes it with saliva. Saliva contains the enzyme salivary amylase, which begins breaking starch into sugar. The food is swallowed and passes down the food pipe to the stomach. In the stomach, the walls churn the food and gastric glands release hydrochloric acid, which kills germs and makes the medium acidic, and the enzyme pepsin, which begins digesting proteins. The partly digested food then enters the small intestine. Here the liver sends bile, which emulsifies fats into tiny droplets, and the pancreas sends pancreatic juice, which contains enzymes for digesting carbohydrates, proteins and fats. The intestinal wall itself releases enzymes that complete digestion. The inner wall of the small intestine has millions of finger-like projections called villi, which have a rich blood supply and a large surface area; digested food is absorbed through the villi into the blood and carried to all parts of the body. The remaining undigested food passes into the large intestine, where water is absorbed, and the waste is removed from the body. This step-by-step system ensures that large, insoluble food molecules are broken into small, soluble molecules that the body can absorb and use.

Long Questions with Answers - Chapter 5 (continued)

Q2. Explain how oxygen and carbon dioxide are exchanged in the lungs, and how blood is transported through the human heart.

When we breathe in, air travels through the nose, windpipe and bronchi into the lungs, reaching tiny air sacs called alveoli. The alveoli are surrounded by a dense network of blood capillaries, and their walls are only one cell thick, so gases pass across easily: oxygen from the air diffuses into the blood, and carbon dioxide from the blood diffuses into the alveoli to be breathed out. The oxygen-rich blood then flows to the heart. The human heart has four chambers: the right atrium and right ventricle, and the left atrium and left ventricle. Deoxygenated blood from the body enters the right atrium, passes to the right ventricle, and is pumped to the lungs to get oxygen. The oxygenated blood returns to the left atrium, passes to the left ventricle, and is pumped to the whole body through the aorta. This is called double circulation, because blood passes through the heart twice in each complete circuit. Arteries carry blood away from the heart, veins carry it back, and capillaries are the thin-walled vessels where exchange of oxygen, food and waste takes place with the body cells. Valves in the heart and veins prevent blood from flowing backwards, keeping the flow in one direction.

Answer Key - Chapter 5 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	B	B	B	C	C	B	C	D	B

Chapter 5 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 6 - Control and Coordination.

Chapter 6 - Control and Coordination

Biology - Unit: World of Living. How animals and plants control and coordinate their responses: the nervous system, reflex actions, the brain, plant movements, and hormones.

Living things must respond to changes in their surroundings and keep their internal conditions steady. In animals this control is done by two systems working together: the **nervous system** (fast, electrical signals) and the **endocrine system** (slow, chemical signals through hormones in the blood). Plants have no nervous system; they respond through growth movements and plant hormones.

The nervous system and reflex action

The basic unit of the nervous system is the **neuron** (nerve cell). It has dendrites (receive signals), a cell body, and an axon (carries the signal away). Signals travel as electrical impulses along a neuron and pass from one neuron to the next across a tiny gap called a **synapse**, using chemicals. The central nervous system is the brain and spinal cord; the peripheral nervous system is the network of nerves. A **reflex action** is a sudden, automatic response to a stimulus that does not wait for thinking - for example, pulling your hand away from a hot object. The path of a reflex is the **reflex arc**: receptor (in the skin) -> sensory neuron -> spinal cord (where the decision is made) -> motor neuron -> effector (muscle), which acts. Reflexes protect the body because they are faster than thinking.

The human brain

The brain has three main parts. The **fore-brain** is the largest part: the cerebrum is the thinking part (it receives signals from the sense organs, stores memory, and controls voluntary actions like speaking and writing), and the hypothalamus controls hunger, thirst and body temperature. The **mid-brain** controls reflex movements of the eye and ear. The **hind-brain** has the cerebellum, which controls posture and balance and makes movements precise, and the medulla, which controls involuntary actions such as heartbeat, breathing, swallowing and blood pressure. The brain is protected by the skull and by three membranes, and the spinal cord is protected by the backbone.

Chapter 6 - Control and Coordination (continued)

Notes continued.

Coordination in plants

Plants respond to stimuli by growing towards or away from them - these are **tropisms**. Phototropism is growth towards light (shoots bend towards light); geotropism is growth in response to gravity (roots grow down, shoots grow up); chemotropism is growth towards a chemical (pollen tube grows towards the ovule); thigmotropism is the response to touch (tendrils coil around a support). Some plant movements are not growth movements: the sensitive plant (touch-me-not) folds its leaves when touched, and this is caused by changes in water content. Plant movements are controlled by **plant hormones**: auxins (help cells grow longer - used in bending towards light), gibberellins (help stems grow), cytokinins (promote cell division), and abscisic acid (causes wilting of leaves and closing of stomata).

Hormones in animals

Hormones are chemical messengers released by endocrine glands directly into the blood; they act on specific target organs. The **pituitary gland** is the master gland: it releases growth hormone (controls growth) and other hormones that control other glands. The **thyroid gland** releases thyroxine, which controls the rate of metabolism; iodine is needed to make it, and iodine deficiency causes goitre (swollen neck). The **pancreas** releases insulin, which controls blood sugar; lack of insulin causes diabetes. The **adrenal glands** release adrenaline, the "fight or flight" hormone - it increases heartbeat and breathing in an emergency. The testes release testosterone (male) and the ovaries release oestrogen (female), which control puberty and reproduction. Hormone levels are controlled by a **feedback mechanism**: for example, when blood sugar rises, the pancreas releases insulin, which lowers blood sugar back to normal.

MCQs - Chapter 6

1. The gap between two neurons is called a:

A) axon B) dendrite C) synapse D) receptor

2. The correct order of the reflex arc is:

A) receptor - motor neuron - spinal cord - sensory neuron - effector B) receptor - sensory neuron - spinal cord - motor neuron - effector C) effector - sensory neuron - spinal cord - motor neuron - receptor D) receptor - spinal cord - sensory neuron - motor neuron - effector

3. Which part of the brain controls posture and balance?

A) Cerebrum B) Cerebellum C) Medulla D) Hypothalamus

4. Involuntary actions like heartbeat and breathing are controlled by the:

A) cerebrum B) cerebellum C) medulla D) mid-brain

5. The bending of a shoot towards light is called:

A) geotropism B) phototropism C) chemotropism D) thigmotropism

MCQs - Chapter 6 (continued)

6. Which plant hormone promotes cell division?

A) Auxin B) Gibberellin C) Cytokinin D) Abscisic acid

7. Goitre is caused by the deficiency of:

A) iron B) calcium C) iodine D) vitamin D

8. Insulin is released by the:

A) thyroid gland B) adrenal gland C) pituitary gland D) pancreas

9. Adrenaline is called the "fight or flight" hormone because it:

A) lowers blood sugar B) increases heartbeat and breathing in emergencies C) controls growth D) controls sleep

10. Which of these is a growth movement in plants?

A) Folding of touch-me-not leaves B) Bending of a root towards water C) Closing of stomata D) Wilting of leaves

Short Questions with Answers - Chapter 6

Q1. What is a reflex action? Give one example.

A reflex action is a sudden, automatic and involuntary response to a stimulus that happens without thinking. Example: pulling your hand away quickly when you touch a hot object.

Q2. How does a message travel from one neuron to another?

An electrical impulse travels along a neuron to its end, where it releases chemicals into the tiny gap (synapse) between two neurons. These chemicals start a new electrical impulse in the next neuron, so the message continues.

Q3. What is the function of the cerebrum?

The cerebrum is the main thinking part of the brain. It receives signals from the sense organs, controls voluntary actions like speaking, writing and moving, and is the seat of memory, intelligence and willpower.

Short Questions with Answers - Chapter 6 (continued)

Q4. How does auxin help a shoot bend towards light?

When light falls on one side of a shoot, auxin collects on the shaded side. Auxin makes cells grow longer, so the shaded side grows faster than the lit side, and the shoot bends towards the light.

Q5. What is the feedback mechanism? Give one example.

A feedback mechanism is a system in which the level of a hormone controls its own release. Example: when blood sugar rises, the pancreas releases insulin; insulin lowers blood sugar, and when sugar returns to normal, insulin release slows down.

Long Questions with Answers - Chapter 6

Q1. Describe the structure of the human brain and the functions of its three main parts.

The human brain is the control centre of the body, protected by the skull and three membranes, and it has three main parts. The fore-brain is the largest part and contains the cerebrum, the thinking part of the brain. The cerebrum receives information from the sense organs, controls voluntary actions such as speaking, writing and walking, and is responsible for memory, intelligence and willpower. The fore-brain also contains the hypothalamus, which controls hunger, thirst, sleep and body temperature. The mid-brain is the middle part; it controls reflex movements of the eyes and ears, such as turning the head towards a sudden sound or blinking at a bright light. The hind-brain contains the cerebellum and the medulla. The cerebellum controls posture, balance and the precision of voluntary movements - for example, it allows us to walk in a straight line or pick up a pen without looking. The medulla controls involuntary actions that we do not have to think about: heartbeat, breathing, swallowing, coughing, sneezing and blood pressure. Together the three parts let the body sense the world, think and decide, move precisely, and keep its vital processes running without conscious effort.

