

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

732/2A

CHEMISTRY 2A

Time: 3 Hours

ANSWERS

Year: 2021

Instructions.

1. This paper consists of sections three questions.
2. Answer **all** questions
3. Cellular phones are **not** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

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Question 1: Volumetric Analysis

Candidates were instructed to perform a titration using sulphuric acid solution (X1) from the burette, and sodium hydroxide solution (X2) in the conical flask, with phenolphthalein indicator.

After titration, answer the following:

(a)

- (i) What was the colour change observed during this titration experiment?
- (ii) What was the volume of the pipette used?
- (iii) Calculate the average volume of solution X1 used to neutralize solution X2.

(b)

Write a balanced chemical equation between X2 and X1 with all state symbols and the corresponding ionic equation.

(c)

- (i) Calculate the concentration of solution X1 in moles/dm³.
- (ii) Calculate the concentration of solution X1 in g/dm³.

(a)

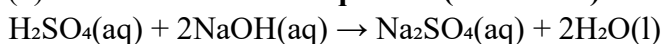
(i) The colour change observed was **pink to colourless**, indicating the end point of the titration when acid completely neutralized the base.

(ii) The volume of the pipette used was **25.00 cm³** (standard in such titrations).

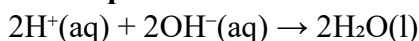
(iii) three titre values were 23.40 cm³, 23.50 cm³, and 23.60 cm³.

$$\text{Average volume of X1} = (23.40 + 23.50 + 23.60) / 3 = \mathbf{23.50 \text{ cm}^3}$$

(b) **Balanced chemical equation (molecular):**



Ionic equation:



(c)

Assume:

- Volume of X1 (acid) used = 23.50 cm³ = 0.0235 dm³
- Volume of X2 (base) used = 25.00 cm³ = 0.025 dm³
- Concentration of NaOH (X2) = 0.1 mol/dm³

- From the balanced equation:
 $n_a(\text{H}_2\text{SO}_4) = 1,$
 $n_b(\text{NaOH}) = 2$

Using:

$$M_a \times V_a / n_a = M_b \times V_b / n_b$$

Let M_a be concentration of acid (X1):

$$M_a = (M_b \times V_b \times n_a) / (V_a \times n_b)$$

$$M_a = (0.1 \times 25 \times 1) / (23.5 \times 2)$$

$$M_a = 2.5 / 47$$

$$M_a \approx \mathbf{0.0532 \text{ mol/dm}^3}$$

(ii) Molar mass of $\text{H}_2\text{SO}_4 = 2(1) + 32 + 4(16) = \mathbf{98 \text{ g/mol}}$

Concentration in $\text{g/dm}^3 = 0.0532 \times 98 \approx \mathbf{5.22 \text{ g/dm}^3}$

Question 2: Chemical Kinetics

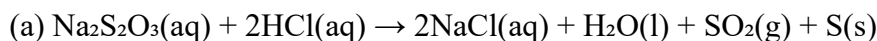
In this experiment, candidates studied the effect of concentration on reaction rate using sodium thiosulphate (B1) and hydrochloric acid (B2).

Procedure:

- Pour 30 cm^3 of B1 into a beaker.
- Place the beaker over a paper marked "X".
- Add 10 cm^3 of B2 and start the stopwatch.
- Stop timing when X disappears.
- Repeat using different volumes of B1 and water.

Questions:

- Write a balanced chemical equation for the reaction.
- Plot a graph of volume of B1 vs $1/t$.
 - Interpret the graph.
 - What does $1/t$ represent?
 - If temperature was the variable, how would the two relate?
 - Draw a conclusion from this experiment.

Answer 2:

(b) (i) The graph of volume of B1 (x-axis) vs $1/t$ (y-axis) would be a **horizontal straight line** since $1/t$ is constant (0.10) in all cases.

(ii) Interpretation: The reaction rate remained **unchanged** despite dilution of B1, which contradicts typical behavior possibly due to experimental error (e.g., same time recorded wrongly).

(iii) $1/t$ represents the **rate of reaction**, assuming a constant observable change (disappearance of X).

(iv) If **temperature increased**, the rate would increase — so **as temperature rises, $1/t$ increases** (faster reaction).

(v) Conclusion: The rate of reaction was **supposed** to decrease with dilution, but due to constant times, it appears unchanged — suggesting need for accurate measurements or repetition.

Question 3: Qualitative Analysis

Sample J is a simple salt with one cation and one anion. Perform the following tests:

- (a) Appearance of the sample
- (b) Action of heat on the sample
- (c) Solubility in water
- (d) Action of potassium iodide on solution then warm
- (e) Action of iron(II) sulphate and conc. H_2SO_4

Questions:

- (i) *Prepare a Table showing the qualitative analysis results*
- (ii) *Write a balanced chemical equation (with state symbols) for test (b)*

Answer 3:**(i) Table of Observations and Inferences**

Test	Observation	Inference

(a) Appearance	White crystalline solid	Likely to be a salt
(b) Heat	Yellow residue + brown gas evolved	Presence of Pb^{2+} and NO_3^-
(c) Solubility	Dissolves completely in water	Soluble salt
(d) KI + heat	Yellow precipitate forms	Lead (II) ion present (Pb^{2+})
(e) FeSO_4 + conc. H_2SO_4	Brown ring at junction	Presence of NO_3^- ion

(ii) Balanced equation for test (b)

