Affiliated to CBSE, New Delhi (Affiliation No. 1030642)

GNPS

GOMTI NANDAN PUBLIC SCHOOL

Gandhi Ward, Bina (M.P.) 470113. | 9165 609 333. | info@mygnps.com | www.mygnps.com

CLASS X · SCIENCE (086) · CHEMISTRY · CBSE BOARD EXAMINATION 2027

CHAPTER 1

Chemical Reactions and Equations

$2H_2 + O_2 \rightarrow 2H_2O$

Answer Booklet · CBSE marking-scheme answers with marks for every point

Every question of the chapter booklet | Marks shown point by point | MCQ keys with reasons

INSIDE THIS BOOKLET

✓	**Marking Guide** How value points and step marks are given	2
A	**NCERT Practice – Answers** 20 answers	2
B	**Exemplar Practice – Answers** 17 answers	6
C	**Board Pattern Practice – Answers** 32 answers	8
D	**Case-Based Questions – Answers** 3 case studies, every part and OR	12

HOW TO USE THE ANSWERS

1. Answer the question in your notebook **first**. Open this booklet only to check.
2. Each answer is written the way the CBSE marking scheme sets it out: **value points**, with the **mark for each point** in orange beside it.
3. Give yourself marks point by point. Use the same **key words** in your own answers.
4. Equations must be balanced; diagrams must be labelled; numericals need formula, substitution and unit.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Model answers to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN SCIENCE ANSWERS

1. **MCQ and assertion–reason (1 mark):** only the correct option scores. The reason given here is for your understanding.
2. **2 and 3 marks:** one mark (or ½) for each correct **value point**. The examiner looks for the key word – a long answer without it scores less than a short answer with it.
3. **Equations:** a correct balanced equation earns its full mark; an unbalanced one, or one with wrong formulae, usually earns ½ or nothing.
4. **Numericals:** formula, substitution and the final answer **with unit** are marked separately.
5. **Diagrams:** marks for a correct drawing and for the labels asked for. An unlabelled diagram earns little.
6. **Case study (4 marks):** 1 + 1 + 2. **Long answer (5 marks):** the split is shown beside each point.

PART A · ANSWERS

A NCERT Practice – Answers

Marking-scheme answers for every question in Part A of the chapter booklet.

Chemical equations

A1. Why should a magnesium ribbon be cleaned with sandpaper before it is burnt in air? State the colour of the flame and of the product. **[2]**

To remove the layer of magnesium oxide (and dirt) on its surface, which stops the metal from burning properly. — 1

Flame: dazzling white. Product: white powder of magnesium oxide (MgO). — 1

A2. Write balanced chemical equations, with state symbols, for the following: **(i)** Nitrogen combines with oxygen to form nitric oxide. **(ii)** Methane burns in air to give carbon dioxide and water. **(iii)** Aluminium reacts with copper(II) chloride solution to give aluminium chloride solution and copper. **(iv)** Potassium reacts with water to give potassium hydroxide solution and hydrogen gas. **[4]**

(i) $N_2(g) + O_2(g) \longrightarrow 2\,NO(g)$ — 1

(ii) $CH_4(g) + 2\,O_2(g) \longrightarrow CO_2(g) + 2\,H_2O(l)$ — 1

(iii) $2\,Al(s) + 3\,CuCl_2(aq) \longrightarrow 2\,AlCl_3(aq) + 3\,Cu(s)$ — 1

(iv) $2\,K(s) + 2\,H_2O(l) \longrightarrow 2\,KOH(aq) + H_2(g)$ — 1

Correct but unbalanced equation: ½. Missing state symbols when asked: lose ½.

