ACID AND BASES

PAPER 2 : STRUCTURE

No.	Answer	Marks
1(a)	Neutralisation	1
(b)	$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$ Correct formulae of reactants and products Balanced equation	 1 1
(c)	i. H^+ , OH^- , K^+ and SO_4^{2-} ii. K^+ and SO_4^{2-}	1 1
(d)	5 cm^3	1
(e)	Mol H_2SO_4 = 0.005 mol 1 mol H_2SO_4 --> 2 mol KOH 0.005 mol $H_2SO_4 \rightarrow$ 0.01 mol KOH Molarity of KOH = 0.4 mol dm^{-3} // $\frac{M_a V_a}{M_b V_b} = \frac{1}{2}$ $M_b = \frac{2 \times 1 \times 1\,000}{25}$ $= 0.4$ mol dm^{-3}	1 1 1
(f)	10 cm^3 HNO_3 is monoprotic acid // H_2SO_4 is diprotic acid	1 1
		11
2(a)	i. water ii ethyl benzene , [any organic solvent]	1 1
(b)	i. solution X ii. ionise hydrogen chloride and produce hydrogen ions	1 1
(c)	i. carbon dioxide ii. channel / pass through the gas into lime water lime water turns cloudy	1 1 1
(d)	Solution X contain freely hydrogen ions and chloride ions Solution Y contain hydrogen chloride molecule	1 1
		9

No.	Answer	Marks
3(a)	(i) sodium hydroxide / potassium hydroxide r ; formula (ii)$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ / $2KOH + H_2SO_4 \rightarrow KSO_4 + 2H_2O$ - Correct formulae of reactants and products - Balanced chemical equation (iii) neutralisation	1 1 1 1
(b)	Y	1
(c)	(i) W / X (ii)calcium carbonate is added to solution X/W Gas released turns lime water chalky // Magnesium/ zinc added to solution X/W Gas released gives a pop sound with a lighted splinter	1 1 1
(d)	W is a strong acid but X is a weak acid W completely dissociates in water produce high concentration of hydrogen ions // X partially ionise in water Produce low concentration of hydrogen ions	1 1
		10
4(a)	To prevent sucking back of the solution	1
(b)	i. no change in Beaker A . Effervescence occur in Beaker B ii. hydrogen chloride in methyl benzene in Beaker A do not contain hydrogen ion hydrogen chloride in water in Beaker B produces hydrogen ion which react with magnesium to produce hydrogen gas	1 1 1
(c)	i. hydrogen chloride molecules ii. hydrogen ions and chloride ions	1 1
(d)	i. carbon dioxide gas. Pass the gas evolved into lime water Lime water turns cloudy/chalky/milky ii. in the presence of water , hydrogen chloride dissociates/ ionises produce hydrogen ion which react with sodium carbonate solution to produce carbon dioxide gas. iii. $2H^+ + CO_3^{2-} \rightarrow CO_2 + H_2O$	1 1 1
		9

No.	Answer	Mark s
5(a) (i)	Blue to red	1
(ii)	H^+	1
(b)	1. No 2. No water / H^+ ions	1 1 **2**
(c)	1. Ethanoic acid is weak acid, hydrochloric acid is strong acid 2. The concentration of H^+ ions in ethanoic acid is lower / The concentration of H^+ ions in hydrochloric acid is higher.	1 1 **2**
(d)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$	1
(e)	1. [Material : name of reactive metal / name of carbonate salt] 2. [To test gas produced] 3. [Observation] <u>Example 1</u> *Procedure:* 1. Magnesium ribbon is added into the aqueous solution X 2. Lower a lighted wooden splinter *Observation:* A "pop" sound is heard <u>Example 2</u> *Procedure:* 1. Calcium carbonate is added into the aqueous solution X 2. Passing the gas through lime water *Observation:* Lime water turns milky	1 1 **2** 1 1 1 **2** 1 1 1 **2** 1
6(a)	i. Q ii. R iii. P iv. U	1 1 1 1
(b)	i. Acid molecules that ionise partially in water Produce low concentration of hydrogen ion ii. malic acid is weak acid but hydrochloric acid is a strong acid malic acid partially ionise in water but hydrochloric ionise completely in water less number of hydrogen ion in malic acid	1 1 1 1
(c)	i. hydrogen ii. bring burning splinter near the mouth of the test tube pop sound is produced iii. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ correct formulae of reactants and products balanced chemical equation	1 1 1 1 1

