CBSE CLASS X

Science (086)

ANSWER KEY

AI-generated question paper

Code: TAYPTV	Questions: 45	Maximum Marks: 124	Generated: 2026-06-25 13:34

SELECTIONS USED

Subject	Science
Lessons	1 Chemical Reactions and Equations
Level of understanding	Thorough understanding
Question selection	Curated chapter coverage (~5 questions per section + 8 synthesis)
Model	claude-sonnet-4-6

Composition — Difficulty: 4 straightforward · 28 medium · 13 deep | Types: 33 Short · 6 Long · 3 Very short · 3 MCQ

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Q1. medium | thorough-understanding | § Chapter Introduction **[3]**

Iron left in a humid atmosphere develops a reddish-brown coating over days, while magnesium ribbon, when ignited, produces a white powder almost instantly. Both involve oxygen, yet one is a slow process and the other is rapid. State the common criterion that allows BOTH to be classified as chemical reactions, and identify the type of chemical reaction each represents.

◆ Chemical Reactions and Equations

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Model Answer

Common criterion: A chemical reaction has taken place when there is a change in the chemical nature of the substance, resulting in the formation of one or more new substances with different properties. Observable indicators include change in colour, state, temperature, or evolution of gas.

Both rusting of iron and burning of magnesium produce new substances (iron oxide and magnesium oxide respectively), confirming both are chemical reactions.

Type of reaction:

- **Rusting of iron** — It is a **corrosion** (slow oxidation) reaction:

$$4Fe + 3O_2 + xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$$

- **Burning of magnesium** — It is a **rapid oxidation (combination)** reaction:

$$2Mg + O_2 \rightarrow 2MgO$$

Both are **oxidation reactions**, but differ greatly in rate.

Source: Chapter 1, Section 1.1; Chapter 3, Section 3.2.1

Explanation

- **Key criterion (1 mark):** The examiner wants you to state that formation of a new substance with changed properties = chemical reaction. The textbook lists indicators: change in colour, state, temperature, gas evolution.
- **Rusting (1 mark):** Identify it as corrosion/slow oxidation. Mentioning it occurs in humid atmosphere matches the textbook ("The surface of some metals, such as iron, is corroded when they are exposed to moist air for a long period of time").
- **Burning Mg (1 mark):** Identify it as rapid oxidation or combination reaction — textbook explicitly calls it burning in oxygen forming magnesium oxide.
- Both are oxidation/combination reactions, but the rate difference is what the question highlights — always note this contrast.
- Writing balanced equations earns full credit and demonstrates understanding; don't skip them in a 3-mark answer.

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Q2. straightforward | thorough-understanding | § Chapter Introduction **[1]**

When zinc granules are added to dilute sulphuric acid, bubbles are observed and the container becomes warm. Which TWO indicators from this observation confirm that a chemical reaction has taken place?

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Model Answer

Evolution of bubbles (gas produced) and the container becoming warm (heat released/exothermic reaction) confirm that a chemical reaction has taken place.

Explanation

CBSE expects students to name the two observable indicators: **production of gas** (bubbles of hydrogen) and **change in temperature** (heat released). Both are standard signs of a chemical reaction from Chapter 1. No equation is needed for 1 mark.

Q3. medium | thorough-understanding | § Chapter Introduction **[2]**

A student argues: 'When we cook food, no new substance is formed — it just gets soft and changes texture, so it is a physical change.' Using your understanding of chemical reactions, explain why this argument is incorrect.

◆ Chemical Reactions and Equations

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Model Answer

The student's argument is incorrect. Cooking food is a **chemical change**, not physical. During cooking, new substances are formed due to breaking and making of bonds between atoms. Indicators like change in colour, change in smell, and irreversibility confirm a chemical reaction has occurred. The change cannot be reversed, unlike physical changes.

Source: Chapter 1 – Chemical Reactions and Equations, Chapter Introduction

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Explanation

- The textbook explicitly lists **cooking food** as an example where "the nature and identity of the initial substance have somewhat changed" — i.e., a chemical reaction occurs.
- Key examiner expectation: state that **new substances are formed** (bonds broken and made) and give **evidence** of chemical change (irreversibility, change in colour/smell).
- Don't just say "it is a chemical change" — briefly justify *why* with at least one indicator. That earns both marks.

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Q4. medium | thorough-understanding | § 1.1 CHEMICAL EQUATIONS **[3]**

A student trying to balance the equation Fe + H_2O → Fe_3O_4 + H_2 changes the formula of water to H_2O_4 in order to equalise the oxygen atoms on both sides. (i) State why this approach is chemically incorrect. (ii) Using the correct method, write the fully balanced chemical equation for this reaction.

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Model Answer

(i) This approach is chemically incorrect because **we cannot change the formula of any reactant or product** to balance an equation. H_2O_4 is not a real compound; altering a formula violates the law of conservation of mass and misrepresents the actual substances involved. Balancing is done only by placing coefficients (whole numbers) in front of the formulae.

(ii) Using the hit-and-trial method (placing coefficients only):

$$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$$

Verification:

Element	LHS	RHS
Fe	3	3 ✓
H	8	8 ✓
O	4	4 ✓

Source: Chapter 1, Section 1.1.2 Balanced Chemical Equations

Explanation

- **Part (i)** carries ~1 mark: state the rule clearly — formulae must never be changed; only coefficients are adjusted. The textbook explicitly says "we cannot alter the formulae of the compounds."
- **Part (ii)** carries ~2 marks: write the balanced equation with correct coefficients (3, 4, 1, 4). The verification table is good practice and shows the examiner you have checked your answer, but keep it brief. State symbols are a bonus if asked; include them if the question says "with state symbols."
- The key term to use: **hit-and-trial method** (as named in the NCERT text).

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Q5. medium | thorough-understanding | § 1.1.1 Writing a Chemical Equation **[3]**

When magnesium burns in oxygen, a student writes the chemical equation as: Mg + O_2 → MgO. Explain why this equation is considered 'skeletal' and what must be done to make it scientifically valid. What principle of chemistry makes this step necessary?

◆ **Chemical Reactions and Equations**

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Model Answer

The equation Mg + O_2 → MgO is called a **skeletal chemical equation** because it only shows the reactants and products using chemical formulae, but the number of atoms of each element is **not equal** on both sides. On the LHS, there are 2 oxygen atoms (O_2), but only 1 on the RHS (MgO). This makes it unbalanced.

To make it scientifically valid, it must be **balanced** by adding appropriate coefficients:

$$2Mg + O_2 \rightarrow 2MgO$$

This step is necessary because of the **Law of Conservation of Mass**, which states that mass can neither be created nor destroyed in a chemical reaction. Therefore, the number of atoms of each element must be equal on both sides.

Source: Chapter 1, Sections 1.1.1 and 1.1.2

Explanation

Examiners look for three things here (1 mark each): (1) defining "skeletal equation" and identifying the imbalance, (2) writing the correctly balanced equation, and (3) naming the Law of Conservation of Mass and stating it. Don't just say "atoms are not equal" — explain *which* atom is unequal as evidence. Always write the balanced equation explicitly; it earns a dedicated mark.

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Q6. medium | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[2]**

A student writes the equation for the burning of magnesium as: Mg + O_2 → MgO. (i) Why is this called a skeletal chemical equation? (ii) Why is it also considered unbalanced? Show the correctly balanced equation.

◆ Chemical Reactions and Equations

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Model Answer

(i) The equation Mg + O_2 → MgO is called a **skeletal chemical equation** because it only represents the reactants and products using chemical formulae, without indicating the correct number of atoms/molecules of each substance.

(ii) It is unbalanced because the number of atoms of each element is **not equal** on both sides — there are 2 oxygen atoms on LHS but only 1 on RHS, violating the law of conservation of mass.

Balanced equation:

$$2Mg + O_2 \rightarrow 2MgO$$

Source: Chapter 1, Section 1.1.1 Writing a Chemical Equation

Explanation

- Examiners expect **two distinct points**: definition of skeletal equation + reason it is unbalanced. Both parts carry marks separately.
- The balanced equation must be shown explicitly — simply stating "add coefficient 2" is not enough.
- Key phrase to use: "law of conservation of mass" — it signals you understand *why* balancing is necessary.
- Do not change the formula of any compound (e.g., do not write MgO_2); only add coefficients.

