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## CHAPTER 3

# Metals and Non-metals

Fe

Class 10 Science – NCERT Exemplar | Complete Study Guide

## KEY TERMS / GLOSSARY

<b>Ductility</b>	Ability to be drawn into thin wires. e.g. copper, gold.
<b>Malleability</b>	Ability to be beaten into thin sheets. e.g. gold, aluminium.
<b>Sonorous</b>	Property of metals to produce ringing sound when struck.
<b>Alloy</b>	Homogeneous mixture of a metal with another metal or non-metal.
<b>Ore</b>	Mineral from which a metal can be profitably extracted.
<b>Gangue</b>	Unwanted rocky material present along with the ore.
<b>Calcination</b>	Heating ore in absence of air to remove moisture/CO <sub>2</sub> .
<b>Roasting</b>	Heating sulphide ore in presence of air to convert to oxide.
<b>Smelting</b>	Reduction of metal oxide with coke to obtain metal.
<b>Electrolytic refining</b>	Purification of impure metal using electrolysis.
<b>Corrosion</b>	Slow destruction of metal surface by chemical reactions.
<b>Galvanisation</b>	Coating iron with zinc to prevent rusting.
<b>Amphoteric oxide</b>	Oxide that reacts with both acids and bases. e.g. Al <sub>2</sub> O <sub>3</sub> , ZnO.
<b>Native state</b>	Metals found in free (uncombined) form in nature. e.g. Au, Ag, Pt.
<b>Activity series</b>	Arrangement of metals in decreasing order of reactivity.

## PROPERTIES: METALS vs NON-METALS — QUICK COMPARISON

Property	Metals	Non-metals
Physical state	Mostly solid (except Hg=liquid)	Solid, liquid, or gas
Lustre	Lustrous (shiny)	Generally dull (iodine = lustrous exception)
Hardness	Hard (except Na, K = soft)	Generally soft (diamond = exception)
Conductivity	Good conductor of heat & electricity	Generally poor conductors (graphite = exception)
Malleability	Malleable (can be beaten flat)	Brittle (shatter when struck)
Ductility	Ductile (drawn into wires)	Not ductile
Sonorosity	Sonorous (ringing sound)	Not sonorous

Melting point	High (except Ga, Cs, Hg)	Variable (low to high)
Oxides formed	Basic oxides (Al <sub>2</sub> O <sub>3</sub> , ZnO = amphoteric)	Acidic oxides (CO <sub>2</sub> , SO <sub>2</sub> )
Ionic/covalent	Form ionic compounds (lose electrons)	Form covalent compounds (share/gain e <sup>-</sup> )

## SECTION A: MULTIPLE CHOICE QUESTIONS (Q1–Q36)

✓ **Green** = Correct | ✗ **Red** = Incorrect

**Q1.**

Which property is generally **NOT** shown by metals?

- ✗ (a) Electrical conduction — metals ARE good conductors
- ✗ (b) Sonorous — metals DO produce ringing sound
- ✓ (c) Dullness
- ✗ (d) Ductility — metals ARE ductile

✓ **CORRECT ANSWER: (c) Dullness**

Metals are **LUSTROUS** (shiny) — NOT dull. Dullness is a property of non-metals.

Key metal properties: lustre, ductility, malleability, sonority, high conductivity.

Exception: Iodine (non-metal) is lustrous. Na, K (metals) are soft but still lustrous.

**Q2.**

Ability of metals to be drawn into thin wire is known as:

- ✓ (a) Ductility
- ✗ (b) Malleability — beaten into sheets, not wires
- ✗ (c) Sonorousity — ringing sound property
- ✗ (d) Conductivity — ability to conduct heat/electricity

✓ **CORRECT ANSWER: (a) Ductility**

**Ductility** = ability to be drawn into thin wires. e.g. copper, gold, aluminium.

**Malleability** = ability to be beaten into thin flat sheets. e.g. gold (most malleable).

Gold is most malleable AND most ductile metal.

**Q3.**

Aluminium used for cooking utensils. Which properties are responsible?

(i) Good thermal conductivity (ii) Good electrical conductivity  
(iii) Ductility (iv) High melting point

- ✗ (a) (i) and (ii)
- ✗ (b) (i) and (iii)
- ✗ (c) (ii) and (iii)
- ✓ (d) (i) and (iv)

✓ CORRECT ANSWER: (d) (i) and (iv)

(i) ✓ **Good thermal conductivity:** Al heats up quickly and evenly — perfect for cooking.

(iv) ✓ **High melting point:** Al's melting point (660°C) is far above cooking temperatures — safe.

(ii) ✗ **Electrical conductivity:** Not relevant for cooking utensils.

(iii) ✗ **Ductility:** Not needed for utensils (used for wires, not pots).

Q4.

Which metal does NOT react with cold water OR hot water?

✗ (a) Na — reacts vigorously with cold water

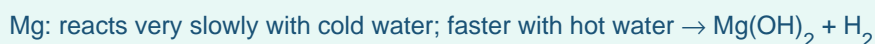
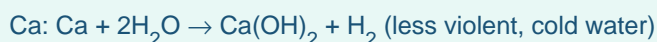
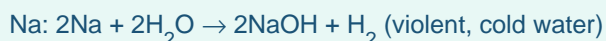
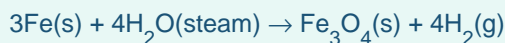
✗ (b) Ca — reacts with cold water

✗ (c) Mg — reacts very slowly with cold water, faster with hot water

✓ (d) Fe — reacts only with steam, not cold/hot water

✓ CORRECT ANSWER: (d) Fe (Iron)

Fe does NOT react with cold or hot water. It reacts only with STEAM:



Q5.

Oxide of iron obtained on PROLONGED reaction with steam?

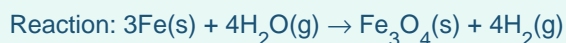
✗ (a) FeO — iron(II) oxide, not from steam reaction

✗ (b) Fe<sub>2</sub>O<sub>3</sub> — rust, forms in air+moisture not steam

✓ (c) Fe<sub>3</sub>O<sub>4</sub> — magnetite, from steam reaction

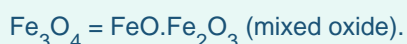
✗ (d) Fe<sub>2</sub>O<sub>3</sub> and Fe<sub>3</sub>O<sub>4</sub> — only Fe<sub>3</sub>O<sub>4</sub> from steam

✓ CORRECT ANSWER: (c) Fe<sub>3</sub>O<sub>4</sub>



Fe<sub>3</sub>O<sub>4</sub> is a black magnetic oxide (magnetite). It contains both Fe<sup>2+</sup> and Fe<sup>3+</sup>.

Fe<sub>2</sub>O<sub>3</sub> (rust) forms in presence of oxygen AND moisture, not steam.



Q6.

What happens when calcium is treated with water?