PAPER 2 : ESSAY

No.	Answer	Marks
7(a)	Standard solution is a solution with known concentration	
(i)	Calculation:-	
(ii)	Moles of NaOH needed = $\frac{2.0 \times 100}{1000}$	1
	= 0.2 mol	
	Mass of NaOH = 0.2 x 40	1
	= 8 g	
		1
	1. Weigh **exactly** 8.0g NaOH	
	2. Add a little distilled water to dissolve NaOH in	1
	a beaker/ container . Stir	1
	3. Transfer solution into **100 cm^3** volumetric flask	
	4. Rinse beaker / container with distlled water .Transfer into the volumetric flask.	1
	5. Add distilled water into volumetric flask up **to the mark** // **exactly in line** with calibration mark.	1
	6. Volumetric flask stoppered/ closed and shake	1
(b)		
	1. Fill burette with hydrochloric acid and	1
	clamp / fixed	1
	2. Record initial reading	
	3. Measure (20-25)cm^3 1.0 mol dm^{-3} NaOH solution with pipette / burette	1
	4. and transfer / pour to a conical flask	1
	5. Add few drops of phenolphthalein / methyl orange.	
	Shake / swirl mixture.	1
	6. Hydrochloric acid is **added slowly/carefully**	
	(into the conical flask)	1
	7. **Swirl** the flask	1
	8. Pink becomes pale/ almost colourless (with Phenolphthalein //Yellow turns orange (with Methyl orange)	1
	9. **Add acid drop by drop** until (mixture becomes	
	colourless or red) // end –point reached.	1
	10.Record reading at end-point	1
	11. NaOH + HCl → NaCl + H_2O	1
	12. No. of moles NaOH used = $\frac{25 \times 1.0}{1000} = 0.025$	1
	13. $M_a = \frac{0.025 \times 1000}{V_a}$ mol dm^{-3}	1
		1

No.	Answer	Marks
8(a)	1. Sodium hydroxide strong alkali 2. ionises completely in water 3. produce high concentration of hydroxide ions 4. ammonia is a weak alkali 5. ionises partially in water 6. Produce low concentration of hydroxide ions 7. the higher the concentration of hydroxide ion, the higher the pH	6
2(b)	Test 1 1. a spatula of zinc powder is added to 5cm^3 of the acid in a test tube. 2. Effervescence occur 3. insert a lighted wooden splinter to the mouth of the test tube. Pop sound is heard 4. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ Test 2 1. a spatula of marble powder is added to 5cm^3 of the acid in a test tube. 2. Effervescence occur 3. the gas released is flowed through lime water. The lime water turns cloudy. 4. $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$	8
2(c)	1. glacial ethanoic acid exists as molecules 2. no hydrogen ions present , no reaction with calcium carbonate. 3. when water is added to glacial etahnoic acid, it ionises 4. produce hydrogen ion 5. the hydrogen ion react with calcium carbonate 6.produce carbon dioxide gas	6

PAPER 3 : STRUCTURE

No.	Rubric
9(a)	*[Able to write all burette readings with correct decimal places*] Sample answer: Final reading = 20.60 ……. cm^3 Initial reading = 0.60 ……. cm^3 Volume of H_2SO_4 = 20.00 …… cm^3
(b)	*Able to construct a table with correct headings and units*] Sample answer: Final reading/ cm^3 : 20.60 Initial reading/ cm^3 : 0.60 Volume of H_2SO_4/ cm^3 : 20.00
(c)(i)	[*Able to state the colour change correctlyl*] Sample answer: Pink colour turns to colourless/pale pink.

