

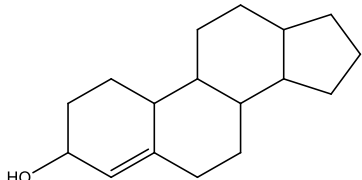


MURANGA UNIVERSITY COLLEGE
(A Constituent College of Jomo Kenyatta University of Agriculture and Technology)
University Examinations 2014/2015
END OF TERM EXAMINATION
FOR DIPLOMA IN ANALYTICAL CHEMISTRY

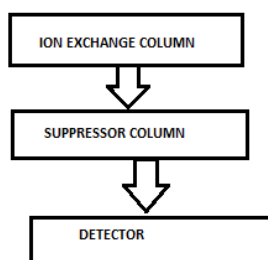
ASC1305: CHEMICAL ANALYTICAL METHODS AND BIOCHEMISTRY
DATE: 21ST JULY 2015 **TIME:**

SECTION A (40 marks)
Attempt ALL questions

1. Describe how a standard solution of NaOH may be prepared with the use of ion exchange resins (3 marks)
2. With respect to TLC chromatography name any factor that affect the movement of components present in a sample during elution (1 marks)
3. Distinguish between simple and mixed triglycerides using molecular structures (4 marks)
4. Name the vitamins associated with the following maladies (4 marks)
 - (a) Pellagra
 - (b) Osteomalacia/ bone wasting
 - (c) Loss of blood clotting power
 - (d) Beriberi
5. Structurally distinguish a wax from a fatty acid (2 marks)
6. Below is a structure of a terpenoid. Name the subclass and any two biological roles of the subclass. (3 marks)



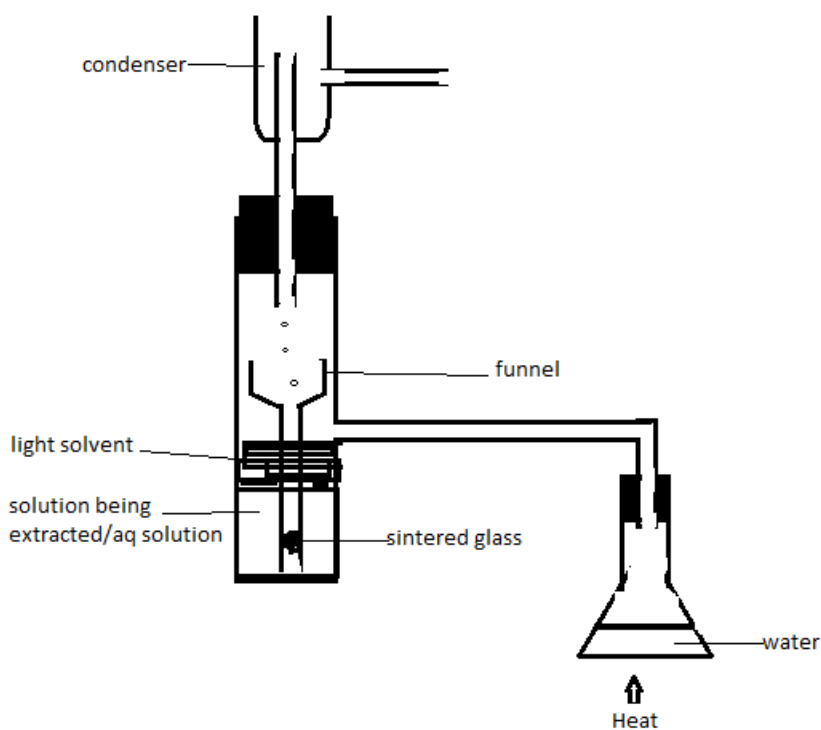
7. Explain how one can stop the formation of “comets” in paper chromatography (1 marks)
8. Define the following terms (2 marks)
 (a) Mutarotation
 (b) Peptide bond
9. State the nature of glycosidic bonds in (2 marks)
 (a) Sucrose
 (b) Lactose
10. Describe the behavior of amino acids in solution and use structures where possible (2marks)
11. Describe how you can filter a precipitate under suction/reduced pressure (3 marks)
12. Briefly explain how polarity is used to pair a stationary phase with a mobile phase (2marks)
- (a) Adsorption chromatography can be applied to separate isomeric mixtures. Steric hindrance can affect the degree of adsorption of the analytes on the stationary phase. If a mixture contains two compounds 2-propylphenol and 4-propylphenol.
 Draw the structures of the compounds (2 marks)
- (b) Identify the isomer that will adsorb strongly onto the stationary phase. Explain. (2 marks)
13. Below is the outline of a ion exchange chromatography.



