

Chemical Reactions and Equations

CBSE Class 10 Science · Chapter 1

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FREE SAMPLE CHAPTER

Section A — Multiple Choice Questions

Q1. Which of the following correctly represents the balanced chemical equation for the burning of magnesium in air? [1 mark]

- A) $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
- B) $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
- C) $\text{Mg} + 2\text{O}_2 \rightarrow \text{MgO}_2$
- D) $2\text{Mg} + \text{O} \rightarrow 2\text{MgO}$

Difficulty: easy

Q2. In the reaction $\text{CuO(s)} + \text{H}_2\text{(g)} \rightarrow \text{Cu(s)} + \text{H}_2\text{O(l)}$, which substance is oxidised? [1 mark]

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

Difficulty: medium

Q3. The decomposition of ferrous sulphate on heating produces which set of products? [1 mark]

- A) FeO, SO_2 , SO_3
- B) Fe_2O_3 , SO_2 , SO_3
- C) Fe_3O_4 , SO_2 , H_2O
- D) Fe_2O_3 , SO_3 , H_2S

Difficulty: medium

Q4. In the electrolysis of water (Activity 1.8), the volume of hydrogen gas collected is _____ the volume of oxygen gas collected. [1 mark]

- A) Equal to
- B) Half of
- C) Double of
- D) Four times

Difficulty: easy

Q5. Which of the following reactions is an example of a combination reaction that is also exothermic? [1 mark]

- A) $\text{CaCO}_3\text{(s)} \rightarrow \text{CaO(s)} + \text{CO}_2\text{(g)}$
- B) $2\text{AgCl(s)} \rightarrow 2\text{Ag(s)} + \text{Cl}_2\text{(g)}$
- C) $\text{CaO(s)} + \text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(aq)} + \text{Heat}$
- D) $2\text{Pb(NO}_3)_2\text{(s)} \rightarrow 2\text{PbO(s)} + 4\text{NO}_2\text{(g)} + \text{O}_2\text{(g)}$

Difficulty: easy

Q6. In the reaction $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$, which element displaces which from its oxide? [1 mark]

- A) Iron displaces aluminium from aluminium oxide
- B) Aluminium displaces iron from iron oxide
- C) Both elements displace each other simultaneously
- D) No displacement occurs; it is a combination reaction

Difficulty: medium

Q7. What is the role of nitrogen gas flushed into bags of chips by manufacturers? [1 mark]

- A) To keep the chips dry by absorbing moisture
- B) To prevent the chips from getting oxidised and becoming rancid
- C) To maintain the crispness by providing pressure
- D) To kill bacteria and prevent decomposition

Difficulty: easy

Q8. When lead nitrate is heated, brown fumes are observed. What is the chemical identity of these fumes?

[1 mark]

- A) Nitrogen monoxide (NO)
- B) Nitrogen dioxide (NO₂)
- C) Dinitrogen tetroxide (N₂O₄)
- D) Oxygen (O₂)

Difficulty: medium

Section B — Fill in the Blanks

Q9. The process by which fats and oils in food get oxidised on prolonged exposure, leading to a change in smell and taste, is called _____. [1 mark]

Difficulty: easy

Q10. In a balanced chemical equation $3\text{Fe(s)} + 4\text{H}_2\text{O(g)} \rightarrow \text{Fe}_3\text{O}_4\text{(s)} + 4\text{H}_2\text{(g)}$, the symbol (g) with H₂O indicates that water is used in the form of _____. [1 mark]

Difficulty: medium

Q11. A reaction in which two reactants exchange ions to form two new products, one of which is often an insoluble precipitate, is called a _____ reaction. [1 mark]

Difficulty: easy

Q12. The method used to balance chemical equations by using the smallest whole number coefficients through trial is called the _____ method. [1 mark]

Difficulty: easy

Section C — True or False

Q13. Respiration in living organisms is an endothermic reaction because energy is consumed during the process. [1 mark]

Difficulty: easy

Q14. In the reaction $2\text{AgCl(s)} \rightarrow 2\text{Ag(s)} + \text{Cl}_2\text{(g)}$, decomposition is caused by heat energy. [1 mark]

Difficulty: medium

Q15. When iron nails are dipped in copper sulphate solution, the blue colour of the solution fades because iron displaces copper from copper sulphate. [1 mark]

Difficulty: medium

Q16. The green coating formed on copper articles exposed to moist air is an example of corrosion. [1 mark]

Difficulty: easy

Section E — Assertion and Reasoning

Q17. Assertion (A): A magnesium ribbon is cleaned with sandpaper before burning in air. Reason (R): The layer of magnesium oxide on the surface of the ribbon prevents it from catching fire easily. [1 mark]

- A) Both A and R are true, and R is the correct explanation of A.
- B) Both A and R are true, but R is NOT the correct explanation of A.
- C) A is true but R is false.