(i) Does not react (ii) Reacts violently (iii) Reacts less violently (iv) H<sub>2</sub> bubbles stick to Ca surface

✗ (a) (i) and (iv)

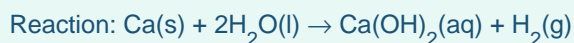
✗ (b) (ii) and (iii)

**x (c)** (i) and (ii)

**✓ (d)** (iii) and (iv)

**✓ CORRECT ANSWER: (d) (iii) and (iv)**

Ca reacts LESS VIOLENTLY than Na with water. So (iii) is correct.



H<sub>2</sub> gas bubbles form and stick to the surface of Ca — Ca floats/sinks as bubbles attach/detach.

(ii) is wrong — Na reacts violently; Ca is less violent. (i) wrong — Ca does react.

**Q7.**

**Which acid does NOT give H<sub>2</sub> gas when reacting with metals (except Mn and Mg)?**

**x (a)** H<sub>2</sub>SO<sub>4</sub> — gives H<sub>2</sub> with most metals

**x (b)** HCl — gives H<sub>2</sub> with most metals

**✓ (c)** HNO<sub>3</sub> — does NOT give H<sub>2</sub> gas

**x (d)** All of these

**✓ CORRECT ANSWER: (c) HNO<sub>3</sub>**

HNO<sub>3</sub> is a strong OXIDISING ACID — it oxidises H<sub>2</sub> as soon as it forms, converting it to H<sub>2</sub>O.

Instead, oxides of nitrogen (NO, NO<sub>2</sub>, N<sub>2</sub>O) are produced.



Mn and Mg are exceptions — they do react with HNO<sub>3</sub> to give H<sub>2</sub>.

**Q8.**

**Composition of aqua regia is:**

**x (a)** Dil.HCl : Conc.HNO<sub>3</sub> = 3:1 — wrong concentrations

**x (b)** Conc.HCl : Dil.HNO<sub>3</sub> = 3:1 — HNO<sub>3</sub> must be conc.

**✓ (c)** Conc.HCl : Conc.HNO<sub>3</sub> = 3:1

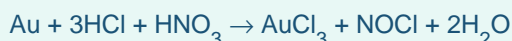
**x (d)** Dil.HCl : Dil.HNO<sub>3</sub> = 3:1 — both must be concentrated

**✓ CORRECT ANSWER: (c) Conc. HCl : Conc. HNO<sub>3</sub> = 3:1**

Aqua regia = 3 parts concentrated HCl + 1 part concentrated HNO<sub>3</sub>.

Latin: 'Royal water' — dissolves noble/royal metals (gold, platinum).

Neither HCl nor HNO<sub>3</sub> alone can dissolve gold. Together they produce Cl<sub>2</sub> and NOCl (nitrosyl chloride).



**Q9.**

**Which are NOT ionic compounds?**

**(i) KCl (ii) HCl (iii) CCl<sub>4</sub> (iv) NaCl**

**x (a)** (i) and (ii) — KCl IS ionic

✓ (b) (ii) and (iii)

✗ (c) (iii) and (iv) — NaCl IS ionic

✗ (d) (i) and (iii) — KCl IS ionic

✓ CORRECT ANSWER: (b) (ii) and (iii)

Ionic compounds: metal + non-metal, formed by electron TRANSFER.

KCl ✓ ionic ( $K^+ Cl^-$ ); NaCl ✓ ionic ( $Na^+ Cl^-$ ).

HCl ✗ NOT ionic — H is non-metal, Cl is non-metal → COVALENT bond (sharing of electrons).

$CCl_4$  ✗ NOT ionic — C is non-metal, Cl is non-metal → COVALENT compound.

Q10.

Which property is NOT generally exhibited by ionic compounds?

✗ (a) Solubility in water — ionic compounds DO dissolve in water

✓ (b) Electrical conductivity in SOLID state

✗ (c) High melting and boiling points — ionic DO have high mp/bp

✗ (d) Electrical conductivity in molten state — ionic DO conduct when molten

✓ CORRECT ANSWER: (b) Electrical conductivity in solid state

Ionic compounds do NOT conduct electricity in SOLID state.

Reason: In solid state, ions are fixed in rigid lattice — cannot move freely.

They CONDUCT in (i) MOLTEN state — ions free to move, and (ii) AQUEOUS solution — ions dissociate.

High mp/bp: strong electrostatic forces between ions need lots of energy to break.

Soluble in water: polar water molecules surround and separate the ions.

Q11.

Which metals exist in native (free) state in nature?

(i) Cu (ii) Au (iii) Zn (iv) Ag

✗ (a) (i) and (ii) — Cu is rarely found native

✗ (b) (ii) and (iii) — Zn is not found native

✓ (c) (ii) and (iv) — Au and Ag

✗ (d) (iii) and (iv) — Zn is not found native

✓ CORRECT ANSWER: (c) (ii) and (iv) — Au and Ag

Metals found in native (free/uncombined) state: Gold (Au), Silver (Ag), Platinum (Pt).

These are LEAST REACTIVE metals — at the bottom of the activity series.

They don't react with air, water, or acids → exist naturally as pure metal.

Zn and Cu are moderately reactive → found as ores (sulphides, oxides), NOT free.

Q12.

### Which metals are refined by electrolytic refining?

(i) Au (ii) Cu (iii) Na (iv) K

- ✓ (a) (i) and (ii) — Au and Cu
- ✗ (b) (i) and (iii) — Na not refined by electrolysis of salt
- ✗ (c) (ii) and (iii)
- ✗ (d) (iii) and (iv) — Na and K extracted, not refined this way

✓ **CORRECT ANSWER: (a) (i) and (ii)**

Electrolytic refining purifies metals like Cu, Ag, Au, Zn.

Impure metal = anode; Pure metal = cathode; Salt solution of metal = electrolyte.

Na and K are extracted by electrolysis of their **MOLTEN** chlorides (not refined this way).

Cu is the most common example in electrolytic refining.

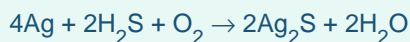
### Q13.

Silver articles turn black on prolonged exposure to air due to formation of:

- ✗ (a) Ag<sub>3</sub>N — unlikely in normal air
- ✗ (b) Ag<sub>2</sub>O — silver oxide is not the main cause of blackening
- ✓ (c) Ag<sub>2</sub>S — silver sulphide
- ✗ (d) Ag<sub>2</sub>S and Ag<sub>3</sub>N — mainly Ag<sub>2</sub>S is responsible

✓ **CORRECT ANSWER: (c) Ag<sub>2</sub>S — Silver sulphide**

Silver reacts with H<sub>2</sub>S present in air → black Ag<sub>2</sub>S coating.



This is an example of **CORROSION** (tarnishing) of silver.

Toothpaste (mild abrasive) removes the Ag<sub>2</sub>S layer — restores shine.

### Q14.

Galvanisation protects iron from rusting by coating with:

- ✗ (a) Gallium — not used for galvanisation
- ✗ (b) Aluminium — Al is used but process called aluminising, not galvanisation
- ✓ (c) Zinc
- ✗ (d) Silver — too expensive, not used for galvanisation

✓ **CORRECT ANSWER: (c) Zinc**

Galvanisation = coating iron with zinc to prevent rusting.

