CBSE CLASS X

Science (086)

ANSWER KEY

AI-generated question paper

Code: V8MTHK	Questions: 12	Maximum Marks: 24	Generated: 2026-06-25 17:38

SELECTIONS USED

Subject	Science
Lessons	3 Metals and Non-metals
Level of understanding	Initial understanding
Question selection	Curated chapter coverage (~3 questions per section)
Model	claude-sonnet-4-6

Composition — Difficulty: 6 straightforward · 6 medium | Types: 7 Short · 3 Very short · 2 MCQ

Q1. straightforward | initial-understanding | § Chapter Introduction **[1]**

Name two physical properties that are generally used to distinguish metals from non-metals.

◆ **Metals and Non-metals**

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Model Answer

Two physical properties used to distinguish metals from non-metals are **lustre** (metals have a shiny surface) and **electrical conductivity** (metals are good conductors, non-metals are not).

Source: Chapter 3, Section 3.1 Physical Properties

Explanation

The examiner expects any two valid physical properties from: lustre, malleability, ductility, conductivity of heat/electricity, or sonority. Lustre and electrical conductivity are the most commonly cited pair. Stating just the property name without a brief qualifier may cost half a mark, so include a one-phrase distinction for each.

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Q2. straightforward | initial-understanding | § 3.1 PHYSICAL PROPERTIES **[1]**

Which of the following is a physical property generally associated with metals?
(A) They form acidic oxides when burnt in oxygen.
(B) They can be beaten into thin sheets.
(C) They are poor conductors of heat and electricity.
(D) They are brittle and dull in appearance.

A They form acidic oxides when burnt in air.
B They can be beaten into thin sheets.
C They exist as gases at room temperature.
D They react vigorously with cold water.

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Model Answer

(B) They can be beaten into thin sheets.

Metals possess the property of **malleability** — they can be beaten into thin sheets. Gold and silver are the most malleable metals. Metals are also good conductors of heat and electricity, and form **basic** (not acidic) oxides.

Source: Metals and Non-metals, Section 3.1.1

Explanation

- The question asks for a **physical** property of metals.
- Option B describes **malleability**, which is a key physical property of metals confirmed in Activity 3.3.
- Option A is wrong — metals form **basic** oxides (non-metals form acidic oxides).
- Option C is wrong — metals are **good** conductors.
- Option D describes non-metals (brittle, dull).
- Remember: malleability and ductility are the two most commonly tested physical properties of metals in MCQs.

Q3. straightforward | initial-understanding | § 3.2 CHEMICAL PROPERTIES OF METALS **[1]**

When sodium reacts with cold water, name the two products formed.

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Model Answer

When sodium reacts with cold water, the two products formed are **sodium hydroxide (NaOH)** and **hydrogen gas (H_2)**.

Explanation

This is a standard 1-mark factual recall question. Examiners expect both products named clearly. The reaction is: $2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$. Note: the source passages do not explicitly state this reaction, but it is standard CBSE Class 10 Chapter 1 content on displacement reactions involving metals and water.

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Q4. medium | initial-understanding | § 3.2 CHEMICAL PROPERTIES OF METALS **[2]**

Potassium and sodium catch fire when they react with cold water, whereas calcium does not, even though all three produce hydrogen gas. What is the reason for this difference in behaviour?

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Model Answer

Potassium and sodium are highly reactive metals. When they react with cold water, the reaction is **so vigorous and exothermic** that the hydrogen gas evolved immediately catches fire.

In contrast, calcium's reaction with water is **less violent** and the heat evolved is **not sufficient** to ignite the hydrogen gas produced. Hence calcium does not catch fire.

$$2\mathrm{Na(s)} + 2\mathrm{H_2O(l)} \rightarrow 2\mathrm{NaOH(aq)} + \mathrm{H_2(g)} + \text{heat (large)}$$

$$\mathrm{Ca(s)} + 2\mathrm{H_2O(l)} \rightarrow \mathrm{Ca(OH)_2(aq)} + \mathrm{H_2(g)} + \text{heat (less)}$$

Source: Chapter 3, Section 3.2.2

Explanation

The key distinction examiners look for is **reactivity/heat evolved**, not the gas produced (all three produce H_2). Award-winning answers state that K and Na react *violently/exothermically* enough to ignite H_2, while Ca's reaction is *less exothermic* so H_2 does not catch fire. Including the equations earns full marks for a 2-mark question.

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Q5. straightforward | initial-understanding | § 3.2 CHEMICAL PROPERTIES OF METALS **[1]**

Which of the following correctly describes what happens when dilute hydrochloric acid is added to copper?
(A) Hydrogen gas is evolved and a copper chloride solution forms.
(B) No reaction takes place.
(C) Copper displaces hydrogen and forms copper oxide.
(D) Carbon dioxide gas is evolved.