Q7. straightforward | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[1]**

During a chemical reaction, the total mass of reactants is found to equal the total mass of products. How does this observation make it compulsory to balance a chemical equation? Name the law that governs this.

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Model Answer

Since mass is conserved (Law of Conservation of Mass), the number of atoms of each element must be equal on both sides, making it compulsory to balance a chemical equation.

Explanation

The examiner expects you to link mass conservation directly to the need for balancing. Name the law clearly. One crisp sentence is sufficient for 1 mark.

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Q8. medium | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[2]**

When balancing a chemical equation, why is it incorrect to change the subscripts inside a chemical formula (e.g., writing H_2O_4 instead of 4 H_2O) even if doing so would make the atom counts equal?

♦ Chemical Reactions and Equations

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Model Answer

Changing subscripts in a chemical formula changes the substance itself. For example, H_2O_4 is a completely different compound from H_2O. We can only add **coefficients** (e.g., 4 H_2O) to balance an equation, because the law of conservation of mass requires that the number of atoms of each element remains the same — not that we alter the identities of the reactants or products.

Source: Chapter 1, Section 1.1.2 (Balanced Chemical Equations)

Explanation

Examiners look for **two key points** (1 mark each):

1. Changing subscripts changes the identity/formula of the compound — it becomes a different substance entirely.
2. Only coefficients may be changed; this follows from the **law of conservation of mass**, which governs why we balance equations in the first place.

The textbook explicitly states: *"we cannot alter the formulae of the compounds or elements involved in the reactions... we can put coefficient '4' as 4 H_2O and not H_2O_4."* Quote or paraphrase this directly if possible.

Q9. medium | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[2]**

What information does the notation (aq) convey when written alongside a substance in a chemical equation, and how is it different from (l)?

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Model Answer

The notation **(aq)** means the substance is dissolved in water (aqueous solution). For example, NaCl(aq) indicates sodium chloride dissolved in water.

(l) denotes that the substance is in pure liquid form, not dissolved in any solvent. For example, H_2O(l) means liquid water itself.

Difference: (aq) = dissolved in water; (l) = pure liquid state.

Source: Chapter 1, Writing a Chemical Equation (physical states notation); Chapter 2, Acids-Bases

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Explanation

- Examiners expect **both** notations to be defined clearly and a **direct comparison** made — that earns both marks.
- A common mistake is saying (l) means "liquid solution" — it strictly means the **pure substance in liquid phase**, not a solution.
- You can support with examples (e.g., HCl(aq) vs Br_2(l)) to make the distinction crisp.
- The source passages mention H^+(aq) and OH^-(aq) ions in solution, confirming (aq) = dissolved in water.

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Q10. medium | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[2]**

The balanced equation for the reaction of iron with steam is: $3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$. Why is the symbol (g) used for water here instead of (l), even though water is normally a liquid at room temperature?

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Model Answer

The symbol (g) is used with H_2O because in this reaction, water is not in liquid form but is used as **steam** (water vapour). Since the reaction requires high temperature, water exists in the gaseous state. The notation (g) indicates this physical state accurately, making the equation more informative.

Source: Chapter 1, Section 1.1.2 – Writing Symbols of Physical States

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Explanation

- The textbook explicitly states: *"the symbol (g) is used with H_2O to indicate that in this reaction water is used in the form of steam."*
- Examiners expect two key points: (1) water is in the form of steam/vapour due to high temperature, and (2) (g) denotes gaseous state, not liquid.
- Do **not** just say "water is heated" — say it is used **as steam**, which is the gaseous state.

Q11. medium | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[2]**

In a chemical equation, conditions such as heat or a catalyst are written above or below the arrow rather than on the reactant or product side. What does the arrow in a chemical equation represent, and why is it more appropriate to show reaction conditions on the arrow?

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Model Answer

The arrow in a chemical equation represents the **direction of the reaction**, showing that reactants (LHS) are converted into products (RHS).

Reaction conditions like heat or a catalyst are written **above or below the arrow** because they are not reactants or products — they only influence how the reaction proceeds. Placing them on the arrow keeps the equation accurate and uncluttered.

Source: Chapter 1, Section 1.1.2 Writing a Chemical Equation

Explanation

- **1 mark** for stating what the arrow represents (direction of reaction / conversion of reactants to products).
- **1 mark** for explaining why conditions go on the arrow — they are neither reactants nor products, only facilitating factors.
- Use examples from the textbook (e.g., sunlight/chlorophyll written above/below the arrow in Eq. 1.12) to support if needed, but keep it brief for 2 marks.
- Avoid writing a long paragraph; examiners look for these two specific points clearly stated.

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Q12. medium | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[1]**

Consider the unbalanced equation: Al + Cl_2 → $AlCl_3$. Which of the following correctly balances it?
(A) Al + Cl_2 → $AlCl_3$
(B) 2Al + 3Cl_2 → 2$AlCl_3$
(C) Al + Cl_3 → $AlCl_3$
(D) 2Al + Cl_2 → 2AlCl

A Al + Cl_2 → $AlCl_3$
B 2Al + 3Cl_2 → 2$AlCl_3$
C Al + Cl_3 → $AlCl_3$
D 2Al + Cl_2 → 2AlCl

◆ Chemical Reactions and Equations

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Model Answer

(B) 2Al + 3Cl_2 → 2$AlCl_3$

LHS: 2 Al, 6 Cl atoms. RHS: 2 Al, 6 Cl atoms — both sides are equal, so the equation is balanced.

Explanation

To balance Al + Cl_2 → $AlCl_3$, apply the hit-and-trial method. $AlCl_3$ needs 3 Cl atoms, but Cl_2 provides 2 — so use 3 Cl_2 (6 Cl atoms) and 2 $AlCl_3$ (6 Cl atoms), then balance Al with coefficient 2. Options C and D use incorrect formulae/products, violating the rule that formulae cannot be altered during balancing.

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Q13. deep | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[3]**

Physical states are described as not always necessary in a chemical equation. However, in some reactions specifying them becomes essential. Give ONE situation where omitting the physical state would make the equation misleading or incomplete, and explain why.

◆ **Chemical Reactions and Equations**

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Model Answer

When water (H_2O) can exist as liquid or steam, omitting its physical state makes the equation misleading. For example, in the reaction of iron with water:

$$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$$

Here, the symbol **(g)** is essential to indicate that water is used as **steam**, not liquid water. Without it, the reader cannot determine the actual reaction conditions, making the equation incomplete and potentially misleading about how the reaction proceeds.

Source: Chapter 1, Section 1.1.2 (Step VII — Writing Symbols of Physical States)

Explanation

- Examiners want: (1) a specific, relevant example, (2) the physical state symbol shown, and (3) a clear reason why omission is misleading.
- The textbook explicitly uses the Fe/H_2O example to illustrate exactly this point — always use it here rather than inventing another.
- Key phrase to include: *"water is used in the form of steam"* — this is the textbook's own wording and signals to examiners you know the source.
- Don't just say "physical states are important in general"; the question asks for ONE specific situation with an explanation.

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Q14. deep | thorough-understanding | § 1.1.2 Balanced Chemical Equations **[5]**

Compare a word equation with a balanced chemical equation for the same reaction. What additional information does a balanced chemical equation provide that cannot be obtained from a word equation? Illustrate your answer with a suitable example.

◆ **Chemical Reactions and Equations**

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Model Answer

Word Equation vs. Balanced Chemical Equation

A **word equation** names the reactants and products in words, showing the direction of the reaction. It only tells us *what* substances are involved.

Example:
Zinc + Sulphuric acid → Zinc sulphate + Hydrogen

A **balanced chemical equation** uses chemical formulae and coefficients, ensuring the number of atoms of each element is equal on both sides (obeying the Law of Conservation of Mass).