Zinc is more reactive than iron → it acts as **SACRIFICIAL** anode.

Even if the Zn coating is scratched, Zn corrodes first (protects Fe).

Used on buckets, dustbins, roofing sheets, iron pipes.

### Q15.

In stainless steel, iron is mixed with:

- ✓ (a) Ni and Cr — nickel and chromium
- ✗ (b) Cu and Cr
- ✗ (c) Ni and Cu
- ✗ (d) Cu and Au

✓ CORRECT ANSWER: (a) Ni and Cr

Stainless steel = Fe + Cr (chromium, ~18%) + Ni (nickel, ~8%) + small amounts of C.

Chromium forms  $\text{Cr}_2\text{O}_3$  layer on surface → prevents rusting.

Used for cutlery, surgical instruments, kitchen utensils.

Q16.

Copper in air loses shiny brown surface and gains green coating. Due to:

- ✗ (a)  $\text{CuSO}_4$  — copper sulphate, blue solid
- ✓ (b)  $\text{CuCO}_3$  — copper carbonate, green
- ✗ (c)  $\text{Cu}(\text{NO}_3)_2$  — blue compound
- ✗ (d)  $\text{CuO}$  — black compound

✓ CORRECT ANSWER: (b)  $\text{CuCO}_3$  — Basic copper carbonate

Copper reacts with  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ , and  $\text{O}_2$  in air → forms green patina.

The green coating is basic copper carbonate:  $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ .

This is CORROSION of copper (also called tarnishing or patination).

Famous example: The Statue of Liberty — made of copper, green due to same reaction.

Q17.

Which metal is found in LIQUID state at room temperature?

- ✗ (a) Na — solid at room temp
- ✗ (b) Fe — solid
- ✗ (c) Cr — solid
- ✓ (d) Hg — Mercury, liquid metal

✓ CORRECT ANSWER: (d) Hg — Mercury

Mercury (Hg) is the ONLY metal that is liquid at room temperature (melting point =  $-39^\circ\text{C}$ ).

Other nearly-liquid metals: Gallium (Ga) melts at  $29.8^\circ\text{C}$  — melts in your hand!

Non-metal liquid at room temp: Bromine (Br) — reddish-brown liquid.

Q18.

Which metals obtained by electrolysis of molten chlorides?

(i) Na (ii) Ca (iii) Fe (iv) Cu

- ✗ (a) (i) and (iv)

**x (b)** (iii) and (iv)

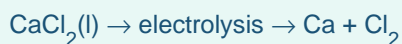
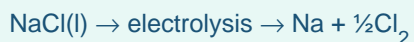
**x (c)** (i) and (iii)

**✓ (d)** (i) and (ii)

**✓ CORRECT ANSWER: (d) (i) and (ii) — Na and Ca**

Very reactive metals (top of activity series: Na, K, Ca, Mg, Al) cannot be reduced by carbon.

They are extracted by electrolysis of their **MOLTEN** chlorides:



Fe and Cu are less reactive → extracted by carbon reduction/smelting, **NOT** electrolysis.

**Q19.**

**Which non-metal is LUSTROUS?**

**x (a)** Sulphur — dull yellow solid

**x (b)** Oxygen — gas, not lustrous

**x (c)** Nitrogen — gas, not lustrous

**✓ (d)** Iodine — has metallic lustre

**✓ CORRECT ANSWER: (d) Iodine**

Iodine is the exception — a non-metal that has a shiny/metallic lustre.

Most non-metals are dull (no lustre). Iodine is a greyish-black crystalline solid with a sheen.

Similarly: Graphite (allotrope of carbon) is also lustrous.

These are exceptions to general non-metal properties.

**Q20.**

**Which metal would be DISPLACED from salt solution by the other three?**

**x (a)** Mg — most reactive, displaces all others

**✓ (b)** Ag — least reactive

**x (c)** Zn — reactive, displaces Cu, Ag

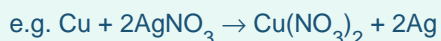
**x (d)** Cu — displaces only Ag

**✓ CORRECT ANSWER: (b) Ag — Silver**

Activity series for these metals: Mg > Zn > Cu > Ag.

Ag is **LEAST** reactive → can be displaced by all three others (Mg, Zn, Cu).

More reactive metal displaces less reactive metal from its salt solution.



**Q21.**

**Tube A = conc. HCl, Tube B = conc. HNO<sub>3</sub>, Tube C = conc.HCl:conc.HNO<sub>3</sub> (3:1). Metal dissolves ONLY in C. Metal is:**

**x (a)** Al — dissolves in conc. HNO<sub>3</sub> (passivation by HNO<sub>3</sub>)

**✓ (b)** Au — gold dissolves only in aqua regia

**x (c)** Cu — dissolves in conc. HNO<sub>3</sub>

**x (d)** Pt — platinum; question says Au or Pt, but Au is standard answer

**✓ CORRECT ANSWER: (b) Au (Gold)**

Tube C = aqua regia (3 parts HCl : 1 part HNO<sub>3</sub>) — the ONLY acid mixture that dissolves gold.

Gold does not react with HCl alone or HNO<sub>3</sub> alone.

Pt (platinum) also dissolves only in aqua regia — both Au and Pt are valid but Au is the standard answer.

Al becomes passive in conc. HNO<sub>3</sub> (forms protective Al<sub>2</sub>O<sub>3</sub> layer).

**Q22.**

**An alloy is:**

**x (a)** An element — alloys are mixtures, not elements

**x (b)** A compound — not chemically bonded

**✓ (c)** A homogeneous mixture

**x (d)** A heterogeneous mixture — alloys are uniform/homogeneous

**✓ CORRECT ANSWER: (c) A homogeneous mixture**

An alloy is a HOMOGENEOUS MIXTURE of metals (or metal + non-metal).

Homogeneous = uniform composition throughout.

Examples: Brass (Cu+Zn), Bronze (Cu+Sn), Solder (Pb+Sn), Steel (Fe+C).

Alloys improve properties: harder, stronger, more resistant to corrosion.

**Q23.**

**An electrolytic cell consists of:**

**(i) Positively charged cathode (ii) Negatively charged anode**

**(iii) Positively charged anode (iv) Negatively charged cathode**

**x (a)** (i) and (ii)

**✓ (b)** (iii) and (iv)

**x (c)** (i) and (iii)

**x (d)** (ii) and (iv)

**✓ CORRECT ANSWER: (b) (iii) and (iv)**

Anode = positive electrode (+) — connected to positive terminal of battery.

Cathode = negative electrode (-) — connected to negative terminal.

At anode: oxidation (loss of electrons). At cathode: reduction (gain of electrons).

In refining: Impure metal at ANODE dissolves; pure metal deposits at CATHODE.

**Q24.**

During electrolytic refining of zinc, it gets:

- ✓ (a) Deposited on cathode
- ✗ (b) Deposited on anode — anode dissolves, doesn't gain
- ✗ (c) Deposited on both — wrong
- ✗ (d) Remains in solution — pure metal deposits, not stays

✓ **CORRECT ANSWER: (a) Deposited on cathode**

In electrolytic refining: Impure Zn (anode) dissolves →  $Zn^{2+}$  ions in solution → Pure Zn deposits at cathode.