A Hydrogen gas is evolved and a copper chloride solution forms.
B No reaction takes place.
C Copper displaces hydrogen and forms copper oxide.
D Carbon dioxide gas is evolved.

◆ Metals and Non-metals

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Model Answer

(B) No reaction takes place.

Copper is less reactive than hydrogen in the activity series, so it cannot displace hydrogen from dilute HCl; hence no reaction occurs.

Explanation

Examiners expect students to apply the **reactivity series**: only metals above hydrogen (e.g., Fe, Zn, Mg) can displace hydrogen from dilute acids. Copper lies **below hydrogen** in the series, so it does not react with dilute HCl. This is a standard application question from Chapter 1 (Chemical Reactions and Equations).

Q6. medium | initial-understanding | § 3.2 CHEMICAL PROPERTIES OF METALS **[2]**

Why is hydrogen gas not produced when most metals react with nitric acid, even though it is produced when the same metals react with hydrochloric acid?

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Model Answer

HNO_3 is a strong oxidising agent. When a metal reacts with nitric acid, the hydrogen gas produced is immediately oxidised to water by HNO_3, which itself gets reduced to nitrogen oxides (N_2O, NO, NO_2). HCl is not an oxidising agent, so hydrogen gas is released freely.

(Exception: Mg and Mn react with very dilute HNO_3 to produce H_2.)

Source: Chapter 3, Section 3.2.3

Explanation

- The key phrase examiners look for: **"HNO_3 is a strong oxidising agent"** — this must appear.
- Then explain the consequence: H_2 is **oxidised to water**, and HNO_3 is **reduced to nitrogen oxides**.
- Contrast with HCl: HCl has **no oxidising property**, so H_2 escapes.
- Mentioning the exception (Mg/Mn with very dilute HNO_3) is a bonus point but not compulsory for 2 marks.

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Q7. medium | initial-understanding | § 3.2 CHEMICAL PROPERTIES OF METALS **[3]**

Iron filings are added to copper sulphate solution and copper pieces are added to iron sulphate solution. State what you would observe in each case. What do these observations tell you about the relative reactivity of iron and copper?

◆ **Metals and Non-metals**

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Model Answer

Observation 1: When iron filings are added to copper sulphate solution, the blue colour of the solution fades and a reddish-brown deposit of copper is formed on the iron. The reaction is:

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

Observation 2: When copper pieces are added to iron sulphate solution, **no reaction** occurs — there is no change in the colour of the solution and no deposit is formed.

Conclusion: Iron displaces copper from copper sulphate solution, but copper cannot displace iron from iron sulphate solution. This shows that **iron is more reactive than copper**.

Source: Chapter 1, Section 1.2.3 – Displacement Reaction

Explanation

- The key point examiners look for is **both observations** (one reaction, one no reaction) plus the **equation** for the first case, and the **conclusion** about relative reactivity.
- Many students forget to state that copper + $FeSO_4$ gives **no reaction** — this is worth marks.
- The logic: a more reactive metal displaces a less reactive one from its salt solution. Since Fe displaces Cu but not vice versa, Fe > Cu in reactivity.

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Q8. straightforward | initial-understanding | § 3.3 HOW DO METALS AND NON-METALS REACT? **[3]**

Sodium reacts with chlorine to form sodium chloride. (i) What are the charges on the sodium and chloride ions formed in this reaction? (ii) What force holds these oppositely charged ions together in sodium chloride? (iii) What is the general name for compounds formed by the transfer of electrons between atoms?

◆ Metals and Non-metals

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Model Answer

(i) Sodium loses one electron to form a sodium cation with a **+1 charge** (Na^+), and chlorine gains that electron to form a chloride anion with a **−1 charge** (Cl^-).

(ii) The oppositely charged Na^+ and Cl^- ions are held together by a strong **electrostatic force of attraction**.

(iii) Compounds formed by the transfer of electrons from a metal to a non-metal are called **ionic compounds** (or electrovalent compounds).

Source: Chapter 3, Section 3.3 – How do Metals and Non-metals React?

Explanation

- For (i), always state both charges clearly — examiners check both Na^+ (+1) and Cl^- (−1).
- For (ii), the key phrase is **electrostatic forces of attraction** — avoid vague terms like "magnetic force."
- For (iii), either "ionic compounds" or "electrovalent compounds" is acceptable; writing both is safest.
- This question tests understanding of electron transfer and ionic bond formation — a frequently asked concept in CBSE board exams.

Q9. medium | initial-understanding | § 3.3 HOW DO METALS AND NON-METALS REACT? **[3]**

Ionic compounds do not conduct electricity in the solid state but conduct electricity when they are melted or dissolved in water. Give a reason for this difference in behaviour.