D) A is false but R is true.

Difficulty: medium

Q18. Assertion (A): The decomposition of calcium carbonate is used in the manufacture of cement. Reason (R): When calcium carbonate is heated, it decomposes to form calcium oxide (quick lime) and carbon dioxide. [1 mark]

A) Both A and R are true, and R is the correct explanation of A.

B) Both A and R are true, but R is NOT the correct explanation of A.

C) A is true but R is false.

D) A is false but R is true.

Difficulty: medium

Q19. Assertion (A): In the reaction $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$, carbon is reduced and ZnO is oxidised. Reason (R): Reduction is the loss of oxygen and oxidation is the gain of oxygen. [1 mark]

A) Both A and R are true, and R is the correct explanation of A.

B) Both A and R are true, but R is NOT the correct explanation of A.

C) A is true but R is false.

D) A is false but R is true.

Difficulty: hard

Q20. Assertion (A): Food stored in airtight containers stays fresh longer than food exposed to air. Reason (R): Airtight containers slow down the oxidation of fats and oils present in food, thereby preventing rancidity. [1 mark]

A) Both A and R are true, and R is the correct explanation of A.

B) Both A and R are true, but R is NOT the correct explanation of A.

C) A is true but R is false.

D) A is false but R is true.

Difficulty: easy

Section F — Very Short Answer (2 marks)

Q21. Define a combination reaction and give one example with a balanced chemical equation. [2 marks]

Difficulty: easy

Q22. What is a precipitation reaction? Identify the precipitate formed when sodium sulphate solution is mixed with barium chloride solution. [2 marks]

Difficulty: easy

Q23. State the law of conservation of mass and explain why a chemical equation must be balanced. [2 marks]

Difficulty: easy

Q24. What is rancidity? Name one method used by chips manufacturers to prevent rancidity in packaged chips. [2 marks]

Difficulty: easy

Q25. In the reaction $\text{CuO(s)} + \text{H}_2\text{(g)} \rightarrow \text{Cu(s)} + \text{H}_2\text{O(l)}$, identify which substance is oxidised and which is reduced. Give reasons. [2 marks]

Difficulty: medium

Q26. What notations are used to represent the gaseous, liquid, aqueous, and solid states of reactants and products in a chemical equation? [2 marks]

Difficulty: easy

Section G — Short Answer (3 marks)

Q27. Distinguish between exothermic and endothermic reactions with one example of each. Is the decomposition of ferrous sulphate on heating exothermic or endothermic? [3 marks]

Difficulty: medium

Q28. Write the balanced chemical equation for the electrolysis of water. Why is the volume of gas collected at one electrode double the volume collected at the other? Name both gases. [3 marks]

Difficulty: medium

Q29. What is a displacement reaction? With the help of Activity 1.9, explain why the blue colour of copper sulphate solution fades when iron nails are dipped in it. Write the balanced chemical equation for the reaction. [3 marks]

Difficulty: medium

Q30. Balance the following chemical equation and identify the type of reaction: $\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow \text{PbO}(\text{s}) + \text{NO}_2(\text{g}) + \text{O}_2(\text{g})$. Also state what form of energy causes this reaction. [3 marks]

Difficulty: hard

Q31. What is corrosion? Give two examples of corrosion other than rusting of iron. How does corrosion differ from rancidity? [3 marks]

Difficulty: medium

Section H — Long Answer (5 marks)

Q32. Describe with a labelled activity the step-by-step method of balancing the chemical equation for the reaction of iron with steam: $\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{H}_2$. Write the final balanced equation with physical state symbols. What is this method of balancing called? [5 marks]

Difficulty: medium

Q33. (a) Define decomposition reaction. Explain three types of decomposition reactions with one balanced chemical equation each. (b) How are decomposition reactions opposite to combination reactions? Give one example of a combination reaction to support your answer. [5 marks]

