

CBSE CLASS X
Science (086)**ANSWER KEY***AI-generated question paper***Code: NAWET9****Questions: 34****Maximum Marks: 72****Generated: 2026-06-25 17:41****SELECTIONS USED**

Subject	Science
Lessons	3 Metals and Non-metals
Level of understanding	Exam-ready
Question selection	CBSE board paper, whole lesson (~80 marks across Sections A-E)
Model	claude-sonnet-4-6

Composition — Difficulty: 10 straightforward · 18 medium · 6 deep | Types: 13 MCQ · 6 Short · 5 Very short · 4 Assertion–reason · 3 Long · 3 Case-based | Sections: A 17Q/17m · B 5Q/10m · C 6Q/18m · D 3Q/15m · E 3Q/12m

Q1. straightforward exam-ready**[1]**

Gold is preferred for making jewellery because it:

- (A) is the most malleable of all metals
- (B) does not react with oxygen even at high temperatures
- (C) is the best conductor of electricity
- (D) has the highest density among metals

A is the most malleable of all metals

B does not react with oxygen even at high temperatures

C is the best conductor of electricity

D has the highest density among metals

◆ Metals and Non-metals**Generated by claude-sonnet-4-6 · 2026-06-26 01:04 · grounding rag****Model Answer****(B) does not react with oxygen even at high temperatures**

Gold is the least reactive metal. As stated in the textbook, "Silver and gold do not react with oxygen even at high temperatures," making gold chemically stable and ideal for jewellery.

Source: Chapter 3, Section 3.2.1

Explanation

The key reason gold is used in jewellery is its **chemical inertness** — it does not tarnish or corrode. While gold is highly malleable and ductile, option (A) is factually incorrect (gold is the most ductile, but not the most malleable — gold and silver share top malleability). Silver and copper are better conductors than gold, ruling out (C). Option (D) is also false. Examiners expect you to recall the specific line about gold/silver not reacting with oxygen even at high temperatures.

Q2. straightforward exam-ready

[1]

When calcium reacts with cold water, a gas is evolved which makes the metal float on the surface. The gas evolved is:

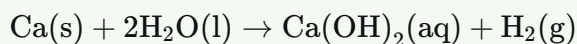
- (A) Oxygen
 - (B) Carbon dioxide
 - (C) Hydrogen
 - (D) Nitrogen
- A Oxygen
B Carbon dioxide
C Hydrogen
D Nitrogen

◆ Metals and Non-metals

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Model Answer**(C) Hydrogen**

When calcium reacts with cold water, hydrogen gas is evolved. The bubbles of H₂ stick to the metal's surface, making calcium float.



Source: Chapter 3, Section 3.2.2

Explanation

The key fact is that **all metals reacting with water produce hydrogen gas**, not oxygen or CO₂. The floating is caused by H₂ bubbles clinging to the metal surface — a detail specifically mentioned for calcium in the textbook. Examiners may test whether students confuse the gas evolved (H₂) with the product in solution (Ca(OH)₂).

Q3. straightforward exam-ready**[1]**

In electrolytic refining of copper, which component is used as the anode?

- (A) Pure copper strip
- (B) Impure copper block
- (C) Copper sulphate solution
- (D) Carbon rod

- A Pure copper strip
- B Impure copper block
- C Copper sulphate solution
- D Carbon rod

◆ Metals and Non-metals

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Model Answer**(B) Impure copper block**

In electrolytic refining of copper, the impure copper block is used as the anode, pure copper strip as the cathode, and acidified copper sulphate solution as the electrolyte.

Source: Chapter 3, Section 3.4.6 (Refining of Metals)

Explanation

The textbook clearly states: "the impure metal is made the anode and a thin strip of pure metal is made the cathode." Examiners expect you to know all three components (anode, cathode, electrolyte) for this topic, even if the question asks only about one. Option (A) is the cathode, (C) is the electrolyte, and (D) is never used here.

Q4. straightforward exam-ready

[1]

Which of the following non-metals is a liquid at room temperature?

- (A) Sulphur
- (B) Iodine
- (C) Bromine
- (D) Phosphorus

- A Sulphur
- B Iodine
- C Bromine
- D Phosphorus

◆ Metals and Non-metals

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Model Answer**(C) Bromine**

Bromine is the only non-metal that exists as a liquid at room temperature. All other non-metals are either solids or gases.

Explanation

The textbook (Section 3.1.2) explicitly states: "*The non-metals are either solids or gases except bromine which is a liquid.*" Sulphur, iodine, and phosphorus are all solids at room temperature. This is a direct fact-based question – just recall the exception.

Q5. straightforward exam-ready

[1]

Aqua regia is a mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of:

- (A) 1:3
- (B) 3:1
- (C) 1:1
- (D) 2:1

- A 1:3 (HCl : HNO₃)
- B 3:1 (HCl : HNO₃)
- C 1:1 (HCl : HNO₃)
- D 2:1 (HCl : HNO₃)

◆ Metals and Non-metals

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Model Answer**(B) 3:1 (HCl : HNO₃)**

Aqua regia is a mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of **3:1 (HCl : HNO₃)**.

Explanation

The term *aqua regia* (Latin for "royal water") is mentioned in NCERT as it can dissolve noble metals like gold. The ratio 3:1 (HCl : HNO₃) is a standard fact students must memorise – note that HCl is taken in greater proportion. This is a direct recall question; no derivation needed.

