THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATTION 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 **note** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

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/dm^3.
(ii) Calculate the concentration of solution X1 in g/dm^3.

(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 cm^3** (standard in such titrations).

(iii) three titre values were 23.40 cm^3, 23.50 cm^3, and 23.60 cm^3.
Average volume of X1 = (23.40 + 23.50 + 23.60) / 3 = **23.50 cm^3**

(b) **Balanced chemical equation (molecular):**
$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

Ionic equation:
$2H^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l)$

(c)
Assume:

- Volume of X1 (acid) used = 23.50 cm^3 = 0.0235 dm^3
- Volume of X2 (base) used = 25.00 cm^3 = 0.025 dm^3
- Concentration of NaOH (X2) = 0.1 mol/dm^3

- From the balanced equation:
  $n_a(H_2SO_4) = 1$,
  n_b(NaOH) = 2

  Using:
  Ma × Va / na = Mb × Vb / nb

  Let Ma be concentration of acid (X1):
  Ma = (Mb × Vb × na) / (Va × nb)
  Ma = (0.1 × 25 × 1) / (23.5 × 2)
  Ma = 2.5 / 47
  Ma ≈ **0.0532 mol/dm³**

  (ii) Molar mass of H_2SO_4 = 2(1) + 32 + 4(16) = **98 g/mol**
  Concentration in g/dm³ = 0.0532 × 98 ≈ **5.22 g/dm³**

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:

(i) Pour 30 cm³ of B1 into a beaker.
(ii) Place the beaker over a paper marked "X".
(iii) Add 10 cm³ of B2 and start the stopwatch.
(iv) Stop timing when X disappears.
(v) Repeat using different volumes of B1 and water.

Questions:

(a) *Write a balanced chemical equation for the reaction.*
(b) (i) *Plot a graph of volume of B1 vs 1/t.*
(ii) *Interpret the graph.*
(iii) *What does 1/t represent?*
(iv) *If temperature was the variable, how would the two relate?*
(v) *Draw a conclusion from this experiment.*

Answer 2:

(a) $Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$

(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)**

$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$