A3. Balance the following equations: **(i)** $Al + O_2 \longrightarrow Al_2O_3$ **(ii)** $NH_3 + O_2 \longrightarrow NO + H_2O$ **(iii)** $Pb(NO_3)_2 \longrightarrow PbO + NO_2 + O_2$ **(iv)** $C_3H_8 + O_2 \longrightarrow CO_2 + H_2O$ **(v)** $Fe_2O_3 + CO \longrightarrow Fe + CO_2$ **(vi)** $Na + H_2O \longrightarrow NaOH + H_2$ **[3]**

(i) $4\,Al + 3\,O_2 \longrightarrow 2\,Al_2O_3$ — ½

(ii) $4\,NH_3 + 5\,O_2 \longrightarrow 4\,NO + 6\,H_2O$ — ½

(iii) $2\,Pb(NO_3)_2 \longrightarrow 2\,PbO + 4\,NO_2 + O_2$ — ½

(iv) $C_3H_8 + 5\,O_2 \longrightarrow 3\,CO_2 + 4\,H_2O$ — ½

(v) $Fe_2O_3 + 3\,CO \longrightarrow 2\,Fe + 3\,CO_2$ — ½

(vi) $2\,Na + 2\,H_2O \longrightarrow 2\,NaOH + H_2$ — ½

A4. Why should a chemical equation be balanced? Name the law involved. **[2]**

So that the number of atoms of each element is the same on both sides – atoms are neither created nor destroyed in a reaction. — 1

Law of conservation of mass: mass can neither be created nor destroyed in a chemical reaction. — 1

A5. Write in words what each equation tells you: **(i)** $CaCO_3\,(s) \xrightarrow{\text{heat}} CaO\,(s) + CO_2\,(g)$ **(ii)** $Zn\,(s) + 2\,HCl\,(aq) \longrightarrow ZnCl_2\,(aq) + H_2\,(g)$ **[2]**

(i) Solid calcium carbonate, on heating, decomposes into solid calcium oxide and carbon dioxide gas. — 1

(ii) Zinc metal reacts with dilute hydrochloric acid to give zinc chloride solution and hydrogen gas. — 1

Types of chemical reactions

A6. Quicklime reacts vigorously with water. **(i)** Name the product and state one use of its solution. **(ii)** Write the balanced equation. Is the reaction exothermic or endothermic? **(iii)** Why do whitewashed walls become shiny after two to three days? Write the equation. **[3]**

(i) Slaked lime, calcium hydroxide $Ca(OH)_2$; its solution is used for whitewashing. — 1

(ii) $CaO\,(s) + H_2O\,(l) \longrightarrow Ca(OH)_2\,(aq)$ + heat; the reaction is **exothermic**. — 1

(iii) Calcium hydroxide slowly reacts with carbon dioxide in air to form a thin shiny layer of calcium carbonate: $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$ — 1

A7. Give one example each of an exothermic and an endothermic reaction, with balanced equations. Why are most decomposition reactions endothermic? **[3]**

Exothermic: $CH_4 + 2\,O_2 \longrightarrow CO_2 + 2\,H_2O$ + heat (burning of natural gas). — 1

Endothermic: $CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$ (heat is absorbed). — 1

Energy (heat, light or electricity) is needed to break the reactant into simpler substances, so most decomposition reactions absorb energy. — 1

A8. Classify each reaction as combination or decomposition: **(i)** $CaCO_3 \longrightarrow CaO + CO_2$ **(ii)** $2\,H_2 + O_2 \longrightarrow 2\,H_2O$ **(iii)** $2\,AgBr \longrightarrow 2\,Ag + Br_2$ **(iv)** $CaO + CO_2 \longrightarrow CaCO_3$ [2]

(i) decomposition · (ii) combination — 1

(iii) decomposition · (iv) combination — 1

A9. Name the form of energy needed and write a balanced equation for each decomposition: **(i)** heating limestone **(ii)** silver bromide kept in sunlight **(iii)** passing electric current through acidified water [3]

(i) Heat: $CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$ — 1

(ii) Light: $2\,AgBr \xrightarrow{\text{sunlight}} 2\,Ag + Br_2$ — 1

(iii) Electricity: $2\,H_2O \xrightarrow{\text{electricity}} 2\,H_2 + O_2$ — 1

A10. Ferrous sulphate crystals are heated in a dry boiling tube. State two observations, write the balanced equation and name the type of reaction. [3]

The green crystals turn white and then a reddish-brown solid (Fe_2O_3) is left. — ½

