MUKONO EXAMINATIONS COUNCIL 2018
Uganda Advanced Certificate of Education
CHEMISTRY
P525/3
MARKING GUIDE

Volume of pipette used 25.0cm³

Experiment	1	2	3
Final burette readings / cm³	24.20	33.00	23.00
Initial burette reading/cm³	1.00	10.00	0.00
Volume of FA1 used /cm³	23.20	23.00	23.00

Volume of FA1 used to obtain average

23.00 and 23.00

Average volume of FA1 used

$$\frac{23.00 + 23.00}{2} = \frac{46}{2} = 23.00\text{cm}^3$$

a) **Calculate the concentration of FA2 in moles per dm³.**
(Ratio of reaction FA1:FA2 = 2 : 5)

RFM of $KMnO_4$ = (39 x 1) + (55 x 1) + (16 x 4) = 158

158g of $KMnO_4$ contains 1 mole

0.64g of $KMnO_4$ contains $\left(\frac{0.64}{158} \times 1\right)$ moles = 0.004050633

Concentration of FA1 = 0.004 moles per dm³

1000cm³ of FA1 contains 0.004moles of $KMnO_4$

23cm³ of FA1 contains $\left(\frac{0.004}{1000} \times 23\right)$ = 0.00009moles of $KMnO_4$

Moles of FA1 that reacted = 0.00009moles.

2 Moles of FA1 reacted with 5moles of FA2

Moles of FA2 that reacted $\left(\frac{5}{2} \times 0.00009\right)$ = 0.00023moles

25cm³ of FA2 contains 0.00023moles of ferrous ammonium sulphate.

1000cm3 of FA2 contains $\left(\frac{0.00023}{25} \times 1000\right)$ = 0.009316456 ≈0.009M

Concentration of FA2 = 0.009M

Part B

Volume of pipette used 25.0 cm³

Experiment	1	2	3
Final burette readings / cm³	6.70	15.60	25.50
Initial burette reading/cm³	1.00	10.00	20.00
Volume of FA1 used /cm³	5.70	5.60	5.50

Volume of FA1 used to obtain average

5.60 and 5.50

Average volume of FA1 used.

$$\frac{5.60 + 5.50}{2} = \frac{11.10}{2} = 5.55\text{cm}^3$$

(i) Write a balanced equation of reaction between FA1 solution and hydrogen peroxide.

$$2MnO^-_{4(aq)} + 5H_2O_{2(aq)} + 6H^+_{(aq)} \rightarrow 2Mn^{2+}_{(aq)} + 5O_{2(g)} + 8H_2O_{(l)}$$

(ii) Calculate the number of moles of FA1 used. (K = 39, Mn = 55, O =16)

From (c) : concentration of FA1 = 0.004M

1000cm³ of FA1 contains 0.004moles of $KMnO_4$

1000cm³ of FA1 contains 0.004moles of MnO^-_4

5.55cm³ of FA1 contains $\left(\frac{0.004}{1000} \times 5.55\right)$ = 0.00002 moles

Moles of FA1 that reacted = 0.00002 moles.

(iii) Calculate the concentration of H_2O_2 in moles per litre in the dilute solution Q.

2 moles of FA1 reacts with 5 moles of Q

Moles of Q that reacted = $\left(\frac{5}{2} \times 0.00002\right)$ moles of Q

= 0.00005 moles of Q

25cm³ of dilute solution Q contains 0.00005 moles of H_2O_2

1000cm³ of Q contains $\left(\frac{0.00005}{25} \times 1000\right)$ moles of H_2O_2

Concentration of H_2O_2 = 0.002 moles per litre.

In dilute solution of Q is ≈0.002M

(iv) Calculate the concentration of H_2O_2 in moles per litre in the concentrated solution of Q

5cm3 of Q contains 0.002 moles of H_2O_2

1000cm3 of Q contains $\left(\frac{0.002}{5} \times 1000\right)$ moles

= 0.4 moles per litre.

Concentration of H_2O_2 in concentrated solution of = 0.4 moles per litre.

2.

Tests	Observations	Deductions
a) Heat a spatula end full of W strongly in a test tube.	White solid colourless gas, turns blue litmus red and lime water milky.	Non- transition metal cation Al^{3+}, Ba^{2+}, Ma^{2+} or Ca^{2+}
	Yellow solid turns white on cooling white residue.	ZnO; Zn^{2+} Al_2O_3; Al^{3+} BaO; Ba^{2+} CaO; Ca^{2+}