Difficulty: hard

Q34. (a) What is a redox reaction? With the help of equations $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$ and $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$, explain the terms oxidation and reduction. (b) Identify the oxidising and reducing agents in the reaction: $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$. (c) Is the burning of magnesium ribbon in air an oxidation or reduction reaction? Justify your answer. [5 marks]

Difficulty: hard

Section I — Case-Based Questions

Q35. Read the following passage and answer the questions that follow:

Rohit's mother prepared food and kept some leftover food in an open container on the kitchen counter. After two days, she noticed that the food smelled bad and the fat in the food had become rancid. Meanwhile, Rohit observed that the iron tawa left in the kitchen without drying had developed a reddish-brown coating

on its surface. His science teacher later explained that both these changes - rancidity and rusting - involve oxidation reactions and are examples of the harmful effects of oxidation in everyday life.

- (i) What is rancidity? State one method, other than using antioxidants, to slow down rancidity in food. [1 mark]
- (ii) What is corrosion? Write the chemical name of the reddish-brown coating formed on iron. State one way to prevent corrosion of iron. [2 marks]
- (iii) Both rancidity and corrosion involve oxidation. Explain the term 'oxidation' as defined in this chapter. Give the balanced chemical equation for the oxidation of copper when heated in air. [1 mark] [4 marks]

Difficulty: medium

Answer Key with Explanations

Q1. B) $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

The skeletal equation $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$ is unbalanced. Balancing by hit-and-trial: 2 Mg atoms on LHS require 2 MgO on RHS, and 1 O_2 supplies 2 oxygen atoms. Hence $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ is balanced.

Source: Section 1.1.2, balancing of Eq. 1.2 (burning of magnesium)

Q2. C) H_2

Oxidation is the gain of oxygen or loss of hydrogen. In this reaction, H_2 gains oxygen to form H_2O , so H_2 is oxidised. CuO loses oxygen and is reduced.

Source: Section 1.2.5, Eq. 1.29 and definition of oxidation/reduction

Q3. B) Fe_2O_3 , SO_2 , SO_3

As given in Eq. 1.19: $2\text{FeSO}_4(\text{s}) \rightarrow \text{Fe}_2\text{O}_3(\text{s}) + \text{SO}_2(\text{g}) + \text{SO}_3(\text{g})$. Ferrous sulphate decomposes on heating to give ferric oxide, sulphur dioxide and sulphur trioxide.

Source: Section 1.2.2, Activity 1.5, Eq. 1.19

Q4. C) Double of

Water decomposes as $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$. For every 1 volume of O_2 produced, 2 volumes of H_2 are produced. Hence hydrogen gas is collected in double the amount of oxygen gas.

Source: Section 1.2.2, Activity 1.8 and Questions section after Activity 1.8

Q5. C) $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{Heat}$

CaO and H_2O combine to form a single product $\text{Ca}(\text{OH})_2$, making it a combination reaction. It also releases heat, so it is exothermic. The other options are decomposition reactions.

Source: Section 1.2.1, Activity 1.4, Eq. 1.13

Q6. B) Aluminium displaces iron from iron oxide

This is a displacement reaction where the more reactive metal aluminium displaces iron from Fe_2O_3 (iron oxide), forming Al_2O_3 and free iron. This is consistent with the Exercise 2 in the textbook.

Source: Exercise 2, Section 1.2.3 displacement reaction concept

Q7. B) To prevent the chips from getting oxidised and becoming rancid

Chips manufacturers flush bags with nitrogen (an inert gas) to prevent oxidation of fats and oils present in chips, which would otherwise cause rancidity. This is directly stated in Section 1.3.2.

Source: Section 1.3.2, Rancidity

Q8. B) Nitrogen dioxide (NO_2)

As per Eq. 1.21: $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$. The brown fumes emitted when lead nitrate is heated are nitrogen dioxide (NO_2), as stated in Activity 1.6.

Source: Section 1.2.2, Activity 1.6, Eq. 1.21

Q9. Rancidity

Section 1.3.2 states that when fats and oils are oxidised, they become rancid and their smell and taste change. This process is called rancidity.

Source: Section 1.3.2, Rancidity

Q10. Steam

The textbook explicitly states: 'Note that the symbol (g) is used with H_2O to indicate that in this reaction water is used in the form of steam.' (Section 1.1.2, Step VII)

Source: Section 1.1.2, Step VII - Writing Symbols of Physical States, Eq. 1.10

Q11. Double displacement

Section 1.2.4 defines double displacement reactions as those in which there is an exchange of ions between the reactants. Example: $\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$.