A smell of burning sulphur (gases SO_2 and SO_3) is given off. — ½

$2\,FeSO_4\,(s) \xrightarrow{\text{heat}} Fe_2O_3\,(s) + SO_2\,(g) + SO_3\,(g)$ — 1

Thermal decomposition reaction. — 1

A11. In the electrolysis of water: (i) why are a few drops of dilute sulphuric acid added? (ii) name the gas collected at each electrode; (iii) in what ratio by volume are they collected? (iv) give a test for each gas. [3]

(i) Pure water is a poor conductor; the acid makes it conduct electricity. — ½

(ii) Cathode (–): hydrogen; anode (+): oxygen. — 1

(iii) Hydrogen : oxygen = 2 : 1 by volume. — ½

(iv) Hydrogen burns with a ‘pop’ sound near a burning splinter; oxygen relights a glowing splinter. — 1

A12. Classify as displacement or double displacement, and complete the equations: **(i)** $Zn + CuSO_4 \longrightarrow$ **(ii)** $Na_2SO_4 + BaCl_2 \longrightarrow$ **(iii)** $Pb + CuCl_2 \longrightarrow$ **(iv)** $AgNO_3 + NaCl \longrightarrow$ [2]

(i) $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$ – displacement — ½

(ii) $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2\,NaCl$ – double displacement — ½

(iii) $Pb + CuCl_2 \longrightarrow PbCl_2 + Cu$ – displacement — ½

(iv) $AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$ – double displacement — ½

A13. A zinc strip is kept in blue copper sulphate solution for an hour. State two changes you observe, explain why they happen and write the equation. [2]

The blue colour of the solution fades (becomes colourless); a reddish-brown coating of copper forms on the zinc strip. — 1

Zinc is more reactive than copper and displaces it: — 1
$Zn\,(s) + CuSO_4\,(aq) \longrightarrow ZnSO_4\,(aq) + Cu\,(s)$

A14. What is a precipitation reaction? Explain with two examples, naming the colour of each precipitate. [2]

A reaction in which an insoluble solid (precipitate) is formed. 1

$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4\downarrow + 2\,NaCl$ – white; $Pb(NO_3)_2 + 2\,KI \longrightarrow PbI_2\downarrow + 2\,KNO_3$ – yellow. 1

Oxidation and reduction

A15. Identify the substance oxidised and the substance reduced: **(i)** $PbO + C \longrightarrow Pb + CO$ **(ii)** $2\,Mg + CO_2 \longrightarrow 2\,MgO + C$ **(iii)** $Fe_2O_3 + 3\,CO \longrightarrow 2\,Fe + 3\,CO_2$ **(iv)** $H_2S + Cl_2 \longrightarrow 2\,HCl + S$ [2]

(i) Oxidised: C; reduced: PbO. ½

(ii) Oxidised: Mg; reduced: CO_2. ½

(iii) Oxidised: CO; reduced: Fe_2O_3. ½

(iv) Oxidised: H_2S (loses hydrogen); reduced: Cl_2 (gains hydrogen). ½

A16. Define oxidation and reduction in terms of oxygen and of hydrogen. What is a redox reaction? Give one example. [3]

Oxidation: gain of oxygen or loss of hydrogen. 1

Reduction: loss of oxygen or gain of hydrogen. 1

Redox: one substance is oxidised and another reduced in the same reaction, e.g. $CuO + H_2 \longrightarrow Cu + H_2O$. 1

A17. A brown metal turns black when heated in air. When hydrogen is passed over the hot black substance, the brown colour returns. Name the metal and the black substance, write both equations and name the type of each reaction. [3]

Metal: copper; black substance: copper(II) oxide, CuO. 1

$2\,Cu + O_2 \xrightarrow{\text{heat}} 2\,CuO$ – combination (oxidation of copper). 1

$CuO + H_2 \xrightarrow{\text{heat}} Cu + H_2O$ – redox (CuO reduced, H_2 oxidised). 1

Corrosion and rancidity

A18. Why are iron articles painted? Name two other ways to prevent rusting. [2]

Paint keeps air (oxygen) and moisture away from the iron, so it does not rust. 1

Galvanising (zinc coating), oiling/greasing, chrome plating, making alloys such as stainless steel (any two). 1