Long Questions with Answers - Chapter 6 (continued)

Q2. Explain how plants respond to light, gravity, touch and chemicals, and name the plant hormones that control these responses.

Plants cannot move from place to place, but they respond to stimuli by growing towards or away from them; these growth responses are called tropisms. Phototropism is the response to light: the shoot bends towards light, and the root grows away from light, so that leaves get maximum sunlight for photosynthesis. Geotropism is the response to gravity: roots grow downwards into the soil (positive geotropism) and shoots grow upwards (negative geotropism). Thigmotropism is the response to touch: tendrils of a climbing plant coil around a support when they touch it. Chemotropism is growth towards a chemical: the pollen tube grows through the style towards the ovule in response to chemicals. These movements are slow because they involve growth, and they are controlled by plant hormones. Auxins promote cell elongation and are responsible for bending towards light; gibberellins promote stem growth and seed germination; cytokinins promote cell division and delay the ageing of leaves; abscisic acid inhibits growth and causes the closing of stomata and the wilting of leaves in dry conditions. Not all plant movements are growth movements: the sensitive plant (touch-me-not) folds its leaves when touched, because water moves out of the cells at the base of the leaflets. So plants use a combination of growth and rapid water movements, directed by hormones, to respond to their environment.

Answer Key - Chapter 6 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	C	B	B	C	B	C	C	D	B	B

Chapter 6 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 7 - How do Organisms Reproduce?

Chapter 7 - How do Organisms Reproduce?

Biology - Unit: World of Living. Why reproduction matters, asexual and sexual reproduction in plants and animals, and the human reproductive system.

Reproduction is the process by which living organisms produce new individuals of the same kind. It is essential because it keeps a species alive from one generation to the next, and it creates **variations** - small differences between parents and children - which help a species survive when conditions change. Reproduction is of two kinds: **asexual** (one parent, offspring identical to the parent) and **sexual** (two parents, offspring different from both parents because of the mixing of genes).

Asexual reproduction

- **Fission:** one cell divides into two - binary fission in Amoeba and Paramecium; multiple fission in Plasmodium (many daughter cells at once).
- **Budding:** a small outgrowth (bud) forms on the parent and grows into a new individual - Hydra and yeast.
- **Fragmentation:** the body breaks into pieces and each piece grows into a new individual - Spirogyra.
- **Regeneration:** a lost body part regrows, and a cut piece can grow into a whole animal - Planaria.
- **Spore formation:** tiny spores are produced in a sporangium and spread by air; each spore can grow into a new individual - Rhizopus (bread mould).
- **Vegetative propagation:** new plants grow from roots, stems or leaves - potato tubers (eyes), Bryophyllum leaf buds, sugarcane stem cuttings, rose cuttings. It is fast and keeps the good qualities of the parent, but gives no variation.

Sexual reproduction in plants

A flower has four whorls: sepals (protect the bud), petals (attract insects), stamens (male part - anther makes pollen grains) and carpels or pistil (female part - stigma, style and ovary, which contains ovules). **Pollination** is the transfer of pollen from an anther to a stigma - by insects, wind, water or animals. **Fertilisation** happens when a pollen grain grows a pollen tube down the style and the male gamete fuses with the egg in the ovule to form a zygote. The zygote grows into an embryo inside a seed, the ovary becomes a fruit, and the seed germinates into a new plant.

Chapter 7 - How do Organisms Reproduce? (continued)

Notes continued.

Sexual reproduction in humans

At **puberty** (about 10-14 years), the body changes and becomes able to reproduce. In the **male reproductive system**, the testes make sperms and the hormone testosterone; sperms travel through the vas deferens and are delivered through the penis. In the **female reproductive system**, the ovaries release one egg each month (ovulation) and make the hormones oestrogen and progesterone; the fallopian tube is where fertilisation takes place, and the uterus is where the baby develops. The **menstrual cycle** lasts about 28 days: if the egg is not fertilised, the lining of the uterus breaks down and is shed as menstrual flow. After fertilisation, the zygote divides and implants in the uterus; the embryo is nourished through the **placenta**, and the baby is born after about nine months (gestation).

> **Reproductive health:** Sexually transmitted diseases (STDs) such as gonorrhoea, syphilis and HIV/AIDS spread through sexual contact; HIV attacks the body's immune system and has no cure, so prevention is the only protection. Contraception prevents unwanted pregnancy: mechanical methods (condoms, copper-T), chemical methods (oral pills), and surgical methods (vasectomy in males, tubectomy in females). Family planning helps control population growth and protects the health of mothers and children.

MCQs - Chapter 7

1. Binary fission takes place in:

A) Hydra B) Amoeba C) Spirogyra D) Rhizopus

2. Budding is the method of reproduction in:

A) Planaria B) Amoeba C) Hydra D) Plasmodium

3. Vegetative propagation in potato takes place by:

A) leaves B) roots C) tubers with eyes D) seeds

4. The male part of a flower is the:

A) carpel B) stamen C) sepal D) petal

5. Pollination is the transfer of pollen from the anther to the:

A) ovary B) ovule C) stigma D) style

MCQs - Chapter 7 (continued)

6. In humans, fertilisation takes place in the:

A) uterus B) ovary C) fallopian tube D) vagina

7. The embryo in the uterus is nourished through the:

A) umbilical cord and placenta B) ovary C) fallopian tube D) cervix

8. Which of these is a sexually transmitted disease?

A) Diabetes B) Tuberculosis C) HIV/AIDS D) Malaria

9. Spore formation is seen in:

A) yeast B) Rhizopus C) Bryophyllum D) Planaria

10. The surgical method of contraception in males is called:

A) tubectomy B) vasectomy C) copper-T D) oral pill

Short Questions with Answers - Chapter 7

Q1. Why is variation important for the survival of a species?

Variation means that offspring are slightly different from their parents. If the environment changes (for example, the climate becomes hotter), some individuals with suitable variations will survive and reproduce, while others may not. Without variation, a whole species could be wiped out by one change.

Q2. What is the difference between binary fission and multiple fission?

In binary fission, one parent cell divides into two daughter cells (Amoeba). In multiple fission, the parent cell divides into many daughter cells at the same time (Plasmodium).

Q3. What is pollination? How is it different from fertilisation?

Pollination is the transfer of pollen grains from an anther to the stigma of a flower. Fertilisation is the fusion of the male gamete (from the pollen) with the female gamete (egg) inside the ovule to form a zygote. Pollination comes first; fertilisation follows it.

Short Questions with Answers - Chapter 7 (continued)

Q4. What happens during the menstrual cycle if the egg is not fertilised?

If the egg is not fertilised, the thick lining of the uterus that was prepared for pregnancy breaks down and is shed along with blood through the vagina. This is menstruation, and it lasts about 3 to 5 days.

Q5. Name two advantages and one disadvantage of vegetative propagation.

Advantages: (1) It is fast - new plants grow quickly from a part of the parent. (2) The new plants keep the exact qualities of the parent, such as good fruit. Disadvantage: there is no variation, so all plants are identical and equally open to disease.

Long Questions with Answers - Chapter 7

Q1. Describe the methods of asexual reproduction in organisms with examples.

Asexual reproduction needs only one parent and produces offspring identical to the parent, so it is fast but gives no variation. The main methods are: (1) Fission - a single cell divides into two or more cells. In binary fission, as in Amoeba, the nucleus divides and the cytoplasm splits to give two daughter cells; in multiple fission, as in Plasmodium, the nucleus divides many times and many daughter cells are formed at once. (2) Budding - a small outgrowth or bud forms on the parent, grows, and separates as a new individual; this is seen in Hydra and in yeast, where a bud grows on the parent cell. (3) Fragmentation - the body of an organism breaks into pieces, and each piece grows into a complete new organism, as in the alga Spirogyra. (4) Regeneration - an organism can regrow a lost part, and in Planaria a cut piece can grow into a whole new animal. (5) Spore formation - in Rhizopus (bread mould), tiny spores are produced inside a sporangium; when the sporangium bursts, spores spread in the air and each one can grow into a new fungus in moist conditions. (6) Vegetative propagation in plants - new plants grow from roots, stems or leaves without seeds: potato tubers grow from "eyes", Bryophyllum grows new plants from buds on its leaves, and sugarcane grows from stem cuttings. Farmers use vegetative propagation to grow plants with the same good qualities quickly, while fission, budding and spore formation let simple organisms multiply rapidly when conditions are favourable.

Long Questions with Answers - Chapter 7 (continued)

Q2. Describe the male and female reproductive systems in humans and explain fertilisation and the development of the embryo.