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

Additional information provided by a balanced chemical equation:

1. **Chemical formulae** of all reactants and products.
2. **Relative number of atoms/molecules** taking part in the reaction.
3. **Physical states** — (s), (l), (g), (aq) — can be added.
4. **Reaction conditions** (temperature, pressure, catalyst) can be shown above/below the arrow.
5. Confirms the **Law of Conservation of Mass** — atoms are neither created nor destroyed.

Source: Chapter 1, Sections 1.1 and 1.1.2

Explanation

- Examiners expect a clear **comparison** (1–2 marks), a **named example with both equations** (1–2 marks), and **at least 3 additional points** a balanced equation provides (remaining marks).
- The Zn + H_2SO_4 example is directly from the textbook — always prefer textbook examples.
- Don't forget to mention physical states and reaction conditions as extra information; students often miss these.
- The Law of Conservation of Mass is the *reason* equations must be balanced — mentioning it earns a mark.

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Q15. deep | thorough-understanding | § 1.2 TYPES OF CHEMICAL REACTIONS **[5]**

When iron nails are dipped in copper sulphate solution, certain changes are observed after some time. (i) State the two observations you would expect in this experiment and write a balanced chemical equation for the reaction. (ii) Identify the type of chemical reaction and explain what property of metals determines whether one metal can displace another from its salt solution. (iii) Identify the substance oxidised and the substance reduced in this reaction, giving a reason for each in terms of gain or loss of electrons (or change in the nature of the compound).

◆ Chemical Reactions and Equations

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Model Answer

(i) Observations and Equation:

1. The iron nail acquires a brownish (reddish-brown) coating of copper on its surface.
2. The blue colour of copper sulphate solution fades (becomes pale green due to formation of $FeSO_4$).

Balanced equation:

$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

(ii) Type of Reaction and Property Determining Displacement:
This is a **displacement reaction** — iron displaces copper from copper sulphate solution. The property that determines whether one metal can displace another is its **reactivity (position in the activity series)**. A more reactive metal displaces a less reactive metal from its salt solution. Since iron is more reactive than copper (iron is above copper in the reactivity series), it displaces copper.

(iii) Oxidised and Reduced Substances:

- **Iron (Fe) is oxidised** — it loses electrons, changing from Fe (neutral metal) to Fe^{2+} in $FeSO_4$.
- **Copper (Cu^{2+}) is reduced** — it gains electrons, changing from Cu^{2+} in $CuSO_4$ to Cu (neutral metal).

Source: Chapter 1, Section 1.2.3 (Displacement Reaction); Chapter 3, Section 3.2.4 & 3.2.5

Explanation

- **Part (i):** Examiners expect both observations clearly — the colour change of the nail AND the fading of the blue colour. The equation must be balanced with state symbols.
- **Part (ii):** The key term is "reactivity series" / "activity series." Just saying "iron is more reactive" without linking it to the series/concept of reactivity will lose a mark.
- **Part (iii):** Always use the electron language — "loses electrons = oxidised," "gains electrons = reduced." Link it back to the specific species (Fe → Fe^{2+} and Cu^{2+} → Cu). This is the OIL RIG concept applied to the reaction.

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Q16. medium | thorough-understanding | § 1.2.1 Combination Reaction **[2]**

Calcium oxide reacts with water to form calcium hydroxide. What type of reaction is this, and what experimental observation tells you that energy is involved in this process?

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Model Answer

This is a **combination reaction** because two reactants (CaO and H_2O) combine to form a single product (calcium hydroxide).

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

Experimental observation: When water is added to calcium oxide, the beaker becomes hot (rise in temperature is felt on touching the beaker), showing that a large amount of heat is released. This makes it an **exothermic reaction**.

Source: Chapter 1, Section 1.2.1 Combination Reaction

Explanation

- **1 mark** for correctly identifying it as a combination reaction (and optionally exothermic).
- **1 mark** for the observation — touching the beaker and feeling the rise in temperature is the key experimental evidence examiners expect. Saying "heat is released" without linking it to the observation may cost you the mark.
- Always write the balanced equation when the reaction is mentioned — it strengthens your answer and takes only one line.

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Q17. medium | thorough-understanding | § 1.2.1 Combination Reaction **[3]**

After whitewashing a wall with slaked lime solution, the wall slowly develops a hard, shiny finish over two to three days. What chemical reaction is responsible for this, and why does the finish take days to appear rather than forming instantly?

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Model Answer

The reaction responsible for the hard, shiny finish is:

$$\mathrm{Ca(OH)_2}(aq) + \mathrm{CO_2}(g) \rightarrow \mathrm{CaCO_3}(s) + \mathrm{H_2O}(l)$$

Calcium hydroxide (slaked lime) reacts with carbon dioxide present in air to form calcium carbonate ($CaCO_3$), which gives the wall a hard, shiny finish. This is a combination reaction.

The finish takes two to three days to appear because calcium hydroxide reacts **slowly** with CO_2 in air. The calcium carbonate layer builds up gradually over this period before it becomes visible.

Source: Chapter 1, Section 1.2.1 – Combination Reaction

Explanation

- Examiners expect the **balanced chemical equation** — award it 1 mark.
- The reaction type (**combination reaction**) should be named — 1 mark.
- The reason for the delay ("reacts slowly with CO_2") must be stated explicitly — 1 mark.
- Do not confuse this with the preparation of slaked lime ($CaO + H_2O$); the whitewashing reaction is $Ca(OH)_2$ with CO_2.
- Note: $CaCO_3$ is also the chemical formula of marble — a nice fact but not required for marks here.

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Q18. medium | thorough-understanding | § 1.2.1 Combination Reaction **[2]**

The burning of coal and the formation of water from hydrogen and oxygen are both classified under the same category of chemical reactions. Identify this category and state the single defining feature that justifies placing these two apparently different reactions together.

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Model Answer

Category: Exothermic reactions.

Defining feature: In both reactions, heat (energy) is **released** to the surroundings during the reaction.

- Burning of coal: $\mathrm{C} + \mathrm{O_2} \rightarrow \mathrm{CO_2} + \text{heat and light}$
- Formation of water: $\mathrm{H_2} + \mathrm{O_2} \rightarrow \mathrm{H_2O} + \text{heat}$

Both release energy, making them exothermic.

Source: Chapter 1, Types of Chemical Reactions (What you have learnt)

Explanation

- Examiners expect the **category name** (1 mark) and the **defining feature** — energy/heat released (1 mark).
- Writing a supporting equation is good practice but not compulsory for 2 marks; it strengthens the answer.
- Do not confuse with combustion (combustion is a *type* of exothermic reaction, not the broader category asked here). The question asks for the common classification, which is **exothermic reactions**.
- Key phrase to remember: *"Reactions in which heat is given out along with the products are called exothermic reactions."* (Chapter 1 summary)

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Q19. deep thorough-understanding § 1.2.1 Combination Reaction **[3]**

A student claims that every combination reaction must also be an exothermic reaction. Is the student correct? Justify your answer using evidence from the reactions you have studied.

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Model Answer

The student is **not correct**. Not every combination reaction is exothermic.

A combination reaction simply involves two or more substances combining to form a single product. While many combination reactions do release heat — for example:

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

— this is not a defining feature of all combination reactions.

The formation of water ($2\mathrm{H_2} + \mathrm{O_2} \rightarrow 2\mathrm{H_2O}$) and burning of coal ($\mathrm{C} + \mathrm{O_2} \rightarrow \mathrm{CO_2}$) are also exothermic combination reactions, but there exist combination reactions that require energy input (endothermic). Exothermic nature is a property of some combination reactions, not all.

Source: Chapter 1, Section 1.2.1 Combination Reaction

Explanation

- CBSE expects you to **clearly state the student is wrong**, then justify with a definition of combination reaction and at least one example.
- The key distinction: combination reaction is defined by *structure* (many → one), not by energy change. Exothermic reactions are separately defined as those releasing heat.
- Mention both the definition and at least one example reaction with equation for full 3-mark credit.
- Avoid writing a long essay — the answer above is appropriately concise for 3 marks.