A19. What is rancidity? Give two ways to prevent it. [2]

Rancidity: oxidation of fats and oils in food kept for a long time, which spoils their smell and taste. 1

Add antioxidants; store in airtight containers; refrigerate; flush packets with nitrogen (any two). 1

A20. What is corrosion? Give two examples from daily life, naming the colour of the coating formed. **[2]**

Corrosion: a metal is slowly eaten away by moisture, air, acids etc. around it. 1

Iron – reddish-brown rust; silver – black coating; copper – green coating (any two). 1

PART B · ANSWERS

B Exemplar Practice – Answers

Marking-scheme answers for every question in Part B of the chapter booklet.

Multiple choice

Q	Answer	Working / reason
B1	**(d)** Burning of LPG	Burning forms new substances (CO_2 and water) – a chemical change.
B2	**(d)** displacement reaction	More reactive aluminium displaces iron from iron(III) oxide.
B3	**(c)** (i) and (iii)	Burning and respiration release energy; the other two absorb it.
B4	**(a)** H_2S	H_2S loses hydrogen, so it is oxidised; SO_2 loses oxygen (reduced).
B5	**(b)** oxygen	Oxygen at the anode (+), hydrogen at the cathode (–).
B6	**(a)** zinc sulphate and hydrogen	$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$
B7	**(b)** (ii) and (iv)	Ions are exchanged and insoluble $BaSO_4$ precipitates.
B8	**(b)** $H_2 + Cl_2 \longrightarrow 2\,HCl$	Chlorine gains hydrogen (reduced) while hydrogen is oxidised.
B9	**(b)** Ag_2S	Silver reacts with sulphur compounds in air to form black silver sulphide.
B10	**(c)** colourless	Zinc sulphate solution is colourless.

Short answer

B11. In the electrolysis of water, why is the volume of gas collected in one tube double that in the other? Name the gas collected in the larger amount. **[2]**

A water molecule has two hydrogen atoms for every oxygen atom, so twice as many molecules (and twice the volume) of hydrogen are formed. 1

The gas in the larger amount is hydrogen. 1

B12. A copper coin is kept in silver nitrate solution. What will you observe after some time? Write the balanced equation. **[2]**

The solution turns blue and a shiny greyish-white layer of silver forms on the coin. 1

$Cu\,(s) + 2\,AgNO_3\,(aq) \longrightarrow Cu(NO_3)_2\,(aq) + 2\,Ag\,(s)$ 1

B13. Write balanced equations: **(i)** Calcium hydroxide + carbon dioxide → calcium carbonate + water **(ii)** Zinc + silver nitrate → zinc nitrate + silver **(iii)** Barium chloride + potassium sulphate → barium sulphate + potassium chloride [3]

(i) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$ 1

(ii) $Zn + 2\,AgNO_3 \longrightarrow Zn(NO_3)_2 + 2\,Ag$ 1

(iii) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2\,KCl$ 1

B14. Classify each change as exothermic or endothermic: (i) burning of LPG (ii) electrolysis of water (iii) decomposition of lead nitrate (iv) respiration. [2]

(i) exothermic · (ii) endothermic 1

(iii) endothermic · (iv) exothermic 1

B15. Identify the reducing agent in each reaction: **(i)** $CuO + H_2 \longrightarrow Cu + H_2O$ **(ii)** $ZnO + C \longrightarrow Zn + CO$ **(iii)** $PbO + CO \longrightarrow Pb + CO_2$ **(iv)** $MnO_2 + 4\,HCl \longrightarrow MnCl_2 + 2\,H_2O + Cl_2$ [2]

(i) H_2 · (ii) C 1

(iii) CO · (iv) HCl 1

The reducing agent is the substance that is itself oxidised.