<table>
<tr><td>(ii)</td><td>[Able to state the inference correctly]
Sample answer:
Alkaline solution becomes neutral</td></tr>
<tr><td>(d)</td><td>[Able to write the operational definition correctly]
Sample answer:
The solution turns from pink to colourless when sodium hydroxide solution is neutralise by sulphuric acid using titration technique</td></tr>
<tr><td>(e)</td><td>Able to classify the acids to monoprotic and diprotic correctly]
Sample answer:
<table><tr><th>Monoprotic</th><th>Diprotic</th></tr><tr><td>Hydrochloric acid
Ethanoic acid</td><td>Sulphuric acid</td></tr></table></td></tr>
<tr><td>(f)</td><td>[Able to calculate the molarity of sodium hydroxide solution correctly]
Sample answer:
$\frac{1 \quad x \ 20}{\text{Molarity of NaOH} \ x \ 25} = \frac{1}{2}$
Molarity of NaOH = 1.6 mol dm^{-3}</td></tr>
</table>

<table>
<tr><th>No.</th><th>Rubric</th></tr>
<tr><td>10(a)</td><td>[Able to exhibit the tabulation of data correctly]

Tabulation of data has the following element :

• 3 columns and 4 rows
• Table contains topics, labeled with two decimal place and unit

<table><tr><th>Experiment</th><th>I</th><th>II</th></tr><tr><td>Initial reading/ cm^3</td><td>0.45</td><td>15.45</td></tr><tr><td>Final reading / cm^3</td><td>20.45</td><td>25.45</td></tr><tr><td>Volume of HX /cm^3</td><td>20.00</td><td>10.00</td></tr></table></td></tr>
<tr><td>(b)</td><td>[Able to state one observation accurately]
Red/Pink to colourless</td></tr>
<tr><td>(c)</td><td>[Able to show the calculation of HX acid concentration with the unit for both experiment correctly] <u>Experiment I</u>

The concentration of HX acid = (1)(20) / 20
= 1.0 $moldm^{-3}$
or
(i) Number of mole for NaOH = (1)(20)/1000
= 0.02 mol
(ii) Based on the equation,
1 mol of NaOH reacts with 1 mol of HX acid,
0.02 mol of NaOH reacts with 0.02 mol of
HX acid.</td></tr>
</table>

	(iii) Concentration of HX acid = (0.02 x 1000) / 20 = 1.0 moldm^{-3} **Experiment II** The concentration of HX acid = (1)(20) / 10 = 2.0 moldm^{-3} **or** (i) Number of mole for NaOH = (1)(20)/1000) = 0.02 mol (ii) Based on the equation, 1 mol of NaOH reacts with 1 mol of HX acid, 0.02 mol of NaOH reacts with 0.02 mol of HX acid. (iii) Concentration of HX acid = (0.02 x 1000) / 10 = 2.0 moldm^{-3}
(d)	The higher/lower the concentration of HX acid, the lower/higher the volume of the acid to neutralize the sodium hydroxide solution / alkali.
(e)	*Able to compare HX acid with sulphuric acid correctly*] • HX acid is a monoprotic/monobasic acid • Sulphuric acid is a diprotic/dibasic acid Number of hydrogen ion in 1 mol of sulphuric acid is double of HX acid// total number of hydrogen ions in both solution are the same

