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).

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.

Average titre volume = (23.2 + 23.1 + 23.2 + 23.0) / 4
= 92.5 / 4
= 23.1 cm^3

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

$MnO_4^- + 8H^+ + 5e^- \text{-----> } Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \text{-----> } 2CO_2 + 2e^-$

(ii) Net ionic equation for this experiment

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \text{-----> } 2Mn^{2+} + 10CO_2 + 8H_2O$

(c) (i) Molarity of potassium permanganate

Molar mass of $KMnO_4$ = 158.04 g/mol
Mass = 2.5 g
Volume = 500 cm^3 = 0.5 dm^3

Molarity = 2.5 / (158.04 × 0.5)
= 2.5 / 79.02
= 0.03163 M

(ii) Concentration of potassium permanganate in g/dm^3

= Molarity × Molar mass
= 0.03163 × 158.04
= 5.0 g/dm^3

(d) (i) Concentration of $H_2C_2O_4 \cdot XH_2O$ in g/dm^3

Mass = 2.67 g
Volume = 750 cm^3 = 0.75 dm^3

Concentration = 2.67 / 0.75
= 3.56 g/dm^3

(ii) Molarity of the diluted $H_2C_2O_4 \cdot XH_2O$

Molar mass of anhydrous $H_2C_2O_4$ = 90.03 g/mol
Let's call hydrated form M = (90.03 + X×18.02) g/mol

Molarity = 3.56 / M

(iii) Value of X in $H_2C_2O_4 \cdot XH_2O$

Use titration result:

From balanced equation:
$2MnO_4^- + 5C_2O_4^{2-}$

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 M

Now, using M = 3.56 / Molarity

Molar mass of $H_2C_2O_4 \cdot XH_2O$ = 3.56 / 0.0915
= 38.9 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

% purity = (Molar mass of $H_2C_2O_4$ / Molar mass of $H_2C_2O_4 \cdot 2H_2O$) × 100
= (90.03 / 126.07) × 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

$Rate_1 / Rate_2 = (C_1 / C_2)^x$

(1/60) / (1/40) = (4/6)^x
0.6667 = 0.6667^x

Therefore, x = 1

(ii) Write a balanced ionic equation for the reaction

$S_2O_3^{2-} + 2H^+ \text{-----> } S + SO_2 + H_2O$

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

Using Rate = k $[S_2O_3^{2-}]^x [H^+]^y$

Choose experiment 1:
$[Na_2S_2O_3]$ proportional to 4, $[H^+]$ = 10

Rate = 1/60 = 0.0167

k = 0.0167 / (4×10^2)
= 0.0167 / 400
= 4.18×10^{-5} (s^{-1} cm^{-6})

(iv) Write the rate law

Rate = k $[Na_2S_2O_3]^1[H^+]^2$

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

Rate = 1/24
= 0.0417 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_2SO_4	Effervescence, colourless gas	Carbonate present (CO_3^{2-})
(f)	Action with concentrated H_2SO_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_2SO_4	Effervescence	CO_2 evolved

(b) Conclusion

(i) The cation and anion
Cation: Na^+
Anion: CO_3^{2-}

(ii) Molecular formula for salt
Na_2CO_3

(c) Write three ionic equations

(i) Experiment (d)
$CO_3^{2-} + 2H^+ \text{-----> } CO_2 + H_2O$

(ii) Experiment (g)
$Na^+ + OH^- \text{-----> No precipitate}$

(iii) Experiment (k)
$CO_3^{2-} + 2H^+ \text{-----> } CO_2 + H_2O$