B16. Metal P displaces Q from QSO_4 solution; metal R displaces P from PSO_4 solution; Q does not react with RSO_4 solution. Arrange P, Q and R in decreasing order of reactivity. [2]

A metal displaces only a less reactive metal: P > Q and R > P; Q cannot displace R, which agrees. 1

Order: **R > P > Q**. 1

B17. Write balanced equations for heating (i) dry ferrous sulphate crystals (ii) lead nitrate (iii) calcium carbonate. Name the type of reaction and give one observation for each. [3]

(i) $2\,FeSO_4 \longrightarrow Fe_2O_3 + SO_2 + SO_3$; green → reddish-brown residue, smell of burning sulphur. 1

(ii) $2\,Pb(NO_3)_2 \longrightarrow 2\,PbO + 4\,NO_2 + O_2$; brown fumes, yellow residue. 1

(iii) $CaCO_3 \longrightarrow CaO + CO_2$; white residue, gas turns lime water milky. All three are thermal decomposition reactions. 1

Each part: equation ½ + observation ½.

C

PART C · ANSWERS

Board Pattern Practice – Answers

Marking-scheme answers for every question in Part C of the chapter booklet.

Decomposition reactions

Q	Answer	Working / reason
C1	**(a)** a yellow residue and brown fumes	Yellow lead(II) oxide is left and brown NO_2 is given off.
C2	**(b)** 1 : 2	Hydrogen : oxygen = 2 : 1, so oxygen : hydrogen = 1 : 2.
C3	**(a)** grey	$2\,AgCl \longrightarrow 2\,Ag + Cl_2$; silver is grey.
C4	**(b)**	Both statements are true, but R (about most decompositions needing energy) does not explain why composting releases heat.

C5. Ferrous sulphate crystals change colour when heated, even before they decompose. Why? Write the equation for their decomposition. [2]

The crystals ($FeSO_4 \cdot 7\,H_2O$) lose their water of crystallisation, so the green colour changes (to white). 1

$2\,FeSO_4 \xrightarrow{\text{heat}} Fe_2O_3 + SO_2 + SO_3$ 1

C6. Give one example each of thermal, electrolytic and photolytic decomposition, with balanced equations. Which of these is used in black-and-white photography? [3]

Thermal: $CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$ 1

Electrolytic: $2\,H_2O \xrightarrow{\text{electricity}} 2\,H_2 + O_2$ 1

Photolytic: $2\,AgBr \xrightarrow{\text{light}} 2\,Ag + Br_2$ – the decomposition of silver bromide by light is used in black-and-white photography. 1

Balancing and writing equations

Q	Answer	Working / reason
C7	**(b)** 3, 4, 4	$3\,Fe + 4\,H_2O \longrightarrow Fe_3O_4 + 4\,H_2$: Fe 3 = 3, O 4 = 4, H 8 = 8.
C8	**(a)** 2, 2, 4	$2\,Pb(NO_3)_2 \longrightarrow 2\,PbO + 4\,NO_2 + O_2$: N 4 = 4, O 12 = 2 + 8 + 2.

C9. Write balanced equations with state symbols: **(i)** Sodium reacts with water. **(ii)** Lead nitrate solution reacts with sodium chloride solution to give a white precipitate of lead chloride. **(iii)** Zinc carbonate is heated strongly. [3]

(i) $2\,Na\,(s) + 2\,H_2O\,(l) \longrightarrow 2\,NaOH\,(aq) + H_2\,(g)$ 1

(ii) $Pb(NO_3)_2\,(aq) + 2\,NaCl\,(aq) \longrightarrow PbCl_2\,(s) + 2\,NaNO_3\,(aq)$ 1

(iii) $ZnCO_3\,(s) \xrightarrow{\text{heat}} ZnO\,(s) + CO_2\,(g)$ 1

C10. Write the balanced equation for the reaction of zinc with silver nitrate solution and name the type of reaction. [2]

$Zn(s) + 2\,AgNO_3(aq) \longrightarrow Zn(NO_3)_2(aq) + 2\,Ag(s)$ — 1

Displacement reaction (zinc is more reactive than silver). — 1

Displacement, double displacement and precipitation

Q	Answer	Working / reason
C11	**(c)** Iron in copper sulphate solution	Only iron is more reactive than the metal in the solution (copper).
C12	**(b)** $BaSO_4$	Barium sulphate is insoluble and white.
C13	**(c)** double displacement and precipitation reactions	Ions are exchanged and an insoluble solid forms in each.

