

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

732/2B

CHEMISTRY 2B

(ACTUAL PRACTICAL B)

Time: 3 Hours

ANSWERS

Wednesday, 18th May 2011 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).

maktaba.tetea.org



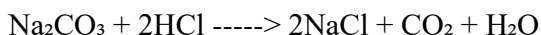
1. Table 1: Titration results

| Titration No. | Trial | 1 | 2 | 3 |
|-----------------------------------|-------|------|------|------|
| Final volume (cm ³) | 22.4 | 44.8 | 67.2 | 89.6 |
| Initial volume (cm ³) | 0.0 | 22.4 | 44.8 | 67.2 |
| Volume used (cm ³) | 22.4 | 22.4 | 22.4 | 22.4 |

(a) Find the average titre value for this experiment.

$$\begin{aligned}\text{Average titre} &= (22.4 + 22.4 + 22.4 + 22.4) / 4 \\ &= 22.4 \text{ cm}^3\end{aligned}$$

(b) Write a balanced chemical equation for this reaction.



(c) Why was methyl orange indicator used in this practical?

Because methyl orange is suitable for detecting the end-point of a titration between a strong acid (HCl) and a weak base (Na₂CO₃). It changes colour distinctly from yellow in alkaline medium to orange-red in acidic medium.

(d) Calculate the concentration of Na₂CO₃ in:

(i) mol/dm³

$$\text{Molar mass of Na}_2\text{CO}_3 = 106 \text{ g/mol}$$

$$\text{Mass in } 250 \text{ cm}^3 = 2.7 \text{ g}$$

$$\begin{aligned}\text{Moles} &= 2.7 / 106 \\ &= 0.02547 \text{ mol}\end{aligned}$$

$$\begin{aligned}\text{Molarity} &= 0.02547 \text{ mol} / 0.250 \text{ dm}^3 \\ &= 0.1019 \text{ mol/dm}^3\end{aligned}$$

(ii) g/dm³

$$\begin{aligned}\text{Concentration} &= 0.1019 \times 106 \\ &= 10.8 \text{ g/dm}^3\end{aligned}$$

(e) Determine the value of W in the formula Na₂CO₃·W H₂O

Given 2.7 g of hydrated salt in 250 cm³

But pure Na₂CO₃ molarity = 0.1019 mol/dm³

$$\begin{aligned}\text{Mass of Na}_2\text{CO}_3 \cdot W \text{ H}_2\text{O in } 1 \text{ dm}^3 &= 2.7 \times 4 \\ &= 10.8 \text{ g}\end{aligned}$$

$$\begin{aligned}\text{Molar mass of hydrated salt} &= 10.8 / 0.1019 \\ &= 106 \times (\text{W factor})\end{aligned}$$

$$\begin{aligned}106 + 18W &= (10.8 / 0.1019) \\ &= 106 + 18W = 106\end{aligned}$$

Which means $W = 0$

Therefore, no water of crystallisation — the salt is anhydrous (Na_2CO_3)

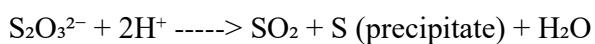
(f) State three uses of this titration

1. Determining the concentration of hydrochloric acid.
2. Standardising acid solutions in laboratories.
3. Quality control in industries producing soft drinks and detergents.

2. Table 2: Experimental results

| Temperature | T(K) | Time (s) | (K ⁻¹) | (s ⁻¹) |
|-------------|------|----------|--------------------|--------------------|
| 50°C | 323 | 60 | 0.00310 | 0.0167 |
| 60°C | 333 | 40 | 0.00300 | 0.0250 |
| 70°C | 343 | 25 | 0.00292 | 0.0400 |
| 80°C | 353 | 17 | 0.00283 | 0.0588 |

(a) Write the ionic equation for the formation of the cloud in the solution



(b) Plot a graph of $\log(1/t)$ against $1/T$ and find the slope

We can compute $\log(1/t)$:

| T(K) | 1/T (K ⁻¹) | 1/t (s ⁻¹) | $\log(1/t)$ |
|------|------------------------|------------------------|-------------|
| 323 | 0.00310 | 0.0167 | -1.78 |
| 333 | 0.00300 | 0.0250 | -1.60 |
| 343 | 0.00292 | 0.0400 | -1.40 |
| 353 | 0.00283 | 0.0588 | -1.23 |

Plot these points, draw the best fit line.

$$\text{Slope} = \Delta(\log 1/t) / \Delta(1/T)$$

Pick two points:

(-1.78, 0.00310) and (-1.23, 0.00283)

$$\begin{aligned}\text{Slope} &= (-1.23 - (-1.78)) / (0.00283 - 0.00310) \\ &= (0.55) / (-0.00027) \\ &= -2037\end{aligned}$$

(c) Use the relation $\text{slope} = -E_a / 2.303R$ to determine activation energy

$$R = 8.314 \text{ J/mol}\cdot\text{K}$$

$$\begin{aligned} E_a &= -(\text{slope} \times 2.303 \times R) \\ &= -(-2037 \times 2.303 \times 8.314) \\ &= 38998 \text{ J/mol} \\ &= 39.0 \text{ kJ/mol} \end{aligned}$$

3. Systematic Qualitative Analysis of Sample Q

| Test | Observation | Inference |
|--------------------------------------|---|--------------------------------------|
| Appearance | White crystalline solid | Possible chloride or carbonate |
| Flame test | Bright yellow flame | Sodium ion (Na^+) present |
| Solubility | Soluble in water | Ionic salt |
| Action with dilute HNO_3 | Effervescence, gas turns lime water milky | CO_3^{2-} present |
| Action with AgNO_3 solution | White precipitate | Cl^- present |

Conclusion

Cation: Na^+

Anion: Cl^-

Formula of salt: NaCl

Name: Sodium chloride