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Q20. deep thorough-understanding § 1.2.1 Combination Reaction **[3]**

When magnesium ribbon burns in air, a single product is formed. Identify the product and explain how this reaction can be simultaneously classified under two different types of chemical reactions, naming both types.

◆ Chemical Reactions and Equations

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Model Answer

Product: When magnesium ribbon burns in air, the product formed is **magnesium oxide (MgO)**.

$$2Mg + O_2 \rightarrow 2MgO$$

Two types of reactions:

1. **Combination reaction** – Two reactants (magnesium and oxygen) combine to form a single product (magnesium oxide).
1. **Oxidation reaction (Redox)** – Magnesium gains oxygen during the reaction, so it is oxidised. Hence, this is also an oxidation reaction.

Thus, the same reaction is classified under both combination and oxidation reactions.

Source: Chapter 1, Section 1.1 & 1.2; Chapter 3, Section 3.2.1

Explanation

- Examiners expect the student to name MgO as the product and write the balanced equation (1 mark).
- Two reaction types must be **named and justified**, not just listed — each needs a one-line reason (1 mark each).
- Common accepted pairs: **Combination + Oxidation**. Some answers also accept **Exothermic** as the second type if the question allows it, but Combination + Oxidation is the most textbook-aligned response here.
- Avoid writing lengthy explanations; crisp labelled points score better in board exams.

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Q21. medium | thorough-understanding | § 1.2.2 Decomposition Reaction **[3]**

When ferrous sulphate crystals are heated strongly, three products are formed. What are they, and how can you tell — from observation alone — that a chemical change has occurred rather than just a physical change?

◆ Chemical Reactions and Equations

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Model Answer

When ferrous sulphate ($FeSO_4$) crystals are heated strongly, they decompose to form three products:

1. **Ferric oxide** (Fe_2O_3) — a reddish-brown solid
2. **Sulphur dioxide** (SO_2) — a gas
3. **Sulphur trioxide** (SO_3) — a gas

$$2FeSO_4 \xrightarrow{\Delta} Fe_2O_3 + SO_2 + SO_3$$

Evidence of chemical change (from observation alone):

- The **colour changes** from green ($FeSO_4$ crystals) to reddish-brown (Fe_2O_3).
- A **characteristic odour** of burning sulphur is produced (due to SO_2/SO_3 gases).

These observations — colour change and gas evolution with odour — confirm a chemical change, not merely a physical one.

Source: Chapter 1, Section 1.2.2 — Decomposition Reaction

Explanation

- Examiners expect you to name all **three products** with correct formulae — each carries marks.
- The equation (optional but good) shows it's a decomposition/thermal decomposition reaction.
- For "observation alone," stick to what you **see** (colour change: green → reddish-brown) and **smell** (sulphur odour) — do not mention formulae or theory here.
- A physical change is reversible and produces no new substance; colour change + new gas with odour proves new substances have formed → chemical change.

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Q22. straightforward | thorough-understanding | § 1.2.2 Decomposition Reaction **[1]**

Which of the following correctly identifies both the energy input and the type of decomposition in the reaction: $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$?

(A) Electrical energy; electrolytic decomposition
(B) Heat energy; thermal decomposition
(C) Light energy; photochemical decomposition
(D) Heat energy; double displacement reaction

A Electrical energy; electrolysis
B Heat energy; thermal decomposition
C Light energy; photolysis
D Heat energy; combination reaction

◆ Chemical Reactions and Equations

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Model Answer

(B) Heat energy; thermal decomposition

$CaCO_3$ is heated strongly to decompose into CaO and CO_2. This is **thermal decomposition** — a single substance breaks down using heat energy.

Explanation

- The reaction requires high temperature (heat energy), ruling out options A (electrical) and C (light).
- It is a **decomposition** reaction (one reactant → two products), not a combination or double displacement, ruling out option D.
- Key term to remember: decomposition using heat = **thermal decomposition**. Classic CBSE example: $CaCO_3 \rightarrow CaO + CO_2$.

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Q23. medium | thorough-understanding | § 1.2.2 Decomposition Reaction **[3]**

Using one balanced chemical equation each, illustrate how a combination reaction and a decomposition reaction differ fundamentally in terms of reactants and products. What does this difference tell you about the direction of the chemical change in each case?

◆ Chemical Reactions and Equations

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Model Answer

Combination Reaction — two or more reactants combine to form a single product:

$$2\text{Mg}(s) + \text{O}_2(g) \rightarrow 2\text{MgO}(s)$$

Decomposition Reaction — a single reactant breaks down into two or more products:

$$2\text{Pb}(\text{NO}_3)_2(s) \xrightarrow{\text{Heat}} 2\text{PbO}(s) + 4\text{NO}_2(g) + \text{O}_2(g)$$

Fundamental Difference: In a combination reaction, multiple reactants converge to form one product (many → one). In a decomposition reaction, one substance splits into multiple products (one → many). This shows that the direction of chemical change is **opposite** in the two reactions — combination builds complexity while decomposition breaks it down.

Source: Chapter 1 — Types of Chemical Reactions, What You Have Learnt

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Explanation

- The examiner expects **one equation each**, both balanced — award 1 mark each.
- The third mark is for clearly stating the directional difference (many→one vs one→many).
- Avoid writing long descriptions; use the equations to do the work. State symbols earn you extra credit but are not strictly required for 3 marks here.
- Key phrase from the textbook: *"Decomposition reactions are opposite to combination reactions"* — use this language.

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Q24. medium | thorough-understanding | § 1.2.2 Decomposition Reaction **[3]**

During the electrolysis of water, why is the volume of gas collected at one electrode exactly double that collected at the other? Name both gases and identify which electrode produces the larger volume.

◆ Chemical Reactions and Equations

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Model Answer

Water (H_2O) is composed of hydrogen and oxygen in the ratio **2:1** by volume. During electrolysis, water molecules break down as:

$$2H_2O \rightarrow 2H_2 + O_2$$

Since two molecules of hydrogen are produced for every one molecule of oxygen, the volume of hydrogen collected is **exactly double** that of oxygen.

- Gas at the **cathode (negative electrode): Hydrogen (H_2)** — larger volume
- Gas at the **anode (positive electrode): Oxygen (O_2)** — smaller volume

The cathode produces the larger volume of gas.

Explanation

- The key reason is the **2:1 molar (and volume) ratio** of H to O in water — examiners expect you to state this clearly.
- Always identify which electrode produces which gas: **cathode → hydrogen, anode → oxygen**. This is a common 1-mark direct question.
- You may write the decomposition equation for full marks; it shows the 2:1 ratio directly.
- The source passages provided do not cover this topic directly, so this answer draws on standard CBSE Class 10 Science (Chapter 1 – Chemical Reactions and Equations / Chapter 2 knowledge of water electrolysis as taught in the course).

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Q25. medium | thorough-understanding | § 1.2.2 Decomposition Reaction **[2]**

Silver chloride is stored in dark-coloured bottles in laboratories. Explain the chemical reason for this precaution, including the products of the reaction that would otherwise occur.

◆ Chemical Reactions and Equations

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Model Answer

Silver chloride (AgCl) undergoes **photodecomposition** when exposed to sunlight (light energy). The reaction is:

$$2\text{AgCl}(s) \xrightarrow{\text{sunlight}} 2\text{Ag}(s) + \text{Cl}_2(g)$$

AgCl decomposes into silver metal and chlorine gas, turning grey. Dark-coloured bottles prevent light from reaching the compound, thus stopping this decomposition.

Explanation

This is a **photochemical decomposition reaction** — a type of decomposition triggered by light, not heat. Examiners expect: (1) naming the type of reaction, (2) the balanced equation, and (3) the practical reason for dark bottles. The textbook uses AgCl as a standard example of photodecomposition, so memorise the equation. Note: the source passages mention corrosion of silver (with sulphur), but the photodecomposition of AgCl is the standard NCERT Class 10 Chemistry example from Chapter 1 (decomposition reactions section).

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Q26. medium | thorough-understanding | § 1.2.2 Decomposition Reaction **[3]**

A student heats lead nitrate powder in a test tube and observes brown fumes along with a colourless gas. Write the balanced chemical equation for this reaction and identify every product formed.

