ICSE CLASS 10 CHEMISTRY – PRACTICE PAPER

STEP-BY-STEP SOLUTIONS AND MARKING SCHEME

Chapter 7: Metallurgy | Maximum Marks: 40

SECTION A (20 Marks)

Question 1 [8 × 1 = 8]

Part	Ans	Step-by-step reasoning
(i)	(b)	ZnO reacts with both acids and alkalis ($ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$; $ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$), so it is amphoteric. Na_2O is basic, CO_2 is acidic and CO is neutral.
(ii)	(b)	Sulphide ores such as zinc blende (ZnS) are wetted by pine oil and float in the froth. Haematite is concentrated by magnetic separation / gravity separation, bauxite by chemical leaching and calamine is a carbonate.
(iii)	(c)	Heating a carbonate or hydrated ore in the absence / limited supply of air to give the oxide is **calcination**. Roasting is done in excess of air for sulphide ores.
(iv)	(d)	Aluminium is high in the activity series and has great affinity for oxygen, so its oxide cannot be reduced by carbon; it is obtained by electrolysis. Pb, Fe and Zn oxides are reduced by carbon.
(v)	(c)	Cryolite (Na_3AlF_6) lowers the fusion temperature of alumina from 2050 °C to about 950 °C and makes the mixture a good conductor.
(vi)	(c)	Both statements are true. The protective Al_2O_3 film is the reason for (A), so (R) explains (A).
(vii)	(b)	Brass = copper + zinc. Bronze = copper + tin; duralumin is an aluminium alloy; solder = lead + tin.
(viii)	(c)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$. Sulphur dioxide is evolved.

Question 2 [3 + 3 = 6]

(i) **[3 × 1]**

(a) **moisture** – iron rusts only in the presence of both oxygen and moisture.

(b) **electrolytic** – these metals are above aluminium; carbon cannot reduce their oxides, so fused salts are electrolysed.

(c) **roasting** – sulphide ores are heated in excess of air to give oxides (calcination is done in limited air for carbonates / hydrated ores).

(ii) **[3 × 1]**

(a) Anode in aluminium extraction → **3** (graphite).

(b) Alloy of lead and tin for joining wires → **4** (solder).

(c) Coating iron with zinc → **2** (galvanisation).

Statement 1 (duralumin) is the extra option.

Question 3 [3 + 3 = 6]

(i) **[3 × 1]**

(a) The nails rust in tube **A** (contact with both air and water). Rust is **hydrated iron(III) oxide**, $Fe_2O_3 \cdot xH_2O$ ($4Fe + 3O_2 + 2xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$).

(b) X is **anhydrous (fused) calcium chloride**; it absorbs moisture from the air so that the nails remain in dry air.

(c) Y is a layer of **oil**; it forms an air-proof layer on the boiled water so that air (oxygen) cannot dissolve in it again. The nails then have water but no air.

(ii) **[3 × 1]**

(a) They are very reactive; they react vigorously with oxygen and moisture of the air (and with water), so they are kept in kerosene to keep out air and moisture.

(b) Aluminium is amphoteric. The alkali dissolves the protective Al_2O_3 film and then reacts with the metal: $2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$, so the vessel is damaged.

(c) The coke layer reduces heat loss by radiation and prevents the burning of the graphite anode (by air) at the surface.

SECTION B (20 Marks)

Question 4 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) P = **graphite rods** (connected to the +ve terminal); Q = **carbon lining** of the iron tank (connected to the −ve terminal). **P is the anode** (Q is the cathode).

(b) Alumina (Al_2O_3) 20%, cryolite (Na_3AlF_6) 60% and fluorspar (CaF_2) 20%.

(c) At the cathode: $\mathbf{Al^{3+} + 3e^- \rightarrow Al}$ (or $4Al^{3+} + 12e^- \rightarrow 4Al$).

(d) Oxygen liberated at the anode oxidises the graphite to CO and CO_2 ($2C + O_2 \rightarrow 2CO$; $2CO + O_2 \rightarrow 2CO_2$), so the rods get burnt away.

(ii) **[3 × 1]**

(a) **Baeyer's process** (chemical method / leaching).

(b) $\mathbf{Al_2O_3 \cdot 2H_2O + 2NaOH \rightarrow 2NaAlO_2 + 3H_2O}$ (heated at 140–150 °C under pressure).

(c) Red mud is the insoluble residue left after treating bauxite with NaOH; it contains ferric oxide (Fe_2O_3), sand (SiO_2) etc.

(iii) **[3 × 1]**

(a) $\mathbf{2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2}$

(b) $\mathbf{2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2}$

(c) $\mathbf{Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe + heat}$

Question 5 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **P > S > Q > R**. P reacts with cold water; S reacts with steam but its oxide is not reduced by carbon (so more reactive than Q); Q reacts with steam and its oxide is reduced by carbon; R is unreactive.

(b) **R** – it is least reactive (no reaction with water or acid) and its oxide decomposes on heating alone.

(c) **Electrolysis of its fused salt** (electrolytic reduction), since it is very reactive.

(d) S is high in the activity series and has a great affinity for oxygen; carbon is not a strong enough reducing agent to reduce its oxide.

(ii) **[3 × 1]**

(a) **$Zn + H_2O$ (steam) → $ZnO + H_2$**

(b) **$ZnO + C \rightarrow Zn + CO$** (heated)

(c) **$2HgO \rightarrow 2Hg + O_2$** (heated above 300 °C)

(iii) **[3 × 1]**

(a) **Froth flotation** (zinc blende, a sulphide ore, is wetted by oil).

(b) **$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$** (roasting at 800–900 °C).

(c) **Smelting** (reduction of ZnO by coke): $ZnO + C \rightarrow Zn + CO$.

Question 6 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **Copper and zinc**.

(b) **Joining electrical connections / soldering** (it has a low melting point, about 180 °C).

(c) **Utensils, cutlery, surgical instruments** (resists corrosion; any one use).

(d) **Bismuth, lead, tin and cadmium** (any two or more correct metals; it melts at a low temperature).

(ii) **[3 × 1]**

(a) An alloy is a **homogeneous mixture of two or more metals**, or of a metal with a non-metal.

(b) Solder (Pb + Sn) has a lower melting point (about 180 °C) than either lead or tin, so it melts easily and the electrical connection can be made without damage.

(c) **Nichrome** (nickel, iron and chromium).

(iii) **[3 × 1]**

(a) Haematite is **Fe_2O_3**. The reducing agent is **carbon monoxide (CO)**.

(b) **$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$**

(c) Limestone is the **flux**; it removes the silica (gangue) as slag: $CaCO_3 \rightarrow CaO + CO_2$; **$CaO + SiO_2 \rightarrow CaSiO_3$** (slag).

Marks summary	Section A: Q1 = 8, Q2 = 6, Q3 = 6 → **20** | Section B: any two of Q4, Q5, Q6 at 10 each → **20** | Total = **40**