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

732/2B **CHEMISTRY 2B**

(PRACTICAL B)

Time: 3 Hours **ANSWERS** **Year: 2020**

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. You are provided with solution PP (1.58 g/dm³ $KMnO_4$), AA (1.575 g/0.5 dm³ $H_2C_2O_4 \cdot VH_2O$) and SA (2 M H_2SO_4). You are also provided with heat source, water bath, thermometer and other relevant reagents and apparatuses.

Procedure

(i) Pipette 20 cm³ or 25 cm³ of AA into a clean conical flask. Add the same volume of SA and heat the mixture solution until the solution attains a temperature of about 70 °C.

(ii) Put PP into a burette and titrate it against the hot solution containing AA and SA until the colour changes from colourless to pink.

(iii) Repeat the procedures (i) and (ii) three more times.

Questions

(a)(i) Copy and fill Table 1 with relevant experimental results.

Table 1: Experimental results

Burette Readings	**Pilot**	**Titration 1**	**Titration 2**	**Titration 3**
Final volume (cm^3)	21.50	21.60	21.50	21.55
Initial volume (cm^3)	0.00	0.00	0.00	0.00
Volume used (cm^3)	21.50	21.60	21.50	21.55

(ii) Find average titre value.

Answer

Average = (21.60 + 21.50 + 21.55) / 3
= 64.65 / 3
= 21.55 cm^3

(iii) Show half and the overall ionic redox reaction equations.

Answer

Half-equations:
$MnO_4^- + 8H^+ + 5e^- \text{-----> } Mn^{2+} + 4H_2O$
$C_2O_4^{2-} \text{-----> } 2CO_2 + 2e^-$

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

(b) Why is the solution pink in colour at the end point?

Answer

At the end point, all the oxalate ions have reacted, and a slight excess of purple MnO_4^- remains unreacted, giving a permanent faint pink colour to the solution.

(c) Calculate the:

(i) Molarity of $H_2C_2O_4$.

Answer

Molar mass of $H_2C_2O_4 \cdot 2H_2O = (1\times2) + (12\times2) + (16\times4) + (18\times2) = 126$ g/mol
Mass in 0.5 dm^3 = 1.575 g

Molarity = (1.575 g / 126 g/mol) ÷ 0.5 dm^3
= (0.0125 mol) / 0.5
= 0.025 M

(ii) Value of V in the compound $H_2C_2O_4 \cdot VH_2O$.

Answer

Given molar mass is 126 g/mol
Anhydrous oxalic acid ($H_2C_2O_4$) = (1×2) + (12×2) + (16×4) = 90 g/mol

Mass of water = 126 - 90 = 36 g
Number of water molecules: 36 ÷ 18 = 2

So, V = 2

(iii) Molar mass of $H_2C_2O_4 \cdot VH_2O$.

Answer

Already confirmed:
= 126 g/mol

2. You are provided with solution SN (0.5 M $Na_2S_2O_3$) and CL (0.15 M HCl) and distilled water. You are also provided with a stop watch; 200 cm^3 or 250 cm^3 beaker; 50 cm^3 beaker, two 10 cm^3 measuring cylinders and other relevant reagents and apparatuses.

Table 2: Experiment Data

Experiment No.	**Volume of SN (cm^3)**	**Volume of H_2O (cm^3)**	**Volume of CL (cm^3)**	**Time (s)**	**1/t (s^{-1})**
1	2	8	10	140	0.00714
2	4	6	10	70	0.01429
3	6	4	10	47	0.02128

(b) If the rate expression is:
Rate = k[$Na_2S_2O_3$]^m [HCl]^n; where m = 1 and n = 2, find the value of the constant k.

Answer

Use experiment 1:

[$Na_2S_2O_3$] = 2 cm^3 / 20 cm^3 = 0.1
[HCl] = 10 cm^3 / 20 cm^3 = 0.5

Rate = k × (0.1)^1 × (0.5)^2
0.00714 = k × 0.1 × 0.25
0.00714 = k × 0.025
k = 0.00714 / 0.025
k = 0.2856 s^{-1}

(c) Giving one reason, state how the rate of reaction would have been affected if the temperature of the reacting solutions was 10 °C.

Answer

The rate of reaction would decrease because lower temperature reduces the kinetic energy of the reacting molecules, resulting in fewer effective collisions per second.

(d) (i) Compute the rate of reaction when the volume of SN is 10 cm^3.

Answer

Total volume = 10 (SN) + 0 (H_2O) + 10 (CL) = 20 cm^3
[$Na_2S_2O_3$] = 10 / 20 = 0.5
[HCl] = 10 / 20 = 0.5

Rate = k × (0.5)^1 × (0.5)^2
Rate = 0.2856 × 0.5 × 0.25
= 0.2856 × 0.125
= 0.0357 s^{-1}

(ii) Determine the time taken for "X" to disappear in this volume.

Answer

t = 1 / Rate
t = 1 / 0.0357
= 28 s

3. A sample of salt Y contains one cation and one anion. You are required to perform a systematic qualitative analysis experiment to identify the ions present in the salt, based on the following tests:

(i) Appearance of sample Y.
(ii) Solubility.
(iii) Action of heat on the dry sample.

(iv) Action with concentrated H_2SO_4 followed by MnO_2.
(v) Action of aqueous NaOH on the solution of Y.
(vi) Action of potassium ferrocyanide on the solution of Y.

Questions

(a) Prepare a relevant Table showing the qualitative analysis results.

Answer

S/N	Test	Observation	Inference
(i)	Appearance	White crystalline solid	Could be a soluble salt
(ii)	Solubility in water	Soluble, clear colourless solution	Soluble salt
(iii)	Action of heat on dry sample	No change	Stable to heat
(iv)	Conc. H_2SO_4 then MnO_2	Colourless gas evolved, turns limewater milky	Presence of CO_2
(v)	Aqueous NaOH	White precipitate, insoluble in excess NaOH	Presence of Pb^{2+}
(vi)	Potassium ferrocyanide	Formation of white precipitate	Confirming Pb^{2+} presence

(b) What gas was evolved in test (iv)?

Answer

Carbon dioxide (CO_2)

(c) What was the purpose of doing test (vi)?

Answer

To confirm the presence of lead(II) ions (Pb^{2+}), as potassium ferrocyanide reacts with Pb^{2+} to form a white precipitate of lead(II) ferrocyanide.