◆ Chemical Reactions and Equations

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Model Answer

When lead nitrate is heated, it undergoes thermal decomposition. The balanced chemical equation is:

$$2\mathrm{Pb(NO_3)_2}(s) \xrightarrow{\Delta} 2\mathrm{PbO}(s) + 4\mathrm{NO_2}(g) + \mathrm{O_2}(g)$$

Products identified:

1. **Lead monoxide (PbO)** — yellow solid residue formed in the test tube.
2. **Nitrogen dioxide (NO_2)** — brown/reddish-brown fumes observed.
3. **Oxygen (O_2)** — colourless, odourless gas released.

This is a **thermal decomposition reaction** (endothermic).

Source: Chapter 1, Chemical Reactions and Equations

Explanation

- The examiner expects the **correctly balanced equation** (1 mark), **identification of all three products** (1 mark each, or grouped as 1 mark), and the **type of reaction** (often implied or explicitly asked).
- The most common mistake is missing O_2 as a product — students notice brown fumes (NO_2) but forget oxygen is also released.
- Remember: 2 formula units of $Pb(NO_3)_2$ give 2 PbO + 4 NO_2 + 1 O_2 — verify atom count on both sides.
- Brown fumes → NO_2; colourless gas → O_2; yellow residue → PbO.

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Q27. deep | thorough-understanding | § 1.2.2 Decomposition Reaction **[3]**

The decomposition of calcium carbonate is carried out on a large industrial scale. (i) Write the balanced chemical equation for this reaction. (ii) Name the product that is directly used in the construction industry and explain its use. (iii) Justify why this reaction is classified as a chemical change and not a physical change, even though no new elements are introduced.

◆ Chemical Reactions and Equations

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Model Answer

(i) Decomposition of calcium carbonate (thermal decomposition):

$$\mathrm{CaCO_3}(s) \xrightarrow{\Delta} \mathrm{CaO}(s) + \mathrm{CO_2}(g)$$

(ii) Calcium oxide (CaO) / Quick lime is directly used in the construction industry. It reacts vigorously with water to form slaked lime [$\mathrm{Ca(OH)_2}$], which is used for whitewashing walls and in making cement and mortar.

(iii) This reaction is a chemical change because new substances with different properties are formed (CaO and $\mathrm{CO_2}$ from $\mathrm{CaCO_3}$), bonds are broken and new bonds are formed, and the reaction is **irreversible** under normal conditions. The composition of matter changes permanently, which is the hallmark of a chemical change.

Source: Chapter 1, Section 1.2 (Decomposition Reactions); Section 1.2.1 (Combination Reaction – slaked lime use)

Explanation

- **(i)** Always include the heat symbol (Δ) above the arrow and state symbols — examiners award a mark for a correctly balanced equation with conditions.
- **(ii)** The textbook specifically mentions CaO (quick lime) reacting with water → slaked lime → whitewashing. Stick to this use.
- **(iii)** Key indicators of chemical change: new substances formed, different properties, irreversibility, bond breaking/making. Mentioning "no new elements" is not enough — you must explain **why** it is still chemical (new compounds with new properties are produced).

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Q28. medium | thorough-understanding | § 1.2.3 Displacement Reaction **[3]**

When iron nails are placed in copper sulphate solution, the blue colour of the solution gradually fades and the nails acquire a brownish coating. Explain why both of these changes occur, referring to what is happening at the atomic/ionic level.

◆ **Chemical Reactions and Equations**

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Model Answer

Iron is more reactive than copper, so it displaces copper from copper sulphate solution. The reaction is:

$$\mathrm{Fe}(s) + \mathrm{CuSO_4}(aq) \rightarrow \mathrm{FeSO_4}(aq) + \mathrm{Cu}(s)$$

At the ionic level, iron atoms lose electrons and enter the solution as Fe^{2+} ions, forming iron sulphate ($FeSO_4$). Simultaneously, Cu^{2+} ions from the solution gain electrons and get deposited as copper metal on the nail. This deposited copper gives the nail a **brownish coating**. As Cu^{2+} ions are consumed and replaced by Fe^{2+} ions, the concentration of copper sulphate decreases, causing the **blue colour to fade**.

Source: Chapter 1, Section 1.2.3 — Displacement Reaction

Explanation

- The examiner expects you to name this as a **displacement reaction** and write the equation (1 mark).
- You must explain **both** observations separately: the brownish coating (Cu deposited) and the fading blue colour (Cu^{2+} ions replaced by Fe^{2+}) — likely 1 mark each.
- Mentioning electron transfer (Fe loses electrons → Fe^{2+}; Cu^{2+} gains electrons → Cu) earns the "atomic/ionic level" mark.
- Do not confuse this with rusting; this is a chemical displacement, not corrosion.

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Q29. medium | thorough-understanding | § 1.2.3 Displacement Reaction **[2]**

Zinc displaces copper from copper sulphate solution, and lead displaces copper from copper chloride solution. However, when a copper strip is placed in zinc sulphate or lead nitrate solution, no reaction is observed. What do these observations tell you about the relative reactivities of zinc, lead, and copper? What broader principle do these observations illustrate?

◆ **Chemical Reactions and Equations**

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Model Answer

These observations show that **zinc and lead are more reactive than copper**. A more reactive metal displaces a less reactive metal from its salt solution. Since copper cannot displace zinc or lead from their salt solutions, copper is less reactive than both zinc and lead.

Broader principle: A more reactive metal displaces a less reactive metal from its salt solution. This is the principle of **displacement reactions**, based on the activity series.

Source: Chapter 1, Section 1.2.3 Displacement Reaction

Explanation

- The examiner expects you to state the reactivity order (Zn > Cu, Pb > Cu) and explain *why* no reaction occurs when copper is placed in zinc sulphate or lead nitrate (copper is less reactive, so it cannot displace them).
- Naming the broader principle — "a more reactive metal displaces a less reactive metal from its salt solution" — is essential for full marks.
- Mentioning the activity series by name adds precision and is rewarded.

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Q30. deep | thorough-understanding | § 1.2.3 Displacement Reaction **[3]**

Consider the reaction: Fe(s) + $CuSO_4$(aq) → $FeSO_4$(aq) + Cu(s). (i) Identify the type(s) of chemical reaction this represents, giving a reason for each type you name. (ii) In terms of oxidation and reduction, identify which species is oxidised and which is reduced, and state how you determined this.

◆ **Chemical Reactions and Equations**

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Model Answer

(i) Types of reaction:

- **Displacement reaction**: Fe displaces Cu from $CuSO_4$ because iron is more reactive than copper, so a more reactive metal displaces a less reactive metal from its salt solution.
- **Redox reaction**: Both oxidation and reduction occur simultaneously in this reaction.

(ii) Oxidation and Reduction:

- **Fe is oxidised**: It loses electrons/gains no oxygen, going from Fe (0) to Fe^{2+} in $FeSO_4$. (Iron gains no oxygen here but is oxidised as a species.)
- **Cu^{2+} is reduced**: Copper ions in $CuSO_4$ gain electrons to form Cu(s), i.e., Cu^{2+} → Cu(0) — loss of combined state/gain of electrons.

This is determined by tracking changes in the state of the elements: Fe becomes part of a compound (oxidised) and Cu^{2+} becomes free copper (reduced).

Source: Chapter 1, Section 1.2.5 Oxidation and Reduction; What you have learnt, Chapter 1 & 3

Explanation

- Examiners expect **two reaction types** named with reasons: displacement (reactivity basis) and redox (simultaneous oxidation + reduction).
- For Part (ii), at Class 10 level, "oxidised = loses electrons / forms compound" and "reduced = gains electrons / becomes free element" is sufficient. You may also use gain/loss of oxygen language if preferred, but electron transfer is cleaner here since no oxygen transfer occurs directly.
- Always state **how** you determined it — that's explicitly asked and carries marks.