In the male reproductive system, the testes (kept outside the body in the scrotum, where the temperature is lower) produce sperms and the hormone testosterone. Sperms are carried by the vas deferens and mixed with fluids from glands to form semen, which is delivered through the penis. A single ejaculation releases millions of sperms. In the female reproductive system, the ovaries release one egg each month (ovulation) and produce the hormones oestrogen and progesterone. The egg travels through the fallopian tube towards the uterus. If sperms reach the egg in the fallopian tube, one sperm fuses with the egg - this is fertilisation - and a zygote is formed. The zygote divides repeatedly as it moves to the uterus and implants in the thick lining of the uterus. The developing embryo is nourished through the placenta, a special tissue that connects the mother and the baby through the umbilical cord; food and oxygen pass from the mother's blood to the baby, and waste passes back. The baby develops for about nine months (gestation) and is then born. If the egg is not fertilised, it lives for about a day, and the uterus lining is shed as menstrual flow. This system also needs care: sexually transmitted diseases such as HIV/AIDS spread through unprotected contact, and contraceptive methods - condoms, copper-T, oral pills, vasectomy and tubectomy - help prevent unwanted pregnancy and protect health.

Answer Key - Chapter 7 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	C	C	B	C	C	A	C	B	B

Chapter 7 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 8 - Heredity.

Chapter 8 - Heredity

Biology - Unit: World of Living. How traits pass from parents to children: Mendel's experiments, dominant and recessive traits, sex determination, and how evolution works.

Heredity is the passing of traits (features) from parents to their children. The information for these traits is carried in **genes**, which are sections of DNA on **chromosomes** inside the nucleus of a cell. Humans have 23 pairs of chromosomes (46 in total). A child gets one set from the mother and one from the father. Some traits are **inherited** (passed through genes, like eye colour or attached earlobes); other features are **acquired** during life (like a scar or a trained skill) and are not passed to children.

Mendel's experiments

Gregor Johann Mendel, the father of genetics, worked with pea plants (Pisum sativum). He crossed plants with contrasting traits - for example, tall plants with dwarf (short) plants - and studied the offspring. In the first generation (F1), all plants were tall, showing that tallness is a **dominant** trait and dwarfness is a **recessive** trait (hidden in F1). When F1 plants were crossed with each other, the second generation (F2) had tall and dwarf plants in a ratio of **3 tall : 1 dwarf**. Mendel concluded that each trait is controlled by two factors (genes), one from each parent, and that the factors separate when gametes (sex cells) are formed. In a **dihybrid cross** (two traits at once, e.g. seed shape and seed colour), the F2 ratio is **9 : 3 : 3 : 1**. Mendel's rules are called the laws of inheritance: the law of dominance and the law of segregation (factors separate in gametes).

Sex determination in humans

Humans have 22 pairs of autosomes and one pair of sex chromosomes. Females have two X chromosomes (XX) and males have one X and one Y chromosome (XY). All eggs carry an X chromosome; half the sperms carry X and half carry Y. If an X-carrying sperm fertilises the egg, the child is a girl (XX); if a Y-carrying sperm fertilises the egg, the child is a boy (XY). So there is a **50% chance** of a boy or a girl at each birth, and it is the father's sperm that decides the sex of the child.

Chapter 8 - Heredity (continued)

Notes continued.

Evolution

Evolution is the slow change in organisms over many generations. Small differences (variations) appear in each generation; those that help an organism survive and reproduce in its environment are passed on, while harmful ones disappear - this is **natural selection**, proposed by Charles Darwin. Over a long time, enough changes collect to form a new species - this is called **speciation**, and it happens when populations are separated (for example, by a river or mountain) and can no longer breed together. Evidence for evolution comes from **fossils** (remains of ancient organisms in rocks), from **homologous organs** (organs with the same basic structure but different functions, like the forelimbs of a human, a bat and a whale - showing common ancestry) and from **analogous organs** (organs with different structures but the same function, like the wings of a bird and of an insect - showing adaptation, not common ancestry). Human evolution shows that humans and apes share a common ancestor, and the earliest human-like fossils come from Africa.

> **Remember:** Dominant traits appear in F1; recessive traits are hidden in F1 but reappear in F2. Acquired traits (like a cut tail or a learned skill) are never inherited. The sex of a human child is decided by the father's sperm, not the mother. Variations are the raw material of evolution, and natural selection is the process that shapes them into new species over time.

MCQs - Chapter 8

1. The father of genetics is:

A) Charles Darwin B) Gregor Johann Mendel C) Watson D) Lamarck

2. In Mendel's monohybrid cross of tall and dwarf pea plants, the F2 ratio is:

A) 1 : 1 B) 3 : 1 C) 9 : 3 : 3 : 1 D) 1 : 2 : 1

3. A recessive trait is one that:

A) always appears B) is hidden in F1 and reappears in F2 C) never appears D) appears only in males

4. The dihybrid cross ratio in the F2 generation is:

A) 3 : 1 B) 1 : 2 : 1 C) 9 : 3 : 3 : 1 D) 1 : 1

5. How many chromosomes do human body cells contain?

A) 23 B) 44 C) 46 D) 48

MCQs - Chapter 8 (continued)

6. A human female has the sex chromosomes:

A) XY B) XX C) YY D) XO

7. The sex of a human child is decided by the:

A) mother's egg B) father's sperm C) mother's health D) time of birth

8. Which of these is an example of homologous organs?

A) Wings of a bird and wings of an insect B) Forelimbs of a human and wings of a bat C) Eyes of an octopus and eyes of a human D) Fins of a fish and flippers of a whale

9. The theory of natural selection was proposed by:

A) Mendel B) Lamarck C) Charles Darwin D) Hugo de Vries

10. Which of these traits is acquired and NOT inherited?

A) Eye colour B) Attached earlobe C) A scar from an injury D) Blood group

Short Questions with Answers - Chapter 8

Q1. What is a gene? Where are genes located?

A gene is a section of DNA that carries the information for one trait, such as eye colour. Genes are located on chromosomes inside the nucleus of a cell.

Q2. Why did Mendel choose pea plants for his experiments?

Pea plants have many contrasting traits (tall/dwarf, round/wrinkled seeds), grow quickly, produce many offspring, and can be self-pollinated or cross-pollinated easily, so Mendel could control the crosses and count the results.

Q3. What is the difference between a dominant and a recessive trait?

A dominant trait appears even when only one copy of its gene is present (it shows in F1). A recessive trait appears only when two copies of its gene are present; it is hidden in F1 when the dominant gene is present.

Short Questions with Answers - Chapter 8 (continued)

Q4. How is the sex of a child decided in humans?

The mother always gives an X chromosome in the egg. The father gives either an X or a Y chromosome in the sperm. An XX child is a girl and an XY child is a boy, so the father's sperm decides the sex, with a 50% chance each way.

Q5. What are fossils? How do they give evidence for evolution?

Fossils are the preserved remains or impressions of ancient organisms found in rocks. They show the forms of life that existed in the past and how organisms have changed over time; older fossils are usually found in deeper layers of rock.

Long Questions with Answers - Chapter 8

Q1. Explain Mendel's monohybrid cross with the example of tall and dwarf pea plants, and state the conclusions he drew.

Mendel crossed a pure tall pea plant (TT) with a pure dwarf pea plant (tt). In the first generation (F1), all the plants were tall. This showed that tallness is dominant and dwarfness is recessive - the dwarf trait was present but hidden. Mendel then allowed the F1 plants to self-pollinate. In the second generation (F2), tall and dwarf plants appeared in a ratio of 3 tall : 1 dwarf. The dwarf trait had reappeared, proving that it was not lost in F1 but only hidden. From this Mendel concluded: (1) Each trait is controlled by two factors (now called genes), one inherited from each parent. (2) When a plant forms gametes (pollen and eggs), the two factors separate, so each gamete carries only one factor - this is the law of segregation. (3) When the two factors are different, only the dominant one shows in the offspring, while the recessive one remains hidden. (4) In F2, the factors combine in new ways, giving the 3:1 ratio - three out of four plants show the dominant trait and one shows the recessive trait. Mendel's work, ignored in his lifetime, became the foundation of genetics, and his laws explain how traits such as eye colour, blood group and many inherited conditions pass from parents to children in humans as well.

Long Questions with Answers - Chapter 8 (continued)

Q2. Explain how new species form and what evidence supports the theory of evolution.

New species form through the slow accumulation of changes over many generations. First, variations appear in every generation because of differences in genes and because of sexual reproduction, which mixes genes from two parents. Second, natural selection acts on these variations: individuals with traits that suit their environment survive and reproduce more successfully, while those with harmful traits die out. Third, when a population is split into separate groups - for example, by a river, a mountain or a sea - the groups cannot breed with each other, and over a long time the differences between them grow so large that they become separate species, unable to produce fertile offspring together. This process is called speciation. The evidence for evolution is strong. Fossils show that organisms in the past were different from those alive today and that forms change gradually through the layers of rock. Homologous organs, such as the forelimbs of humans, bats and whales, have the same basic bone structure but are used for different purposes (grasping, flying, swimming), which shows they evolved from a common ancestor. Analogous organs, such as the wings of birds and insects, have the same function but different structures, showing that different animals can adapt in similar ways to the same problem. Together, fossils, homologous organs and the pattern of life on Earth support Darwin's idea that all living things share common ancestors and have changed over time by natural selection.