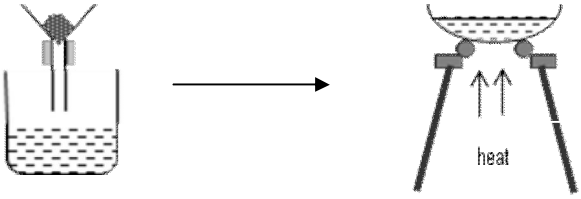
PAPER 3 : ASSAY

NO.	Rubric
11.(a)	Problem statement Does alkali need water to enable it to show its properties?
(b)	Hypothesis Sodium hydroxide solution changes red litmus paper to blue // Solid sodium hydroxide does not change red litmus paper to blue.
(c)	List of materials and apparatus Material :sodium hydroxide pellet, water, red litmus paper Apparatus : test tube
(d)	Procedure 1. several sodium hydroxide pellet is put in a test tube. 2. a piece of dry red litmus paper is put on the sodium hydroxide pellet 3. the change of colour on the dry litmus paper is observed. 4. several drops of water is put into the test tube 5. the change of colour on the dry litmus paper is observed.
(e)	Tabulation of data

Sodium hydroxide	Observation
Solution	
Pellet	

SALTS
PAPER 2: STRUCTURE

NO.	Answer	Marks
1(a)	Zinc ion, aluminium ion and lead (II) ion	1
(b)	Lead (II) ion	1
(c)	$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$	1
(d)	magnesium ion and calcium ion	1
(e)	- pour 2 cm^3 of magnesium ion and calcium ion into two different test tubes respectively. - add 2 cm^3 of ammonia solution and until excess into both test tubes. - magnesium ion forms white precipitate and insoluble in excess. - calcium ion shows no changes.	4
2(a) (i) (ii)	 - lead (II) carbonate changes to brown when hot and yellow when cold. lime water turns chalky - $PbCO_3 \rightarrow PbO + CO_2$.	1 1
(b)(i) (ii) (iii)	mass lead (II) carbonate = 23.13 – 12.45 = 10.68 g mass residue = 22.56 – 12.45 = 10.11 g no of moles lead oxide = 10.11 ÷ (207 + 16) = 0.045 mol volume carbon dioxide = 0.045 x 24 = 1.08 dm^3	1 1 1
(c)(i) (ii)	Lead (II) sulphate $Pb^{2+} + SO_4^{2-}$ $PbSO_4$	1 1
3(a)	Zinc oxide	1
(b)(i) (ii)	$Zn(OH)_2$ White solid is dissolved	1 1
(c)(i) (ii) (iii)	By heating the zinc nitrate Oxygen gas Brown gas is released	1 1 1
(d)(i) (ii)	Zinc iodide $Zn^{2+} + 2I^- \rightarrow ZnI_2$	1 1
(e)	$ZnCO_3$	1

No.	Answer	Marks
4(a) (i) (ii)	Soluble salts : potassium sulphate and zinc sulphate Insoluble salts : Lead (II) sulphate Reactants: Lead (II) nitrate and sodium sulphate	2 2
(b)	Crystallization method  - the mixture is filtered first. - the salt solution is poured into an evaporating dish - the solution is heated gently until the volume is one third of its original volume. - cool the hot saturated solution to allow it to crystallise - filter and press the crystals with a few pieces of filter paper to dry them.	6
(c)(i)	cation test : Fe^{3+} ion - pour 2 cm^3 of solution in the test tube - add 2 cm^3 of sodium hydroxide solution into the test tube - brown precipitate is formed shows the presence iron (III) ion	3
(ii)	anion test : NO_3^- ion -pour 2 cm^3 of solution in the test tube -add 2 cm^3 of dilute sulphuric acid into the test tube -add 2 cm^3 of iron (II) sulphate solution -add slowly concentrated sulphuric acid by slanting the test tube -brown ring is formed shows the presence of nitrate ion	4
(iii)	anion test : Cl^- ion - pour 2 cm^3 of solution in the test tube - add 2 cm^3 nitric acid into the test tube - add 2 cm^3 silver nitrate solution - white precipitate shows the presence of chloride ion.	3

