ICSE CLASS 10 CHEMISTRY – PRACTICE PAPER

STEP-BY-STEP SOLUTIONS AND MARKING SCHEME

Chapter 3: Acids, Bases and Salts | Maximum Marks: 40

SECTION A (20 Marks)

Question 1 [8 × 1 = 8]

Part	Ans	Step-by-step reasoning
(i)	(b)	Basicity is the number of hydronium ions an acid gives per molecule, not the number of hydrogen atoms. $HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$ gives one H_3O^+, so it is monobasic. H_2SO_4 and H_2CO_3 are dibasic; H_3PO_4 is tribasic.
(ii)	(d)	Phenolphthalein turns pink only in an alkaline solution (pH greater than 7). Only S (pH 12) is alkaline. P is acidic, Q is weakly acidic and R (pH 7) is neutral.
(iii)	(c)	Heating $CuSO_4 \cdot 5H_2O$ drives off water of crystallisation as water vapour, which condenses. Water turns white anhydrous copper sulphate blue ($CuSO_4 + 5H_2O \rightarrow CuSO_4 \cdot 5H_2O$). Water is neutral to litmus and does not turn lime water milky.
(iv)	(a)	In $NaHSO_4$ only one of the two replaceable hydrogen atoms of H_2SO_4 is replaced, so it still has ionisable hydrogen: an acid salt. The other three are normal salts.
(v)	(d)	Lead sulphate is insoluble. Adding dilute H_2SO_4 to $PbCO_3$, Pb or PbO forms an insoluble crust of $PbSO_4$ that stops the reaction (impractical). It is made by precipitation: $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4\downarrow + 2HNO_3$.
(vi)	(c)	(A) is true. (R) is true: $2FeCl_3 \cdot 6H_2O \rightarrow Fe_2O_3 + 6HCl + 9H_2O$, so the product is the oxide and not $FeCl_3$. (R) explains (A).
(vii)	(b)	Fused $CaCl_2$ is a deliquescent substance. Washing soda is effloresent, silica gel is hygroscopic (absorbs moisture without dissolving), and blue vitriol is neither.
(viii)	(a)	$[H^+] = 10^{-pH}$. X: 10^{-3}; Y: 10^{-5}. Ratio = $10^{-3} \div 10^{-5} = 100$, so X has 100 times more hydronium ions.

Question 2 [3 + 3 = 6]

(i) **[3 × 1]**

(a) **dibasic** – each molecule of H_2SO_4 ionises in two steps to give two H_3O^+ ions.

(b) **efflorescence** – the hydrated salt loses its water of crystallisation in dry air and becomes powdery ($Na_2CO_3 \cdot H_2O$).

(c) **acid salt** – $NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$. The 1 : 1 ratio replaces only one of the two hydrogen atoms.

(ii) **[3 × 1]**

(a) Sodium sulphate → **3** (neutralisation of NaOH by dilute H_2SO_4, using titration).

(b) Lead chloride → **4** (precipitation: $Pb(NO_3)_2 + 2HCl \rightarrow PbCl_2\downarrow + 2HNO_3$).

(c) Anhydrous iron(III) chloride → **2** (direct combination: $2Fe + 3Cl_2 \rightarrow 2FeCl_3$).

Statement 1 is the extra option (it is used for zinc sulphate and iron(II) sulphate).

Question 3 [3 + 3 = 6]

(i) **[3 × 1]**

(a) A is red: pH **0–2** (strongly acidic). D is violet: pH **12–14** (strongly alkaline).

(b) **C** (green, pH about 7). It has **no effect** on litmus: red litmus stays red and blue litmus stays blue.

(c) **D**. Alkalis liberate ammonia when warmed with ammonium salts. D is strongly alkaline (it contains OH^- ions): $NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3\uparrow$.

(ii) **[3 × 1]**

(a) Dilution of concentrated sulphuric acid is highly **exothermic**. Adding acid slowly to a large amount of water lets the heat be absorbed. Adding water to the acid can cause the acid to splash out and break the container.