Q6. straightforward exam-ready

[1]

The process of converting a sulphide ore into its oxide by heating strongly in the presence of excess air is called:

- (A) Calcination
- (B) Smelting
- (C) Roasting
- (D) Refining

- A Calcination
- B Smelting
- C Roasting
- D Refining

◆ Metals and Non-metals

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Model Answer**(C) Roasting**

Roasting is the process of heating a sulphide ore strongly in excess air to convert it into its oxide.

Explanation

Roasting specifically applies to **sulphide ores** heated in excess air. Calcination (option A) involves heating carbonate/hydroxide ores in limited air. Students often confuse these two — remember: **Sulphide** → **Roasting**; **Carbonate** → **Calcination**.

Q7. straightforward exam-ready

[1]

Which of the following metals does NOT react with dilute hydrochloric acid?

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

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

◆ Metals and Non-metals

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Model Answer**(C) Copper**

Copper does not react with dilute hydrochloric acid because it lies below hydrogen in the reactivity series.

Explanation

The reactivity series (Table 3.2, Chapter 3) places copper below hydrogen, meaning it cannot displace hydrogen from dilute acids. The textbook explicitly states: "In the case of copper, no bubbles were seen and the temperature also remained unchanged. This shows that copper does not react with dilute HCl." Zinc, iron, and magnesium all lie above hydrogen and do react with dilute HCl to produce hydrogen gas.

Q8. straightforward exam-ready

[1]

An alloy of lead and tin is used for welding electrical wires. This alloy is known as:

- (A) Brass
- (B) Bronze
- (C) Solder
- (D) Steel

- A Brass
- B Bronze
- C Solder
- D Steel

◆ Metals and Non-metals

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Model Answer

(C) Solder

An alloy of lead and tin used for welding electrical wires is called **Solder**.

Explanation

Solder is a well-known alloy of lead and tin with a low melting point, making it ideal for joining electrical wires. Brass is copper + zinc; Bronze is copper + tin; Steel is iron + carbon. For MCQs, eliminate the wrong options by recalling alloy compositions.

Q9. medium exam-ready

[1]

Which of the following conditions is essential for iron to rust?

- (A) Presence of air alone
(B) Presence of water alone
(C) Presence of both air and water
(D) Presence of carbon dioxide alone
- A Presence of air alone
B Presence of water alone
C Presence of both air and water
D Presence of carbon dioxide alone

◆ Metals and Non-metals

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Model Answer**(C) Presence of both air and water**

Iron rusts only when exposed to both air (oxygen) and water simultaneously, as shown in Activity 3.14 — nails in dry air or boiled water (without air) did not rust.

Source: Chapter 3, Section 3.5 Corrosion

Explanation

The textbook Activity 3.14 clearly demonstrates that nails rust only in test tube A (air + water), not in B (water only, no air) or C (dry air, no water). Examiners expect you to select option C and may award a mark only for the correct option — no justification is needed in an MCQ, but knowing the reason helps if a follow-up short-answer appears.

Q10. medium exam-ready

[1]

Which of the following correctly represents the order of decreasing reactivity of metals?

- (A) Na > Ca > Mg > Al > Zn
(B) Al > Mg > Ca > Na > Zn
(C) Zn > Al > Mg > Na > Ca
(D) Ca > Na > Al > Mg > Zn
- A Na > Ca > Mg > Al > Zn
B Al > Mg > Ca > Na > Zn
C Zn > Al > Mg > Na > Ca
D Ca > Na > Al > Mg > Zn

◆ Metals and Non-metals

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Model Answer**(A) Na > Ca > Mg > Al > Zn****Explanation**

The reactivity series (Table 3.2, Chapter 3) lists metals in decreasing reactivity: K > Na > Ca > Mg > Al > Zn > Fe > ... Option A is the only one that correctly follows this order. Memorise the reactivity series — it is frequently tested in MCQs and short-answer questions.

Q11. medium exam-ready

[1]

Ionic compounds do not conduct electricity in the solid state, but do so in the molten state. What is the primary reason for this?

- (A) Solid ionic compounds have no ions
 - (B) Ions are mobile in the molten state but are rigidly held in solid state
 - (C) Molten ionic compounds generate new electrons
 - (D) The melting process creates covalent bonds
- A Solid ionic compounds have no ions
B Ions are mobile in the molten state but are rigidly held in solid state
C Molten ionic compounds generate new electrons
D The melting process creates covalent bonds

◆ Metals and Non-metals

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Model Answer**(B) Ions are mobile in the molten state but are rigidly held in solid state**

In solid ionic compounds, ions are fixed in a rigid lattice and cannot move. On melting, electrostatic forces are overcome, ions move freely and conduct electricity.

Source: Chapter 3, Section 3.3.1 – Properties of Ionic Compounds

Explanation

The textbook explicitly states: "Ionic compounds in the solid state do not conduct electricity because movement of ions in the solid is not possible due to their rigid structure. But ionic compounds conduct electricity in the molten state since the electrostatic forces of attraction between oppositely charged ions are overcome due to heat." Option B directly reflects this. Options A, C, and D are factually incorrect — solid ionic compounds do contain ions; melting neither generates new electrons nor creates covalent bonds.