No.	Answer	Marks
5(a)(i)	Reagents: Lead (II) nitrate solution , Sodium sulphate solution	2
(ii)	Chemical equation : $Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + 2NaNO_3$	2
(iii)	Procedure : -Pour 50 cm^3 of 0.1 $moldm^{-3}$ lead (II) nitrate solution into a beaker -Add 50 cm^3 of 0.1 $moldm^{-3}$ sodium sulphate solution into a beaker -Stir the solution -Filter the mixture solution -Rinse the residue with distilled water -Dry the residue / crystal in between filter papers	6
(b)(i)	Anion : nitrate ion Chemical test : -pour 2 cm^3 of solution in the test tube -add 2 cm^3 of dilute sulphuric acid into the test tube -add 2 cm^3 of iron (II) sulphate solution -add slowly concentrated sulphuric acid by slanting the test tube -brown ring is formed shows the presence of nitrate ion	4
(ii)	Cation : aluminium ion and lead (II) ion Chemical test: - pour 2 cm^3 of solution in two test tube respectively -add 2 cm^3 of potassium iodide solution into each test tube -yellow precipitate is formed shows the presence of lead (II) ion and no changes in the test tube indicates the presence of aluminum ion.	6

PAPER 3: STRUCTURE

No.	Rubric
6(a)	[Able to draw 2 graphs of volume of carbon dioxide gas liberated against time for both experiments on the same axes with all the 4 items below correctly] (i) suitable scale used (ii) axes labelled correctly (iii) all points plotted correctly (iv) smooth curve of graphs
(b)	5.0 cm^3 because the height yellow precipitate remains constant and all M ion and chromate (VI) ion have completely reacted.
(c)	Number of moles potassium chromate (VI) = (5.0 x 1.0) ÷ 1000 = 0.005 mol Number of moles of M ion = (5.0 x 1.0) ÷ 1000 = 0.005 mol
(d)	Simplest mole ratio of potassium chromate (VI) : M ion 0.005 mol : 0.005 mol = 1 : 1 Formula of M chromate (VI) = $MCrO_4$
(e)	$M^{2+} + CrO_4^{2-} \rightarrow MCrO_4$

PAPER 3 : ASSAY

<table>
<tr><th>No.</th><th>Rubric</th></tr>
<tr><td>7(a)</td><td>[Able to make a suitable statement of problem]

How to differentiate between magnesium nitrate solution and calcium nitrate solution // How to differentiate between magnesium ion and calcium ion</td></tr>
<tr><td>(b)</td><td>[Able to state the relationship between manipulated variable and responding variable correctly]

If the addition of aqueous ammonia solution forms white precipitate which is insoluble in excess ammonia aqueous solution, then the solution tested is magnesium nitrate. // If aqueous ammonia solution is added and no change occur then the solution tested is calcium nitrate.</td></tr>
<tr><td>(c)</td><td>[Able to state all the three variables correctly]

Manipulated variable : magnesium nitrate and calcium nitrate // Mg^{2+} and Ca^{2+}
Responding variable: formation of white precipitate
Controlled variable : aqueous ammonia solution</td></tr>
<tr><td>(d)</td><td>[Able to state the list of substances and apparatus correctly and completely]
Test tube, dropper, test tube rack
0.5 mol dm^{-3} magnesium nitrate solution, 0.5 mol dm^{-3} calcium nitrate solution, aqueous ammonia solution.</td></tr>
<tr><td>(e)</td><td>[Able to state a complete experimental procedure]

1. 2 cm^3 of solution A is poured into a test tube.
2. A few drops of aqueous ammonia solution are added into the test tube using a dropper and the test tube is shaken well.
3. If the precipitate is formed, aqueous ammonia solution is added continuously until no further change occurred / until excess
4. The mixture is shaken well.
5. The changes occur is recorded in a table.
6. Steps 1 to 4 are repeated using solution B.</td></tr>
<tr><td>(f)</td><td>[Able to exhibit the tabulation of data correctly]

<table>
<tr><td rowspan="2">Reagent</td><td colspan="2">Observation</td></tr>
<tr><td>Test tube/Solution A</td><td>Test tube/Solution B</td></tr>
<tr><td>Aqueous ammonia solution</td><td></td><td></td></tr>
</table>
</td></tr>
</table>