Answer Key - Chapter 8 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	B	B	C	C	B	B	B	C	C

Chapter 8 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 9 - Light - Reflection and Refraction.

Chapter 9 - Light - Reflection and Refraction

Physics - Unit: Natural Phenomena. How light bounces off mirrors and bends through lenses: laws of reflection and refraction, mirror and lens formulas, and the power of a lens.

Light travels in straight lines and in a vacuum it moves at about 3×10^8 metres per second. When light falls on a surface it can be reflected (bounce back) or refracted (bend as it enters a new medium). A ray that falls on a surface is the **incident ray**; the ray that bounces back is the **reflected ray**. The point where the ray hits is the point of incidence, and the line drawn perpendicular to the surface there is the **normal**.

Reflection of light

The **laws of reflection** are: (1) the angle of incidence equals the angle of reflection; (2) the incident ray, the reflected ray and the normal all lie in the same plane. The angle of incidence is measured between the incident ray and the normal. A plane mirror forms an image that is virtual, upright, the same size as the object, and as far behind the mirror as the object is in front of it (laterally inverted - left and right are swapped). **Spherical mirrors** are parts of a hollow sphere: a **concave mirror** (reflecting surface curved inward) converges light and is used in shaving mirrors, torches and solar furnaces; a **convex mirror** (reflecting surface curved outward) diverges light and is used as a rear-view mirror in vehicles because it gives a wide field of view and an erect, smaller image. The **pole** is the centre of the mirror, the **centre of curvature** is the centre of the sphere the mirror is part of, and the **principal focus** is the point where rays parallel to the principal axis meet after reflection. The focal length (f) is half the radius of curvature (R): R = 2f.

> **Mirror formula:** $1/v + 1/u = 1/f$, where u = object distance, v = image distance, f = focal length. Distances are measured from the pole, and distances in front of the mirror are taken as negative (Cartesian sign convention). **Magnification:** m = -v/u = height of image / height of object. A negative m means the image is inverted; a positive m means it is erect.

Chapter 9 - Light - Reflection and Refraction (continued)

Notes continued.

Refraction of light

Refraction is the bending of light when it passes from one transparent medium to another, because its speed changes. The **laws of refraction** are: (1) the incident ray, the refracted ray and the normal all lie in the same plane; (2) the ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant for a pair of media - this constant is the **refractive index** (Snell's law): n = sin i / sin r. Light bends towards the normal when it enters a denser medium (e.g. air to glass) and away from the normal when it enters a rarer medium (e.g. glass to air). A coin at the bottom of a pond looks raised, and a pencil in water looks bent, because of refraction.

Lenses

A **convex lens** (thicker in the middle) converges light and forms real, inverted images; it is used in magnifying glasses, cameras and spectacles for hypermetropia. A **concave lens** (thinner in the middle) diverges light and forms virtual, erect, smaller images; it is used in spectacles for myopia. The **optical centre** is the centre of the lens; the **principal focus** is the point where rays parallel to the principal axis meet after passing through the lens.

> **Lens formula:** 1/v - 1/u = 1/f. **Magnification:** m = v/u. **Power of a lens:** P = 1/f, where f is in metres; the unit of power is the **dioptre (D)**. A convex lens has positive power and a concave lens has negative power.

MCQs - Chapter 9

1. The angle of incidence is equal to the angle of reflection. This is the law of:

A) refraction B) reflection C) dispersion D) scattering

2. The image formed by a plane mirror is:

A) real and inverted B) virtual and erect C) real and erect D) virtual and magnified

3. A concave mirror is used in a torch because it:

A) gives a wide view B) forms a small image C) converges light into a strong beam D) diverges light

4. The focal length of a spherical mirror is related to its radius of curvature by:

A) f = R B) f = R/2 C) f = 2R D) f = R/4

5. A convex mirror is used as a rear-view mirror in vehicles because it:

A) forms a magnified image B) forms a real image C) gives a wide field of view D) converges light

MCQs - Chapter 9 (continued)

6. When light passes from air into glass, it bends:

A) away from the normal B) towards the normal C) along the normal D) it does not bend

7. The refractive index of a medium is given by:

A) sin r / sin i B) sin i / sin r C) i / r D) r / i

8. The power of a lens with focal length 25 cm (convex) is:

A) +4 D B) -4 D C) +2 D D) -2 D

9. A concave lens always forms an image that is:

A) real and inverted B) virtual, erect and smaller C) real and magnified D) virtual and magnified

10. In the mirror formula, the magnification m = -v/u. A negative magnification means the image is:

A) erect B) virtual C) inverted D) same size

Short Questions with Answers - Chapter 9

Q1. State the laws of reflection of light.

First law: the angle of incidence is equal to the angle of reflection. Second law: the incident ray, the reflected ray and the normal to the surface at the point of incidence all lie in the same plane.

Q2. Why is a convex mirror preferred as a rear-view mirror in vehicles?

A convex mirror always forms a virtual, erect and smaller image, and it gives a much wider field of view than a plane mirror, so the driver can see more of the traffic behind the vehicle.

Q3. What is the refractive index of a medium? How is it related to the speed of light?

The refractive index of a medium is the ratio of the speed of light in vacuum to the speed of light in that medium (n = c/v). It also equals sin i / sin r. A higher refractive index means light travels more slowly in that medium.

Short Questions with Answers - Chapter 9 (continued)

Q4. Define the power of a lens. What is its unit?

The power of a lens is the reciprocal of its focal length in metres (P = 1/f). Its unit is the dioptre (D). A convex lens has positive power and a concave lens has negative power.

Q5. Why does a pencil partly dipped in water appear bent?

Light from the submerged part of the pencil is refracted as it passes from water into air, bending away from the normal. Our eyes follow the refracted rays back in straight lines, so the pencil appears bent at the water surface.

Long Questions with Answers - Chapter 9

Q1. Describe the images formed by a concave mirror when the object is (a) at infinity, (b) beyond the centre of curvature, (c) at the centre of curvature, (d) between the centre of curvature and the focus, and (e) between the focus and the pole. Give one use of a concave mirror.

A concave mirror is a converging mirror, and the image changes as the object moves closer. (a) Object at infinity: the image forms at the focus, real, inverted and very small (a point). (b) Object beyond the centre of curvature: the image forms between the focus and the centre of curvature, real, inverted and smaller than the object. (c) Object at the centre of curvature: the image forms at the centre of curvature itself, real, inverted and the same size as the object. (d) Object between the centre of curvature and the focus: the image forms beyond the centre of curvature, real, inverted and larger than the object - this is the position used in a shaving mirror or a dentist's mirror, where a magnified image is needed. (e) Object between the focus and the pole: the rays diverge after reflection, so the image forms behind the mirror; it is virtual, erect and magnified. The mirror formula 1/v + 1/u = 1/f and magnification m = -v/u describe all these cases, with distances measured from the pole and the Cartesian sign convention. Concave mirrors are used in torches and headlights, where a bulb placed at the focus gives a parallel beam, in solar furnaces to concentrate sunlight, and as shaving and dental mirrors to give a magnified image.

Long Questions with Answers - Chapter 9 (continued)

Q2. Explain refraction of light through a glass slab and through a lens. Derive the meaning of the lens formula and the power of a lens, with a numerical example.

When light passes from air into a glass slab, it slows down and bends towards the normal; when it leaves the slab into air, it speeds up and bends away from the normal. The ray that comes out is parallel to the ray that went in, but shifted sideways - this is lateral displacement. The bending follows Snell's law: the ratio sin i / sin r is constant and equal to the refractive index of glass (about 1.5). A lens is two curved surfaces joined together. A convex lens bends rays inwards so that parallel rays meet at the focus on the other side, while a concave lens spreads them out as if they came from a focus on the same side. The lens formula 1/v - 1/u = 1/f connects the object distance (u), the image distance (v) and the focal length (f), with distances measured from the optical centre and the Cartesian sign convention (light travels left to right, distances to the left are negative). Magnification is m = v/u = image height / object height. The power of a lens is P = 1/f with f in metres, measured in dioptres. Example: a convex lens of focal length 20 cm has f = 0.20 m, so P = 1/0.20 = +5 D. If an object is placed 30 cm from this lens, then 1/v = 1/f + 1/u = 1/20 + 1/(-30) = 1/60, so v = +60 cm: a real, inverted image forms 60 cm from the lens on the other side, with magnification m = v/u = 60/(-30) = -2, so the image is twice as large as the object and inverted.

Answer Key - Chapter 9 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	B	C	B	C	B	B	A	B	C

Chapter 9 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 10 - The Human Eye and the Colourful World.

Chapter 10 - The Human Eye and the Colourful World

Physics - Unit: Natural Phenomena. How the human eye works, common defects of vision and their correction, and why the sky is blue and the sunset is red.

