2922/204
ENVIRONMENTAL ANALYTICAL TECHNIQUES
AND LABORATORY MANAGEMENT
Oct./Nov. 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY

MODULE II

ENVIRONMENTAL ANALYTICAL TECHNIQUES AND LABORATORY MANAGEMENT

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Non-programmable scientific calculator.
*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** the questions in section **A** and any **THREE** questions from section **B** in the answer booklet provided.*
*Each question in section **A** carries **4** marks while each question in section **B** carries **20** marks.*
Maximum marks for each part of a question are as shown.
Candidates should answer the questions in English.

This paper consists of 4 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Turn over

SECTION A (40 marks)

*Answer **ALL** questions in this section.*

1. List **four** basic requirements for a filtration process. (4 marks)

2. State **two** differences between simple and fractional distillation processes. (4 marks)

3. Describe the application of sublimation technique in frost-free freezers. (4 marks)

4. State **four** ideal properties of a solvent used in solvent extraction process. (4 marks)

5. Name the components labelled **A, B, C** and **D** in the ion exchange scheme shown in Figure 1. (4 marks)

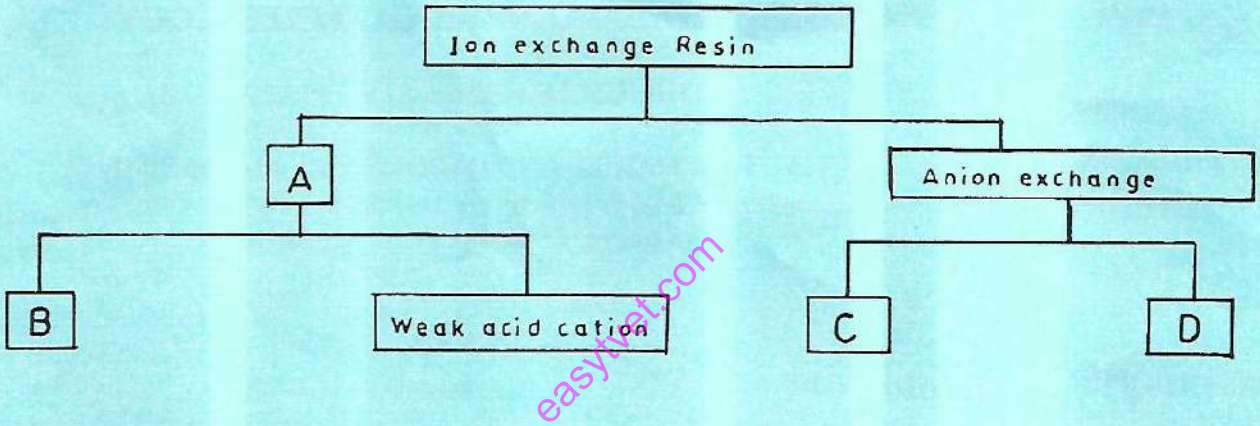

Fig.1

6. Determine the concentration of sodium hydroxide solution given that 25.00 mL of the base required exactly 11.60 mL of 3.0 M sulphuric acid to reach end point. (4 marks)

7. State **four** benefits to an organization for using the contingency approach to management. (4 marks)

8. List **four** functions of management in an organization. (4 marks)

9. State **four** disadvantages of using a centralized storage system in an organization. (4 marks)

10. (a) Define credit note as used in din stores management. (2 marks)

    (b) State **two** reasons for issuing a credit note in a transaction. (2 marks)

SECTION B (60 marks)

*Answer any **THREE** questions from this section.*

11. (a) (i) Define distillation. (2 marks)

(ii) Name **six** apparatus required in separating a mixture by fractional distillation. (6 marks)

(b) Draw an experimental set-up used in separating a mixture of methanol (boiling point = 64.7°C) and ethanol (boiling point = 78.5°C). (8 marks)

(c) Distinguish between reflux and distillation separation techniques. (4 marks)

12. (a) (i) Draw a simple liquid - liquid extraction scheme in which the solute's partitioning depends exclusively on the partition coefficient, K_D. (5 marks)

(ii) Write a mathematical expression of K_D for a solute partitioning between an aqueous phase (S_{aq}) and an organic phase (S_{org}). (2 marks)

(b) Describe the principle of a liquid-liquid extraction process of a solute distributed between an organic and an aqueous phase. (8 marks)

(c) A 30.00 mL sample of a 0.050 M aqueous solution of a solute was extracted using 15.00 mL of chloroform. Determine the extraction efficiency of the process ($K_D = 3.0$). (5 marks)

13. (a) State **four** reasons why Na_2CO_3 is an ideal primary standard in acid-base titrations. (4 marks)

(b) Match the acid-base indicator with the correct colour in an acidic solution shown in Table I. (5 marks)

Table I

	Acid Base Indicator		Colour in acidic solution
–	Methyl orange	–	Yellow
–	Bromothymol blue	–	Red
–	Phenophalein	–	Yellow
–	Litmus solution	–	Colourless
–	Bromocresol green	–	Red

(c) Explain the significance of titration error in acid-base titration. (4 marks)

(d) Determine the molar mass of citric acid ($C_6H_8O_7$) given that 36.10 mL of 0.223 M NaOH solution was required to neutralize a 0.515 g sample of the triprotic acid. (7 marks)

14. (a) Define 'management'. (2 marks)

(b) (i) Use a flow diagram to describe the interlink between the five steps in management by objectives (MBO). (5 marks)

(ii) List **five** benefits to an organization which uses MBO style. (5 marks)

(c) Distinguish between MBO and Management by Exception (MBE) based on:

(i) employee participation; (4 marks)
(ii) efficiency. (4 marks)

15. (a) (i) Define 'terms of employment' as used in labour laws. (2 marks)

(ii) List any **five** examples of job-specific conditions of employment. (5 marks)

(b) Describe the contribution of political interference in causing industrial unrests in Kenya. (8 marks)

(c) Define each of the following as used in the Factories and Other Places of Work Act 2004:

(i) Audit; (2 marks)
(ii) Occupier; (1 mark)
(iii) Regular employee. (2 marks)

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