◆ Metals and Non-metals

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Model Answer

In solid ionic compounds, the ions are held in fixed positions in a rigid crystal lattice and cannot move freely. Since electric current requires the movement of charged particles (ions), ionic solids do not conduct electricity.

When melted or dissolved in water, the ionic lattice breaks down and the ions become free to move. These freely moving ions carry electric charge and thus conduct electricity.

In short: Conductivity requires mobile charged particles. Solid state → ions fixed, no conduction. Molten/dissolved state → ions free to move → conduction occurs.

Source: Chapter 3 (Metals and Non-metals / Ionic compounds), as referenced in Chapter 4, Section 4.1

Explanation

- Examiners look for **two clear points**: (1) why solids don't conduct — ions are fixed in lattice, (2) why molten/dissolved state does conduct — ions become free/mobile.
- Use the terms **rigid lattice**, **free ions**, and **mobile charged particles** for full marks.
- This is a 3-mark answer, so cover both states with a brief reason for each, plus a linking idea (conductivity needs mobile ions). Don't write more than 3–4 sentences.

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Q10. straightforward | initial-understanding | § 3.4 OCCURRENCE OF METALS **[1]**

What is the difference between a mineral and an ore?

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Model Answer

All minerals are naturally occurring compounds in the earth's crust, but only those minerals from which a metal can be profitably extracted are called ores. All ores are minerals, but all minerals are not ores.

Source: Chapter 3, Section 3.4 Occurrence of Metals

Explanation

The key distinction examiners look for is the **profitability/feasibility of extraction** — a mineral becomes an ore only when the metal can be extracted from it economically. Always include the phrase "profitably extracted" and the one-way relationship: all ores are minerals, but not all minerals are ores.

Q11. medium | initial-understanding | § 3.4 OCCURRENCE OF METALS **[3]**

Why cannot highly reactive metals like sodium and aluminium be extracted by heating their oxides with carbon? Name the method used to extract such metals.

◆ Metals and Non-metals

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Model Answer

Highly reactive metals like sodium and aluminium have a **greater affinity for oxygen than carbon** does. Therefore, carbon cannot reduce their oxides — it is not a strong enough reducing agent to displace these metals from their oxides.

The method used to extract such metals is **electrolytic reduction (electrolysis)**. For example, sodium is extracted by electrolysis of molten sodium chloride. At the cathode, sodium is deposited:

$$\mathrm{Na}^+ + e^- \rightarrow \mathrm{Na}$$

At the anode, chlorine is liberated:

$$2\mathrm{Cl}^- \rightarrow \mathrm{Cl}_2 + 2e^-$$

Similarly, aluminium is obtained by electrolytic reduction of aluminium oxide.

Source: Chapter 3, Section 3.4.5 — Extracting Metals towards the Top of the Activity Series

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Explanation

- **Why carbon fails:** The key reason is affinity for oxygen — Na and Al hold oxygen more strongly than carbon does, so carbon cannot "pull" oxygen away from their oxides. State this clearly for full marks.
- **Method name:** "Electrolytic reduction" or "electrolysis" — both are accepted. Naming the method earns 1 mark; the reason earns 1–2 marks.
- **Equations:** Including the cathode/anode half-reactions adds precision and is expected at this level; they demonstrate understanding of the process.
- Avoid vague answers like "carbon is not strong enough" without linking it to oxygen affinity.

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Q12. medium | initial-understanding | § 3.4 OCCURRENCE OF METALS **[3]**

(i) Why must sulphide and carbonate ores be converted into their oxides before reduction with carbon? (ii) Name the processes used to convert (a) sulphide ores and (b) carbonate ores into their respective oxides.

◆ **Metals and Non-metals**

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Model Answer

(i) Carbon can only reduce metal **oxides** to their respective metals. It cannot directly reduce sulphides or carbonates efficiently. Therefore, sulphide and carbonate ores must first be converted to metal oxides before reduction with carbon.

(ii)

(a) Sulphide ores are converted to oxides by **roasting** — heating strongly in the presence of excess air.

Example: $2ZnS(s) + 3O_2(g) \xrightarrow{\Delta} 2ZnO(s) + 2SO_2(g)$

(b) Carbonate ores are converted to oxides by **calcination** — heating strongly in limited air.

Example: $ZnCO_3(s) \xrightarrow{\Delta} ZnO(s) + CO_2(g)$

Source: Chapter 3, Section 3.4.4

Explanation

- Part (i) is worth ~1 mark — one clear reason is enough.
- Parts (ii)(a) and (ii)(b) are worth ~1 mark each — name the process AND give the equation; examiners expect both.
- Key terms to spell correctly: **roasting** (excess air) vs **calcination** (limited air) — mixing these up is a common error.

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