Q12. medium exam-ready

[1]

A copper wire is placed in a solution of silver nitrate. After some time, a shiny deposit appears on the copper wire and the solution turns blue. Which of the following conclusions is correct?

- (A) Copper is less reactive than silver
- (B) Copper is more reactive than silver
- (C) Silver is more reactive than copper
- (D) Both metals have equal reactivity

- A Copper is less reactive than silver
- B Copper is more reactive than silver
- C Silver is more reactive than copper
- D Both metals have equal reactivity

◆ Metals and Non-metals

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Model Answer**(B) Copper is more reactive than silver.**

Copper displaces silver from silver nitrate solution because it is more reactive, forming copper nitrate (solution turns blue) and silver deposits on the wire.

Source: Chapter 3, Section 3.2.4 & 3.2.5 (Reactivity Series)

Explanation

In the reactivity series, copper is placed above silver, meaning copper is more reactive. A more reactive metal displaces a less reactive metal from its salt solution — this is a displacement reaction. The blue colour of the solution is due to Cu^{2+} ions (copper nitrate formed), and the shiny deposit is silver metal. Options A and C say the opposite and are wrong; D is incorrect as the metals clearly differ in reactivity.

Q13. medium exam-ready

[1]

Highly reactive metals such as sodium, magnesium and calcium are extracted by electrolysis of their molten chlorides rather than by reduction with carbon. The best reason for this is:

- (A) Carbon is too expensive
 - (B) These metals have greater affinity for oxygen than carbon does
 - (C) Electrolysis is a cheaper process
 - (D) Their chlorides do not melt easily
- A Carbon is too expensive
B These metals have greater affinity for oxygen than carbon does
C Electrolysis is a cheaper process
D Their chlorides do not melt easily

◆ Metals and Non-metals

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Model Answer**(B) These metals have greater affinity for oxygen than carbon does****Explanation**

The textbook (Section 3.4.5) explicitly states: "carbon cannot reduce the oxides of sodium, magnesium, calcium, aluminium, etc., because **these metals have more affinity for oxygen than carbon.**" This makes carbon ineffective as a reducing agent for these metals, so electrolysis is used instead. Option B is the *reason*, not just a consequence — examiners expect this conceptual distinction.

Q14. medium exam-ready

[1]

Assertion (A): Aluminium metal is highly reactive, yet it is widely used for making cooking utensils.

Reason (R): Aluminium develops a thin, stable oxide layer on its surface when exposed to air, which protects it from further corrosion.

- (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.

- 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.

◆ Metals and Non-metals

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Model Answer

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

Aluminium is highly reactive but develops a thin, stable oxide (Al_2O_3) layer on exposure to air, which protects it from further corrosion, making it suitable for cooking utensils.

Explanation

The textbook explicitly states that aluminium develops a thin oxide layer when exposed to air, making it resistant to further corrosion. This protective layer is the direct reason why a reactive metal like aluminium can still be used safely for everyday purposes like cooking utensils. Both the Assertion and Reason are factually correct, and the Reason directly explains the Assertion — so option (A) is correct. Examiners expect you to identify this cause-effect link clearly.

Q15. medium exam-ready

[1]

Assertion (A): Hydrogen gas is not evolved when a metal reacts with dilute nitric acid.

Reason (R): Nitric acid is a strong oxidising agent that oxidises the hydrogen produced to water.

- (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.

- 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.

◆ Metals and Non-metals

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Model Answer

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

HNO_3 is a strong oxidising agent; it oxidises the H_2 produced to water, so hydrogen gas is not evolved when metals react with dilute nitric acid.

Explanation

The examiner expects the student to know that nitric acid (dilute or concentrated) acts as an oxidising agent and oxidises nascent hydrogen to water, which is why H_2 gas is not liberated — unlike reactions with HCl or H_2SO_4 . Both the assertion and the reason are factually correct, and the reason directly explains why hydrogen is not evolved, making option (A) the correct choice.

Q16. straightforward exam-ready

[1]

Assertion (A): Ionic compounds generally have high melting and boiling points.

Reason (R): A large amount of energy is needed to overcome the strong electrostatic forces of attraction between oppositely charged ions.

- (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.

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.

◆ Metals and Non-metals

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Model Answer

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

Ionic compounds have high melting and boiling points because a considerable amount of energy is required to break the strong electrostatic forces of attraction between oppositely charged ions.

Source: Chapter 3, Section 3.3.1 Properties of Ionic Compounds

Explanation

The textbook explicitly states: *"Ionic compounds have high melting and boiling points. This is because a considerable amount of energy is required to break the strong inter-ionic attraction."* Both the assertion and reason are factually correct, and the reason directly and correctly explains the assertion — so option (A) is the answer. Don't confuse this with covalent compounds, which have **low** melting/boiling points due to weak intermolecular forces.

Q17. deep exam-ready

[1]

Assertion (A): Carbon cannot be used to reduce sodium oxide or aluminium oxide to their respective metals.

Reason (R): Sodium and aluminium have greater affinity for oxygen than carbon does at high temperatures, so carbon cannot displace them from their oxides.

- (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.

- 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.

◆ Metals and Non-metals

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Model Answer

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

Carbon cannot reduce Na_2O or Al_2O_3 because sodium and aluminium are more reactive than carbon and have greater affinity for oxygen, so carbon cannot displace them from their oxides.