At anode:  $Zn(\text{impure}) \rightarrow Zn^{2+} + 2e^{-}$

At cathode:  $Zn^{2+} + 2e^{-} \rightarrow Zn(\text{pure})$

Impurities fall to bottom as 'anode mud'.

**Q25.**

Element A is soft, cut with knife, very reactive to air, reacts vigorously with water. Identify:

- ✗ (a) Mg — not soft, doesn't cut with knife
- ✓ (b) Na — sodium
- ✗ (c) P — phosphorus, non-metal
- ✗ (d) Ca — harder than Na

✓ **CORRECT ANSWER: (b) Na — Sodium**

Na is soft (can be cut with knife), silvery-white metal.

Very reactive to air → stored in kerosene oil.

$2Na + 2H_2O \rightarrow 2NaOH + H_2$  (violent, exothermic).

K (potassium) also fits this description but is even more reactive.

**Q26.**

Which alloy contains a **NON-METAL** as one of its constituents?

- ✗ (a) Brass — Cu + Zn (both metals)
- ✗ (b) Bronze — Cu + Sn (both metals)
- ✗ (c) Amalgam — Hg + metal (all metals)
- ✓ (d) Steel — Fe + C (carbon is non-metal)

Alloy	Constituents	Non-metal?
Brass	Cu + Zn	No
Bronze	Cu + Sn	No
Solder	Pb + Sn	No
Amalgam	Hg + another metal	No

Steel	Fe + C (carbon)	Yes — C is non-metal
Stainless steel	Fe + Ni + Cr + C	Yes — C is non-metal
Alnico	Al + Ni + Co	No

✓ CORRECT ANSWER: (d) Steel

Steel = Fe (iron) + C (carbon). Carbon is a non-metal.

**Q27.**

Which statement is **INCORRECT** for magnesium?

- ✗ (a) Burns in O<sub>2</sub> with dazzling white flame — CORRECT
- ✓ (b) Reacts with COLD water to form MgO + H<sub>2</sub> — INCORRECT
- ✗ (c) Reacts with hot water → Mg(OH)<sub>2</sub> + H<sub>2</sub> — CORRECT
- ✗ (d) Reacts with steam → Mg(OH)<sub>2</sub> + H<sub>2</sub> — CORRECT

✓ CORRECT ANSWER: (b) [The incorrect statement]

Mg does NOT react with cold water. It only reacts VERY SLOWLY.

Mg with hot water:  $\text{Mg(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Mg(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$

Mg with steam:  $\text{Mg(s)} + \text{H}_2\text{O(g)} \rightarrow \text{MgO(s)} + \text{H}_2\text{(g)}$

Note: With cold water, Mg does NOT form MgO — that's for steam reaction.

**Q28.**

Which alloy contains mercury?

- ✗ (a) Stainless steel — Fe+Ni+Cr
- ✗ (b) Alnico — Al+Ni+Co
- ✗ (c) Solder — Pb+Sn
- ✓ (d) Zinc amalgam

✓ CORRECT ANSWER: (d) Zinc amalgam

Amalgam = alloy containing mercury (Hg).

Examples: Zinc amalgam (Zn+Hg), dental amalgam (Ag+Hg+Sn), sodium amalgam.

Any alloy with mercury = amalgam. Mercury is the only liquid metal at room temperature.

**Q29.**

X loses electron, Y gains electron → compound Z. Which property is NOT shown by Z?

- ✗ (a) Has high melting point — ionic compounds DO have high mp
- ✓ (b) Has low melting point
- ✗ (c) Conducts electricity in molten state — ionic compounds DO
- ✗ (d) Occurs as solid — ionic compounds are solid

✓ CORRECT ANSWER: (b) Has low melting point

X loses electron → cation; Y gains electron → anion → they form IONIC compound Z.

Ionic compounds have HIGH melting points (NOT low) due to strong electrostatic forces.

Z is an ionic compound → Properties: high mp, soluble in water, conducts in molten/aqueous state, solid.

LOW melting point = property of covalent compounds (e.g. wax, ice).

### Q30.

Electronic configs: X=2,8; Y=2,8,7; Z=2,8,2. Which is correct?

- (a) X is a metal — X has full outer shell, it's noble gas (Ar-like)
- (b) Y is a metal — Y has 7 valence e-, it's a non-metal/halogen
- (c) Z is a non-metal — Z has 2 valence e-, it's a metal
- (d) Y is a non-metal and Z is a metal

✓ CORRECT ANSWER: (d) Y is a non-metal and Z is a metal

X (2,8) = 8 electrons in outer shell → Noble gas (Neon-like). Neither metal nor typical non-metal.

Y (2,8,7) = 7 valence electrons → tends to GAIN 1 electron → non-metal (halogen, like Cl).

Z (2,8,2) = 2 valence electrons → tends to LOSE 2 electrons → METAL (like Mg).

Metals: 1-3 valence electrons (lose them). Non-metals: 4-7 valence electrons (gain/share).

### Q31.

Which metal forms an AMPHOTERIC oxide?

- (a) Na — Na<sub>2</sub>O is basic only
- (b) Ca — CaO is basic only
- (c) Al — Al<sub>2</sub>O<sub>3</sub> is amphoteric
- (d) Cu — CuO is basic only

✓ CORRECT ANSWER: (c) Al — Aluminium

Al<sub>2</sub>O<sub>3</sub> (aluminium oxide) is AMPHOTERIC — reacts with BOTH acids and bases.

With acid: Al<sub>2</sub>O<sub>3</sub> + 6HCl → 2AlCl<sub>3</sub> + 3H<sub>2</sub>O

With base: Al<sub>2</sub>O<sub>3</sub> + 2NaOH → 2NaAlO<sub>2</sub> + H<sub>2</sub>O

ZnO is also amphoteric. MgO, CaO, Na<sub>2</sub>O are basic only.

### Q32.

Which non-metal is a GOOD CONDUCTOR of electricity?

- (a) Diamond — non-conductor (all covalent bonds in lattice)
- (b) Graphite — good conductor
- (c) Sulphur — insulator
- (d) Fullerene — poor conductor

✓ CORRECT ANSWER: (b) Graphite

Graphite is an allotrope of carbon (non-metal) — a good conductor of electricity.

Reason: Each C atom bonds to 3 others in layers → 4th electron is FREE to move.

These free electrons allow electrical conduction.

Used as electrodes in electrolysis and in dry cells (pencil 'lead').

**Q33.**

**Electrical wire coating (insulating material) generally used is:**

**x (a)** Sulphur — brittle, not flexible

**x (b)** Graphite — it's a CONDUCTOR, cannot insulate!

**✓ (c)** PVC — Polyvinyl chloride

**x (d)** All can be used — Graphite conducts, cannot insulate

**✓ CORRECT ANSWER: (c) PVC — Polyvinyl chloride**

PVC (polyvinyl chloride) is a flexible polymer — good electrical insulator.