C14. Explain what a double displacement reaction is, using the equation for barium chloride and sodium sulphate. Which product is the precipitate, and what is its colour? [2]

Two compounds exchange their ions to form two new compounds: $Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s) + 2\,NaCl(aq)$ — 1

Precipitate: barium sulphate, white. — 1

C15. How is a displacement reaction different from a double displacement reaction? Give one balanced example of each. [2]

Displacement: a more reactive element displaces a less reactive one from its compound. Double displacement: two compounds exchange ions. — 1

$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$ (displacement); $AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$ (double displacement). — 1

Combination reactions

Q	Answer	Working / reason
C16	**(b)** $CaO + H_2O \longrightarrow Ca(OH)_2$	Two reactants form a single product.
C17	**(d)** It is an endothermic reaction.	Burning of magnesium gives out heat and light – it is exothermic.

C18. Copper powder heated in a china dish turns black. Name the black substance, write the equation and give two names for this type of reaction. [2]

Copper(II) oxide, CuO. — ½

$2\,Cu + O_2 \xrightarrow{\text{heat}} 2\,CuO$ — 1

Combination reaction; oxidation reaction. — ½

Exothermic and endothermic reactions

Q	Answer	Working / reason

C19	**(b)** exothermic and an oxidation	$CH_4 + 2\,O_2 \longrightarrow CO_2 + 2\,H_2O$ + heat: methane is oxidised and heat is given out.
C20	**(a)**	Both true; the release of energy when glucose is oxidised is why respiration is exothermic.

C21. Why is the decomposition of vegetable matter into compost an exothermic reaction, while the decomposition of calcium carbonate is endothermic? **[2]**

In composting, microbes break down organic matter and energy is released as heat – so it is exothermic. 1

Calcium carbonate decomposes only when heat is supplied to break it down – energy is absorbed, so it is endothermic. 1

Oxidation and reduction

Q	Answer	Working / reason
C22	**(c)** CuO is the oxidising agent	CuO gives oxygen to hydrogen, so it is the oxidising agent (and is itself reduced).
C23	**(b)** HCl	HCl loses hydrogen (to form Cl_2), so it is oxidised.

C24. In $Fe_2O_3 + 2\,Al \longrightarrow Al_2O_3 + 2\,Fe$, identify the substance oxidised, the substance reduced, the oxidising agent and the reducing agent. **[2]**

Oxidised: Al · reduced: Fe_2O_3 1

Oxidising agent: Fe_2O_3 · reducing agent: Al 1

C25. Define oxidation and reduction in terms of oxygen. For $2\,PbO + C \longrightarrow 2\,Pb + CO_2$, name the substance oxidised and the one reduced, and give one example of oxidation from daily life. **[3]**

Oxidation: gain of oxygen; reduction: loss of oxygen. 1

C is oxidised (to CO_2); PbO is reduced (to Pb). 1

Daily life: rusting of iron / rancidity of oily food / burning of fuels (any one). 1

Electrolysis of water

Q	Answer	Working / reason
C26	**(b)** hydrogen	Hydrogen at the cathode (–).

C27. Why is the volume of gas at one electrode double that at the other during electrolysis of water? Name both gases and give a test for each. **[3]**

Water contains hydrogen and oxygen atoms in the ratio 2 : 1, so the volume of hydrogen formed is twice that of oxygen. 1

Hydrogen at the cathode (double volume); oxygen at the anode. 1

Hydrogen burns with a pop sound; oxygen relights a glowing splinter. 1

Signs of a chemical reaction

C28. List four observations that tell us a chemical reaction has taken place. [2]

Change in state; change in colour. 1

Evolution of a gas; change in temperature; formation of a precipitate (any two). 1

C29. Give one balanced example of a reaction that shows (i) a change in colour (ii) evolution of a gas (iii) a change in temperature. [3]

(i) $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$ – blue solution turns pale green. 1

(ii) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$ – bubbles of hydrogen. 1

(iii) $CaO + H_2O \longrightarrow Ca(OH)_2$ – the mixture becomes hot. 1

Corrosion and rancidity

Q	Answer	Working / reason
C30	**(c)** nitrogen	Nitrogen is unreactive, so the oil in the chips is not oxidised.

