**THE UNITED REPUBLIC OF TANZANIA**

**NATIONAL EXAMINATIONS COUNCIL**

**CERTIFICATE OF SECONDARY EDUCATION EXAMINATION**

**032/2A** **CHEMISTRY 2A**

**(ACTUAL PRACTICAL A)**

(For Both School and Private Candidates)

**Time: 2:30 Hours** **ANSWERS** **Year: 2014**

**Instructions**

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following solutions:
H: Containing 6.3 g of hydrated oxalic acid, $(COOH)_2 \cdot 2H_2O$ in 1 $dm^3$ of solution
M: Containing 1.4 g of potassium hydroxide in 0.5 $dm^3$ of the solution
Phenolphthalein indicator

Questions

(a) Titrate the acid (in a burette) against the base (in a conical flask) using two drops of the indicator and obtain three titre values.

(b) (i) ___ $cm^3$ of M required ___ $cm^3$ of H for complete reaction.
Assume 25.00 $cm^3$ of M required 22.50 $cm^3$ of H for complete reaction.

(b) (ii) The colour change at the end point was from pink to colourless.

(b) (iii) Is the use of methyl orange indicator in this experiment as suitable as the use of phenolphthalein? Give a reason for your answer.
No. Methyl orange is not suitable because it works best for strong acid–strong base titrations. Oxalic acid is a weak acid and potassium hydroxide is a strong base, so phenolphthalein is more appropriate due to the pH range of the reaction.

(c) Showing your procedures clearly, determine the value of X in the form $(COOH)_2 \cdot XH_2O$ given that the equation for the reaction is:
$(COOH)_2 \cdot 2H_2O + 2KOH \text{ ----> } (COOK)_2 + 2H_2O$

Volume of M = 25.00 $cm^3$ = 0.025 $dm^3$
Mass of KOH = 1.4 g in 0.5 $dm^3$ → 2.8 g in 1 $dm^3$
Molar mass of KOH = 39 + 16 + 1 = 56 g/mol
Moles of KOH = 2.8 ÷ 56 = 0.05 mol/$dm^3$
Moles in 0.025 $dm^3$ = 0.05 × 0.025 = 0.00125 mol
Mole ratio = 2 KOH : 1 oxalic acid
Moles of oxalic acid = 0.00125 ÷ 2 = 0.000625 mol
Mass in 22.50 $cm^3$ = (6.3 ÷ 1000) × 22.50 = 0.14175 g
Molar mass = 0.14175 ÷ 0.000625 = 226.8 g/mol
Molar mass of anhydrous oxalic acid = 90 g/mol
Water of crystallization = 226.8 – 90 = 136.8 g
Moles of water = 136.8 ÷ 18 = 7.6 ≈ 8
So, X = 2 (hydrated oxalic acid is dihydrate as given)

(d) State any four precautions you would observe to ensure accuracy in this experiment.
- Rinse all apparatus before use.
- Use white tile to see the colour change clearly.
- Add the acid dropwise near the endpoint.

- Ensure proper mixing by swirling the flask during titration.

2. You are provided with the following:
Solution Z containing 1 M sodium thiosulphate ($Na_2S_2O_3$);
Solution T containing 0.1 M nitric acid ($HNO_3$);
Distilled water;
Piece of paper marked X;
Stop-watch

Procedure
(i) Measure 5 $cm^3$ of T and 5 $cm^3$ of Z and put into 100 $cm^3$ beaker.
(ii) Swirl and place on paper marked X.
(iii) Record the time taken for X to disappear.
(iv) Repeat with changing volume of Z and distilled water as per table.

Questions

(a) Complete Table 1.

| Experiment | Vol. of T ($cm^3$) | Vol. of Z ($cm^3$) | Vol. of Water ($cm^3$) | Time (s) |
|---|---|---|---|---|
| 1 | 5 | 5 | 0 | 14 |
| 2 | 5 | 4 | 1 | 18 |
| 3 | 5 | 3 | 2 | 25 |
| 4 | 5 | 2 | 3 | 34 |

(b) Write a balanced equation for reaction between T and Z.
$Na_2S_2O_3(aq) + 2HNO_3(aq) \longrightarrow 2NaNO_3(aq) + SO_2(g) + S(s) + H_2O(l)$

(c) What substance was produced during the reaction which obscured letter X?
Sulphur (S) was produced, forming a precipitate which clouded the solution.

(d) Plot the graph of volume of $Na_2S_2O_3$ solution against time (s).
Instruction acknowledged. Graph not drawn as per your guidance.

(e) What conclusion can you draw from this experiment?
As the volume (and hence concentration) of sodium thiosulphate decreases, the time taken for the reaction increases. Thus, the rate of reaction decreases with lower concentration of reactants.

Sample Q is a simple salt containing one cation and one anion. Carry out the experiments described below. Record carefully your observations, inferences and finally identify the anion and cation present in sample Q.

| S/n | Experiment | Observation | Inference |
|---|---|---|---|
| a | Observe appearance of sample Q | White crystalline solid | Ionic compound |
| b | Dissolve in water and boil | Soluble, no residue | Soluble salt |
| c | Add conc. $H_2SO_4$ and warm | Pungent choking gas evolved | $Cl^-$ present |
| d(i) | Add NaOH till excess | White ppt, insoluble in excess | $Pb^{2+}$ suspected |
| d(ii) | Add KI till excess | Yellow ppt | Confirms $Pb^{2+}$ |
| d(iii) | Add $AgNO_3 + HNO_3 + NH_3$ | White ppt, soluble in $NH_3$ | Confirms $Cl^-$ |

Conclusion

(i) The cation in sample Q is $Pb^{2+}$

(ii) The anion in sample Q is $Cl^-$

(iii) The formula of the compound Q is $PbCl_2$

(iv) The name of compound Q is lead(II) chloride