Source: Section 1.2.4, Double Displacement Reaction

Q12. Hit-and-trial method

The textbook states in Section 1.1.2 (Step VI): 'This method of balancing chemical equations is called hit-and-trial method as we make trials to balance the equation by using the smallest whole number coefficient.'

Source: Section 1.1.2, Step VI - hit-and-trial method

Q13. False

According to Section 1.2.1, respiration is an exothermic reaction. The glucose in our body combines with oxygen to release energy: $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq}) + 6\text{O}_2(\text{aq}) \rightarrow 6\text{CO}_2(\text{aq}) + 6\text{H}_2\text{O}(\text{l}) + \text{energy}$ (Eq. 1.18). Energy is released, not absorbed.

Source: Section 1.2.1, Eq. 1.18 - respiration as an exothermic reaction

Q14. False

Section 1.2.2 and Activity 1.7 clearly state that silver chloride decomposes in sunlight (light energy), not heat. The equation is $2\text{AgCl}(\text{s}) \xrightarrow{\text{Sunlight}} 2\text{Ag}(\text{s}) + \text{Cl}_2(\text{g})$. This is a photochemical decomposition, not thermal decomposition.

Source: Section 1.2.2, Activity 1.7, Eq. 1.22

Q15. True

As per Eq. 1.24: $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$. Iron displaces copper from copper sulphate solution. The blue colour of CuSO_4 fades as it is replaced by the light green FeSO_4 solution, and copper deposits on the iron nail.

Source: Section 1.2.3, Activity 1.9, Eq. 1.24

Q16. True

Section 1.3.1 states: 'The black coating on silver and the green coating on copper are other examples of corrosion.' When a metal is attacked by substances like moisture around it, it is said to corrode and this process is called corrosion.

Source: Section 1.3.1, Corrosion

Q17. A) Both A and R are true, and R is the correct explanation of A.

Magnesium ribbon has a layer of magnesium oxide (formed due to prior oxidation) on its surface. This coating prevents magnesium from catching fire easily. Cleaning with sandpaper removes this layer, allowing the ribbon to burn readily. This is the reason given in the textbook (Exercise Q1 and Activity 1.1).

Source: Activity 1.1 and Exercise Question 1 - cleaning magnesium ribbon

Q18. A) Both A and R are true, and R is the correct explanation of A.

The textbook states (Section 1.2.2, Eq. 1.20): 'Decomposition of calcium carbonate to calcium oxide and carbon dioxide on heating is an important decomposition reaction used in various industries. Calcium oxide is called lime or quick lime. It has many uses - one is in the manufacture of cement.' R correctly explains A.

Source: Section 1.2.2, Eq. 1.20 - thermal decomposition of CaCO_3

Q19. D) A is false but R is true.

R is correct: reduction is loss of oxygen and oxidation is gain of oxygen (Section 1.2.5). However, A is incorrect. In $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$: ZnO loses oxygen $\rightarrow$ ZnO is REDUCED; C gains oxygen $\rightarrow$ C is OXIDISED. So the assertion has it reversed - carbon is oxidised and ZnO is reduced, as stated in Eq. 1.31 of the textbook.

Source: Section 1.2.5, Eq. 1.31 - redox reaction, $\text{ZnO} + \text{C}$

Q20. A) Both A and R are true, and R is the correct explanation of A.

Section 1.3.2 states: 'Keeping food in airtight containers helps to slow down oxidation.' Oxidation of fats and oils leads to rancidity - a change in smell and taste. Airtight containers reduce exposure to oxygen, thus preventing oxidation and rancidity. R correctly explains A.

Source: Section 1.3.2, Rancidity - airtight containers and oxidation

Q21. A reaction in which two or more reactants combine to form a single product is called a combination reaction. Example: $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{Heat}$

Marking Scheme (2 marks): 1 mark for correct definition (single product formed from two or more reactants). 1 mark for correct balanced equation with correct formulae. Acceptable alternatives include: $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ or $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$.

Source: Section 1.2.1 - Combination Reaction, Activity 1.4 and equations 1.13, 1.15, 1.16

Q22. A reaction that produces an insoluble substance (precipitate) is called a precipitation reaction. When sodium sulphate reacts with barium chloride, barium sulphate (BaSO_4) is formed as a white precipitate.

