ICSE CLASS 10 CHEMISTRY – PRACTICE PAPER

STEP-BY-STEP SOLUTIONS AND MARKING SCHEME

Chapter 10: Study of Compounds – Nitric Acid | Maximum Marks: 40

SECTION A (20 Marks)

Question 1 [8 × 1 = 8]

Part	Ans	Step-by-step reasoning
(i)	(b)	$KNO_3 + H_2SO_4$ (conc.) → $KHSO_4 + HNO_3$. H_2SO_4 is non-volatile, so volatile HNO_3 distils over. HCl is volatile and would also distil.
(ii)	(c)	Nitric acid partly decomposes: $4HNO_3 \rightarrow 4NO_2 + 2H_2O + O_2$. The reddish brown NO_2 dissolves in the acid and makes it yellow.
(iii)	(c)	Aluminium (like iron, cobalt, nickel) is rendered passive by conc. HNO_3 because a thin insoluble oxide layer forms.
(iv)	(c)	$3Cu + 8HNO_3$ (dil.) → $3Cu(NO_3)_2 + 4H_2O + 2NO$. Nitric oxide is evolved.
(v)	(d)	Nitrates of sodium and potassium give the nitrite and oxygen: $2NaNO_3 \rightarrow 2NaNO_2 + O_2$. The others also give NO_2.
(vi)	(c)	Both are true. Fresh $FeSO_4$ is needed because air oxidises Fe^{2+} to Fe^{3+}, which does not form the nitroso complex, so (R) explains (A).
(vii)	(a)	Aqua regia contains nascent chlorine, which dissolves noble metals such as gold and platinum.
(viii)	(b)	$NH_4NO_3 \rightarrow N_2O + 2H_2O$ (nitrous oxide and steam), with no residue.

Question 2 [3 + 3 = 6]

(i) **[3 × 1]**

(a) **glass** – nitric acid vapours attack cork and rubber.

(b) **coloured** – sunlight decomposes the acid into NO_2, H_2O and O_2.

(c) **nitrogen dioxide** – $4HNO_3 \rightarrow 4NO_2 + 2H_2O + O_2$.

(ii) **[3 × 1]**

(a) Silver nitrate → **1** (grey silver: $2AgNO_3 \rightarrow 2Ag + 2NO_2 + O_2$).

(b) Copper(II) nitrate → **2** (black CuO: $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$).

(c) Ammonium nitrate → **3** (no residue: $NH_4NO_3 \rightarrow N_2O + 2H_2O$).

Statement 4 is the extra option (it does not match any of (a)–(c)).

Question 3 [3 + 3 = 6]

(i) **[3 × 1]**

(a) Potassium (or sodium) nitrate and concentrated sulphuric acid (equal parts by weight). **$KNO_3 + H_2SO_4 \rightarrow KHSO_4 + HNO_3$** (below 200 °C).

(b) The running cold water **condenses the vapours** of nitric acid into a liquid.

(c) The yellow colour is due to dissolved **nitrogen dioxide** formed by the decomposition of some nitric acid. It is removed by passing dry air or CO_2 through the warm acid (or by adding excess water).

(ii) **[3 × 1]**

(a) HCl is volatile, so its vapours would distil over with the nitric acid and contaminate it.

(b) Above 200 °C the glass apparatus may crack, the sodium sulphate formed makes a hard crust on the vessel, the acid may decompose, and fuel is wasted.

(c) Concentrated nitric acid makes these metals passive by forming a thin, insoluble oxide layer that stops further reaction.

SECTION B (20 Marks)

Question 4 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) The **brown ring test** for nitrates. X is the **brown ring** of nitroso ferrous sulphate.

(b) Ferrous sulphate gets oxidised to ferric sulphate on exposure to air, and ferric sulphate does not give the brown ring.

(c) The concentrated acid is denser and forms a separate layer at the bottom, so the ring forms at the junction of the two liquids; if it is poured quickly the layers mix and the unstable ring is not formed (the heat evolved decomposes it).

(d) **$FeSO_4 \cdot NO$** (nitroso ferrous sulphate).

(ii) **[3 × 1]**

(a) **$C + 4HNO_3 \rightarrow CO_2 + 2H_2O + 4NO_2$**

(b) **$S + 6HNO_3 \rightarrow H_2SO_4 + 2H_2O + 6NO_2$**

(c) **$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$**

(iii) **[3 × 1]**

(a) 1 part (by volume) conc. HNO_3 to 3 parts conc. HCl; the mixture is **aqua regia**.

(b) **$HNO_3 + 3HCl \rightarrow NOCl + 2H_2O + 2[Cl]$**

(c) **Gold** (or platinum): the nascent chlorine formed attacks it, e.g. $Au + 3[Cl] \rightarrow AuCl_3$.

Question 5 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **Nitric oxide (NO)**.

(b) **Nitrogen dioxide (NO_2)**.

(c) **No reaction** – iron becomes passive in cold concentrated nitric acid.

(d) **Hydrogen** ($Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$).

(ii) **[3 × 1]**

(a) **$CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$**

(b) **$NaHCO_3 + HNO_3 \rightarrow NaNO_3 + H_2O + CO_2$**

(c) **$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$**

(iii) **[3 × 1]**

(a) **$N_2 + O_2 \rightarrow 2NO$** (by lightning; $2NO + O_2 \rightarrow 2NO_2$).

(b) **$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$**

(c) Conversion of free atmospheric nitrogen into useful nitrogen compounds in the soil.

Question 6 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **Sodium nitrite ($NaNO_2$)**.

(b) **Nitrogen dioxide and oxygen** ($2Zn(NO_3)_2 \rightarrow 2ZnO + 4NO_2 + O_2$).

(c) **Silver metal** (grey).

(d) **Nitrous oxide (N_2O) and steam**.

(ii) **[3 × 1]**

(a) **$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$**

(b) **$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$**

(c) **$2KNO_3 \rightarrow 2KNO_2 + O_2$**

(iii) **[3 × 1]**

(a) Nitrogen dioxide (reddish brown) and oxygen (relights the glowing splinter).

(b) Nitric acid acts as a solvent for a large number of metals (except noble metals), so it dissolves the metal in the design.

(c) Manufacture of explosives (e.g. T.N.T.), fertilisers (ammonium nitrate), synthetic fibres, dyes and drugs (any two).

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**