

2915/203

**CHEMICAL ANALYTICAL METHODS II  
AND BIOCHEMICAL TECHNIQUES**

June/July 2020

Time: 4 hours



**THE KENYA NATIONAL EXAMINATIONS COUNCIL**

**DIPLOMA IN ANALYTICAL CHEMISTRY**

**MODULE II**

**CHEMICAL ANALYTICAL METHODS II AND BIOCHEMICAL TECHNIQUES**

**4 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 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 the question are indicated.*

*Candidates should answer the questions in English.*

**This paper consists of 5 printed pages.**

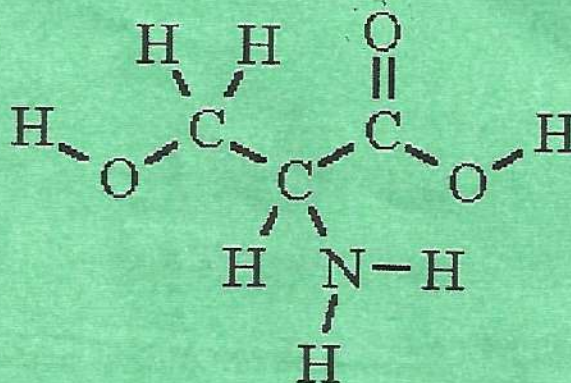
**Candidates should check the question paper to ascertain that  
all the pages are printed as indicated and that no questions are missing.**



SECTION A (40 marks)

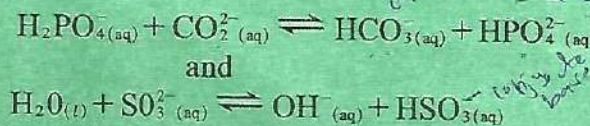
Answer ALL the questions in this section.

1. Figure 1 shows a structure of serine. Study and use it to answer the questions that follow.



- (a) Copy the structure and draw a circle around each atom or group of the serine molecule which would be removed when two other amino acid molecules join directly to it. (2 marks)
- (b) Name the two substances that would be formed in (a). (2 marks)
2. Lactose is formed from a molecule of  $\alpha$ -D-glucose and a molecule of one of its epimers.
- (a) Define the term *epimers*. *differs in configuration* (2 marks)
- (b) Write the structure of the epimer referred herein using the Fischer Projection formula. (1 mark)
- (c) The formula of glucose is C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>. Give the formula. (1 mark)
3. A quantitative Benedict's test can be used to determine the concentration of a reducing sugar in a solution. During a practical lesson, a student decided to find the concentration of a suspected glucose sample. Describe how this could be accomplished by way of a calibration curve. (4 marks)

4. Consider the following reactions:



For each of the reactions, explain how the conjugate acid-base pairs can be identified.

(4 marks)



5. Give IUPAC names to each of the following small peptides:
- (a) Glu-Ser-Ala
  - (b) Gly-Tyr-Leu
  - (c) Gly-Ala-Leu
  - (d) Gly-Tyr-Ser-Ser
- (4 marks)
6. Explain **two** disadvantages of gravimetry as a method of analysis.  
*Expensive*
- (4 marks)
7. Draw a labelled diagram gravity filtration in operation.
- (4 marks)
8. State **four** criteria used in selecting a filter paper for a filtration process.  
*- Paper is considered*
- (4 marks)
9. (a) Define the phrase *acid value* as used in lipids. (1 mark)
- (b) Explain the importance of acid value. (3 marks)
10. (a) Define the phrase *iodine-value* of a fatty acid.  
*The amount of iodine required to* (1 mark)
- (b) Describe how the iodine value of a fatty acid is estimated. (3 marks)

### SECTION B (60 marks)

Answer **THREE** questions from this section.

11. (a) Derive the Henderson - Hasselbalch equation. (10 marks)
- (b) An environmental chemist needs a carbonate buffer of pH = 10.00 to study the effects of acid rain on limestone-rich soils. Determine the amount, in grams, of  $\text{Na}_2\text{CO}_3$  that must be added to 1.5 litres of freshly prepared 0.20 M  $\text{NaHCO}_3$  to make the buffer. ( $K_a$  of  $\text{HCO}_3^- = 4.7 \times 10^{-11}$ ). (10 marks)
12. (a) State **five** characteristics of a good filter medium. (5 marks)
- (b) Describe the preparation of filter pulp. (5 marks)
- (c) List **eight** steps which are followed during gravimetric analysis.  
*weighing,* (8 marks)
- (d) State **four** factors that affect solubility of a precipitate. (2 marks)