Marking Scheme (2 marks): 1 mark for correct definition of precipitation reaction. 1 mark for correctly identifying BaSO_4 as the white precipitate. Reference equation: $\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$.

Source: Section 1.2.4 - Double Displacement Reaction, Activity 1.10, equation 1.27

Q23. The law of conservation of mass states that mass can neither be created nor destroyed in a chemical reaction. A chemical equation must be balanced so that the number of atoms of each element is the same on both sides of the equation, ensuring total mass of reactants equals total mass of products.

Marking Scheme (2 marks): 1 mark for correct statement of the law of conservation of mass. 1 mark for explaining that balancing ensures equal number of atoms of each element on both sides (atoms are neither created nor destroyed).

Source: Section 1.1.2 - Balanced Chemical Equations

Q24. Rancidity is the process by which fats and oils in food get oxidised, causing a change in their smell and taste. Chips manufacturers flush bags with nitrogen gas to prevent oxidation and thus prevent rancidity.

Marking Scheme (2 marks): 1 mark for correct explanation of rancidity (oxidation of fats/oils leading to change in smell and taste). 1 mark for naming nitrogen gas as the method used to prevent rancidity.

Source: Section 1.3.2 - Rancidity

Q25. H_2 is oxidised because it gains oxygen (to form H_2O). CuO is reduced because it loses oxygen (to form Cu).

Marking Scheme (2 marks): 1 mark for correctly identifying H_2 as oxidised with reason (gains oxygen). 1 mark for correctly identifying CuO as reduced with reason (loses oxygen). Both reasons are required for full marks.

Source: Section 1.2.5 - Oxidation and Reduction, equation 1.29

Q26. Gaseous state: (g), Liquid state: (l), Aqueous state (dissolved in water): (aq), Solid state: (s).

Marking Scheme (2 marks): $\frac{1}{2}$ mark for each correct notation with its corresponding physical state (all four must be stated for full 2 marks). Example from text: $3\text{Fe}(\text{s}) + 4\text{H}_2\text{O}(\text{g}) \rightarrow \text{Fe}_3\text{O}_4(\text{s}) + 4\text{H}_2(\text{g})$.

Source: Section 1.1.2 - Step VII: Writing Symbols of Physical States, equation 1.10

Q27. Exothermic reactions: Reactions in which heat is released along with the formation of products.

Example: $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{Heat}$. Endothermic reactions: Reactions in which energy is absorbed. Example: $2\text{FeSO}_4(\text{s}) \rightarrow \text{Fe}_2\text{O}_3(\text{s}) + \text{SO}_2(\text{g}) + \text{SO}_3(\text{g})$. The decomposition of ferrous sulphate on heating is an endothermic reaction because heat energy is absorbed to break down the reactant.

Marking Scheme (3 marks): 1 mark for correct definition and example of exothermic reaction. 1 mark for correct definition and example of endothermic reaction. 1 mark for correctly identifying the decomposition of ferrous sulphate as endothermic with justification. Note: Students may use other valid examples from the textbook.

Source: Section 1.2.1 (exothermic) and Section 1.2.2 (endothermic), Activity 1.5, equation 1.19

Q28. Balanced equation: $2\text{H}_2\text{O}(\text{l}) \rightarrow (\text{Electric current}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$. The volume of hydrogen gas collected is double the volume of oxygen gas because water contains hydrogen and oxygen in a 2:1 ratio by volume (and by moles). The two gases are hydrogen (H_2) at the cathode and oxygen (O_2) at the anode.

Marking Scheme (3 marks): 1 mark for correct balanced chemical equation. 1 mark for correct reasoning (2:1 ratio of H to O in water, so twice as many moles/volume of H_2 produced). 1 mark for naming both gases correctly (hydrogen and oxygen).

Source: Section 1.2.2 - Decomposition Reaction, Activity 1.7/1.8 and the question following Activity 1.7 in the textbook

Q29. A displacement reaction is one in which a more reactive element displaces a less reactive element from its compound. When iron nails are dipped in copper sulphate solution, iron (being more reactive than copper) displaces copper from copper sulphate. The blue colour of CuSO_4 fades as Cu^{2+} ions are removed from the solution and replaced by Fe^{2+} ions (forming FeSO_4). The iron nails become coated with a brownish layer of copper. Balanced equation: $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$

Marking Scheme (3 marks): 1 mark for correct definition of displacement reaction. 1 mark for correct explanation of

why colour fades (iron displaces copper; Fe^{2+} replaces Cu^{2+} in solution). 1 mark for correct balanced chemical equation.

