2528/204
2922/204
ENVIRONMENTAL ANALYTICAL
TECHNIQUES AND LABORATORY
MANAGEMENT
Oct./Nov. 2019
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.

1. (a) Explain the difference in the rate of filtration between gravity filtration and vacuum filtration methods. (2 marks)

    (b) State the reason for not using vacuum filtration for hot solutions. (2 marks)

2. Explain the observations made when a sealed vessel containing solid dry ice is opened at room temperature. (4 marks)

3. Draw a reflex set up that can be used to extract an organic compound from a sample given a round bottomed flask, water bath, heat source and condenser apparatus. (4 marks)

4. Outline the steps used in separating the individual components of a mixture containing sodium chloride crystals, sand and iodine particles. (4 marks)

5. (a) Explain the consequences of rapidly cooling a material in freeze drying process. (2 marks)

    (b) Write a mathematical expression for the partition coefficient of a solute, S, extracted from an aqueous phase into an organic phase in liquid-liquid extraction. (2 marks)

6. Distinguish between a cation exchange resin and anion exchange resin. (4 marks)

7. Consider an acid-base indicator in the acid form HIn. Write:

    (a) the equilibrium equation obtained on its dissolution in water; (2 marks)

    (b) the indicator's dissociation constant. (2 marks)

8. Explain the constraints that affect decisions within an organization that adopts the contingency approach. (4 marks)

9. (a) Define the term 'delegation' as used in management. (2 marks)

    (b) State any **two** benefits of effective delegation. (2 marks)

10. List any **four** advantages of a centralized storage system in an organization. (4 marks)

SECTION B (60 marks)

Answer any THREE questions from this section.

11. (a) Define the term liquid - liquid extraction. (2 marks)

(b) 0.24 g of an organic acid dissolves in 100 ml of water and 2.70 g of the same acid dissolves in 100 ml hexane at 20 °C. Determine the:

(i) partition coefficient, K_D, of the acid; (3 marks)

(ii) percentage extraction if 0.12 g of the acid is extracted in 100 ml of aqueous solution; (5 marks)

(iii) volume of hexane required to extract 85% of 3.0 g sample of the acid in 100 ml solution; (4 marks)

(iv) total amount of the acid extracted. (6 marks)

12. (a) With the aid of a labelled diagram, outline the preparation of a chromatographic column using the slurry method given glass wool, sand, glass column, funnel, glass rod beaker and silica gel materials. (12 marks)

(b) Write the equilibrium constant expression, K_1, for the ion exchange reaction between a sodium-form resin, $Na - R$ with:

(i) a monovalent ion A^+; (2 marks)

(ii) a divalent ion B^{2+}. (2 marks)

(c) (i) Define 'chelating ion exchange resins'. (2 marks)

(ii) Explain why liquid cation exchangers are used in many industrial processes involving recovery of metals. (2 marks)

13. (a) Differentiate between a primary and a secondary standard in terms of:

(i) purity; (2 marks)
(ii) reactivity; (2 marks)
(iii) applications. (2 marks)

(b)   Match the primary standard solution with the appropriate application shown in table 1.

(4 marks)

Table 1

Primary standard	Application
Sodium chloride	EDTA solution
Sodium carbonate	Potassium iodide
Potassium dichromate	Silver nitrate solution
Zinc powder	Hydrochloric acid

(c)   Outline the process of standardizing a sample of potassium permanganate solution using sodium oxalate and 1 M dilute hydrochloric acid solutions.   (5 marks)

(d)   A 10.00 ml sample of concentrated hydrochloric acid was diluted to a volume of 250.00 mL. Determine the concentration of the sample if 25.00 ml of the diluted hydrochloric acid solution required 43.50 ml of 0.1023 M NaOH to reach end point.

(5 marks)

14.   (a)   Define the term 'planning' as used in management.   (2 marks)

(b)   Distinguish between tactical planning and operational planning.   (6 marks)

(c)   State **four** ways in which a large organization can cluster jobs into departments for better coordination.   (4 marks)

(d)   (i)   Outline the **three** steps that an organization can adopt to ensure that performance standards are maintained.   (3 marks)

(ii)   List **five** ways of measuring performance in an organisation.   (5 marks)

15.   (a)   Distinguish between sick leave and compassionate leave granted to an employee working in a Kenyan organization.   (6 marks)

(b)   (i)   Define the term collective bargaining agreement.   (3 marks)

(ii)   State **three** prerequisite conditions that a union in Kenya must fulfil before entering into a bargaining process.   (3 marks)

(c)   Describe any **four** management practices that have led to industrial disputes in Kenyan organizations.   (8 marks)

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