The **human eye** is a natural optical instrument. Light enters through the transparent **cornea**, passes through the **aqueous humour**, then through the **pupil** - the black opening in the centre of the **iris**, the coloured part that controls how much light enters. The **eye lens** is a flexible convex lens held by **ciliary muscles**; it focuses light onto the **retina** at the back of the eye, where light-sensitive cells (rods for dim light, cones for colour) send signals to the brain through the optic nerve. The image on the retina is real and inverted, and the brain interprets it as erect.

Power of accommodation and defects of vision

The **power of accommodation** is the ability of the eye lens to change its focal length: the ciliary muscles make the lens thicker to focus on near objects and thinner to focus on distant objects. The **near point** of a normal young adult eye is 25 cm (the least distance of distinct vision) and the **far point** is infinity. Three common defects are: **Myopia (short sight):** the eye can see near objects but not distant ones, because the image forms in front of the retina (eyeball too long, or lens too strong). It is corrected with a **concave lens** of suitable power. **Hypermetropia (long sight):** the eye can see distant objects but not near ones, because the image forms behind the retina (eyeball too short, or lens too weak). It is corrected with a **convex lens**. **Presbyopia:** in old age the eye lens loses flexibility and the power of accommodation decreases, so near objects become hard to see; it is corrected with **bifocal lenses** (upper part concave for distance, lower part convex for reading). **Cataract** is the clouding of the eye lens with age; it is treated by surgery that replaces the lens.

Chapter 10 - The Human Eye and the Colourful World (continued)

Notes continued.

Refraction through a prism and dispersion

A **prism** is a transparent object with two triangular bases and three rectangular sides. When white light passes through a glass prism, it is refracted twice and splits into its seven colours - violet, indigo, blue, green, yellow, orange and red (VIBGYOR). This splitting is called **dispersion**. It happens because different colours travel at different speeds in glass: violet bends the most and red bends the least. The band of colours is called the **spectrum**. A rainbow is a natural spectrum: sunlight is dispersed by tiny water droplets in the air after rain, and the colours are seen when the sun is behind the observer.

Atmospheric refraction and scattering

Atmospheric refraction is the bending of light by the layers of air, which have different densities. It makes the stars appear to twinkle (their light is refracted differently as air moves), and it makes the sun visible for a few minutes before actual sunrise and after actual sunset (the sun appears raised by about half a degree). **Scattering** is the spreading of light in all directions by tiny particles in the air. Blue light is scattered the most, which is why the sky looks blue. At sunrise and sunset, sunlight travels a longer path through the atmosphere, so the blue light is scattered away and only the red light reaches our eyes - hence the red sun. The **Tyndall effect** is the scattering of light by colloidal particles, which makes a beam of light visible in a dark room with dust or smoke.

MCQs - Chapter 10

1. The part of the eye that controls the amount of light entering is the:

A) cornea B) iris C) retina D) eye lens

2. The image formed on the retina is:

A) virtual and erect B) real and inverted C) virtual and inverted D) real and erect

3. The least distance of distinct vision for a normal young adult eye is:

A) 10 cm B) 25 cm C) 50 cm D) 100 cm

4. Myopia is corrected by using a:

A) convex lens B) concave lens C) bifocal lens D) cylindrical lens

5. In hypermetropia, the image of a near object forms:

A) in front of the retina B) behind the retina C) on the retina D) on the cornea

MCQs - Chapter 10 (continued)

6. Dispersion of white light through a prism gives:

A) one colour B) three colours C) seven colours D) no colours

7. In the spectrum, the colour that bends the most is:

A) red B) yellow C) green D) violet

8. The sky appears blue because of:

A) reflection B) refraction C) scattering of light D) dispersion

9. Stars twinkle because of:

A) scattering B) atmospheric refraction C) dispersion D) diffraction

10. Presbyopia is corrected with:

A) concave lenses B) convex lenses C) bifocal lenses D) contact lenses only

Short Questions with Answers - Chapter 10

Q1. What is the power of accommodation of the eye?

The power of accommodation is the ability of the eye lens to adjust its focal length so that near and distant objects can be focused clearly on the retina. The ciliary muscles change the shape of the lens: it becomes thicker for near objects and thinner for distant objects.

Q2. What is myopia? How is it corrected?

Myopia (short sight) is a defect in which a person can see near objects clearly but not distant objects, because the image forms in front of the retina. It is corrected by a concave lens of suitable power, which diverges the rays so that the image forms on the retina.

Q3. What is dispersion of light? Why does it happen in a prism?

Dispersion is the splitting of white light into its seven colours when it passes through a prism. It happens because different colours travel at different speeds in glass and bend by different amounts - violet bends the most and red the least.

Short Questions with Answers - Chapter 10 (continued)

Q4. Why does the sun appear red at sunset?

At sunset the sunlight travels a longer path through the atmosphere. The blue and violet light is scattered away by air particles, and mostly red light, which is scattered least, reaches our eyes, so the sun looks red.

Q5. What is the Tyndall effect?

The Tyndall effect is the scattering of a beam of light by tiny particles in a colloidal mixture or in smoky air, which makes the path of the beam visible. Example: sunlight entering a dark room through a small opening becomes visible because of dust particles.

Long Questions with Answers - Chapter 10

Q1. Describe the structure of the human eye and explain myopia, hypermetropia and presbyopia with their corrections.

The human eye is like a camera. Light enters through the cornea, the transparent front part, and passes through the aqueous humour and the pupil, the opening in the iris that controls how much light enters. The eye lens, a flexible convex lens held by ciliary muscles, focuses the light onto the retina, where rods (for dim light) and cones (for colour) convert it into electrical signals sent to the brain by the optic nerve. The image on the retina is real and inverted, but the brain sees it as erect. The eye adjusts its focal length by the power of accommodation: the lens becomes thicker for near objects and thinner for distant objects; the near point is 25 cm and the far point is infinity. Three defects are common. In myopia (short sight), the eyeball is too long or the lens is too strong, so the image of a distant object forms in front of the retina; the person sees near objects clearly but not far ones, and it is corrected with a concave lens that diverges the rays onto the retina. In hypermetropia (long sight), the eyeball is too short or the lens is too weak, so the image of a near object forms behind the retina; the person sees distant objects clearly but not near ones, and it is corrected with a convex lens that converges the rays onto the retina. In presbyopia, which comes with old age, the lens loses flexibility and the ciliary muscles weaken, so the power of accommodation falls and near objects become blurred; it is corrected with bifocal lenses, whose upper part is concave for distance vision and lower part is convex for reading. Cataract, the clouding of the lens in old age, is treated by surgery.

Long Questions with Answers - Chapter 10 (continued)

Q2. Explain dispersion of white light by a prism, the formation of a rainbow, atmospheric refraction, and scattering of light.

When white light enters a glass prism, it is refracted at both faces. Because the refractive index of glass is slightly different for each colour - violet light is slowed most and bends most, red light is slowed least and bends least - the white light splits into a band of seven colours (violet, indigo, blue, green, yellow, orange, red), called the spectrum. This splitting is dispersion. A rainbow is a natural spectrum formed when sunlight is dispersed by water droplets in the air after rain: each droplet acts like a tiny prism, dispersing the light, and the observer sees the bow of colours when the sun is behind them. Atmospheric refraction is the bending of light as it passes through layers of air of different densities. It makes stars twinkle, because the light from a star is refracted by different amounts as the air moves, and it makes the sun visible a few minutes before it actually rises and after it actually sets, because the sun's rays are bent so that the sun appears raised. Scattering is the spreading of light in all directions by small particles. Blue light has a short wavelength and is scattered much more than red light, so the sky looks blue on a clear day. At sunrise and sunset the sunlight travels a long path through the atmosphere, the blue light is scattered away, and mostly red light reaches the observer, so the sun and the sky near it look red. The Tyndall effect is a form of scattering by colloidal particles, which makes a light beam visible in dusty or smoky air.

Answer Key - Chapter 10 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	B	B	B	B	C	D	C	B	C

Chapter 10 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 11 - Electricity.

Chapter 11 - Electricity

Physics - Unit: Effects of Current. Electric current, potential difference, resistance, Ohm's law, series and parallel circuits, and the heating effect of current.

Electric current is the flow of electric charge. In a metal wire, current is the flow of electrons, but by convention the direction of current is taken as the direction in which positive charge would flow - opposite to the flow of electrons. Current is measured in **amperes (A)** with an ammeter connected in series. The amount of charge passing a point in one second is the current: I = Q/t, where Q is charge in coulombs and t is time in seconds. One ampere is one coulomb per second. **Electric potential difference** between two points is the work done to move a unit charge from one point to the other: V = W/Q. It is measured in **volts (V)** with a voltmeter connected in parallel. A cell or battery provides the potential difference that pushes the current around a circuit.

Ohm's law and resistance

Ohm's law states that the current through a conductor is directly proportional to the potential difference across it, provided the temperature stays the same: V = IR. **Resistance (R)** is the opposition to the flow of current, measured in **ohms**. A resistor is a component that provides resistance. The resistance of a wire depends on its length, its cross-sectional area, and the material: R = rho x l / A, where rho is the **resistivity** of the material. Longer wires have more resistance; thicker wires have less resistance. Resistivity depends on the material and on temperature, not on the size of the wire. Good conductors (copper, aluminium) have low resistivity; insulators (rubber, glass) have very high resistivity; alloys like nichrome have high resistivity and are used in heating elements.