Used to coat electrical wires to prevent shock and short circuits.

Graphite is a CONDUCTOR — it would allow electricity to pass, causing short circuits.

Rubber is also used as insulating coating.

**Q34.**

**Which non-metal is a LIQUID?**

**x (a)** Carbon — solid (graphite/diamond)

**✓ (b)** Bromine — reddish-brown liquid

**x (c)** Phosphorus — solid

**x (d)** Sulphur — solid

**✓ CORRECT ANSWER: (b) Bromine**

Bromine (Br) is the only non-metal that is liquid at room temperature.

Reddish-brown liquid, very reactive, choking smell.

Note: Mercury (Hg) is the only metal liquid at room temperature.

These two (Br and Hg) are the only elements liquid at room temperature.

**Q35.**

**Which can undergo a chemical reaction?**

**x (a)**  $\text{MgSO}_4 + \text{Fe}$  — Fe less reactive than Mg, no displacement

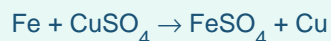
**x (b)**  $\text{ZnSO}_4 + \text{Fe}$  — Fe less reactive than Zn, no displacement

**x (c)**  $\text{MgSO}_4 + \text{Pb}$  — Pb less reactive than Mg, no displacement

**✓ (d)**  $\text{CuSO}_4 + \text{Fe}$  — Fe more reactive than Cu, displaces it

**✓ CORRECT ANSWER: (d)  $\text{CuSO}_4 + \text{Fe}$**

Activity series:  $Mg > Zn > Fe > Cu$ . Fe is MORE reactive than Cu.



Iron displaces copper from copper sulphate solution.

Blue colour of  $CuSO_4$  fades  $\rightarrow$  colourless  $FeSO_4$ ; reddish Cu deposits.

Only a more reactive metal can displace a less reactive one from its salt solution.

**Q36.**

Which figure correctly shows electrolytic refining?

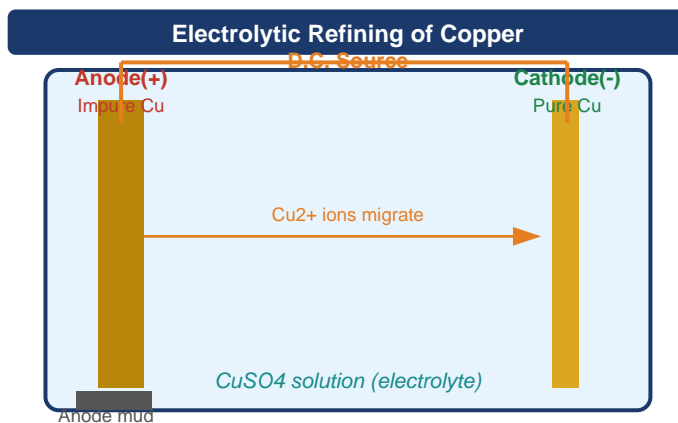
(Setup: impure metal=anode, pure metal=cathode, metal salt=electrolyte)

✓ **CORRECT ANSWER: (c)**

Correct setup: Impure metal at ANODE (connected to +ve terminal), Pure metal at CATHODE (connected to -ve terminal).

Key + terminal  $\rightarrow$  anode (positive). Key - terminal  $\rightarrow$  cathode (negative).

Impurities fall as anode mud at bottom. Pure metal builds up at cathode.



## SECTION B: SHORT ANSWER QUESTIONS (Q37–Q58)

**Q37.**

Lustrous divalent element M reacts with NaOH AND with HCl → both give bubbles. Identify gas and write equations:

✓ Answer 37 — Element M = Zinc (Zn)

Zinc is DIVALENT ( $Zn^{2+}$ ), lustrous, AMPHOTERIC — reacts with both acids AND bases.

Gas produced in both cases =  $H_2$  (hydrogen) — burns with pop sound.

With NaOH:  $Zn(s) + 2NaOH(aq) \rightarrow Na_2ZnO_2(aq) + H_2(g)$

With HCl:  $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

Test for  $H_2$ : Bring a burning splinter near the gas — burns with a 'pop' sound.

**Q38.**

Electrolytic refining of silver: (a) anode/cathode material, (b) electrolyte, (c) where do we get pure silver?

✓ Answer 38

(a) Anode = Impure silver (crude silver); Cathode = Pure silver (thin strip)

(b) Electrolyte = Silver nitrate solution ( $AgNO_3$ )

(c) Pure silver is obtained at the CATHODE

Process: Impure Ag (anode) dissolves →  $Ag^+$  ions in solution →  $Ag^+$  deposits as pure Ag at cathode.

At anode:  $Ag(\text{impure}) \rightarrow Ag^+ + e^-$

At cathode:  $Ag^+ + e^- \rightarrow Ag(\text{pure})$

Impurities (Cu, Pb, etc.) fall as anode mud.

**Q39.**

Why must metal sulphides and carbonates be converted to metal oxides before extraction?

✓ Answer 39

It is EASIER to reduce metal oxides compared to sulphides or carbonates.

Metal oxides + coke (C) → metal +  $CO_2$  (simple reduction)

If we tried to reduce sulphides directly: we'd get metal sulphides +  $SO_2$  (toxic gas).

Carbonates: directly heated (calcination) → oxide +  $CO_2$

e.g.  $ZnCO_3 \rightarrow ZnO + CO_2$  (calcination)

Sulphides: heated in air (roasting) → oxide +  $SO_2$

e.g.  $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$  (roasting)

Then:  $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$  (reduction/smelting)

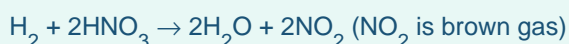
**Q40.**

**Metals + mineral acids  $\rightarrow$  H<sub>2</sub>; but metals + HNO<sub>3</sub>  $\rightarrow$  no H<sub>2</sub> (except Mn, Mg). Why?**

✓ Answer 40

HNO<sub>3</sub> is a strong OXIDISING AGENT.

When H<sub>2</sub> gas is first produced, HNO<sub>3</sub> immediately oxidises it:



Instead, oxides of nitrogen are produced: NO<sub>2</sub>, NO, or N<sub>2</sub>O depending on concentration.



Mn and Mg are exceptions — they react so fast that H<sub>2</sub> is produced before it can be oxidised.

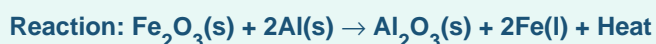
**Q41.**

**Compound X + aluminium  $\rightarrow$  used to join railway tracks. Identify X, name reaction, write reaction:**

✓ Answer 41 — Thermite Reaction

X = Fe<sub>2</sub>O<sub>3</sub> (Iron(III) oxide / ferric oxide)

Reaction name: Thermite Reaction (also called thermit welding)



This reaction produces molten iron (2500°C+) which is poured into gaps between railway tracks.

It is a displacement reaction: Al (more reactive) displaces Fe from its oxide.

Also a redox reaction: Al is oxidised; Fe is reduced.

