

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2

CHEMISTRY 2
ALTERNATIVE TO PRACTICAL
(For Both School and Private Candidates)

Time: 2:30 Hours

Tuesday, 12th November 2013 a.m.

Instructions

1. This paper consists of **five (5)** questions. Answer **all** questions.
2. Each question carries **ten (10)** marks.
3. Qualitative Analysis Guidance Pamphlets may be used after a thorough check by the Supervisor.
4. Calculators and Cellular phones are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).
6. You may use the following constants:

Atomic masses: H = 1, N = 14, Na = 23, S = 32, Cl = 35.5, Cu = 64.

1 faraday = 96500 coulombs.

GMV at s.t.p. = 22.4 dm^3 .

1 litre = $1 \text{ dm}^3 = 1000 \text{ cm}^3$.



1. Figure 1 represents one of the laboratory experiments. Study it carefully and then answer the questions that follow.

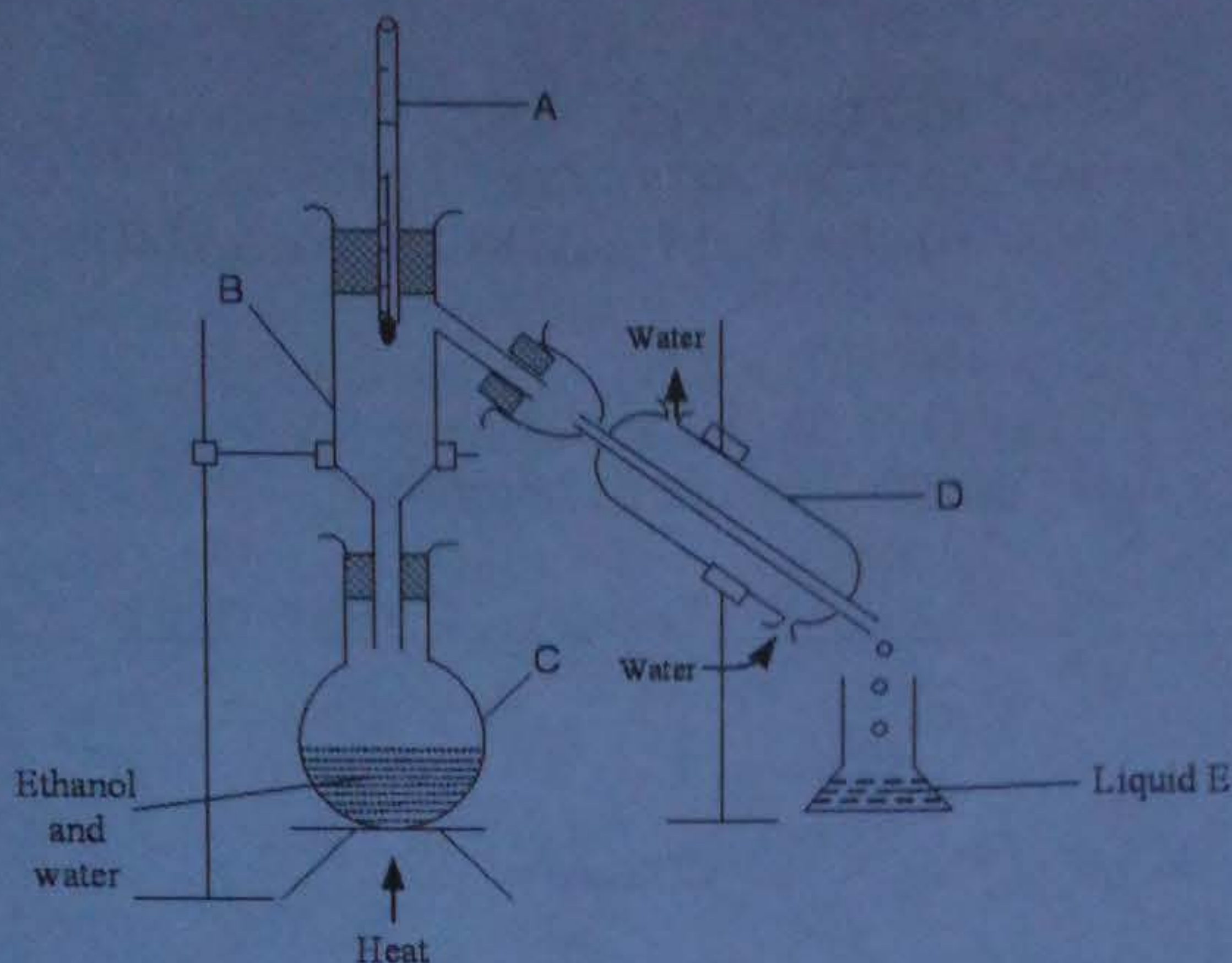


Figure 1

- (a) (i) Identify the apparatuses labelled A, B, C and D and state the use of each.
(ii) Giving reasons for your answers, state which apparatus in (a) (i) above do the following processes occur:
- Evaporation.
 - Condensation.
- (6 marks)**
- (b) (i) Name liquid E and explain why it is first collected.
(ii) Give a reason as to why water moves in and out as shown in Figure 1.
- (2.5 marks)**
- (c) (i) What is the name of the experiment?
(ii) Why apparatus A is inserted to the level of the column outlet rather than into the boiling liquid?
- (1.5 marks)**
2. (a) Briefly explain the colour changes which will be observed when each of the following indicators is used in the titration of potassium hydroxide with nitric acid (assume nitric acid is in the burette).

| S/n | Indicator | Colour at the starting point | Colour at the end point |
|-------|-----------------|------------------------------|-------------------------|
| (i) | Methyl orange | | |
| (ii) | Phenolphthalein | | |
| (iii) | Litmus solution | | |

(3 marks)

- (b) In a certain volumetric analysis experiment, 0.1M nitric acid was titrated against 25 cm³ of NaOH solution. Methyl orange was used as an indicator. The results of the experiment were recorded as shown in Table 1.

Table 1

| Titration | Pilot | 1 | 2 | 3 |
|-----------------------------------|-------|-------|-------|-------|
| Final Volume (cm ³) | 20.80 | 25.50 | 39.50 | 35.00 |
| Initial volume (cm ³) | 0.00 | 5.00 | 20.00 | 15.00 |
| Titre value (cm ³) | | | | |

Questions

- Complete Table 1 by calculating the titre value for each column.
- Determine the mean titre value.
- Calculate the concentration of the base solution in g dm⁻³ and mol dm⁻³.
(5.5 marks)

- What volume of water should be added to the 25 cm³ of NaOH to make a 0.01M solution?
(1.5 marks)

- Two voltameters were connected in series as shown in Figure 2. One of the voltameters contained dilute sulphuric acid and the other contained dilute copper (II) sulphate solution. Electrodes labelled B, C, D and E were made of platinum.