Explanation

The reactivity series places Na and Al above carbon. A more reactive metal has greater affinity for oxygen and cannot be displaced by a less reactive reducing agent like carbon. Thus R directly and correctly explains A – making option (A) the right choice. Remember: carbon can reduce oxides of metals below it in the reactivity series (e.g., ZnO , PbO), but not Na_2O or Al_2O_3 .

Q18. medium exam-ready

[2]

Zinc oxide reacts with both dilute hydrochloric acid and with sodium hydroxide solution. Write the balanced chemical equations for both reactions. What does this dual behaviour indicate about the chemical nature of zinc oxide?

◆ Metals and Non-metals

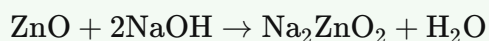
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Model Answer

With dilute HCl:



With sodium hydroxide:



Since zinc oxide reacts with both acids and bases, it is **amphoteric** in nature.

Explanation

- The examiner expects **both balanced equations** (1 mark) and the term **amphoteric** with a one-line explanation (1 mark).
- "Amphoteric" is the key word — do not write just "neutral" or "dual nature" without naming it.
- The sodium zincate formula (Na_2ZnO_2) must be correct; some boards also accept $\text{ZnO} + 2\text{NaOH} \rightarrow \text{Na}_2[\text{Zn}(\text{OH})_4]$ — either is acceptable as long as it is balanced.
- These reactions are a classic example from the Acids, Bases and Salts chapter (Class 10 Chemistry).

Q19. medium exam-ready

[2]

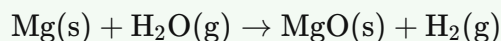
Magnesium does not react with cold water but reacts with hot water and also with steam. What products are formed in each case? Write the equation for the reaction of magnesium with steam.

◆ Metals and Non-metals

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Model Answer

- **With hot water:** Magnesium reacts to form **magnesium hydroxide** and **hydrogen gas**.
- **With steam:** Magnesium reacts to form **magnesium oxide** and **hydrogen gas**.

Equation for reaction with steam:

Source: Chapter 3, Section 3.2.2

Explanation

- The key distinction: hot water \rightarrow $\text{Mg}(\text{OH})_2$ (hydroxide); steam \rightarrow MgO (oxide). This difference is commonly tested.
- Examiners expect both products named for each case **and** the balanced chemical equation for steam specifically.
- Remember: Mg does **not** react with cold water at all — state this if asked.

Q20. straightforward exam-ready

[2]

Define the term 'gangue'. Why is it necessary to remove gangue before extracting a metal from its ore?

◆ Metals and Non-metals

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Model Answer

Gangue: The earthly impurities such as soil and sand associated with an ore mined from the earth are called gangue.

Why it must be removed: If gangue is not removed before extraction, it will interfere with the extraction process, waste energy, and reduce the efficiency and purity of the metal obtained. Removal is done based on differences in physical or chemical properties between gangue and the ore.

Source: *Metals and Non-metals, Section 3.4.2 Enrichment of Ores*

Explanation

- The definition is directly from Section 3.4.2 — use the exact textbook phrasing for 1 mark.
- For the second part (1 mark), examiners expect you to state that impurities interfere with extraction and must be removed prior to it. Mentioning that separation uses differences in physical/chemical properties adds value.
- Do not over-explain; two crisp points are sufficient for 2 marks.

Q21. medium exam-ready

[2]

What is galvanisation? Why does a galvanised iron article remain protected against rusting even if its zinc coating is scratched?

◆ Metals and Non-metals

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Model Answer

Galvanisation is a method of protecting iron and steel from rusting by coating them with a thin layer of zinc. Even if the zinc coating is scratched, the iron beneath remains protected because zinc is more reactive than iron. Zinc corrodes preferentially (acts as a sacrificial metal), thereby preventing iron from rusting.

Source: *Chapter 3, Section 3.5.1 – Prevention of Corrosion*

Explanation

- **Part 1** (definition) fetches 1 mark — state it concisely.
- **Part 2** (reason) fetches the other 1 mark — the key idea is that zinc is **more reactive** than iron, so it oxidises first and protects iron even when the coating is broken. Examiners look for the phrase "more reactive" or "sacrificial protection." Don't just say "zinc forms a protective layer" — that only explains unscratched coating.

Q22. medium exam-ready

[2]

State one physical property each that makes (i) iodine an exception among non-metals and (ii) graphite an exception among non-metals.

◆ Metals and Non-metals

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Model Answer

(i) **Iodine** is lustrous (shiny surface), whereas non-metals are generally non-lustrous.

(ii) **Graphite** conducts electricity, whereas non-metals are generally bad conductors of electricity.

Source: Metals and Non-metals, Section 3.1.2

Explanation

The examiner expects one specific physical property for each exception — no elaboration needed. The key words are **lustrous** for iodine and **conducts electricity** for graphite. These are directly stated in the textbook as exceptions among non-metals. Avoid writing about chemical properties here; the question specifically asks for *physical* properties.

Q23. medium exam-ready

[3]

Distinguish between roasting and calcination. Give one example of each, with the relevant chemical equation.

