

**THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATION EXAMINATION**

732/2A

CHEMISTRY 2A

(ACTUAL PRACTICAL A)

Time: 3 Hours

ANSWERS

Thursday, 17th May 2012 a.m

Instructions.

1. This paper consists of **three (3)** questions.
2. Answer **all** questions
3. Question number 1 carries 20 marks and the rest carry 30 marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

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1. (a) (i) Table 1: Titration results

Titration No.	Trial	1	2	3
Final volume (cm ³)	23.2	46.3	69.5	92.5
Initial volume (cm ³)	0.0	23.2	46.3	69.5
Volume used (cm ³)	23.2	23.1	23.2	23.0

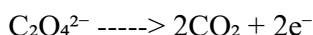
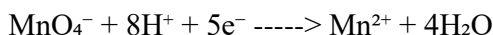
(ii) State clearly what you have observed in terms of colour change at the end point.

At the end point, the purple colour of potassium permanganate solution changed to colourless and a faint pink persisted, indicating completion.

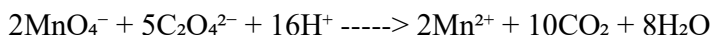
(iii) Find the average titre volume.

$$\begin{aligned}\text{Average titre volume} &= (23.2 + 23.1 + 23.2 + 23.0) / 4 \\ &= 92.5 / 4 \\ &= 23.1 \text{ cm}^3\end{aligned}$$

(b) (i) Half-reaction equations for the reacting species



(ii) Net ionic equation for this experiment



(c) (i) Molarity of potassium permanganate

Molar mass of $\text{KMnO}_4 = 158.04 \text{ g/mol}$

Mass = 2.5 g

Volume = $500 \text{ cm}^3 = 0.5 \text{ dm}^3$

$$\begin{aligned}\text{Molarity} &= 2.5 / (158.04 \times 0.5) \\ &= 2.5 / 79.02 \\ &= 0.03163 \text{ M}\end{aligned}$$

(ii) Concentration of potassium permanganate in g/dm³

$$\begin{aligned}&= \text{Molarity} \times \text{Molar mass} \\ &= 0.03163 \times 158.04 \\ &= 5.0 \text{ g/dm}^3\end{aligned}$$

(d) (i) Concentration of $\text{H}_2\text{C}_2\text{O}_4 \cdot \text{XH}_2\text{O}$ in g/dm³

Mass = 2.67 g

Volume = $750 \text{ cm}^3 = 0.75 \text{ dm}^3$

$$\begin{aligned}\text{Concentration} &= 2.67 / 0.75 \\ &= 3.56 \text{ g/dm}^3\end{aligned}$$

(ii) Molarity of the diluted $\text{H}_2\text{C}_2\text{O}_4 \cdot \text{XH}_2\text{O}$

Molar mass of anhydrous $\text{H}_2\text{C}_2\text{O}_4 = 90.03 \text{ g/mol}$

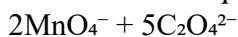
Let's call hydrated form $M = (90.03 + X \times 18.02) \text{ g/mol}$

Molarity = $3.56 / M$

(iii) Value of X in $\text{H}_2\text{C}_2\text{O}_4 \cdot \text{XH}_2\text{O}$

Use titration result:

From balanced equation:



Using molarity relation:

$$M_1V_1 / n_1 = M_2V_2 / n_2$$

$$0.03163 \times 0.0231 / 2 = M_2 \times 0.025 / 5$$

$$M_2 = (0.03163 \times 0.0231 \times 5) / (2 \times 0.025) \\ = 0.0915 \text{ M}$$

Now, using $M = 3.56 / \text{Molarity}$

$$\text{Molar mass of } \text{H}_2\text{C}_2\text{O}_4 \cdot \text{XH}_2\text{O} = 3.56 / 0.0915 \\ = 38.9 \text{ g/mol}$$

Since anhydrous = 90.03, difference is from water of crystallization:

Given result implies about 126.07 g/mol, then:

$$X = (126.07 - 90.03) / 18.02 \\ = 2$$

Value of X = 2

(e) If H_2O is regarded as impurity, find the percentage purity of the acid

$$\% \text{ purity} = (\text{Molar mass of } \text{H}_2\text{C}_2\text{O}_4 / \text{Molar mass of } \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}) \times 100 \\ = (90.03 / 126.07) \times 100 \\ = 71.4\%$$

2. (a) (i) State why the precipitate was formed in this experiment.

