

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.

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1. You are provided with the following solutions:

H: Containing 6.3 g of hydrated oxalic acid, $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$ in 1 dm³ of solution

M: Containing 1.4 g of potassium hydroxide in 0.5 dm³ 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) ____ cm³ of M required ____ cm³ of H for complete reaction.

Assume 25.00 cm³ of M required 22.50 cm³ 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 $(\text{COOH})_2 \cdot \text{XH}_2\text{O}$ given that the equation for the reaction is:



Volume of M = 25.00 cm³ = 0.025 dm³

Mass of KOH = 1.4 g in 0.5 dm³ → 2.8 g in 1 dm³

Molar mass of KOH = 39 + 16 + 1 = 56 g/mol

Moles of KOH = $2.8 \div 56 = 0.05 \text{ mol/dm}^3$

Moles in 0.025 dm³ = $0.05 \times 0.025 = 0.00125 \text{ mol}$

Mole ratio = 2 KOH : 1 oxalic acid

Moles of oxalic acid = $0.00125 \div 2 = 0.000625 \text{ mol}$

Mass in 22.50 cm³ = $(6.3 \div 1000) \times 22.50 = 0.14175 \text{ g}$

Molar mass = $0.14175 \div 0.000625 = 226.8 \text{ g/mol}$

Molar mass of anhydrous oxalic acid = 90 g/mol

Water of crystallization = $226.8 - 90 = 136.8 \text{ g}$

Moles of water = $136.8 \div 18 = 7.6 \approx 8$

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 ($\text{Na}_2\text{S}_2\text{O}_3$);

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.

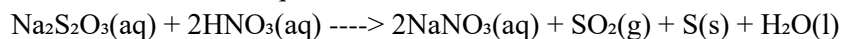
(iv) Repeat with changing volume of Z and distilled water as per table.

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.



(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 $\text{Na}_2\text{S}_2\text{O}_3$ 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 $\text{AgNO}_3 + \text{HNO}_3 + \text{NH}_3$	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