2915/302
INSTRUMENTATION METHODS II
AND BIOCHEMISTRY
Oct./Nov. 2021
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE II

INSTRUMENTATION METHODS II AND BIOCHEMISTRY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Scientific calculator.
*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** questions in section **A** and any **THREE** questions from section **B**.*
*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 indicated.
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.

SECTION A (40 marks)

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

1. State **four** factors that affect molecular vibrations. (4 marks)

2. Describe the procedure of calibrating an I.R spectrophotometer. (4 marks)

3. State **four** characteristics of the mobile liquid phase in HPLC. (4 marks)

4. Explain how the presence of manganese in a metal ore sample is determined using an AAS method. (4 marks)

5. (a) Explain how refractory compounds are formed in atomic absorption spectroscopic analysis. (2 marks)

   (b) Explain how the formation of refractory compounds in (a) above is prevented. (2 marks)

6. Explain the effects of suspensions on absorbance in atomic spectroscopy. (4 marks)

7. Describe the induced-fit model of enzyme action. (4 marks)

8. State the meaning of the following terms as used in enzyme selectivity:

   (a) absolute specificity; (1 mark)

   (b) linkage specificity; (1 mark)

   (c) group specificity; (1 mark)

   (d) stereochemical specificity. (1 mark)

9. Complete the following reactions:

   (i) Oleic acid + H_2 $\xrightarrow{\text{Nickel}}$

   (ii) Oleic acid + $KMnO_4$ $\xrightarrow[\text{condition}]{\text{Mild}}$

   (iii) Glycerol + $NaHSO_4$ $\longrightarrow$

   (iv) Triolein + 3NaOH $\longrightarrow$ (4 marks)

10. Identify the composition of Fehling's reagent. (4 marks)

SECTION B (60 marks)

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

11. (a) Differentiate between '*protective agent*' and '*releasing agent*' as used in atomic spectroscopy. (4 marks)

(b) Explain the reasons for spiking both samples and standards with EDTA during analysis of calcium by AAS. (4 marks)

(c) Explain the type of flame used during analysis of lead by AAS. (4 marks)

(d) (i) State the reason for chemical derivatization in:

I. GLC; (3 marks)

II. HPLC. (3 marks)

(ii) List **two** other methods of volatilizing samples in GLC. (2 marks)

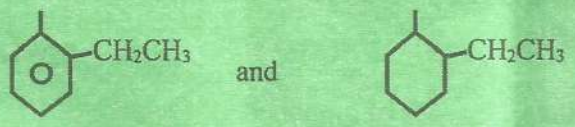
12. (a) Explain why organic solvents produce more enhanced signals than aqueous solvents in flame spectroscopy analysis. (10 marks)

(b) (i) Write down the Van Deemter equation, identifing all the symbols in it. (6 marks)

(ii) Sketch the curve of Van Deemter equation use it to indicate the optimum velocity. (4 marks)

13. (a) Describe the quantitative aspects of IR analytical procedure. (12 marks)

(b) Describe how to distinguish the following compounds by spectroscopic methods.



(5 marks)

(c) (i) Define thephrase **instrumental sensitivity**. (1 mark)

(ii) Determine the instrumental sensitivity of $KMnO_4$, whose absorbance is 0.65 in a 200 ppm solution . ($KMnO_4 = 158$). (2 marks)

14. (a) Explain the effect that each of the following changes would have on the rate of reaction involving the substrate urea and the liver enzyme urease:

(i) increasing the urea concentration; (2 marks)

(ii) increasing the urease concentration; (2 marks)

(iii) increasing temperature from its optimum value 10° C higher; (2 marks)

(iv) lowering the pH from the optimum value of 5.0 to 3.0. (2 marks)

(b) List **two** types of enzyme specificity that are best accounted for by the lock-and-key model of enzyme action. (2 marks)

(c) (i) Draw the structures of the following fatty acids:

I. 16:1, 9; (1 mark)

II. 18:2;9, 12; (1 mark)

III. 18:1; 9 (1 mark)

IV. 18.2; 9, 15,15. (1 mark)

(ii) Draw the structure and name the triglyceride formed from:

I. the fatty acid in (i) III. above; (3 marks)

II. the saturated form of the fatty acid in (i) I. above. (3 marks)

15. (a) Name the products of complete hydrolysis of phosphatidyl choline. (4 marks)

(b) (i) Draw the structure and name the compound formed if one of the following hydrolysis products in (a) is replaced by:

I. ethanolamine; (3 marks)

II. serine. (3 marks)

(ii) I. state the function of phosphatidyl choline in the human body; (1 mark)

II. name the clinical condition in the animal expected in the absence of phosphatidyl choline. (1 mark)

(c) Differentiate between the following types of enzymes:

(i) apoenzymes and proenzymes; (2 marks)
(ii) simply enzyme and allosteric enzyme; (2 marks)
(iii) coenzyme and isoenzyme; (2 marks)
(iv) conjugated and holoenzyme. (2 marks)

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