C31. Describe an activity with three test tubes to show that both air and water are needed for iron to rust. State what you observe in each tube. [3]

Tube A: iron nails in tap water, open to air → nails rust (air and water present). 1

Tube B: nails in boiled distilled water with a layer of oil on top (no air) → no rust. 1

Tube C: nails in dry air with anhydrous calcium chloride (no moisture) → no rust. So both air and water are needed. 1

Long answer

C32. (a) What is a balanced chemical equation, and why must equations be balanced? (b) Write balanced equations with state symbols: (i) aluminium reacts with iron(III) oxide on heating to give aluminium oxide and molten iron; (ii) calcium hydroxide solution reacts with carbon dioxide to give insoluble calcium carbonate and water. (c) Name the type of each reaction in (b). [5]

(a) An equation in which the number of atoms of each element is equal on both sides. 1

It must be balanced to obey the law of conservation of mass. 1

(b)(i) $Fe_2O_3\,(s) + 2\,Al\,(s) \longrightarrow Al_2O_3\,(s) + 2\,Fe\,(l)$ 1

(b)(ii) $Ca(OH)_2\,(aq) + CO_2\,(g) \longrightarrow CaCO_3\,(s) + H_2O\,(l)$ 1

(c)(i) Displacement (also redox and exothermic); (ii) precipitation – insoluble $CaCO_3$ forms (a base reacting with an acidic oxide). 1

PART D · ANSWERS

D Case-Based Questions – Answers

Marking-scheme answers for every question in Part D of the chapter booklet.

D1. Case Study · The Green Crystals [4]

(i) Identify X and Y. **[1]**

X: ferrous sulphate crystals, $FeSO_4 \cdot 7\,H_2O$; Y: ferric oxide, Fe_2O_3. 1

(ii) Why did the crystals turn white first? **[1]**

They lost their water of crystallisation. 1

(iii) Write the balanced equation for the decomposition of X and name the type of reaction. **[2]**

$2\,FeSO_4 \xrightarrow{\text{heat}} Fe_2O_3 + SO_2 + SO_3$ 1

Thermal decomposition. 1

OR

(iii) Give one example each, with equations, of a decomposition reaction that uses light and one that uses electricity. **[2]**

Light: $2\,AgCl \xrightarrow{\text{sunlight}} 2\,Ag + Cl_2$ (or AgBr). 1

Electricity: $2\,H_2O \xrightarrow{\text{electricity}} 2\,H_2 + O_2$ 1

D2. Case Study · Metal Strips in the Lab [4]

(i) In which test tubes will a reaction take place? **[1]**

A, C and D. 1

(ii) What colour change will she see in test tube A? **[1]**

The blue solution turns pale green (and the nail gets a brown coat of copper). 1

(iii) Arrange zinc, iron, copper and silver in decreasing order of reactivity, and write the balanced equation for test tube D. **[2]**

Zn > Fe > Cu > Ag. 1

$Cu + 2\,AgNO_3 \longrightarrow Cu(NO_3)_2 + 2\,Ag$ 1

OR

(iii) Why is there no change in test tube B? Name the type of reaction in A and C. **[2]**

Copper is less reactive than iron, so it cannot displace iron from iron sulphate. 1

Displacement reactions. 1

D3. Case Study · Kitchen Chemistry [4]

(i) Name the process that forms the reddish-brown layer and give its chemical name. **[1]**

Rusting (corrosion); hydrated iron(III) oxide, $Fe_2O_3 \cdot x\,H_2O$. 1

(ii) What is the black coating on the silver anklet? **[1]**

Silver sulphide, Ag_2S. 1

(iii) What is rancidity? Give two ways to prevent it. **[2]**

Oxidation of fats and oils in food, which changes its smell and taste. 1

Airtight containers / antioxidants / refrigeration / nitrogen-filled packets (any two). 1

OR

(iii) State the two conditions needed for rusting and two ways to prevent it. **[2]**

Both air (oxygen) and water (moisture) must be present. 1

Painting, oiling/greasing, galvanising, alloying (any two). 1