Chapter 11 - Electricity (continued)

Notes continued.

Series combination: the same current flows through all resistors; R(total) = R1 + R2 + R3. The total resistance is more than any single resistance. **Parallel combination:** the same potential difference is across all resistors; 1/R(total) = 1/R1 + 1/R2 + 1/R3. The total resistance is less than the smallest single resistance. In a home, appliances are connected in parallel so that each gets the full voltage and can be switched off separately.

Heating effect of electric current

When current flows through a resistor, electrical energy is converted into heat. The heat produced is given by **Joule's law**: $H = I^2Rt$. This heating effect is used in electric bulbs (the filament gets hot and glows), heaters, irons and fuses. A **fuse** is a safety device: a thin wire of low melting point that melts and breaks the circuit when the current becomes too large, protecting appliances. **Electric power** is the rate at which electrical energy is used: $P = VI = I^2R = V^2/R$, measured in **watts (W)**. One kilowatt is 1000 watts. The commercial unit of electrical energy is the **kilowatt-hour (kWh)**, also called a "unit": 1 kWh = 3.6×10^6 joules. The energy used by an appliance is: Energy (kWh) = Power (kW) x Time (hours).

MCQs - Chapter 11

1. The SI unit of electric current is the:

A) volt B) ohm C) ampere D) watt

2. An ammeter is always connected in a circuit in:

A) parallel B) series C) either way D) across the battery only

3. Ohm's law is expressed as:

A) V = I/R B) V = IR C) I = VR D) R = VI

4. The resistance of a wire depends on all of the following EXCEPT:

A) its length B) its thickness C) the material D) the current through it

5. Two resistors of 2 ohm and 3 ohm in series have a total resistance of:

A) 1.2 ohm B) 5 ohm C) 6 ohm D) 1 ohm

MCQs - Chapter 11 (continued)

6. Two resistors of 2 ohm and 3 ohm in parallel have a total resistance of:

A) 5 ohm B) 6 ohm C) 1.2 ohm D) 0.8 ohm

7. The heat produced in a resistor is given by:

A) $H = IRt$ B) $H = I^2Rt$ C) $H = VIt$ D) $H = I^2t/R$

8. One kilowatt-hour is equal to:

A) 3.6×10^3 J B) 3.6×10^5 J C) 3.6×10^6 J D) 3.6×10^4 J

9. A fuse is used in a circuit to:

A) increase the current B) protect appliances from excessive current C) measure the voltage D) store charge

10. An electric bulb of 100 W used for 5 hours consumes:

A) 0.5 kWh B) 5 kWh C) 500 kWh D) 20 kWh

Short Questions with Answers - Chapter 11

Q1. Define electric current and potential difference, with their units.

Electric current is the rate of flow of electric charge: I = Q/t, measured in amperes (A). Potential difference is the work done to move a unit charge between two points: V = W/Q, measured in volts (V).

Q2. Why is a voltmeter connected in parallel and an ammeter in series?

A voltmeter measures the potential difference between two points, so it is connected across (in parallel with) the component. An ammeter measures the current flowing through a component, so it is connected in series so that the same current passes through it. A voltmeter has very high resistance and an ammeter has very low resistance.

Q3. How does the resistance of a wire change if its length is doubled and its area is halved?

Resistance R = rho x l / A. Doubling the length doubles R, and halving the area doubles R again, so the resistance becomes four times the original value.

Short Questions with Answers - Chapter 11 (continued)

Q4. Why are the heating elements of electric heaters made of nichrome?

Nichrome has high resistivity, so it produces a lot of heat for a given current, and it has a high melting point, so it does not melt when it becomes red hot. It also does not oxidise easily at high temperatures.

Q5. What is the commercial unit of electrical energy? How is it related to the joule?

The commercial unit is the kilowatt-hour (kWh), also called a unit. 1 kWh is the energy used by a 1000 W appliance in one hour: 1 kWh = 1000 W x 3600 s = 3.6×10^6 joules.

Long Questions with Answers - Chapter 11

Q1. State Ohm's law and explain the factors on which the resistance of a conductor depends. Describe series and parallel combinations of resistors with formulas.

Ohm's law states that the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends, provided its temperature remains constant: V = IR, where R is the resistance. If we plot V against I, we get a straight line through the origin, and its slope is the resistance. The resistance of a wire depends on three factors: its length (longer wire, more resistance), its cross-sectional area (thicker wire, less resistance), and the material it is made of. This is given by R = rho x l / A, where rho is the resistivity of the material - a property of the material itself. Copper has low resistivity and is used for wires; nichrome has high resistivity and is used in heaters. Resistors can be combined in two ways. In series, the same current flows through each resistor and the potential differences add up: V = V1 + V2 + V3, so the total resistance is R = R1 + R2 + R3, which is larger than any single resistance. In parallel, the potential difference is the same across each resistor and the currents add up: I = I1 + I2 + I3, so 1/R = 1/R1 + 1/R2 + 1/R3, and the total resistance is smaller than the smallest single resistance. In a house, appliances are connected in parallel so that each gets the full 220 V and can be used independently, while the fuse and the main switch are in series with the circuit.

Long Questions with Answers - Chapter 11 (continued)

Q2. Explain the heating effect of electric current (Joule's law) and its uses. Define electric power and calculate the energy consumed by a 60 W bulb used for 10 hours.

When current flows through a resistor, the electrons collide with the atoms of the conductor and transfer energy to them, so electrical energy is converted into heat. The heat produced is given by Joule's law: $H = I^2Rt$, where I is the current, R is the resistance and t is the time. The heat is proportional to the square of the current, to the resistance, and to the time. This effect is useful in electric bulbs, where a tungsten filament is heated until it glows and gives light; in electric heaters, irons and kettles, where a nichrome element produces heat; and in a fuse, where a wire of low melting point melts and breaks the circuit when the current becomes too large, protecting the appliances. The heating effect is a waste in other cases, such as in transmission lines, where energy is lost as heat. Electric power is the rate at which electrical energy is consumed: $P = VI = I^2R = V^2/R$, measured in watts. A 60 W bulb uses 60 joules of energy per second. Used for 10 hours, the energy consumed is: Energy = Power x Time = 60 W x 10 h = 600 Wh = 0.6 kWh (0.6 units). In joules, this is $0.6 \times 3.6 \times 10^6 = 2.16 \times 10^6$ J. Electricity bills charge for this energy in kilowatt-hours, so knowing the power of an appliance and the time it is used tells us the cost.

Answer Key - Chapter 11 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	C	B	B	D	B	C	B	C	B	A

Chapter 11 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 12 - Magnetic Effects of Electric Current.

Chapter 12 - Magnetic Effects of Electric Current

Physics - Unit: Effects of Current. Magnetic fields, the magnetic effect of current, electromagnets, the electric motor, electromagnetic induction, and domestic circuits.

A **magnet** attracts iron, nickel and cobalt. Every magnet has two poles - north and south - and like poles repel while unlike poles attract. The region around a magnet where its force can be felt is its **magnetic field**. The field is shown by **magnetic field lines**, which start at the north pole and end at the south pole outside the magnet; they never cross each other, and where they are crowded together the field is stronger. A compass needle points along the field lines: its north pole points towards the Earth's magnetic south, which is near the geographic north.

Magnetic effect of electric current

When current flows through a straight wire, it produces a magnetic field around the wire - this was discovered by Oersted. The direction of the field is given by the **right-hand thumb rule**: if you hold the wire with your right hand so that the thumb points in the direction of the current, your fingers curl in the direction of the magnetic field lines. The field is in circles around the wire and is stronger near the wire. A **solenoid** is a coil of many turns of wire; when current passes through it, it behaves like a bar magnet, with one end as the north pole and the other as the south pole. Putting a soft iron core inside a solenoid makes a strong temporary magnet called an **electromagnet**; it is used in cranes to lift scrap iron, in electric bells, and in loudspeakers. A permanent magnet is made of steel, while an electromagnet uses soft iron, which loses its magnetism when the current is switched off.

Force on a current-carrying conductor and the electric motor

When a current-carrying conductor is placed in a magnetic field, it experiences a force. The direction of the force is given by **Fleming's left-hand rule**: stretch the thumb, forefinger and middle finger of the left hand so that they are at right angles to each other - the forefinger points in the direction of the magnetic field, the middle finger in the direction of the current, and the thumb in the direction of the force (motion). This is the principle of the **electric motor**, which converts electrical energy into mechanical energy. In a motor, a rectangular coil of wire carrying current is placed between the poles of a magnet; the forces on the two sides of the coil turn it. A **commutator** (split rings) reverses the current every half-turn so that the coil keeps rotating in the same direction. Electric motors are used in fans, mixers, washing machines and trains.

Chapter 12 - Magnetic Effects of Electric Current (continued)

Notes continued.