◆ Metals and Non-metals

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Model Answer

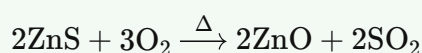
|| **Roasting** | **Calcination** |

|---|---|---|

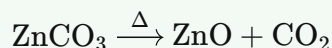
| Definition | Heating sulphide or carbonate ores **in excess of air** below their melting point | Heating carbonate or hydroxide ores **in limited/absence of air** below their melting point |

| Product | Oxide of the metal + SO₂ gas | Oxide of the metal + CO₂ / water vapour |

Example of Roasting (sulphide ore of zinc):



Example of Calcination (carbonate ore of zinc):



Source: Metals and Non-metals, Extraction of Metals

Explanation

- Examiners expect one clear distinguishing point + one example each with a **balanced equation** — that earns all 3 marks.
- The key distinction is **excess air (roasting)** vs **limited/no air (calcination)**, and **sulphide ore** vs **carbonate/hydroxide ore**.
- ZnS/ZnO and ZnCO₃/ZnO are the standard NCERT examples; you may also use Cu₂S or CaCO₃.
- Do not confuse calcination with decomposition in general — it is specifically applied to ores in metallurgy.

Q24. medium exam-ready

[3]

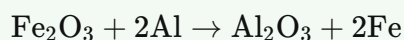
The thermit reaction is used to join railway tracks. Write the chemical equation for this reaction and explain why the iron produced is in the molten state.

◆ Metals and Non-metals

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Model Answer

The thermit reaction is a displacement reaction between aluminium and iron(III) oxide:



This reaction is **highly exothermic** — it releases a very large amount of heat (approximately 3000°C). The melting point of iron is about 1535°C, which is far lower than the heat produced. Therefore, the iron formed immediately melts and is obtained in the **molten state**, which flows into the gap between railway tracks and solidifies to join them firmly.

Source: Chapter 1 (Displacement Reactions); Chapter 3, Section 3.2.4

Explanation

- **1 mark:** Correct balanced chemical equation.
- **1 mark:** Stating the reaction is highly exothermic / releases enormous heat.
- **1 mark:** Explaining that heat produced exceeds iron's melting point, so iron is obtained in molten form.

Examiners look for the equation written correctly ($\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$) and a logical two-step explanation linking exothermic heat → temperature exceeds melting point of iron → molten iron. Don't just say "it's exothermic" — you must connect it to *why* iron melts.

Q25. deep exam-ready

[3]

Four metals P, Q, R and S were tested with cold water, hot water and steam. P reacted vigorously with cold water producing fire; Q reacted only with steam; R did not react with water at all; and S reacted with hot water but not violently. Arrange P, Q, R and S in decreasing order of reactivity. Identify one metal from the activity series that could correspond to each of P, Q and R.

◆ Metals and Non-metals

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Model Answer**Decreasing order of reactivity:** $P > S > Q > R$ **Identification of metals:**

- **P** reacted vigorously with cold water, producing fire → **Sodium (Na)** (reaction is so violent and exothermic that hydrogen catches fire)
- **Q** reacted only with steam → **Iron (Fe)** or Aluminium (Al) (metals like aluminium and iron react only with steam, not cold or hot water)
- **R** did not react with water at all → **Copper (Cu)** (metals like copper, silver and gold do not react with water at all)

(S corresponds to Magnesium, which reacts with hot water but not violently.)

Source: Chapter 3, Section 3.2.2

Explanation

- The examiner expects the correct order first, then identification with brief justification for each.
- S (hot water only, not violently) = Magnesium — but the question only asks to identify P, Q, R, so mention S briefly or skip if marks are tight.
- For Q, either iron or aluminium is acceptable; iron is the most commonly cited textbook example.
- Always link each metal to its behaviour described in the question to earn full method marks.

Q26. medium exam-ready

[3]

Pure gold is described as 24 carat gold and is considered too soft for making jewellery. Explain why it is alloyed and what 22 carat gold means. Also state one general effect alloying has on the electrical conductivity and melting point of a pure metal.

◆ Metals and Non-metals

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Model Answer

Pure gold (24 carat) is too soft for jewellery, so it is alloyed with metals like copper or silver to make it harder and more durable.

22 carat gold means that out of 24 parts of the alloy, 22 parts are pure gold and 2 parts are other metals (such as copper or silver).

Effect of alloying on a pure metal:

- **Electrical conductivity** decreases — alloying reduces the conductivity of the pure metal.
- **Melting point** changes (generally decreases) compared to the pure metal.

Explanation

- The question has three clear parts: (i) why gold is alloyed, (ii) meaning of 22 carat, and (iii) one general effect on conductivity AND melting point (the question says "one general effect" but lists two properties — address both briefly).
- Remember: an alloy is a **homogeneous mixture**, not a compound. Alloying improves hardness/strength but reduces electrical conductivity and often lowers melting point.
- 22 carat = 22/24 parts gold — state this as a fraction out of 24 to make it clear.

Q27. medium exam-ready

[3]

Explain why copper articles develop a green coating on their surface over time. Also explain the chemical nature of the substance that tarnishes silver articles and that which tarnishes copper articles.

◆ Metals and Non-metals

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Model Answer

Copper reacts with moist carbon dioxide in the air, forming a green coating of **basic copper carbonate** on its surface. This is a corrosion reaction.

- The substance that tarnishes **silver** is **silver sulphide** — it is a **sulphide** (formed by reaction of silver with sulphur present in air). It is chemically a **salt**.
- The substance that tarnishes **copper** is **basic copper carbonate** — it is chemically a **basic salt** (or carbonate in nature).