**Q42.**

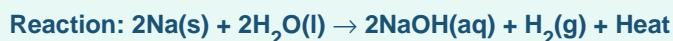
**Metal X + cold water  $\rightarrow$  salt Y (formula XOH, mass=40) + gas Z (catches fire). Identify X, Y, Z:**

✓ Answer 42

X = Na (Sodium). Molecular mass of NaOH = 23+16+1 = 40 ✓

Y = NaOH (Sodium hydroxide). Formula XOH  $\rightarrow$  NaOH, mass 40.

Z = H<sub>2</sub> (Hydrogen gas) — catches fire (burns with pop sound).



This is a highly exothermic reaction. Na melts into a ball and skates on water.

**Q43.**

**Non-metal X has two forms Y and Z. Y = hardest natural substance, Z = good conductor. Identify X, Y, Z:**

✓ Answer 43 — Carbon and its allotropes

X = Carbon (C) — non-metal existing in two allotropic forms.

**Y = Diamond** — hardest known natural substance. Used in cutting tools.

**Z = Graphite** — good conductor of electricity (free electrons).

Both Diamond and Graphite are pure carbon — different crystal structures.

Diamond: tetrahedral 3D network — no free electrons — insulator, hardest.

Graphite: layered hexagonal structure — free electrons — soft, conductor.

**Q44.**

$3\text{MnO}_2 + 4\text{Al} \rightarrow 3\text{Mn} + 2\text{Al}_2\text{O}_3 + \text{Heat}$ . (a) Is Al getting reduced? (b) Is  $\text{MnO}_2$  getting oxidised?

✓ Answer 44

(a) Is Al getting REDUCED? → NO!

Al is OXIDISED:  $\text{Al} \rightarrow \text{Al}_2\text{O}_3$  (oxygen is ADDED to Al). Oxidation = gain of oxygen.

(b) Is  $\text{MnO}_2$  getting OXIDISED? → NO!

$\text{MnO}_2$  is REDUCED:  $\text{MnO}_2 \rightarrow \text{Mn}$  (oxygen is LOST from Mn). Reduction = loss of oxygen.

Al is the REDUCING agent (gets oxidised).  $\text{MnO}_2$  is the OXIDISING agent (gets reduced).

■ **EXAM TIP** Remember: OIL RIG — Oxidation Is Loss, Reduction Is Gain. Oxidising agent gets reduced; reducing agent gets oxidised.

**Q45.**

Constituents of solder alloy? Why suitable for welding electrical wires?

✓ Answer 45

**Solder = Pb (lead) + Sn (tin)** in ratio approximately 1:1 or 37:63.

**Suitable because of LOW MELTING POINT** — solder melts at  $\sim 183\text{--}250^\circ\text{C}$ .

This low mp allows it to melt and fill gaps between wires without damaging nearby components.

On cooling it solidifies quickly, forming a strong joint.

Lead is being replaced by lead-free solders (Sn+Ag, Sn+Cu) due to health/environmental concerns.

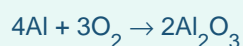
**Q46.**

Metal A used in thermite process → heated with  $\text{O}_2$  → amphoteric oxide B. Identify A, B. Write B + HCl and B + NaOH:

✓ Answer 46

**A = Aluminium (Al)** — used in thermite process (thermite =  $\text{Al} + \text{Fe}_2\text{O}_3$ ).

**B =  $\text{Al}_2\text{O}_3$**  (Aluminium oxide) — amphoteric oxide.



**B with HCl:**  $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$  (acts as BASE)

**B with NaOH:**  $\text{Al}_2\text{O}_3 + 2\text{NaOH} \rightarrow 2\text{NaAlO}_2 + \text{H}_2\text{O}$  (acts as ACID)

**Q47.**

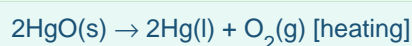
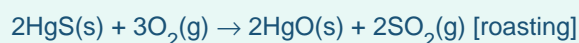
Liquid metal at room temp obtained by heating sulphide ore in air. Identify metal, ore, reaction:

✓ Answer 47

**Metal = Mercury (Hg)** — only liquid metal at room temperature.

**Ore = Cinnabar (HgS)** — sulphide ore of mercury.

**Extraction:**



Mercury is one of the few metals that can be obtained just by heating its ore in air (auto-reduction).

**Q48.**

Give formulae of stable binary compounds formed by:

(a) Mg + N<sub>2</sub> (b) Li + O<sub>2</sub> (c) Al + Cl<sub>2</sub> (d) K + O<sub>2</sub>

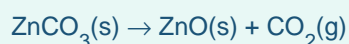
Elements	Product Formula	Name
(a) Mg + N <sub>2</sub>	Mg <sub>3</sub> N <sub>2</sub>	Magnesium nitride
(b) Li + O <sub>2</sub>	Li <sub>2</sub> O	Lithium oxide
(c) Al + Cl <sub>2</sub>	AlCl <sub>3</sub>	Aluminium chloride
(d) K + O <sub>2</sub>	K <sub>2</sub> O	Potassium oxide

**Q49.**

What happens when: (a) ZnCO<sub>3</sub> heated in absence of O<sub>2</sub>? (b) Cu<sub>2</sub>O + Cu<sub>2</sub>S heated?

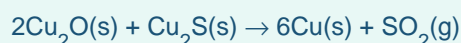
✓ Answer 49

**(a) ZnCO<sub>3</sub> heated without oxygen (calcination):**



Zinc carbonate decomposes to zinc oxide and carbon dioxide. This is calcination.

**(b) Cu<sub>2</sub>O + Cu<sub>2</sub>S heated (auto-reduction/self-reduction):**



Copper(I) oxide is reduced by copper(I) sulphide → pure copper obtained.

This is called auto-reduction or self-reduction — used in copper extraction.

**Q50.**

Non-metal A in food forms two oxides: B (toxic) and C (global warming). Identify A, B, C and group:

✓ Answer 50

**A = Carbon (C)** — essential for food (carbohydrates, proteins, fats).

**B = CO (Carbon monoxide)** — TOXIC gas, incomplete combustion product.

**C = CO<sub>2</sub> (Carbon dioxide)** — causes GLOBAL WARMING (greenhouse gas).

**Group of A:** Carbon belongs to Group 14 of the Periodic Table.

**Q51.**

**Two metals each: good conductors and poor conductors of heat:**

✓ Answer 51

**Good conductors of heat:** Silver (Ag) — best conductor; Copper (Cu).

**Poor conductors of heat:** Lead (Pb); Mercury (Hg).

**Q52.**

**One metal and one non-metal liquid at room temperature. Two metals with melting point < 310K:**

✓ Answer 52

**Metal liquid at room temp:** Mercury (Hg)

**Non-metal liquid at room temp:** Bromine (Br)

**Two metals with mp < 310K (37°C):** Caesium (Cs, mp=28.5°C) and Gallium (Ga, mp=29.8°C)

Note: Both Cs and Ga melt near/below body temperature.

