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2922/204
ENVIRONMENTAL ANALYTICAL TECHNIQUES
AND LABORATORY MANAGEMENT
June/July 2021
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 5 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. State **two** advantages of suction filtration over gravity filtration. (4 marks)

2. Distinguish between simple distillation and fractional distillation. (4 marks)

3. Outline **four** steps used in purifying a solid material by recrystallization method. (4 marks)

4. A 50.00 ml sample of 0.050 M aqueous solution of a solute was extracted once with 15.00 ml dichloromethane. Given that the distribution constant, K_D, between water and dichloromethane is 3.00, determine the separation efficiency. (4 marks)

5. Distinguish between planar and column chromatographic separation techniques. (4 marks)

6. List **four** properties of potassium permanganate that makes it a good primary standard. (4 marks)

7. Match the management school of thought with the appropriate area of emphasis shown in Table 1. (4 marks)

Table I

Management School	Emphasis
• Classical school	• Applying management principles and processes as dictated by unique characteristics of the situation.
• Behavioural school	• Managing workers and organizations more efficiently.
• Quantitative school	• Understanding human behaviour in the organization.
• Contingency school	• Increasing quality of management decision making through application of mathematics and statistical methods.

8. Describe the significance of organising as a managerial function in ensuring optimal utilization of resources. (4 marks)

9. Describe the two systems used in numerical arrangement of files in an organization. (4 marks)

10. Describe the role of the industrial court in Kenya. (4 marks)

SECTION B (60 marks)

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

11. (a) Draw a labelled diagram describing steam distillation process. (12 marks)

(b) Distinguish between distillation and reflux processes. (4 marks)

(c) Draw a labelled diagram describing a reflux set-up utilizing the apparatus: round bottom flask; hot plate; ice bug condenser and a clamp. (4 marks)

12. (a) With the aid of a mathematical expression, state the distribution law. (4 marks)

(b) A solute has a partition coefficient, K_D, between water and chloroform of 5.00. Given that 100.0 ml sample of 0.10 M aqueous solution of the solute was extracted with 25.00 ml chloroform, determine:

(i) the extraction efficiency for three extractions. (4 marks)

(ii) the number of extractions required to ensure 99.9% of the solute is extracted. (6 marks)

(c) Describe the function of each of the following parts of a soxhlet apparatus:

(i) Heating mantle; (2 marks)

(ii) Thimble (2 marks)

(iii) Condenser. (2 marks)

13. (a) The properties of two compounds A and B are shown in Table 2.
Explain the most suitable compound between A and B that can be used as a primary standard. (4 marks)

Table II

Property	A	B
• Molar mass	• 148 g/mol	• 158 g/mol
• Reaction with atmospheric oxygen	• No reaction	• Gets oxidized
• Purity (%)	• 99%	• 99%
• Cost (in Ksh.) per kg	• 3800	• 4600

(b) (i) Define stoichiometry as used in acid-base titrations. (2 marks)

(ii) Distinguish between a burette and a pipette with respect to their uses in an acid-base titration. (4 marks)

(c) (i) Determine the volume of NaOH solution added at equivalent point in a titration where 50 ml of 0.100 M HCl solution was titrated with 0.200 M NaOH solution. (4 marks)

(ii) A 2.0 g sample suspected to contain sodium carbonate was dissolved in 250.0 ml of water. 25.0 ml of this solution was titrated with 0.20 M HCl solution giving the results shown in Table III. Determine the percentage by mass of sodium carbonate in the sample. (6 marks)

Table III

Experiment	1	2	3
• Final burette reading	9.8	19.3	29.0
• Initial burette reading	0.2	9.8	19.5
• Volume of HCl used	9.6	9.5	9.5

14. (a) Describe **three** key concepts in the chain of command of an organisational structure. (6 marks)

(b) Draw a labelled scheme showing a functional relationship type of organisational chart for an organisation having the following: (8 marks)
   • Deputy managing director (marketing);
   • Quality control manager;
   • Sales manager;
   • Managing director;
   • Deputy managing director (production);
   • Human resources manager;
   • Deputy managing director(Human resources);
   • Production manager.

(c) (i) List the **three** elements involved in delegation in an organization. (3 marks)

(ii) Describe how delegation in an organization may impact negatively on quality of work. (3 marks)

15 (a) (i) Distinguish between recruitment and selection as used in human resource management. (4 marks)

(ii) Describe any **three** benefits accruing to an organization that internally recruits its staff. (6 marks)

(b) (i) Describe the **two** classifications of motivation theories. (4 marks)

(ii) Describe how employees in an organization are motivated according to Maslow's hierarchy of needs. (6 marks)

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