Source: Section 1.2.3 - Displacement Reaction, Activity 1.9, equation 1.24

Q30. Balanced equation: $2\text{Pb}(\text{NO}_3)_2(\text{s}) \xrightarrow{\text{Heat}} 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$. Type of reaction: Thermal decomposition reaction (a type of decomposition reaction). The form of energy that causes this reaction is heat.

Marking Scheme (3 marks): 1 mark for correctly balanced equation (coefficients 2, 2, 4, 1). 1 mark for correctly identifying it as a thermal decomposition reaction. 1 mark for stating that heat is the form of energy responsible. Check: LHS: 2 Pb, 4 N, 12 O; RHS: 2 Pb (in 2PbO) + 2 O (in 2PbO) + 4 N + 8 O (in 4NO₂) + 2 O (in O₂) = 2 Pb, 4 N, 12 O. (correct)

Source: Section 1.2.2 - Decomposition Reaction, Activity 1.6, equation 1.21

Q31. Corrosion is the process by which a metal is attacked by substances around it such as moisture and acids, resulting in the formation of undesirable compounds on its surface. Two examples other than rusting: (1) Black coating formed on silver. (2) Green coating formed on copper. Difference: Corrosion involves the oxidation of metals (e.g., iron, silver, copper) by substances in the environment, whereas rancidity involves the oxidation of fats and oils in food, causing changes in their smell and taste.

Marking Scheme (3 marks): 1 mark for correct definition of corrosion. 1 mark for any two valid examples of corrosion other than rusting (½ mark each). 1 mark for a clear distinction between corrosion and rancidity (corrosion = metals; rancidity = fats/oils).

Source: Section 1.3.1 - Corrosion and Section 1.3.2 - Rancidity

Q32. Step I: Draw boxes around each formula (do not change anything inside): $[\text{Fe}] + [\text{H}_2\text{O}] \rightarrow [\text{Fe}_3\text{O}_4] + [\text{H}_2]$. Step II: Count atoms on each side. Fe: LHS=1, RHS=3; H: LHS=2, RHS=2; O: LHS=1, RHS=4. Step III: Start with the compound having the maximum atoms - Fe_3O_4 (oxygen has maximum: 4 on RHS, 1 on LHS). Balance oxygen by putting coefficient 4 before H_2O : $\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{H}_2$. Step IV: Balance H atoms - LHS has 8H (in 4H₂O), RHS has 2H (in H₂). Put coefficient 4 before H₂: $\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$. Step V: Balance Fe - LHS has 1 Fe, RHS has 3 Fe. Put coefficient 3 before Fe: $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$. Step VI: Verify - Fe: 3=3 (correct), H: 8=8 (correct), O: 4=4 (correct). Final balanced equation with physical states: $3\text{Fe}(\text{s}) + 4\text{H}_2\text{O}(\text{g}) \rightarrow \text{Fe}_3\text{O}_4(\text{s}) + 4\text{H}_2(\text{g})$. This method is called the hit-and-trial method.

Marking Scheme (5 marks): 1 mark for correct atom count table (Step II). 1 mark for correctly balancing oxygen (Step III - coefficient 4 before H₂O). 1 mark for correctly balancing hydrogen (Step IV - coefficient 4 before H₂). 1 mark for correctly balancing iron (Step V - coefficient 3 before Fe) and verification. 1 mark for final balanced equation with correct physical state symbols and naming the method as hit-and-trial.

Source: Section 1.1.2 - Balanced Chemical Equations, Steps I-VII, equations 1.4 to 1.10