Source: Chapter 3, Section 3.5 Corrosion

Explanation

- The question has two parts: (i) **why** copper develops a green coat (the reason/reaction), and (ii) the **chemical nature** of the tarnishing substances for both silver and copper. Address both clearly.
- Key fact: silver → silver **sulphide** (sulphide salt); copper → basic copper **carbonate** (basic salt/carbonate).
- Don't confuse: silver turns **black** (silver sulphide), copper turns **green** (basic copper carbonate). Examiners check whether you correctly name both compounds and their chemical nature.
- The word "basic copper carbonate" is expected verbatim from the textbook.

Q28. medium exam-ready

[3]

State any three general physical properties of ionic compounds. Explain why ionic compounds dissolve readily in water but not in non-polar solvents such as petrol or kerosene.

◆ Metals and Non-metals

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Model Answer**Three general physical properties of ionic compounds:**

1. They have **high melting and boiling points** due to strong electrostatic forces between ions.
2. They **conduct electricity** in molten state or when dissolved in water (due to free ions).
3. They are generally **hard and brittle** solids at room temperature.

Why ionic compounds dissolve in water but not in non-polar solvents:

Water is a polar solvent. Its polar molecules interact with the positive and negative ions of ionic compounds, overcoming the ionic bonds and dissolving them. Non-polar solvents like petrol or kerosene cannot interact with ions in this way, so ionic compounds do not dissolve in them. The principle is "**like dissolves like**" — polar solvents dissolve ionic/polar compounds; non-polar solvents dissolve non-polar compounds.

Source: Chapter 3, Ionic Compounds; Chapter 4, Section 4.1

Explanation

- The textbook (Ch. 3 summary) directly states ionic compounds have high melting/boiling points and conduct electricity — use these confidently.
- The third property (hard and brittle) is standard CBSE content for ionic compounds from Ch. 3.
- For the dissolution part, the examiner expects the "like dissolves like" principle and the idea that polar water stabilises ions, while non-polar solvents cannot. This is a conceptual explanation, so 2–3 clear lines are enough — don't over-explain.
- Avoid copying carbon compound properties (low MP/BP, non-conductors) — those belong to covalent compounds.

Q29. deep exam-ready

[5]

- (a) What is the reactivity series of metals? On the basis of the reactivity series, explain how metals are grouped for the purpose of extraction from their ores.
- (b) Write the steps involved in the extraction of a metal of medium reactivity from its sulphide ore, giving an example with relevant equations.
- (c) Why can carbon not be used to reduce the oxides of metals like sodium and magnesium? How are these metals extracted?

◆ Metals and Non-metals

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Model Answer**(a) Reactivity Series and Grouping of Metals:**

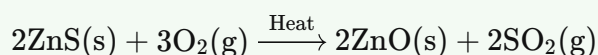
The reactivity series is a list of metals arranged in decreasing order of their reactivity (K, Na, Ca, Mg, Al, Zn, Fe, Pb, Cu, Hg, Ag, Au).

Based on this, metals are grouped into three categories for extraction:

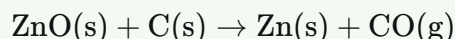
- **Low reactivity** (Ag, Au, Hg) – found free in nature; extracted by heating alone.
- **Medium reactivity** (Zn, Fe, Pb, Cu) – extracted by reduction using carbon or displacement.
- **High reactivity** (K, Na, Ca, Mg, Al) – extracted by electrolytic reduction.

(b) Extraction of Medium Reactivity Metal from Sulphide Ore (e.g., Zinc from ZnS):

Step 1 – Roasting: Sulphide ore is heated strongly in excess air, converting it to the oxide:



Step 2 – Reduction: The oxide is reduced with carbon (coke):



(c) Carbon cannot reduce oxides of Na or Mg because these metals have a **greater affinity for oxygen than carbon** does, making carbon ineffective as a reducing agent here.

These metals are extracted by **electrolytic reduction** of their molten chlorides. For example, sodium is obtained by electrolysis of molten NaCl:

- At cathode: $\text{Na}^+ + e^- \rightarrow \text{Na}$
- At anode: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2e^-$

Source: Chapter 3, Sections 3.4.1, 3.4.4, 3.4.5

Explanation

- **(a)** Always define the reactivity series first, then list the three groups with examples – examiners look for both the definition and the classification.
- **(b)** The key steps are **roasting** (sulphide → oxide) then **reduction with carbon**. Write both equations; missing either loses marks.
- **(c)** The reason must be stated as "greater affinity for oxygen than carbon." Then name electrolytic reduction and give the electrode reactions – these are frequently asked and carry easy marks.

Q30. deep exam-ready

[5]

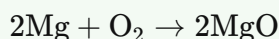
- (a) Describe the chemical properties of metals with respect to their reactions with (i) oxygen, (ii) water, and (iii) dilute acids. Give one example with a balanced equation for each.
- (b) Explain why hydrogen gas is NOT evolved when copper reacts with dilute nitric acid, whereas it IS evolved when magnesium reacts with very dilute nitric acid.

◆ Metals and Non-metals

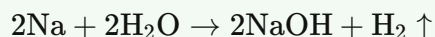
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Model Answer**(a) Chemical Properties of Metals:****(i) Reaction with Oxygen:**

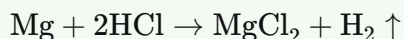
Almost all metals react with oxygen to form metal oxides (basic in nature).