Electromagnetic induction and domestic circuits

Electromagnetic induction is the production of an electric current by a changing magnetic field: when a magnet is moved towards or away from a coil, a current is induced in the coil. This was discovered by Faraday and is the principle of the **electric generator**, which converts mechanical energy into electrical energy. The direction of the induced current is given by **Fleming's right-hand rule** (forefinger = field, thumb = motion, middle finger = induced current). A generator produces **alternating current (AC)**, which changes direction many times a second (in India, 50 times a second, 50 Hz); a cell or battery gives **direct current (DC)**, which flows in one direction only. AC is used in homes because it can be transmitted over long distances with less loss. In a domestic circuit, there are three wires: the **live wire** (red, carries current), the **neutral wire** (black, returns current) and the **earth wire** (green, safety wire that protects against electric shock). A **fuse** or MCB in the live wire breaks the circuit if the current becomes too large; overloading (too many appliances) or a short circuit (live and neutral wires touching) can cause the fuse to blow.

MCQs - Chapter 12

1. Magnetic field lines around a bar magnet:

A) start at the south pole and end at the north pole B) start at the north pole and end at the south pole C) cross each other D) start and end at the same pole

2. The magnetic effect of electric current was discovered by:

A) Faraday B) Fleming C) Oersted D) Ampere

3. The direction of the magnetic field around a straight current-carrying wire is given by the:

A) left-hand thumb rule B) right-hand thumb rule C) Fleming's left-hand rule D) Fleming's right-hand rule

4. A solenoid carrying current behaves like a:

A) resistor B) bar magnet C) electric bulb D) battery

5. An electromagnet is made with a core of:

A) steel B) soft iron C) copper D) aluminium

MCQs - Chapter 12 (continued)

6. The direction of the force on a current-carrying conductor in a magnetic field is given by:

A) Fleming's right-hand rule B) Fleming's left-hand rule C) right-hand thumb rule D) left-hand thumb rule

7. An electric motor converts:

A) mechanical energy into electrical energy B) electrical energy into mechanical energy C) heat energy into electrical energy D) chemical energy into electrical energy

8. The part of a DC motor that reverses the current every half-turn is the:

A) armature B) commutator (split rings) C) brush D) field magnet

9. In India, the frequency of alternating current supplied to homes is:

A) 60 Hz B) 50 Hz C) 100 Hz D) 220 Hz

10. In a domestic circuit, the earth wire is coloured:

A) red B) black C) green D) white

Short Questions with Answers - Chapter 12

Q1. What are magnetic field lines? State two properties of them.

Magnetic field lines are imaginary lines that show the direction and strength of a magnetic field. Two properties: (1) they start at the north pole and end at the south pole outside the magnet; (2) they never cross each other, because if they did, a compass needle placed at the crossing would point in two directions at once.

Q2. How does a solenoid behave like a magnet? How can its strength be increased?

When current passes through a solenoid (a coil of wire), it produces a magnetic field like that of a bar magnet, with one end as north and the other as south. Its strength can be increased by increasing the current, increasing the number of turns, or placing a soft iron core inside it.

Q3. State Fleming's left-hand rule.

Stretch the thumb, forefinger and middle finger of the left hand so that they are at right angles to each other. The forefinger points in the direction of the magnetic field, the middle finger in the direction of the current, and the thumb in the direction of the force (motion) on the conductor.

Short Questions with Answers - Chapter 12 (continued)

Q4. What is electromagnetic induction? Give one use of it.

Electromagnetic induction is the production of an electric current in a coil when the magnetic field around it changes, for example when a magnet is moved towards or away from the coil. It is the principle of the electric generator, which produces electricity in power stations.

Q5. What is the function of the earth wire in a domestic circuit?

The earth wire is a safety wire connected to the metal body of an appliance and to the earth. If the live wire touches the metal body, the current flows through the earth wire to the ground instead of through a person, so it protects against electric shock.

Long Questions with Answers - Chapter 12

Q1. Describe the magnetic field around a straight current-carrying wire and around a solenoid. How is an electromagnet made, and where is it used?

When current flows through a straight wire, a magnetic field is produced around it in circles centred on the wire. The field is strongest close to the wire and becomes weaker as we move away. Its direction is given by the right-hand thumb rule: if the thumb of the right hand points in the direction of the current, the fingers curl in the direction of the magnetic field lines. If the current is reversed, the field reverses. A solenoid is a long coil of insulated copper wire wound in the shape of a cylinder. When current passes through it, the magnetic fields of all the turns add up, and the solenoid behaves like a bar magnet: one end acts as the north pole and the other as the south pole, and the field inside is strong and uniform. The poles can be found by looking at the ends: the end where current flows clockwise is the south pole, and the end where it flows anticlockwise is the north pole. An electromagnet is made by placing a soft iron core inside a solenoid and passing current through the coil. Soft iron is used because it becomes strongly magnetised while the current flows and loses its magnetism as soon as the current is switched off, so the magnet can be turned on and off. Electromagnets are used in cranes to lift heavy scrap iron, in electric bells, in loudspeakers, in relays, and in medical machines. They are stronger and more controllable than permanent magnets, and their strength can be changed by changing the current or the number of turns.

Long Questions with Answers - Chapter 12 (continued)

Q2. Explain the working of an electric motor and an electric generator, and describe the domestic electric circuit with its safety devices.

An electric motor converts electrical energy into mechanical energy. It has a rectangular coil of insulated copper wire (the armature) placed between the poles of a magnet. When current flows through the coil, the two sides of the coil experience forces in opposite directions (by Fleming's left-hand rule), so the coil rotates. A commutator made of two split rings reverses the direction of the current in the coil every half-turn, so the coil keeps rotating in the same direction instead of swinging back. Brushes keep contact with the rotating rings and supply the current. Motors are used in fans, mixers, washing machines and electric trains. An electric generator does the opposite: it converts mechanical energy into electrical energy using electromagnetic induction. A coil is rotated in a magnetic field (by a turbine driven by water, steam or wind), and as the coil turns, the magnetic field through it changes, inducing a current in the coil. The current changes direction every half-turn, giving alternating current (AC). In India, the AC supplied to homes has a frequency of 50 Hz and a voltage of 220 V. The domestic circuit has three wires: the live wire (red, at 220 V), the neutral wire (black, at 0 V) and the earth wire (green, connected to the ground for safety). Appliances are connected in parallel between the live and neutral wires so that each gets the full voltage. Two dangers can occur: overloading (connecting too many appliances, which draws too much current) and short-circuiting (the live and neutral wires touching directly, which causes a very large current). Both are guarded against by a fuse or an MCB in the live wire, which melts or trips and breaks the circuit when the current exceeds a safe value, and by the earth wire, which carries any leakage current safely to the ground.

Answer Key - Chapter 12 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	C	B	B	B	B	B	B	B	C

Chapter 12 complete: 10 MCQs, 5 short questions, 2 long questions. Next: Chapter 13 - Our Environment.

Chapter 13 - Our Environment

Unit: Natural Resources. Ecosystems, food chains and food webs, how energy flows, and how human activities damage the environment - ozone depletion and waste.

Our **environment** is everything around us - air, water, soil, plants, animals and other living things. An **ecosystem** is a system formed by the living things (biotic components) and the non-living things (abiotic components - air, water, sunlight, temperature, soil) in an area, interacting with each other. A pond, a forest and a field are all ecosystems. A garden or a crop field is an artificial (man-made) ecosystem, while a forest or a lake is a natural ecosystem.

Food chains, food webs and trophic levels

All living things depend on each other for food. A **food chain** is a sequence showing who eats whom: for example, grass -> grasshopper -> frog -> snake -> hawk. Each step in a food chain is a **trophic level**: producers (green plants, which make food by photosynthesis) are the first level; herbivores (plant-eaters) are the second; small carnivores are the third; large carnivores are the fourth. In nature, food chains are joined together into a **food web**, because most animals eat more than one kind of food. The number of organisms decreases at each higher trophic level, because energy is lost at every step.

Flow of energy and the 10% law

Energy enters an ecosystem as sunlight and is captured by producers through photosynthesis. It then flows from one trophic level to the next as organisms eat each other. At each step, most of the energy is lost as heat (used in life processes), and only about **10% of the energy is passed on to the next level** - this is the **10% law**. For example, if plants capture 10,000 joules of energy, herbivores get about 1,000 joules, small carnivores about 100 joules, and large carnivores about 10 joules. This is why there are always fewer top carnivores than plants in an ecosystem, and why food chains are usually short (three or four steps). Energy flows in one direction only and is not recycled, unlike nutrients such as carbon and nitrogen, which are recycled through the ecosystem.

Chapter 13 - Our Environment (continued)

Notes continued.