(b) Anhydrous $FeCl_3$ is deliquescent. Fused $CaCl_2$ absorbs any moisture, so that it keeps the receiver dry.

(c) Strength depends on the degree of ionisation, not on concentration. HCl is a strong acid and ionises completely, while acetic acid is a weak acid and ionises only slightly. So dilute HCl gives more H_3O^+ than concentrated acetic acid.

SECTION B (20 Marks)

Question 4 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **Concentrated sulphuric acid**. It dries the chlorine gas (drying agent), as the reaction must take place in dry conditions.

(b) Tube D contains fused calcium chloride. It prevents moisture from the air from entering the receiver, because iron(III) chloride is highly deliquescent.

(c) $2Fe + 3Cl_2 \rightarrow 2FeCl_3$ (on heating, in dry conditions).

(d) The reaction is **exothermic**. The heat produced keeps the iron red hot, so external heating is not needed.

(ii) **[1 + 1 + 1]**

(a) On heating, $FeCl_3 \cdot 6H_2O$ is not dehydrated. It decomposes to give iron(III) oxide and hydrogen chloride.

(b) $2FeCl_3 \cdot 6H_2O \rightarrow Fe_2O_3 + 6HCl + 9H_2O$ ($Fe_2O_3 \cdot H_2O$ in the product is also accepted).

(c) It is used as a catalyst in certain reactions.

(iii) **[3 × 1]**

(a) $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2\uparrow$

(b) $FeSO_4 \cdot 7H_2O$, **pale green** (green vitriol).

(c) Dilute nitric acid is a strong oxidising agent. It oxidises the hydrogen formed to water, so hydrogen is not liberated.

Question 5 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **Y** (its curve is almost flat, about 36 g). The common salt is **sodium chloride**.

(b) **64 g** per 100 g of water (read from the curve of X at 40 °C).

(c) The solubility of X is 64 g at 40 °C and 32 g at 20 °C. Mass crystallised = 64 − 32 = **32 g**.

(d) **Z** (its curve falls from 30 g to 9 g as the temperature increases from 0 °C to 80 °C).

(ii) **[1 + 1 + 1]**

(a) An insoluble crust of lead sulphate forms on lead carbonate, which prevents further reaction of the acid with the carbonate.

(b) $PbCO_3 + 2HNO_3 \rightarrow Pb(NO_3)_2 + H_2O + CO_2\uparrow$

(c) $Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4\downarrow + 2NaNO_3$ (a white precipitate, which is filtered, washed and dried).

(iii) **[2 + 1]**

(a) **Efflorescence** [1]. $Na_2CO_3\cdot 10H_2O \rightarrow Na_2CO_3\cdot H_2O + 9H_2O$ [1].

(b) Any one: caustic soda (NaOH), caustic potash (KOH), calcium chloride ($CaCl_2$), magnesium chloride ($MgCl_2$), zinc chloride or iron(III) chloride. [1]

Question 6 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) **Pink** at the start (alkaline solution with phenolphthalein) and **colourless** at the end point (all NaOH neutralised).

(b) Both reactants and the product are soluble, so an excess of either cannot be removed by filtration. The exact volume of acid required for complete neutralisation is therefore found by titration.

(c) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(d) $Na_2SO_4\cdot 10H_2O$ (Glauber's salt).

(ii) **[1 + 1 + 1]**

(a) **Twice** the volume of acid is used. The same volume of acid is added again to the sodium sulphate formed, so the alkali is not completely neutralised (insufficient base).

(b) $NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$

(c) It still has one ionisable hydrogen: $NaHSO_4 \rightarrow Na^+ + H^+ + SO_4^{2-}$. The H^+ ions give it the acidic properties.

(iii) **[3 × 1]**

(a) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$

(b) $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2\uparrow$

(c) $NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3\uparrow$ (on warming)

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**