**(ii) Reaction with Water:**

Metals react with water to form metal oxide/hydroxide and hydrogen gas. Reactivity varies — Na/K react with cold water, Mg with hot water, Al/Fe/Zn with steam; Cu does not react.

**(iii) Reaction with Dilute Acids:**

Metals above hydrogen in the activity series react with dilute acids to give salt and hydrogen gas.



(b) HNO₃ is a strong oxidising agent. It oxidises the H₂ produced to water and itself gets reduced to nitrogen oxides (NO, NO₂, N₂O). Therefore, hydrogen gas is **not** evolved when copper (or most metals) react with dilute HNO₃.

However, magnesium is highly reactive. When Mg reacts with **very dilute** HNO₃, the acid is too weak to oxidise all the H₂ produced, so hydrogen gas **is** evolved.

Source: Chapter 3, Section 3.2 (Chemical Properties of Metals)

Explanation

- Part (a) carries ~3 marks — one point + equation per reaction type. Keep equations balanced; examiners check this.
- Part (b) carries ~2 marks — the key phrase is "strong oxidising agent" for HNO₃, and "very dilute" for Mg's exception. Both must be stated.
- Common mistake: writing H₂ evolved for Cu + HNO₃ — it is NOT.
- The amphoteric oxide point (Al₂O₃, ZnO) is relevant for oxygen reactions but not required here unless asked specifically.

Q31. deep exam-ready

[5]

(a) Compare the physical properties of metals and non-metals under the following heads: (i) physical state at room temperature, (ii) malleability and ductility, (iii) electrical conductivity.

(b) When magnesium burns in air, the ash formed dissolves in water to give a solution that turns red litmus blue. When sulphur burns and the fumes dissolve in water, the solution turns blue litmus red. What does this indicate about the general nature of metal and non-metal oxides? Write the equations for the formation of these oxides.

(c) Name one metal and one non-metal that are exceptions to these general rules for electrical conductivity.

◆ Metals and Non-metals

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Model Answer**(a)**

| Property | Metals | Non-metals |

|---|---|---|

| Physical state | Mostly solids at room temperature (except mercury, which is liquid) | Solids or gases (except bromine, which is liquid) |

| Malleability & Ductility | Malleable (beaten into sheets) and ductile (drawn into wires) | Neither malleable nor ductile; they are brittle |

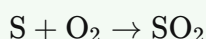
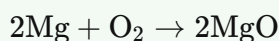
| Electrical conductivity | Good conductors of electricity | Bad conductors (insulators) |

(b)

When magnesium burns, it forms **magnesium oxide (MgO)**, a **basic oxide** — its solution turns red litmus blue. When sulphur burns, it forms **sulphur dioxide (SO₂)**, an **acidic oxide** — its solution turns blue litmus red.

This indicates that **metal oxides are basic** in nature and **non-metal oxides are acidic** in nature.

Equations:

**(c)**

- Exception in metals (poor conductor): **Mercury** (or lead)
- Exception in non-metals (good conductor): **Graphite** (an allotrope of carbon)

Source: Chapter 3, Sections 3.1 and 3.2.1

Explanation

- For part (a), the table format earns full marks efficiently — state, malleability/ductility, and conductivity are the three specific heads asked.
- For part (b), examiners expect you to explicitly state the conclusion: metal oxides = basic; non-metal oxides = acidic. The two balanced equations are mandatory.
- For part (c), graphite (not just "carbon") is the expected answer for the non-metal exception, as stated in the textbook. Mercury is the most common metal exception for conductivity (though lead is also acceptable). The textbook specifically names graphite as the non-metal exception.

Q32. medium exam-ready

[4]

Read the following and answer the questions that follow:

Ramesh is a jeweller who works with different metals daily. He notices that iron tools rust quickly if left damp, while his gold and silver ornaments stay shiny for years. Old copper bangles develop a green coating, which disappears when dipped in dilute acid. To make jewellery more durable, pure gold is mixed with copper or silver before shaping.

(i) Gold and silver resist corrosion under normal conditions while iron rusts. What does this tell you about the relative positions of these metals in the reactivity series? (1 mark)

(ii) What is the green coating on copper bangles? Why does it dissolve in dilute acid? (1 mark)

(iii) What is the term for the mixture obtained by combining gold with copper or silver? State one advantage of making this mixture over using pure gold. (1 mark)

(iv) A student claims that iron will rust if kept in completely dry air. Is this claim correct? Justify your answer. (1 mark)

◆ Metals and Non-metals

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Model Answer

(i) Gold and silver are low in the reactivity series (least reactive), so they do not react with moisture or oxygen easily. Iron is higher in the reactivity series and thus more reactive, making it prone to rusting.

(ii) The green coating is **basic copper carbonate**, formed when copper reacts with moist CO₂ in air. It is a base, so it reacts with and dissolves in dilute acid (neutralisation reaction).

(iii) The mixture is called an **alloy**. Advantage: Pure gold (24 carat) is very soft; alloying with copper or silver makes it harder and more suitable for making jewellery.

(iv) The claim is **incorrect**. Iron requires both air (oxygen) and moisture to rust. In completely dry air, no moisture is present, so rusting will not occur (as shown by the iron nail in dry air remaining rust-free).