- (a) What is the role of this column (2 marks)
- (b) What type of detector is used (1 mark)
- (c) When transition metal cations are being separated, dilute hydrochloric acid can be used as the mobile phase with the suppressor column as anionic exchange resin. If the product of the reaction in the suppressor column is water write an equation representing this reaction (2 marks)
14. State how the presence of glycerol can be detected in a fat molecule (2 marks)

SECTION B (60 marks)
Attempt ANY THREE questions

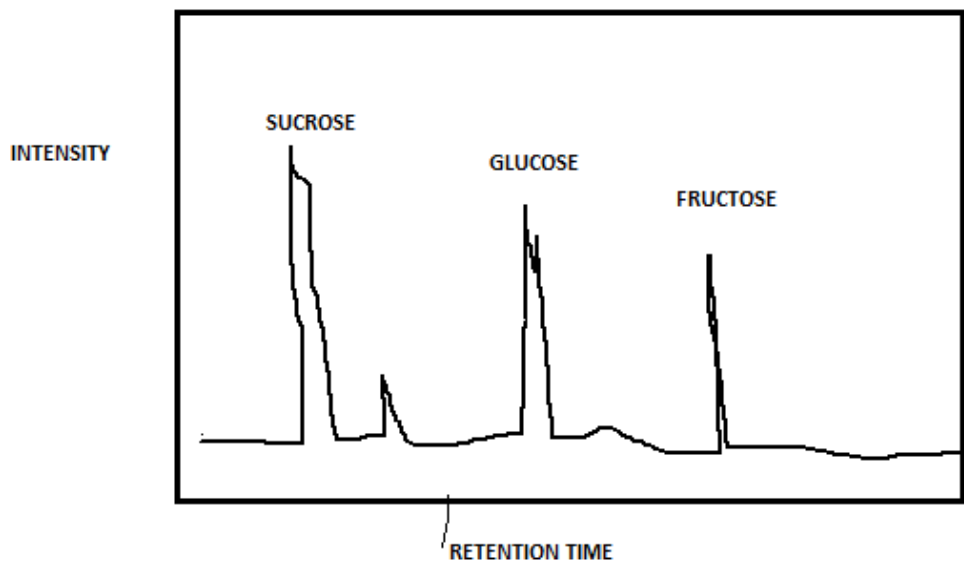
1. The following apparatus was set up to be used for the continuous extraction of a sample dissolved in aqueous solution using less dense solvent.



- (a) (i) Describe how the apparatus functions (8 marks)
(ii) List two advantages of the above method (2marks)
- (b) List four advantages of TLC over paper chromatography (4marks)
- (c) Explain why resolution in TLC is better than in paper chromatography (2 marks)
- (d) State **two** similarities and two differences between paper chromatography and TLC (4 marks)
2. (a) Discuss vitamin B₆ with respect to the following
- (i) Structure (2marks)
- (ii) Properties (4marks)
- (iii) Effect of deficiency (2 marks)

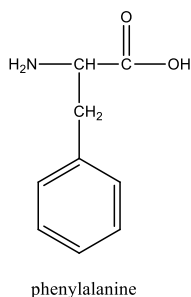
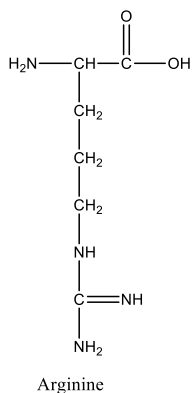
- (b) Define the term iodine number (2 marks)
- (c) Describe the experimental procedure one can follow to determine the iodine number of a lipid (10 marks)

3. The diagram below represents a gel filtration chromatogram when sugars present in a fruit juice are separated.



- (a) With reasons identify which sugar has a larger molecular size (2 marks)
- (b) Which sugar has the highest concentration?, explain. (2 marks)
- (c) Which solvent would be suitable as the mobile phase? Explain. (2 marks)
- (d) Glucose is a pyranose while fructose is a furanose, how does this affect their retention times. (2 marks)
- (e) Explain the meaning of the following statement: “ It is more prudent to use three portions of 100cm³ each of extracting solvent than to use 300cm³ of extracting solvent at once.” (2 marks)
- (f) State any **three** factors which should be considered when choosing a solvent for an Extraction (3 marks)
- (g) Consider the following substances:
- Plasmogens
 - Prostaglandins
 - Luekotrienes
 - Cholesterol
- Assign each of the above substances to any of the classes of lipids below: (4marks)
- Phosphoglycerides
 - Eicosanoids
 - Steroids
 - Triacylglycerols