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Q31. medium | thorough-understanding | § 1.2.4 Double Displacement Reaction **[3]**

When sodium sulphate solution is mixed with barium chloride solution, a white precipitate forms and sodium chloride remains dissolved. Explain why one product forms a precipitate while the other stays in solution, and identify what type of reaction this is.

◆ **Chemical Reactions and Equations**

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Model Answer

When Na_2SO_4 and $BaCl_2$ solutions are mixed, the ions exchange partners. The reaction is:

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

$BaSO_4$ forms a precipitate because it is insoluble in water. The SO_4^{2-} and Ba^{2+} ions combine to form this white insoluble solid.

NaCl remains dissolved because it is soluble in water; Na^+ and Cl^- ions stay in solution.

This is a **double displacement reaction** (also called a precipitation reaction) because the ions of the two reactants exchange places to form two new compounds.

Source: Chapter 1, Section 1.2.4 – Double Displacement Reaction

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Explanation

- Examiners expect the balanced equation with state symbols — always include **(s)** for precipitate and **(aq)** for dissolved species.
- You must name **both** types: double displacement reaction AND precipitation reaction for full marks.
- The key reason for $BaSO_4$ precipitating is its **insolubility** in water — state this explicitly.
- NaCl staying in solution must be explained by its **solubility**, not just stated.
- Three marks typically split as: equation (1) + reason for precipitate/solution (1) + type of reaction (1).

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Q32. deep thorough-understanding § 1.2.4 Double Displacement Reaction **[3]**

A student states: 'All precipitation reactions are double displacement reactions, but not all double displacement reactions are precipitation reactions.' Do you agree with this statement? Justify your answer with one example of a double displacement reaction that does NOT produce a precipitate.

◆ Chemical Reactions and Equations

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Model Answer

Yes, I agree with the statement.

Justification:
In a double displacement reaction, ions are exchanged between two compounds. A precipitation reaction is a *type* of double displacement reaction where one product is insoluble (precipitate). However, double displacement reactions can also produce water (neutralisation) or a gas instead of a precipitate.

Example of a double displacement reaction WITHOUT a precipitate:

$$\mathrm{NaOH}(aq) + \mathrm{HCl}(aq) \rightarrow \mathrm{NaCl}(aq) + \mathrm{H_2O}(l)$$

Here, OH^- and Cl^- ions are exchanged (double displacement), but no precipitate is formed — only water and sodium chloride in solution are produced.

Source: Chapter 1, Section 1.2.4 Double Displacement Reaction

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Explanation

- The examiner awards marks for: (1) agreeing and stating the logic (all precipitation reactions involve ion exchange = double displacement), (2) explaining that double displacement reactions are broader (can produce water/gas too), and (3) a correct example with equation.
- The neutralisation reaction NaOH + HCl is the simplest and most reliable example to use here since it appears in the chapter's exercises.
- Do not write a neutralisation reaction as a precipitation reaction — they are distinct subtypes of double displacement.

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Q33. medium | thorough-understanding | § 1.2.5 Oxidation and Reduction **[3]**

When copper oxide is heated with hydrogen gas, the black coating turns brown. In this reaction, identify which substance is oxidised and which is reduced, and explain why, using the definitions of oxidation and reduction in terms of oxygen.

◆ Chemical Reactions and Equations

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Model Answer

The reaction is:

$$CuO + H_2 \xrightarrow{\text{Heat}} Cu + H_2O$$

Hydrogen is oxidised because it gains oxygen (from CuO) to form water. Oxidation is defined as the gain of oxygen by a substance.

Copper(II) oxide is reduced because it loses oxygen to form copper. Reduction is defined as the loss of oxygen by a substance.

Since one reactant is oxidised and the other is reduced simultaneously, this is called a **redox reaction**.

Source: Chapter 1, Section 1.2.5 — Oxidation and Reduction

Explanation

- **3 marks are split as:** 1 mark for identifying the oxidised substance with reason, 1 mark for identifying the reduced substance with reason, 1 mark for the definitions (or the term "redox reaction").
- Always state the definition of oxidation/reduction explicitly — examiners look for "gains oxygen" / "loses oxygen" in the answer.
- Writing the chemical equation at the start is good practice and shows clarity.
- Do not confuse: hydrogen gains oxygen → oxidised; CuO loses oxygen → reduced. A common mistake is flipping these.

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Q34. medium | thorough-understanding | § 1.2.5 Oxidation and Reduction **[2]**

In the reaction ZnO + C → Zn + CO, identify the oxidising agent and the reducing agent. Explain your answer in terms of the gain and loss of oxygen by each substance.

◆ Chemical Reactions and Equations

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Model Answer

In ZnO + C → Zn + CO:

- **ZnO is the oxidising agent** — it gives oxygen to carbon, thereby getting reduced (loses oxygen to form Zn).
- **C is the reducing agent** — it gains oxygen from ZnO to form CO, thereby getting oxidised.

Oxidation = gain of oxygen; Reduction = loss of oxygen.

Source: Chapter 1, "What you have learnt"

Explanation

- Examiners award 1 mark for correctly identifying both agents and 1 mark for the explanation in terms of gain/loss of oxygen.
- A common mistake is confusing the two: always link "oxidising agent" to the substance that *provides* oxygen (and itself gets reduced), and "reducing agent" to the substance that *takes* oxygen (and itself gets oxidised).
- Stating the definitions of oxidation and reduction in the last line shows conceptual clarity and helps secure full marks.

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Q35. deep | thorough-understanding | § 1.2.5 Oxidation and Reduction **[3]**

A student claims: 'In a redox reaction, it is possible for one substance to be oxidised without any other substance being reduced.' Is this claim correct? Justify your answer with reference to how oxidation and reduction occur in chemical reactions.

◆ Chemical Reactions and Equations

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Model Answer

The student's claim is **incorrect**.

Oxidation and reduction always occur simultaneously in a chemical reaction. If a substance gains oxygen (or loses hydrogen), it is oxidised; if a substance loses oxygen (or gains hydrogen), it is reduced. Such reactions are called **redox reactions**.

For example: $\mathrm{CuO} + \mathrm{H_2} \xrightarrow{\text{Heat}} \mathrm{Cu} + \mathrm{H_2O}$

Here, CuO is reduced (loses oxygen) and H_2 is oxidised (gains oxygen) at the same time. One cannot occur without the other — the oxygen lost by one substance must be gained by another.

Source: Chapter 1, Section 1.2.5 — Oxidation and Reduction

Explanation

- The examiner expects students to clearly state the claim is **wrong** and explain **why** using the definition of oxidation and reduction from the textbook.
- The key concept: oxidation and reduction are complementary — oxygen lost by one reactant is gained by another. This is why such reactions are called **redox reactions**.
- Including the example reaction (CuO + H_2) with identification of which substance is oxidised and which is reduced scores full marks. Don't just define — **apply** the concept.

Q36. straightforward | thorough-understanding | § 1.3 HAVE YOU OBSERVED THE EFFECTS OF OXIDATION REACTIONS IN EVERYDAY LIFE? **[1]**

Iron exposed to moist air develops a reddish-brown coating, while silver kept in air gradually turns black. (i) Name the chemical process responsible for each change and write the chemical formula of the product formed in each case. (ii) In what way are these two changes similar, and in what way are they different?

◆ Chemical Reactions and Equations

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Model Answer

(i) Iron: **Corrosion (rusting)** — product is rust, $\mathrm{Fe_2O_3.xH_2O}$. Silver: **Corrosion (tarnishing)** — product is silver sulphide, $\mathrm{Ag_2S}$.
(ii) **Similar:** Both are corrosion — metals reacting with substances in air. **Different:** Iron reacts with oxygen and moisture; silver reacts with sulphur in air.

Source: Chapter 3, Section 3.5 Corrosion; Chapter 1, Section 1.3.1

Explanation

Even though this is marked as 1 mark, it has two parts — examiners expect both to be addressed briefly. Key points: use the word "corrosion" for both, give correct formulae ($\mathrm{Fe_2O_3.xH_2O}$ and $\mathrm{Ag_2S}$), and note that the difference lies in *what* the metal reacts with (oxygen + moisture vs. sulphur).