Ozone depletion and waste management

The **ozone layer** is a layer of ozone gas (O_3) in the upper atmosphere (stratosphere) that absorbs harmful ultraviolet (UV) rays from the sun and protects life on Earth. Chemicals called **chlorofluorocarbons (CFCs)**, used in old refrigerators, air conditioners and spray cans, release chlorine that destroys ozone, thinning the layer (the "ozone hole"). More UV rays reaching the Earth can cause skin cancer and cataracts in humans and harm plants and animals. The use of CFCs has been reduced worldwide by agreement. **Biodegradable waste** (food waste, paper, cloth) is broken down by decomposers (bacteria and fungi) and returns to the soil. **Non-biodegradable waste** (plastic, glass, metal) is not broken down and stays in the environment for a long time, polluting soil and water and harming animals. Waste should be reduced, reused and recycled: use cloth bags instead of plastic bags, separate wet and dry waste, and dispose of harmful waste (batteries, electronic waste) properly.

> **Remember:** Producers make food; consumers eat; decomposers break down dead matter and return nutrients to the soil. Only 10% of energy passes to the next trophic level, so food chains are short and top predators are few. Human actions - cutting forests, using CFCs, throwing plastic - damage the environment, and the damage comes back to us through polluted air, water and soil.

MCQs - Chapter 13

1. The biotic components of an ecosystem are:

A) air, water and soil B) plants, animals and microorganisms C) sunlight and temperature D) rocks and minerals

2. In a food chain, the first trophic level is occupied by the:

A) herbivores B) carnivores C) producers D) decomposers

3. Which of these is a food chain?

A) Grass - grasshopper - frog - snake - hawk B) Grass - frog - grasshopper - snake C) Hawk - snake - frog - grasshopper - grass D) Grasshopper - grass - frog - snake

4. According to the 10% law, the energy available to the second trophic level from 10,000 J captured by producers is:

A) 10,000 J B) 1,000 J C) 100 J D) 10 J

5. Decomposers in an ecosystem are mainly:

A) green plants B) herbivores C) bacteria and fungi D) top carnivores

MCQs - Chapter 13 (continued)

6. The ozone layer protects us from:

A) infrared rays B) ultraviolet rays C) visible light D) X-rays

7. Ozone depletion is mainly caused by:

A) carbon dioxide B) methane C) chlorofluorocarbons (CFCs) D) nitrogen

8. Which of these wastes is biodegradable?

A) Plastic bag B) Glass bottle C) Vegetable peels D) Aluminium can

9. The number of organisms is usually smallest at the:

A) producer level B) herbivore level C) top carnivore level D) decomposer level

10. Which of these is an artificial ecosystem?

A) Forest B) Pond C) Crop field D) Lake

Short Questions with Answers - Chapter 13

Q1. What is an ecosystem? Give two examples of natural and artificial ecosystems.

An ecosystem is a system formed by living organisms and their non-living surroundings interacting with each other in an area. Natural ecosystems: a forest, a pond. Artificial ecosystems: a crop field, a garden.

Q2. What is a food web? How is it different from a food chain?

A food web is a network of many food chains joined together, because most organisms eat more than one kind of food. A food chain is a single straight sequence showing who eats whom; a food web shows the real, branched feeding relationships in nature.

Q3. State the 10% law of energy flow.

The 10% law states that only about 10% of the energy available at one trophic level is transferred to the next trophic level; the rest is lost as heat or used in life processes. That is why food chains are short and top carnivores are few.

Short Questions with Answers - Chapter 13 (continued)

Q4. Why is the ozone layer important, and what damages it?

The ozone layer in the stratosphere absorbs harmful ultraviolet rays from the sun and protects living things from skin cancer, cataracts and damage to crops. It is damaged by chlorofluorocarbons (CFCs) used in old refrigerators, air conditioners and spray cans.

Q5. What is the difference between biodegradable and non-biodegradable waste? Give one example of each.

Biodegradable waste can be broken down by decomposers into simple substances - example: vegetable peels. Non-biodegradable waste cannot be broken down by natural processes and stays in the environment - example: plastic bags.

Long Questions with Answers - Chapter 13

Q1. Explain food chains, food webs and trophic levels, and describe how energy flows through an ecosystem using the 10% law.

A food chain is a sequence of organisms in which each one is eaten by the next: for example, grass (producer) is eaten by a grasshopper (herbivore), which is eaten by a frog (small carnivore), which is eaten by a snake (larger carnivore), which is eaten by a hawk (top carnivore). Each step in this sequence is called a trophic level. The first trophic level is the producers - green plants that capture sunlight by photosynthesis and make food. The second level is the herbivores that eat plants, the third is the small carnivores that eat herbivores, and the fourth is the large carnivores. In nature, these chains are not straight lines: one animal may eat several kinds of food and may itself be eaten by several predators, so the chains link together into a food web. Energy flows through this system in one direction only. It enters as sunlight and is captured by producers. When a herbivore eats a plant, it gets only a part of the plant's energy; most of the energy is used by the plant for its own life processes or lost as heat. The 10% law states that, on average, only about 10% of the energy at one trophic level is passed to the next. So if producers capture 10,000 joules, herbivores receive about 1,000 joules, small carnivores about 100 joules and top carnivores about 10 joules. This explains why there are always many more plants than herbivores and very few top carnivores, and why food chains rarely have more than four or five levels. Unlike energy, nutrients such as carbon and nitrogen are recycled: decomposers (bacteria and fungi) break down dead organisms and return the nutrients to the soil for plants to use again.

Long Questions with Answers - Chapter 13 (continued)

Q2. What is ozone depletion and how does it harm life? Describe the difference between biodegradable and non-biodegradable waste and how we should manage waste.

The ozone layer is a layer of ozone gas (O_3) in the stratosphere, about 15 to 30 km above the Earth. It absorbs most of the harmful ultraviolet (UV) rays from the sun, which would otherwise damage living things. Ozone is damaged by chlorofluorocarbons (CFCs), chemicals once widely used in refrigerators, air conditioners and spray cans. When CFCs reach the stratosphere, sunlight breaks them apart and releases chlorine atoms; one chlorine atom can destroy thousands of ozone molecules, thinning the layer and creating an "ozone hole", largest over Antarctica. With less ozone, more UV rays reach the Earth's surface, increasing skin cancer and cataracts in humans, damaging the eyes of animals, reducing crop yields, and harming the tiny organisms (plankton) at the base of ocean food chains. The world has agreed to phase out CFCs, and the layer is slowly recovering, but it is a warning that human chemicals can damage the whole planet. A second human problem is waste. Biodegradable waste (food scraps, paper, cloth, leaves) is broken down by decomposers into simple substances that return to the soil, so it does not pile up. Non-biodegradable waste (plastic bags and bottles, glass, metals, electronic waste) is not broken down by natural processes; it stays in the environment for hundreds of years, blocks drains, pollutes soil and water, and kills animals that eat it or get trapped in it. Waste should be managed by the three Rs: reduce (use less, carry cloth bags), reuse (use bottles and containers again), and recycle (separate paper, plastic, glass and metal for recycling). Wet and dry waste should be separated, compost should be made from kitchen waste, and harmful waste like batteries and old electronics should be handed to proper collection centres, not thrown in the open.

Answer Key - Chapter 13 MCQs

Q	1	2	3	4	5	6	7	8	9	10
Ans	B	C	A	B	C	B	C	C	C	C

Chapter 13 complete: 10 MCQs, 5 short questions, 2 long questions. The full book is complete.

How to Use These Notes - Revision Checklist

Use this page in the last weeks before the exam. Tick each item when you can do it without looking at the notes.

1. **Chemistry (Chapters 1-4):** I can balance any chemical equation, name the five types of reactions, and write the formulas of baking soda, washing soda, bleaching powder and Plaster of Paris. I know the reactivity series and can place a metal in it. I can draw the structures of methane, ethane, ethanol and ethanoic acid and name their functional groups.
2. **Biology (Chapters 5-8):** I can write the photosynthesis and respiration equations, trace food through the human digestive system, trace blood through the heart, and describe the nephron. I can draw a labelled neuron and the reflex arc, and list the endocrine glands and their hormones. I can describe asexual and sexual reproduction in plants and humans, and explain Mendel's 3:1 and 9:3:3:1 ratios and human sex determination.
3. **Physics (Chapters 9-12):** I can state the laws of reflection and refraction, use the mirror formula ($1/v + 1/u = 1/f$) and the lens formula ($1/v - 1/u = 1/f$), and calculate the power of a lens. I can explain myopia and hypermetropia and their corrections, dispersion, and why the sky is blue. I can state Ohm's law, find the resistance of series and parallel combinations, apply Joule's law ($H = I^2Rt$), and explain the motor, the generator and the domestic circuit.

Revision Checklist (continued)

4. **Environment (Chapter 13):** I can draw a food chain and a food web, state the 10% law with an example, and explain ozone depletion and the difference between biodegradable and non-biodegradable waste.
5. **Exam practice:** I have attempted all 130 MCQs without looking at the answer keys, written out the short answers from memory, and practised the long answers within a time limit. I have solved the official CBSE sample papers from cbseacademic.nic.in and checked the marking scheme.
6. **Honesty check:** I remember that this book is practice material, not the official paper. No question here is guaranteed to appear in the board exam. I will check the exam date sheet and paper pattern on the official CBSE site (cbseacademic.nic.in) and follow my teacher's guidance.

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