**Q53.**

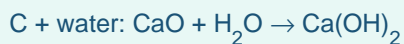
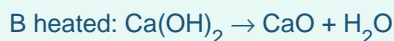
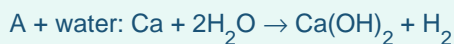
**Element A + water → B (whitewash). B heated → oxide C. C + water → B again. Identify A, B, C:**

✓ Answer 53

**A = Calcium (Ca)** — reacts with water to form slaked lime.

**B = Ca(OH)<sub>2</sub>** (Calcium hydroxide / slaked lime) — used in whitewash.

**C = CaO** (Calcium oxide / quicklime) — formed on heating slaked lime.



**Q54.**

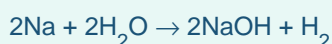
**Alkali metal A + water → compound B (mol. mass=40). B + Al<sub>2</sub>O<sub>3</sub> → soluble C. Identify A, B, C:**

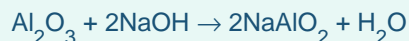
✓ Answer 54

**A = Na (Sodium)** — alkali metal. Mol mass of NaOH = 40 ✓

**B = NaOH** (Sodium hydroxide) — formed when Na reacts with water.

**C = NaAlO<sub>2</sub>** (Sodium aluminate) — soluble compound.



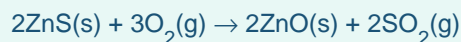


**Q55.**

Reactions during extraction of zinc by: (a) roasting (b) calcination:

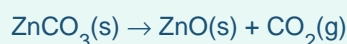
✓ Answer 55

**(a) Roasting (sulphide ore — sphalerite ZnS):**



Heated in excess air → ZnO formed.

**(b) Calcination (carbonate ore — smithsonite ZnCO<sub>3</sub>):**



Heated in absence of air → ZnO formed.

Both processes convert zinc ore to ZnO, which is then reduced:  $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$

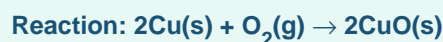
**Q56.**

Metal M doesn't liberate H<sub>2</sub> from acids but reacts with O<sub>2</sub> giving black product. Identify M and black product:

✓ Answer 56

**M = Copper (Cu)** — below hydrogen in activity series → doesn't displace H<sub>2</sub> from acids.

**Black product = CuO** (Copper(II) oxide / cupric oxide)



On heating copper in air → black CuO coating forms.

This CuO can be reduced back to Cu:  $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$

**Q57.**

Element forms oxide A<sub>2</sub>O<sub>3</sub> which is ACIDIC. Is A a metal or non-metal?

✓ Answer 57

**A is a NON-METAL.**

General rule: METAL oxides are BASIC. NON-METAL oxides are ACIDIC.

Since A<sub>2</sub>O<sub>3</sub> is acidic → A is a non-metal.

Example: As<sub>2</sub>O<sub>3</sub> (arsenic trioxide) is acidic → As is a non-metal.

Contrast: Al<sub>2</sub>O<sub>3</sub> (aluminium oxide) is AMPHOTERIC (acts as both) → Al is a metal but shows some non-metal character.

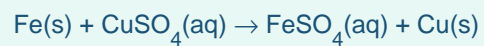
**Q58.**

CuSO<sub>4</sub> solution kept in iron pot. After days, pot has holes. Explain.

✓ Answer 58

Fe is MORE reactive than Cu (Fe is above Cu in activity series).

Fe displaces Cu from  $\text{CuSO}_4$  solution:



The iron atoms of the pot are consumed (dissolved) → iron pot develops holes.

The blue colour of  $\text{CuSO}_4$  fades; reddish-brown Cu deposits in the pot.

This shows Fe is more reactive than Cu and can displace it from its salt solution.

## SECTION C: LONG ANSWER QUESTIONS (Q59–Q65)

**Q59.**

Non-metal A (largest constituent of air) + H<sub>2</sub> (1:3, Fe catalyst) → gas B. + O<sub>2</sub> → oxide C. C + water + air → acid D (strong oxidising agent). Identify A, B, C, D:

✓ Answer 59

**A = N<sub>2</sub> (Nitrogen)** — 78% of air, largest constituent.

**B = NH<sub>3</sub> (Ammonia)** — from Haber process:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$  (Fe catalyst, high T and P)

**C = NO (Nitric oxide)** — from oxidation:  $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$

**D = HNO<sub>3</sub> (Nitric acid)** — from:  $4\text{NO} + 3\text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3$

**Group of A:** Nitrogen belongs to Group 15 (VA) of the Periodic Table.

**Q60.**

Steps for extraction of metals of **LOW** and **MEDIUM** reactivity from sulphide ores:

Step	Low Reactivity Metals (Cu, Hg)	Medium Reactivity Metals (Zn, Fe)
1. Concentration	Froth flotation or gravity separation	Froth flotation or gravity separation
2. Conversion to oxide	ROASTING in air $2\text{CuS} + 3\text{O}_2 \rightarrow 2\text{CuO} + 2\text{SO}_2$	ROASTING in air $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$
3. Reduction	Self-reduction (auto-reduction) $2\text{Cu}_2\text{O} + \text{Cu}_2\text{S} \rightarrow 6\text{Cu} + \text{SO}_2$	Reduction with coke $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$
4. Refining	Electrolytic refining	Electrolytic refining

**Q61.**

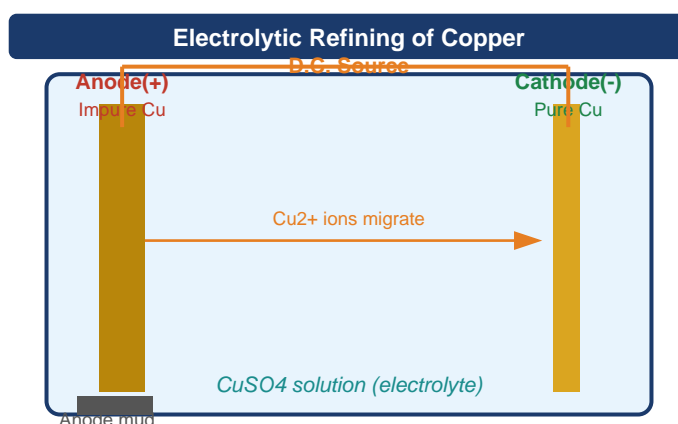
Explain: (a) Al reactivity decreases in HNO<sub>3</sub> (b) Carbon can't reduce Na/Mg oxides (c) NaCl non-conductor in solid, conductor in solution (d) Iron galvanised (e) Na,K,Ca,Mg never free in nature

Part	Explanation
(a) Al in HNO <sub>3</sub>	HNO <sub>3</sub> oxidises surface of Al → thin layer of Al <sub>2</sub> O <sub>3</sub> (passivation). This layer is inert and prevents further reaction. Al becomes passive.
(b) C can't reduce Na/Mg	Na and Mg are MORE reactive than Carbon in the activity series. A reducing agent must be more reactive than the metal it reduces. C can only reduce metals below it.
(c) NaCl conductivity	Solid NaCl: ions locked in rigid lattice, cannot move → no conduction. In solution/molten: Na <sup>+</sup> and Cl <sup>-</sup> ions are FREE to move → conduct electricity.
(d) Iron galvanised	Zinc is more reactive than iron (acts as sacrificial anode). Even if Zn coating is scratched, Zn corrodes first, protecting Fe underneath.
(e) Na,K,Ca,Mg free state	Highly reactive metals → react with air, water, acids immediately. Cannot exist as free elements in nature. Always found as compounds (oxides, carbonates, chlorides).