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Q37. medium thorough-understanding § 1.3 HAVE YOU OBSERVED THE EFFECTS OF OXIDATION REACTIONS IN EVERYDAY LIFE? **[3]**

Chips manufacturers flush their packets with nitrogen gas before sealing. Explain why this step is necessary, and what would happen to the chips if the packets were sealed with air instead.

◆ Chemical Reactions and Equations

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Model Answer

Chips manufacturers flush packets with nitrogen gas because nitrogen is an inert gas that does not react with food. Chips are oily/fatty snacks that undergo **oxidation (rancidity)** in the presence of oxygen, making them stale, foul-smelling, and unfit for eating. Nitrogen displaces oxygen inside the packet, preventing this oxidation reaction.

If packets were sealed with air instead, the oxygen present in air would oxidise the fats/oils in the chips, causing **rancidity**. The chips would become stale quickly, develop a bad smell and taste, and lose their quality before the expiry date.

Source: Chapter 1, Section 1.2.5 – Oxidation and Reduction

Explanation

- The key concept tested here is **rancidity**, which is oxidation of fats/oils by atmospheric oxygen.
- Nitrogen is chosen because it is **inert** — it does not react with food.
- The examiner expects two parts: (1) why nitrogen is used (prevents oxidation/rancidity), and (2) what happens with air (oxidation occurs → rancidity). Cover both for full marks.
- The word "rancidity" (or "oxidation of fats") is essential — do not omit it.

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Q38. deep thorough-understanding § 1.3 HAVE YOU OBSERVED THE EFFECTS OF OXIDATION REACTIONS IN EVERYDAY LIFE? **[5]**

Both rusting of iron and rancidity of food are caused by oxidation, yet we use very different methods to slow them down — painting iron surfaces versus adding antioxidants or using airtight containers for food. Explain why oxidation is harmful in each case and analyse how each preventive method tackles the root cause of the problem.

◆ Chemical Reactions and Equations

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Model Answer

Oxidation and its harmful effects:

- **Rusting of iron:** When iron is exposed to moist air, it reacts with oxygen and water to form reddish-brown rust (iron oxide). This damages the metal structurally, causing car bodies, bridges, and iron railings to deteriorate, leading to enormous financial losses every year.
- **Rancidity of food:** When fats and oils in food are oxidised, they become rancid — their smell and taste change, making food unfit for consumption.

How preventive methods tackle the root cause:

- **Painting iron:** Rust requires both air (oxygen) and moisture. Painting creates a physical barrier that cuts off contact between iron and moist air, directly eliminating the conditions needed for oxidation.
- **Adding antioxidants:** These substances preferentially react with oxygen themselves, preventing the fats/oils from getting oxidised and turning rancid.
- **Airtight containers / nitrogen flushing:** These methods remove or displace oxygen around the food (chips manufacturers flush bags with nitrogen), so oxidation of fats simply cannot occur.

Both strategies share the same logic: **deny oxygen access** to the substance being protected.

Source: Chapter 1, Section 1.3; Chapter 3, Section 3.5

Explanation

- Examiners want you to clearly connect **why oxidation is harmful** in each case (structural damage vs. taste/smell change) and then **analyse** — not just list — how each prevention method works against the root cause (oxygen + moisture for rusting; oxygen for rancidity).
- The word "analyse" in the question means you must explain the *mechanism* of protection, not just name the method.
- Mentioning nitrogen flushing shows you've read the passage carefully and earns extra credit.
- Avoid padding; keep points crisp and targeted at marks.

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Q39. medium | thorough-understanding | § (whole-chapter synthesis) **[3]**

Burning of magnesium in air and the thermal decomposition of calcium carbonate both involve a metal compound and oxygen, yet one is classified as a combination reaction and the other as a decomposition reaction. Write balanced chemical equations for both reactions and explain, with reasoning, the basis on which each is assigned to its respective category.

◆ Chemical Reactions and Equations

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Model Answer

Burning of Magnesium (Combination Reaction):

$$2\text{Mg}(s) + \text{O}_2(g) \rightarrow 2\text{MgO}(s)$$

Thermal Decomposition of Calcium Carbonate (Decomposition Reaction):

$$\text{CaCO}_3(s) \xrightarrow{\Delta} \text{CaO}(s) + \text{CO}_2(g)$$

Reasoning:

In the first reaction, two reactants (Mg and O_2) combine to form a **single product** (MgO) — this defines a combination reaction.

In the second reaction, a **single reactant** ($CaCO_3$) breaks down into two products (CaO and CO_2) on heating — this defines a decomposition reaction. The two reactions are therefore opposites of each other.

Source: Chapter 1, Section 1.2.1 (Combination Reaction); Chapter 1, Section 1.2.2 (Decomposition Reaction)

Explanation

- The examiner awards marks for: (1) correct balanced equation for Mg burning, (2) correct balanced equation for thermal decomposition of $CaCO_3$, and (3) clear reasoning linking "two reactants → one product" = combination, and "one reactant → two products" = decomposition.
- The key phrase to remember: *decomposition is the opposite of combination* — the textbook states this explicitly.
- Always balance equations: Mg needs a coefficient of 2, giving 2MgO.
- The heat/delta symbol (Δ) above the arrow for $CaCO_3$ decomposition shows it requires heat (endothermic); include it for full credit.

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Q40. deep | thorough-understanding | § (whole-chapter synthesis) **[3]**

When iron nails are placed in copper sulphate solution, the blue colour of the solution fades and a brown deposit forms on the nails. Using the concept of redox reactions, explain the chemical changes responsible for (i) the colour change in the solution and (ii) the deposit on the nail. Write the balanced chemical equation for the reaction and identify which substance is oxidised and which is reduced.

◆ Chemical Reactions and Equations

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Model Answer

When iron nails are placed in copper sulphate solution, iron displaces copper because iron is more reactive than copper.

(i) Colour change: Cu^{2+} ions (which give the blue colour) are removed from the solution and replaced by Fe^{2+} ions (forming light green $FeSO_4$). Hence, the blue colour fades.

(ii) Brown deposit: Copper metal is deposited on the iron nails, forming the brown coating.

Balanced equation:

$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

Redox identification:

- **Iron (Fe) is oxidised** — it loses electrons ($Fe \rightarrow Fe^{2+}$).
- **Copper (Cu^{2+}) is reduced** — it gains electrons ($Cu^{2+} \rightarrow Cu$).

Source: Chapter 1, Section 1.2.3 Displacement Reaction

Explanation

Examiners award marks for: (1) correct balanced equation, (2) explanation of colour change linking Cu^{2+} removal, and (3) correct identification of oxidised and reduced substances. Always state *why* something is oxidised/reduced (loss/gain of electrons). The term "redox" implies both oxidation and reduction must be addressed — do not skip either.

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Q41. medium | thorough-understanding | § (whole-chapter synthesis) **[1]**

Which of the following correctly pairs a reaction type with its energy relationship?
(A) Decomposition of water by electricity — exothermic; combination of CaO with water — endothermic
(B) Decomposition of water by electricity — endothermic; combination of CaO with water — exothermic
(C) Both reactions are exothermic
(D) Both reactions are endothermic

A Decomposition of water by electricity — exothermic; combination of CaO with water — endothermic
B Decomposition of water by electricity — endothermic; combination of CaO with water — exothermic
C Both reactions are exothermic
D Both reactions are endothermic

◆ Chemical Reactions and Equations

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Model Answer

(B) Decomposition of water by electricity — endothermic; combination of CaO with water — exothermic.

Explanation

Electrolysis of water requires electrical energy to be absorbed, making it endothermic. The reaction of CaO with water releases a large amount of heat, making it exothermic. The textbook explicitly states $CaO + H_2O \rightarrow Ca(OH)_2 + Heat$.

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Q42. medium | thorough-understanding | § (whole-chapter synthesis) **[5]**

A student observes two reactions: (i) zinc granules dissolve in dilute sulphuric acid, warming the test tube; (ii) barium hydroxide is mixed with ammonium chloride, cooling the test tube. Both produce new substances, yet they have opposite energy behaviours.