Q33. (a) Decomposition reaction: A reaction in which a single reactant breaks down to give two or more simpler products. Three types: (i) Thermal decomposition (decomposition by heat): $\text{CaCO}_3(\text{s}) \xrightarrow{\text{Heat}} \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ [or $2\text{FeSO}_4(\text{s}) \rightarrow \text{Fe}_2\text{O}_3(\text{s}) + \text{SO}_2(\text{g}) + \text{SO}_3(\text{g})$ or $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$]. (ii) Photolytic decomposition (decomposition by light): $2\text{AgCl}(\text{s}) \xrightarrow{\text{Sunlight}} 2\text{Ag}(\text{s}) + \text{Cl}_2(\text{g})$ [or $2\text{AgBr}(\text{s}) \rightarrow 2\text{Ag}(\text{s}) + \text{Br}_2(\text{g})$]. (iii) Electrolytic decomposition (decomposition by electricity): $2\text{H}_2\text{O}(\text{l}) \xrightarrow{\text{Electric current}} 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$. (b) In a combination reaction, two or more reactants combine to form a single product, whereas in a decomposition reaction, a single reactant breaks down into two or more products. They are thus opposite to each other. Example of combination reaction: $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{Heat}$ [Quick lime reacts with water to give slaked lime - one product from two reactants].

Marking Scheme (5 marks): 1 mark for correct definition of decomposition reaction. 1 mark for each type of decomposition with correct balanced equation (1 mark x 3 = 3 marks): thermal (1 mark), photolytic (1 mark), electrolytic (1 mark). 1 mark for explaining how decomposition is opposite to combination with a valid example and correct equation. Award partial marks if equations are correct but type name is missing.

Source: Section 1.2.2 - Decomposition Reaction, Activities 1.5, 1.6, 1.7, 1.8; Section 1.2.1 - Combination Reaction

Q34. (a) A redox reaction is one in which oxidation and reduction occur simultaneously. One reactant gets oxidised while the other gets reduced. In $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$: Copper gains oxygen → Copper is OXIDISED. In

$\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$: CuO loses oxygen $\rightarrow$ CuO (copper) is REDUCED. H_2 gains oxygen $\rightarrow$ H_2 is OXIDISED. Oxidation: gain of oxygen or loss of hydrogen. Reduction: loss of oxygen or gain of hydrogen. (b) In $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$: ZnO loses oxygen $\rightarrow$ ZnO is reduced (C is the reducing agent). C gains oxygen $\rightarrow$ C is oxidised (ZnO is the oxidising agent). Oxidising agent: ZnO. Reducing agent: C. (c) Burning of magnesium: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$. Magnesium gains oxygen, so magnesium is OXIDISED. This is an oxidation reaction.

Marking Scheme (5 marks): 1 mark for correct definition of redox reaction (simultaneous oxidation and reduction). 1 mark for correct explanation of oxidation using $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$ (Cu gains O_2). 1 mark for correct explanation of reduction and oxidation in $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$ (CuO loses O_2 ; H_2 gains O_2). 1 mark for correctly identifying oxidising agent (ZnO) and reducing agent (C) in $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$ with justification. 1 mark for correctly identifying burning of Mg as oxidation with equation and reason.

Source: Section 1.2.5 - Oxidation and Reduction, equations 1.28, 1.29, 1.30, 1.31; Section 1.3 recall of Activity 1.1

Q35. (i) Rancidity is the process by which fats and oils in food are oxidised, causing a change in their smell and taste (they become unfit to eat). One method to slow it down: Keeping food in airtight containers (to prevent contact with oxygen/air). [Accept also: flushing food packets with nitrogen gas.] (ii) Corrosion is the process by which a metal is attacked by substances around it such as moisture and acids, resulting in undesirable compounds on its surface. The reddish-brown coating on iron is iron oxide (rust), chemically Fe_2O_3 (hydrated). One way to prevent: Painting the iron surface / galvanising / applying oil or grease. (iii) Oxidation is the gain of oxygen or loss of hydrogen by a substance during a chemical reaction. Balanced equation for oxidation of copper: $2\text{Cu(s)} + \text{O}_2\text{(g)} \xrightarrow{\text{Heat}} 2\text{CuO(s)}$.

Marking Scheme (4 marks total): Sub-question (i) [1 mark]: $\frac{1}{2}$ mark for definition of rancidity; $\frac{1}{2}$ mark for one valid prevention method. Sub-question (ii) [2 marks]: $\frac{1}{2}$ mark for definition of corrosion; $\frac{1}{2}$ mark for naming reddish-brown coating (iron oxide/rust/ Fe_2O_3); 1 mark for one valid prevention method. Sub-question (iii) [1 mark]: $\frac{1}{2}$ mark for definition of oxidation; $\frac{1}{2}$ mark for correct balanced equation $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$.

Source: Section 1.3.1 - Corrosion, Section 1.3.2 - Rancidity, Section 1.2.5 - Oxidation, equation 1.28

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