*Weighing  
dissolve  
dilution*

*Filtering  
burning/churning  
cooling  
weighing  
calculate* (10 marks)



13. (a) Define the phrase *isoelectric point*.  
*electrically neutral - pH is neutral* (2 marks)
- (b) Using structural formulae, explain the direction of movement of each of the following amino acids in solution at the pH value specified, under the influence of an electric field:
- (i) Alanine (pH = 12.0) (3 marks)
- (ii) Valine (pH = 5.97); (3 marks)
- (iii) Aspartic acid (pH = 1.0); (3 marks)
- (iv) Lysine (pH = 13.0). (3 marks)
- (c) List **four** types of attractive forces that give rise to tertiary structure of a protein.  
*covalent* (4 marks)
- (d) (i) State the meaning of the phrase *Primary structure of a protein*.  
*- physical appearance of cell membrane* (1 mark)
- (ii) Name the type of bond responsible for the primary structure of a protein. (1 mark)

14. (a) Explain the following terms:
- (i) glycosides; (2 marks)
- (ii) glucosides. (2 marks)

- (b) Figure 2 is a flow chart showing the isolation of chloroplasts from leaves. Study and use it to answer the questions that follow:

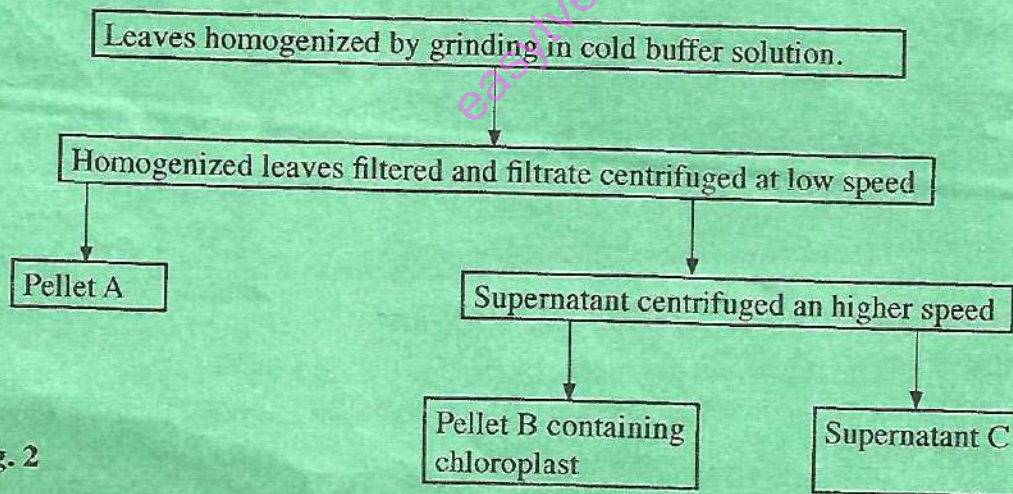


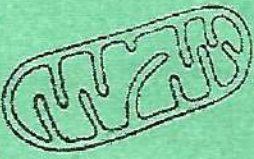
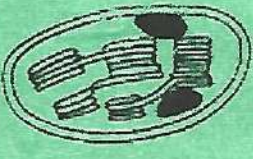
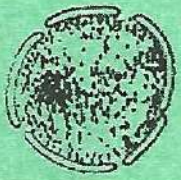
Fig. 2

Explain why:

- (i) the leaves were homogenized; (2 marks)
- (ii) a buffer solution was used. (2 marks)



(c) **Table I** shows some of the organelles present in the leaf cells.

Organelle	X	Y	Z
			
Fraction containing organelle			

- (i) Determine in which of the pellets A or B or the supernatant C one would expect to find the organelles X, Y and Z. (3 marks)
- (ii) Organelle X is found in large numbers in cells which take up substances by active transport. Explain. (3 marks)

(c) Draw the Haworth projection formula and give the systematic name of the monosaccharide(s) produced from the hydrolysis of:

- (i) sucrose;
- (ii) maltose. (6 marks)

15. (a) Using a labelled diagram, describe the method used in estimation of lipids in a food sample. (14 marks)

(b) Calculate the:

- (i) specific refraction; (3 marks)
- (ii) molar refraction of  $C_{12}H_{22}O_{11}$ .

$$\text{density, } \rho = 1.010 \text{ g/cm}^3 \quad \eta = 1.3388 \text{ and f.wt} = 342$$

(3 marks)

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