- (h) State three factors that need to be maintained constant in order to obtain reproducible R_f values. (3 marks)
4. A sample of weight 0.4097g and containing NaOH, Na_2CO_3 and a non ionic material was dissolved and diluted to 100mL with water. A 25mL aliquot of the dissolved sample was passed through a column of an ion exchange resin in the chloride ion form and washed through the column with distilled water. The collected solution required 12.86mL of 0.01522M HCl for titration to the phenolphthalein endpoint. Another 25mL aliquot of the dissolved sample required 16.47mL of 0.01522M HCl for titration to reach the phenolphthalein end point.
- Define the term ion exchange resin (2marks)
 - Name two types of resins commonly used in chromatography columns (2 marks)
 - How can leaching of soil minerals be explained in terms for ion exchange (2marks)
 - State two applications of ion exchange (2 marks)
 - Write the ionic equation for the reaction taking place in the ion exchange column (2 marks)
 - Calculate the percentage of NaOH and Na_2CO_3 in the mixture [Na = 23, H = 1, C = 12, O = 16] (10 marks)
5. (a) Indicate whether the following vitamins are water soluble or fat soluble (4 marks)
- Tocopherol
 - Cholecalciferol
 - Ascorbic acid
 - Biotin
- (b) Derive the Line Weaver – Burk plot equation (6 marks)
- (c) State the significance of the line of the Weaver –Burk plot (2 marks)
- (d) Below are structures of two amino acids.
- Draw the ionic forms of the native/ionic forms of the two (2 marks)
 - Describe how the separation phenylalanine and arginine can be achieved



- (i) By electrophoresis (3 marks)
(ii) By ion exchange chromatography (3 marks)

6. (a) Using appropriate equations where necessary explain the reaction between simple aldose sugars like glucose with basic copper(II)sulphate and its application in analytical chemistry (4 marks)

(c) How can normal phase paper chromatography be converted to reverse phase partition paper chromatography (2marks)

(c) What is the importance of reproducible R_f values (2 marks)

(d) Predict the function of the following enzymes (4 marks)

(i) Maltase

(ii) Lactate dehydrogenase

(iii) Fructose oxidase

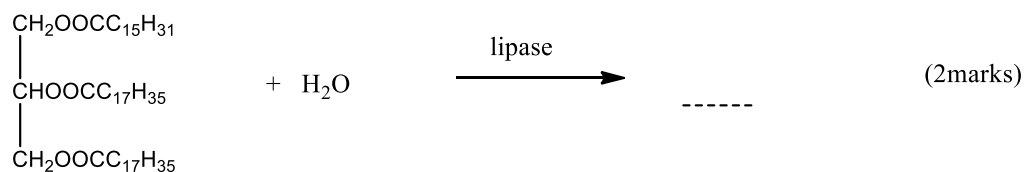
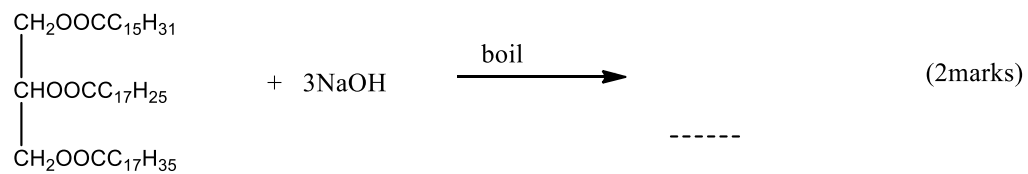
(iv) Maleate isomerase

(e) Outline the basic principles of Craigs Countercurrent extraction (8 marks)

7. (a) A solute with a distribution ratio of 2.6 is to be purified by countercurrent extraction.

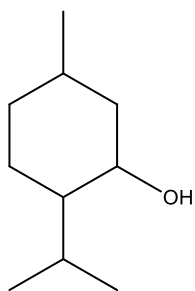
Calculate the fraction of the solute contained in the first tube after twenty transfers. (2 marks)

(b) Complete the following reactions (4 marks)

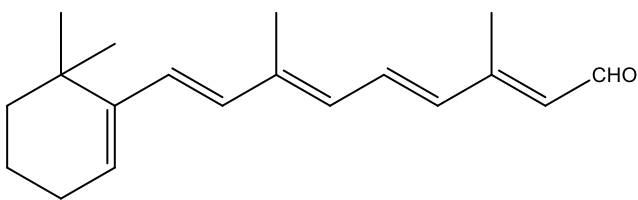


(c) Give the procedure of performing a preparative thin layer chromatography (PTLC) of a mixture of two colorless compounds A and B of R_f values of 0.8 and 0.66 respectively (6marks)

(d) Classify the terpenoids represented below (2 marks)



menthol



All- *trans*-retinal

END