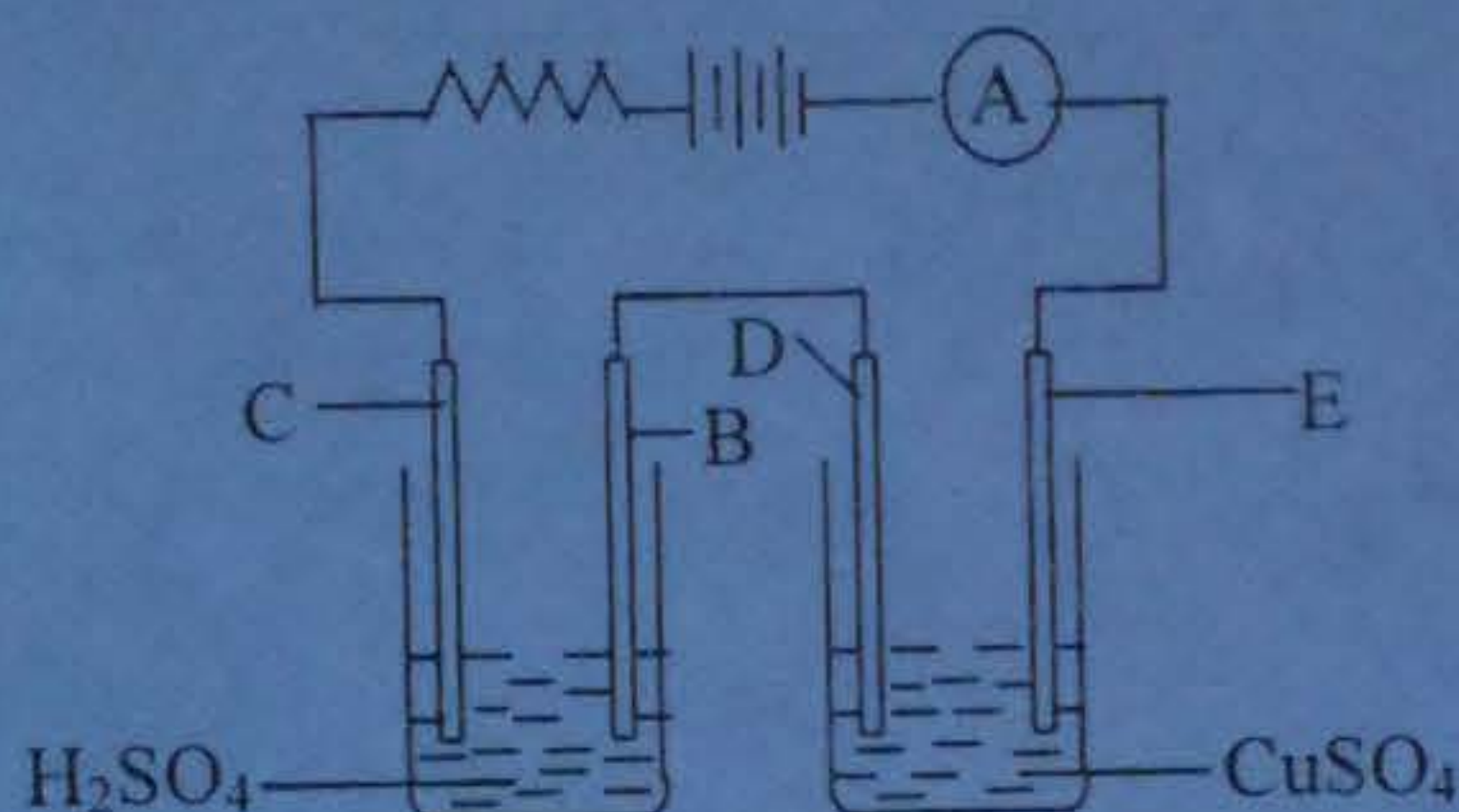


Figure 2

- What law of electrolysis is represented by Figure 2? State the law.
 - Name one factor that affects the discharge of ions in the experiment represented by Figure 2.
(3 marks)
- Write balanced equations for the reactions which take place at C and D.
 - What are the colour changes which would be observed if the electrolysis was allowed to continue to completion?
(4 marks)
- If 125 cm³ of oxygen gas measured at s.t.p. had been collected from one of the electrodes, calculate:
(i) The quantity of electricity.
(ii) The mass of copper deposited.
(3 marks)

- The reactions between sodium thiosulphate (Na₂S₂O₃) solution of different concentrations and nitric acid were allowed to take place at 45°C. The speed of these reactions were then measured by placing a beaker containing the reactants on a piece of white paper with a cross mark (x). The time taken for the cross to become invisible due to the precipitate formed was recorded as shown in Table 2.

Table 2

| Beaker | Concentration (mol.dm ⁻³) | Time taken (t) (seconds) | Rate 1/t (sec ⁻¹) | Concentration x t (mol.dm ⁻³ .sec) |
|--------|--|-----------------------------|----------------------------------|--|
| 1 | 1.6 x 10 ⁻³ | 25 | | |
| 2 | 1.3 x 10 ⁻³ | 30 | | |
| 3 | 1.0 x 10 ⁻³ | 39 | | |
| 4 | 0.6 x 10 ⁻³ | 61 | | |

- (a) (i) What causes the precipitate to occur in the reaction?
(ii) Write the ionic equation between the acid and sodium thiosulphate.
(1.5 marks)
- (b) (i) Complete Table 2 by calculating the rate for each time taken and the product of concentration and time.
(ii) What do you notice about the values of product of concentration and time?
(4.5 marks)