**Q62.**

Steps for extraction of copper from ore + diagram for electrolytic refining:

✓ Answer 62 — Copper Extraction
<b>(a) Roasting of copper(I) sulphide:</b>
$2\text{Cu}_2\text{S}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{Cu}_2\text{O}(\text{s}) + 2\text{SO}_2(\text{g})$
<b>(b) Reduction of Cu<sub>2</sub>O with Cu<sub>2</sub>S (auto-reduction):</b>
$2\text{Cu}_2\text{O}(\text{s}) + \text{Cu}_2\text{S}(\text{s}) \rightarrow 6\text{Cu}(\text{s}) + \text{SO}_2(\text{g})$
<b>(c) Electrolytic refining of copper:</b>
Anode = impure Cu; Cathode = pure Cu; Electrolyte = CuSO <sub>4</sub> solution
At anode: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
At cathode: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}(\text{pure})$



**Q63.**

X reacts with cold water, Y with hot water, Z with steam only. Identify and arrange in increasing reactivity:

✓ Answer 63
<b>X = Na (or K)</b> — reacts vigorously with cold water.
$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$
<b>Y = Mg (or Ca)</b> — reacts with hot water.
$\text{Mg} + 2\text{H}_2\text{O}(\text{hot}) \rightarrow \text{Mg}(\text{OH})_2 + \text{H}_2$
<b>Z = Fe</b> — reacts only with steam.
$3\text{Fe} + 4\text{H}_2\text{O}(\text{steam}) \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$
<b>Increasing reactivity: Z &lt; Y &lt; X (Fe &lt; Mg &lt; Na)</b>

**Q64.**

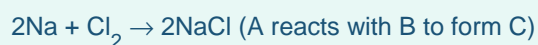
Element A burns with golden flame + element B (at. no.17) → product C. Aqueous C electrolysed → compound D + H<sub>2</sub>. Identify A, B, C, D:

✓ Answer 64

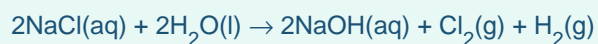
**A = Na (Sodium)** — burns with golden-yellow flame in air.

**B = Cl (Chlorine)** — atomic number 17.

**C = NaCl (Sodium chloride)**



**D = NaOH (Sodium hydroxide)** — from chloralkali process:



Q65.

Ore A gives CO<sub>2</sub> on heating. Ore B gives SO<sub>2</sub> on heating. Steps to convert both to metals:

✓ Answer 65

**Ore A (gives CO<sub>2</sub>) = Carbonate ore (MCO<sub>3</sub>)**

Step 1 — Calcination:  $\text{MCO}_3 \rightarrow \text{MO} + \text{CO}_2$  (heat without air)

Step 2 — Reduction:  $\text{MO} + \text{C} \rightarrow \text{M} + \text{CO}$  (smelting with coke)

Step 3 — Refining: electrolytic refining for pure metal

**Ore B (gives SO<sub>2</sub>) = Sulphide ore (MS)**

Step 1 — Roasting:  $2\text{MS} + 3\text{O}_2 \rightarrow 2\text{MO} + 2\text{SO}_2$  (heat in excess air)

Step 2 — Reduction:  $\text{MO} + \text{C} \rightarrow \text{M} + \text{CO}$  (smelting with coke)

Step 3 — Refining: electrolytic refining for pure metal

## MCQ ANSWER KEY SUMMARY GRID

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	(c)	2	(a)	3	(d)	4	(d)
5	(c)	6	(d)	7	(c)	8	(c)
9	(b)	10	(b)	11	(c)	12	(a)
13	(c)	14	(c)	15	(a)	16	(b)
17	(d)	18	(d)	19	(d)	20	(b)
21	(b)	22	(c)	23	(b)	24	(a)
25	(b)	26	(d)	27	(b)	28	(d)
29	(b)	30	(d)	31	(c)	32	(b)
33	(c)	34	(b)	35	(d)	36	(c)

## ACTIVITY SERIES & EXAM TIPS

### Activity Series of Metals

K	Most Reactive
Na	
Ca	
Mg	
Al	
Zn	
Fe	
Pb	
H	(hydrogen)
Cu	
Ag	Below H → no H <sub>2</sub> with acid
Au	Least Reactive

■ **EXAM TIP** Ductility = WIRES; Malleability = SHEETS. Both are properties of metals.

■ **EXAM TIP** Activity series:  $K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Ag > Au$ . Metals above H react with dilute acids to give H<sub>2</sub>.

■ **EXAM TIP** Ionic compounds conduct in **MOLTEN/AQUEOUS** but **NOT** in **SOLID** state — ions can't move.

■ **COMMON MISTAKE** Galvanisation uses **ZINC**, not gallium or aluminium.

■ **COMMON MISTAKE** Aqua regia = 3 parts conc. HCl + 1 part conc. HNO<sub>3</sub>. **NOT** dilute acids.

■ **NOTE:** Graphite (non-metal) conducts electricity. Diamond (non-metal) does **NOT**. Both are allotropes of Carbon.

## QUICK REVISION TABLE

Concept	Key Point	Example
Ductility	Metal → thin wires	Cu wire, Au wire
Malleability	Metal → thin sheets	Gold leaf, Al foil
Na with water	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$ (violent)	Exothermic, floats, burns
Fe with steam	$3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$	Not cold/hot water
HNO <sub>3</sub> + metals	NO H <sub>2</sub> produced (oxidising acid)	Produces NO, NO <sub>2</sub> , N <sub>2</sub> O
Aqua regia	3 conc.HCl + 1 conc.HNO <sub>3</sub>	Dissolves Au, Pt
Ionic compounds	Conduct in molten/aq; NOT in solid	NaCl, KCl
Native state metals	Au, Ag, Pt (least reactive)	Bottom of activity series
Galvanisation	Fe coated with Zn to prevent rust	Buckets, roofing sheets
Stainless steel	Fe + Cr + Ni + C	Cutlery, surgical tools
Thermite reaction	$\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe} + \text{Heat}$	Railway track welding
Amphoteric oxide	Reacts with acid AND base	Al <sub>2</sub> O <sub>3</sub> , ZnO
Calcination	Heat carbonate/hydroxide ore without air	$\text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2$
Roasting	Heat sulphide ore in excess air	$2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$
Electrolytic refining	Impure=anode, pure=cathode, metal salt=electrolyte	Cu, Ag, Au refining
Graphite (non-metal)	Good conductor of electricity	Used as electrode
Bromine	Only non-metal liquid at room temp	Reddish-brown liquid
Mercury	Only metal liquid at room temp	mp = -39°C

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