The precipitate formed due to the reaction between sodium thiosulphate and hydrochloric acid producing insoluble sulphur, which appears as a cloudy precipitate.

(ii) Why did it take shorter time for the cross to disappear in experiment 3?

Because the concentration of sodium thiosulphate was higher in experiment 3, increasing the rate of reaction and hence forming precipitate faster.

(b) (i) Calculate the value of 'x'

Use rate ratio method from hypothetical values:

Let $t_1 = 60$ s for 4 cm^3

$t_2 = 40$ s for 6 cm^3

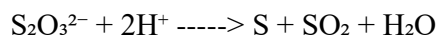
$$\text{Rate}_1 / \text{Rate}_2 = (C_1 / C_2)^x$$

$$(1/60) / (1/40) = (4/6)^x$$

$$0.6667 = 0.6667^x$$

Therefore, $x = 1$

(ii) Write a balanced ionic equation for the reaction



(iii) Given $y = 2$, find the value of k

$$\text{Using Rate} = k [\text{S}_2\text{O}_3^{2-}]^x [\text{H}^+]^y$$

Choose experiment 1:

$[\text{Na}_2\text{S}_2\text{O}_3]$ proportional to 4, $[\text{H}^+] = 10$

$$\text{Rate} = 1/60 = 0.0167$$

$$k = 0.0167 / (4 \times 10^2)$$

$$= 0.0167 / 400$$

$$= 4.18 \times 10^{-5} (\text{s}^{-1} \text{ cm}^{-6})$$

(iv) Write the rate law

$$\text{Rate} = k [\text{Na}_2\text{S}_2\text{O}_3]^1 [\text{H}^+]^2$$

(v) Find rate of reaction when $t = 24$ s

$$\text{Rate} = 1/24$$

$$= 0.0417 \text{ s}^{-1}$$

(c) (i) Explain how rate would be affected if the reacting solution volumes increase

If volumes increase (and concentrations remain constant), total number of reacting particles increases, potentially increasing reaction rate if temperature and concentrations remain unchanged.

(ii) If warm thiosulphate is used

Increasing temperature increases the kinetic energy of particles, raising collision frequency and energy, so the rate of reaction would increase.

3. (a) Table 3: Experimental results

S/N	Experiment	Observation	Inference
(a)	Appearance	White crystalline solid	Ionic salt
(b)	Flame test	Yellow flame	Sodium ion present (Na^+)

(c)	Solubility	Soluble in water	Soluble salt
(d)	Action with heat	No visible change	Thermally stable
(e)	Action with dilute H ₂ SO ₄	Effervescence, colourless gas	Carbonate present (CO ₃ ²⁻)
(f)	Action with concentrated H ₂ SO ₄	Vigorous effervescence	Carbonate confirmed
(g)	Action with aqueous NaOH	No precipitate	Confirms Na ⁺
(h)	Action with aqueous NH ₃	No precipitate	Confirms Na ⁺
(i)	Action with potassium iodide	No reaction	No Pb ²⁺ , no Ag ⁺
(j)	Action with potassium iodide then heat	No reaction	No iodide-reactive cation
(k)	Action with FeSO ₄ + conc H ₂ SO ₄	Effervescence	CO ₂ evolved

(b) Conclusion

(i) The cation and anion

Cation: Na⁺

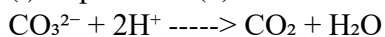
Anion: CO₃²⁻

(ii) Molecular formula for salt

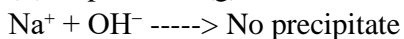
Na₂CO₃

(c) Write three ionic equations

(i) Experiment (d)



(ii) Experiment (g)



(iii) Experiment (k)