- (c) (i) Plot a graph of reaction rate (sec⁻¹) against concentration of sodium thiosulphate.
(ii) What is the effect of concentration of Na₂S₂O₃ on the rate of reaction?
(4 marks)

5. Sample **NP** contains one cation and one anion. A series of experiments to identify ions in the sample were performed and corresponding observations were recorded as shown in Table 3. Carefully fill in the inference column and hence identify the ions present in sample **NP**.

Table 3

| S/n | Experiment | Observation | Inference |
|-----|---|--|-----------|
| (a) | Appearance of sample NP . | White crystalline solid. | |
| (b) | A spatulaful of solid sample NP was dissolved in distilled water. | The sample was soluble forming clear colourless solution. | |
| (c) | A spatulaful of sample NP was heated in a dry test tube. | White sublimate. | |
| (d) | To a spatulaful of solid sample NP in a test tube, concentrated H ₂ SO ₄ was added, the mixture was slightly warmed and the gas given off was tested. | The gas given off, forms white dense fumes with gaseous ammonia. | |
| (e) | To another spatulaful of solid sample NP in a test tube, MnO ₂ and H ₂ SO ₄ were added and the mixture was slightly warmed. The gas given off was passed over wet litmus paper. | The yellowish green gas given off bleached the wet litmus paper. | |
| (f) | NaOH solution was added to a solid sample NP in a test tube and warmed. The gas given off was tested. | The gas given off turns litmus paper from red to blue. | |

(6 marks)

Conclusion

- (i) Anion present in the sample NP is _____ and the cation is _____.
- (ii) The chemical name of sample NP is _____.
- (iii) Write a balanced chemical equation for the reaction taking place in experiment (f).
(4 marks)