Source: Chapter 3, Section 3.5 Corrosion; Do You Know box (Alloys)

Explanation

- **(i)** Examiners expect mention of reactivity series positions — gold/silver are least reactive (bottom), iron is above them.
- **(ii)** The exact name "basic copper carbonate" is required; saying "it dissolves because it is basic/alkaline" earns the mark.
- **(iii)** "Alloy" is the keyword. The advantage must relate to hardness/durability, not just appearance.
- **(iv)** This is a direct application of Activity 3.14 — both air AND water are needed. Stating only one condition is insufficient.

Q33. medium exam-ready

[4]

Read the following and answer the questions that follow:

In a school laboratory, a teacher demonstrated the extraction of metals using different methods. For metal X (found as its sulphide ore), she first heated it strongly in excess air, then reduced the product with carbon to obtain the metal. For metal Y, she showed that simply heating its oxide in a test tube was sufficient to obtain the metal as droplets. For metal Z (a very reactive metal), she performed electrolysis of its molten chloride to deposit it at one of the electrodes.

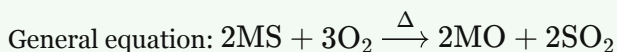
- (i) What is the name of the process used to convert the sulphide ore of metal X into its oxide? Write a general equation for this conversion. (1 mark)
- (ii) What does the extraction of metal Y by heating alone tell you about its position in the activity series? Name one such metal. (1 mark)
- (iii) At which electrode is metal Z deposited during electrolysis? Write the half-reaction that occurs at that electrode. (1 mark)
- (iv) During the electrolytic refining of a metal, an impure residue settles at the bottom of the electrolytic cell. What is this residue called, and what does it contain? (1 mark)

◆ Metals and Non-metals

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Model Answer

(i) The process is called **roasting**. The sulphide ore is heated strongly in excess air to convert it into a metal oxide.



(ii) It tells us that metal Y is **low in the activity series** (least reactive). Its oxide is unstable and is easily reduced by heat alone. **Mercury (Hg)** is one such metal.

(iii) Metal Z is deposited at the **cathode** (negatively charged electrode).



(iv) The insoluble residue that settles at the bottom is called **anode mud**. It contains insoluble impurities from the impure metal, which may include precious metals like gold and silver.

Source: Chapter 3, Sections 3.4.3, 3.4.4, 3.4.5, 3.4.6

Explanation

- (i) Roasting = heating sulphide ore in excess air → metal oxide + SO₂. Don't confuse with calcination (carbonate ores, limited air).
- (ii) Key link: metals low in activity series → oxide easily decomposed by heat alone. Mercury is the textbook example (from cinnabar/HgS).
- (iii) Cathode is negative → attracts positive metal ions → metal deposited. The half-reaction given in the textbook uses Na⁺ (as metal Z is a very reactive metal extracted by electrolysis of molten chloride — fits Na/Mg/Ca).
- (iv) "Anode mud" is the exact CBSE term. Examiners expect both the name and that it contains insoluble/precious metal impurities.

Q34. deep exam-ready

[4]

Read the following and answer the questions that follow:

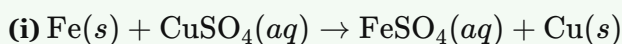
Preeti observed that when she added a clean iron nail to a blue solution of copper sulphate, the solution gradually turned light green and a reddish-brown deposit appeared on the iron nail. Her teacher explained that a metal higher in the activity series displaces a metal lower down from its salt solution, and that this principle is used to compare the reactivity of metals.

- (i) Write the balanced chemical equation for the reaction that occurred when the iron nail was placed in copper sulphate solution. Name the type of reaction. (1 mark)
- (ii) Why did the blue colour of the copper sulphate solution fade and turn light green? (1 mark)
- (iii) If Preeti places a copper wire in a solution of iron sulphate (FeSO_4), what will she observe? Give a reason based on the activity series. (1 mark)
- (iv) Using the same principle of displacement, predict whether zinc can displace copper from copper sulphate solution. Write the balanced equation if the reaction occurs, or justify why it does not. (1 mark)

◆ Metals and Non-metals

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Model Answer

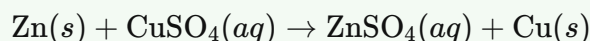


This is a **displacement reaction** (iron displaces copper from copper sulphate solution).

(ii) Iron reacts with blue copper sulphate to form green iron sulphate (FeSO_4). As Cu^{2+} ions are replaced by Fe^{2+} ions, the blue colour fades and turns light green.

(iii) No reaction will occur. Copper is lower than iron in the activity series, so copper cannot displace iron from iron sulphate solution. No change will be observed in the solution or on the copper wire.

(iv) Yes, zinc can displace copper because zinc is more reactive than copper (higher in the activity series). The reaction is:



Source: Chapter 1, Section 1.2.3 Displacement Reaction

Explanation

- (i) The equation from the textbook (Eq. 1.24) is already balanced (1 Fe, 1 Cu, 1 S, 4 O on each side). Always name the reaction type.
- (ii) Focus on the *ionic* change: Cu^{2+} (blue) is replaced by Fe^{2+} (pale green). Examiners want both the chemical reason and the colour explanation.
- (iii) A common trap — students assume a reaction always occurs. The activity series rule works both ways: a less reactive metal **cannot** displace a more reactive one.
- (iv) Equation 1.25 from the textbook directly supports this. Zinc and lead are explicitly stated to be more reactive than copper.

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