(a) Classify each reaction as exothermic or endothermic and justify.

(b) In reaction (i), identify the type of reaction (other than exothermic) and write its balanced chemical equation.

(c) State one industrial or everyday process that shares the same energy classification as reaction (i).

◆ Chemical Reactions and Equations

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Model Answer

(a) Classification:

- **Reaction (i)** — Zn with dilute H_2SO_4 — is **exothermic**. Heat is released during the reaction, which is why the test tube warms up. Reactions that release heat along with products are called exothermic reactions.
- **Reaction (ii)** — $Ba(OH)_2$ with NH_4Cl — is **endothermic**. Energy is absorbed from the surroundings, causing the test tube to cool down. Reactions in which energy is absorbed are called endothermic reactions.

(b) Type of reaction (i) and balanced equation:

Reaction (i) is a **displacement reaction** — zinc (a more reactive metal) displaces hydrogen from dilute sulphuric acid.

Balanced equation:

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

(c) Everyday exothermic process:

Respiration is an exothermic process. Glucose is broken down in the body to release energy, carbon dioxide and water.

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{energy}$$

Source: Chapter 1 — Chemical Reactions and Equations

Explanation

- **Part (a)** tests the core definitions of exothermic (heat released → surroundings warm) and endothermic (heat absorbed → surroundings cool). Always link the observation (warming/cooling) to the definition.
- **Part (b)** the question says "other than exothermic," so write **displacement** (not single-displacement or double-displacement). The balanced equation is directly given in the textbook as Eq. 1.3 — memorise it with state symbols.
- **Part (c)** any valid exothermic example scores marks — burning of fuels, combustion of natural gas, or respiration are all safe choices. Respiration is explicitly discussed in the NCERT text as an exothermic reaction and is the most expected answer.

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Q43. deep | thorough-understanding | § (whole-chapter synthesis) **[5]**

The decomposition of silver chloride in sunlight and the displacement of copper from copper sulphate solution by zinc are both redox reactions. For each reaction: (i) write the balanced chemical equation, and (ii) identify which substance is oxidised and which is reduced, justifying your identification in terms of gain or loss of oxygen or hydrogen.

◆ Chemical Reactions and Equations

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Model Answer

Reaction 1: Decomposition of Silver Chloride

(i) Balanced Chemical Equation:

$$2\text{AgCl}(s) \xrightarrow{\text{Sunlight}} 2\text{Ag}(s) + \text{Cl}_2(g)$$

(ii) Identification of Oxidation and Reduction:

- **Silver chloride (AgCl) is reduced** — Ag^+ in AgCl loses oxygen/chlorine and silver metal is formed; alternatively, AgCl loses a more electronegative partner. In terms of the textbook definition: Ag gains no oxygen, so it undergoes reduction (loss of the combined state to free metal, i.e., loss of oxygen/non-metal).
- **Chloride is oxidised** — chlorine is released as Cl_2 (loss of hydrogen / gain of a partner that reduces it is reversed); Cl^- loses electrons to form Cl_2.

Reaction 2: Displacement of Copper by Zinc

(i) Balanced Chemical Equation:

$$\text{Zn}(s) + \text{CuSO}_4(aq) \rightarrow \text{ZnSO}_4(aq) + \text{Cu}(s)$$

(ii) Identification of Oxidation and Reduction:

- **Zinc (Zn) is oxidised** — Zinc loses electrons and combines with the sulphate, i.e., it goes from free element to a compound (gains oxygen/sulphate group). It is oxidised.
- **Copper (Cu) is reduced** — Copper in $CuSO_4$ is in combined form (with oxygen-containing sulphate); it is displaced as free copper metal, meaning it loses oxygen/combined state. Hence, $CuSO_4$ is reduced.

Source: Chapter 1, Section on Oxidation and Reduction (Gain or Loss of Oxygen)

Explanation

- The textbook defines **oxidation** as gain of oxygen or loss of hydrogen, and **reduction** as loss of oxygen or gain of hydrogen — always justify using these exact terms.
- For the silver chloride reaction, sunlight supplies energy (photochemical decomposition); remember to show the sunlight condition above the arrow.
- For the zinc-copper reaction, zinc displaces copper because zinc is more reactive — this is a classic displacement + redox example.
- Examiners award marks for: (a) correct balanced equation, (b) correct identification of oxidised substance, and (c) correct identification of reduced substance with brief justification. Missing any one loses a mark.

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Q44. medium | thorough-understanding | § (whole-chapter synthesis) **[3]**

Both a precipitation reaction and a decomposition reaction can produce an insoluble solid as one of the products. Citing one example of each, explain how you would distinguish between the two reaction types based on the nature of the reactants and the process involved — not just by counting reactants or products.

◆ **Chemical Reactions and Equations**

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Model Answer

Precipitation Reaction involves **two aqueous solutions** reacting through an **exchange of ions** (double displacement). The insoluble solid forms because the exchanged ions combine to create an insoluble salt.

Example: $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$
Here, Ba^{2+} and SO_4^{2-} ions exchange and form insoluble barium sulphate.

Decomposition Reaction involves a **single compound** breaking down into two or more simpler substances upon supply of energy (heat, light, or electricity).

Example: $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
The insoluble solid (CaO) is produced from the breakdown of one reactant.

Key distinction: Precipitation requires two reactants and ion exchange; decomposition requires only one reactant and an energy input.

Source: Chapter 1, Section 1.2 / 1.2.4

Explanation

- The question specifically says **not** to distinguish by counting reactants/products — so you must mention **ion exchange** (for precipitation) and **energy input / single reactant breaking down** (for decomposition).
- Examiners look for: correct examples with equations, and a clear conceptual distinction about the *nature* of reactants and the *process*.
- Precipitation is a sub-type of double displacement; always mention ion exchange.
- For decomposition, mentioning energy supply (heat/light/electricity) strengthens the answer.

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Q45. deep | thorough-understanding | § (whole-chapter synthesis) **[5]**

Consider the following sequence: calcium carbonate is heated strongly → the product (CaO) is mixed with water → the resulting solution (lime water) is exposed to air for several days.
(a) Write balanced chemical equations for each of the three steps.
(b) Name the type of reaction occurring in the first step and in the third step.
(c) The second step causes the container to become very hot. Identify whether this step is exothermic or endothermic, and explain why this energy behaviour is consistent with the type of reaction it represents.

◆ Chemical Reactions and Equations

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Model Answer

(a) Balanced chemical equations:

Step 1 (Heating calcium carbonate):

$$\mathrm{CaCO_3}(s) \xrightarrow{\text{Heat}} \mathrm{CaO}(s) + \mathrm{CO_2}(g)$$

Step 2 (CaO mixed with water):

$$\mathrm{CaO}(s) + \mathrm{H_2O}(l) \rightarrow \mathrm{Ca(OH)_2}(aq) + \text{Heat}$$

Step 3 (Lime water exposed to air):

$$\mathrm{Ca(OH)_2}(aq) + \mathrm{CO_2}(g) \rightarrow \mathrm{CaCO_3}(s) + \mathrm{H_2O}(l)$$

(b) Types of reaction:

- **Step 1:** Decomposition reaction (a single compound breaks down into two simpler substances on heating).
- **Step 3:** Combination reaction (calcium hydroxide and carbon dioxide combine to form a single product, calcium carbonate).

(c) The second step is an **exothermic** reaction. Calcium oxide reacts vigorously with water to form calcium hydroxide, releasing a large amount of heat — this is why the container becomes hot. It is a combination reaction, and combination reactions typically release energy as two reactants join to form a single, more stable product.

Source: Chapter 1, Section 1.2.1 (Combination Reaction) and Section 1.2 (Decomposition Reaction)

Explanation

- Examiners expect all three equations balanced with correct state symbols.
- "Decomposition" must be named for Step 1 and "combination" for Step 3 — reversing these loses marks.
- For part (c), link the heat release explicitly to the *exothermic* nature of combination reactions — this is the reasoning the examiner wants, not just a label. The textbook Activity 1.4 is the direct source for this observation.

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