b) Place 2 spatula of W in a test tube and add 5cm³ of water. Shake and filter. Keep the residue. Divide the filtrate into 4 parts.	Sparingly soluble colourless filtrate White residue	Non coloured metal cation present Al^{3+}, Zn^{2+}, Ba^{2+}, Ca^{2+} Mg^{2+}
(i) To the 1st part, add 3 -4 drops of barium nitrate solution.	White ppt	SO_3^{2-}, SO_4^{2-}, CO_3^{2-}, $C_2O_4^{2-}$
ii) To the 2nd part, add 3 – 4 drops silver nitrate solution followed by dilute nitric acid	White ppt; soluble in acid forming a colourless solution	$C_2O_4^{2-}$
iii) To 3rd part, add reagent of your own to confirm anion in the filtrate. Add dilute H_2SO_4 and warm followed by 3 drops of $KMnO_4$ solution. Add acidified barium chloride solution and boil	Purple solution turns colourless with bubbles of ca colourless gas, blue litmus turns red and lime water milky	CO_2 gas evolved $C_2O_4^{2-}$ present
c) Shake the residue from (b) in dilute nitric acid. To the resultant solution, add sodium hydroxide solution dropwise until in excess and filter. Keep the residue for part (e).	White residue dissolves with bubbles of a colourless gas, blue litmus red and lime water milky. White ppt insoluble colourless filtrate White residue	CO_2 gas; CO_3^{2-} Zn^{2+}, Al^{3+} or Pb^{2+} or Sn^{2+} Ba^{2+}, Ca^{2+}, Mg^{2+} present
d) Acidify the filtrate using dilute nitric acid and divide into 4 parts.	White ppt, soluble forming a colourless solution.	Zn^{2+}, Al^{3+}, Pb^{2+}, Sn^{2+}
(i) To the 1st part, add dilute Sodium hydroxide solution drop wise until in excess.	White ppt, soluble forming a colourless solution.	Zn^{2+}, Al^{3+}, Pb^{2+}, Sn^{2+}
(ii) To the 2nd part, add dilute ammonia solution drop wise until in excess.	White ppt, soluble forming a colourless solution.	Zn^{2+} present.

(iii) To the 3rd part, add reagent of your own to confirm cation in the filtrate. Add solid NH_4Cl followed by disodium hydrogen phosphate and excess ammonia solution.	White ppt, soluble in ammonia forming a colourless solution.	Zn^{2+}
b) Wash the residue with some water and transfer to a test tube; add dilute nitric acid to dissolve. Divide the mixture into 4 parts.	White residue dissolves forming a colourless solution.	Ba^{2+}, Mg^{2+} or Ca^{2+}
(i) To the 1st part, add dilute sodium hydroxide solution wise till in excess	White ppt insoluble	Ba^{2+}, Mg^{2+} or Ca^{2+}
(ii) To the 2nd part, add dilute ammonia solution drop wise till in excess	White ppt; insoluble	Ba^{2+}, or Mg^{2+}
(iii) To the 3rd part, 3 -4 drops of dilute sulphuric acid.	White ppt	Ba^{2+}
(iv) To the 4th part, potassium chromate solution followed by excess sodium hydroxide solution	Yellow ppt insoluble in NaOH	Ba^{2+}

Cations Zn^{2+} and Ba^{2+}

Anions $C_2O_4^{2-}$ and CO_3^{2-}

3.

	Tests	**Observations**	**Deductions**
a)	**Burn a small amount of K on a spatula.**	K is a colourless liquid that burns with a yellow sooty flame.	K is an aromatic compound.
b)	**Shake three drops of K with about 2cm³ of water and allowed to stand. Test with litmus.**	K is immiscible with water and has no effect on litmus	K is non-polar and neutral compound probably alcohols or carbonyl compound.

c)	**To 1cm^3 of K in a test tube, add a spatula of $NaHCO_3$.**	No observable change	Carboxylic acid absent
d)	**To 3 drops of K in a test tube, add a few drops of neutral iron (III) chloride solution.**	No observable change	Phenol absent
e)	**To a portion of K, add 3 – 5 drops of 2,4-dinitrophenyl hydrazine solution.**	No observable change	Carboxylic compound absent
f)	**To apportion of K, add 2-3 drops of acidified $K_2Cr_2O_7$ solution. Heat the mixture and divide into 2 portions.**	Orange solution turns green	K is oxidized, Alcohol present.
(i)	**To the 1st portion, add 3-4 drops of 2,4 dinitrophenyl hydrazine.**	Orange precipitate	Aromatic carbonyl compound present from oxidation of alcohol.
(ii)	**To about 3cm^3 of silver nitrate solution, add 3cm^3 of NaOH solution followed by ammonia solution until the precipitate just dissolves. Add to the 2nd portion above, shake and heat in a water bath.**	Grey precipitate No observable change	Aldehyde present from oxidation of alcohol (aromatic 1° alcohol). Aldehyde absent; due to complete oxidation of alcohol to carboxylic acid

Comment on the nature of K

- K is a aromatic primary alcohol

K – aromatic compound

- OH attached to a methyl group
- Attached to benzene ring.

END