Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY (ANALYTICAL OPTION)

BTAC

ACH 4212: CHEMISTRY OF CARBOHYDRATES AND PROTEINS

SEMESTER EXAMINATION

DECEMBER 2013 SERIES 2 HOURS

Instructions to candidates:

This paper consist of FIVE questions
Answer question ONE (compulsory) and any other TWO questions

QUESTION ONE

a) Define each of the following:

(i) Anomeric carbon
(ii) Enantiomers
(iii) Furanose
(iv) Epimers
(v) Pyranose
(vi) Ketose

(12marks)

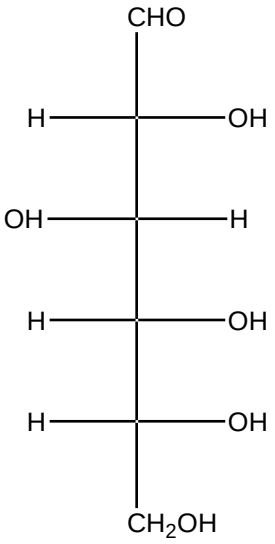
b) Given below are two sugar structures

(i) Write the molecular formula of sugar A **(1mark)**
(ii) Classify sugar A based on:

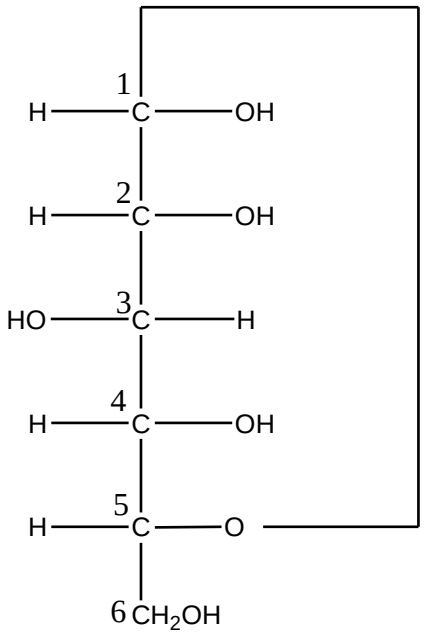
I. Functional group **(1mak)**

II. The number of carbon atoms **(1mark)**

III. Functional group and number of atoms **(1mark)**



Sugar structure A



Sugar structure B

(iii) (I) Give the structure of the anomer of sugar B **(1mark)**

(II) Draw the Hawarth projection formula of sugar B **(2marks)**

c) (i) Define "reducing sugar." **(1mark)**

(ii) Sucrose is a disaccharide composed of glucose and fructose [Glc (1 →2) Fru]. Explain why sucrose is not a reducing sugar, even though both glucose and fructose are reducing sugars **(3marks)**

d) Explain in molecular terms why humans cannot use cellulose as a nutrient, but goats and cattle can. **(3marks)**

e) Name FOUR types of bonds found in tertiary structure of a protein **(4marks)**

QUESTION TWO

a) Explain the difference between a hemiacetal and a glycoside **(2marks)**

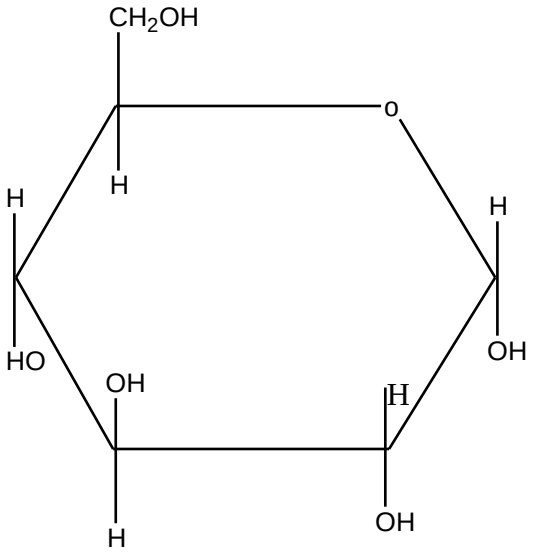
b) (i) Maltose and sucrose were each treated separately with Fehling's solution. Which sugar formed a red color? Explain **(3marks)**

(ii) Lactose exists in two anomeric forms, however, no anomeric forms of sucrose

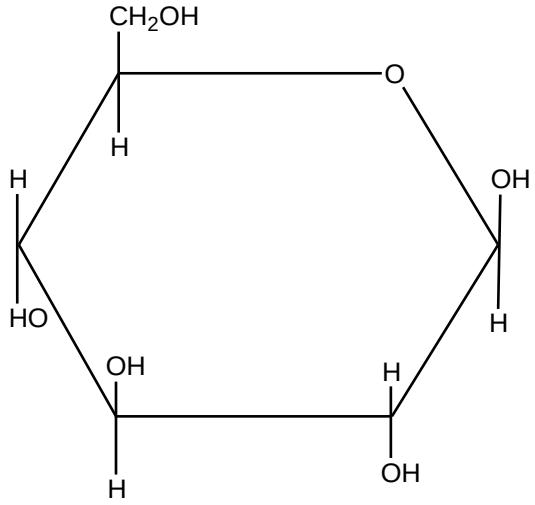
have been reported. Explain **(3marks)**

c) In the monosaccharide derivatives known as sugar alcohols, the carbonyl oxygen is reduced to a hydroxyl group. For example, D-glyceraldehyde can be reduced to glycerol. However, this sugar alcohol is no longer designated D or L. Explain **(2marks)**

d) Given below are the Haworth perspective formulas of α and β forms of D-glucose.



α-D-Glucose



β-D-Glucose

(i) What feature distinguishes the two forms? **(1mark)**

(ii) A freshly prepared solution of α-D-glucose shows a specific rotation of +112˚. Over time, the rotation of this solution decreases and reaches an equilibrium value of $[\alpha]_D^{25^\circ C}$ = +52.5˚. In contrast, a freshly prepared solution of β-D-glucose has a specific rotation of +19˚. The rotation of this solution increases over time to the same equilibrium value of + 52.5˚.

(I) Explain why the specific rotations of the freshly prepared samples change over time and finally reach the same equilibrium value **(3marks)**

(II) Calculate the percentage of each anomer at equilibrium **(3marks)**

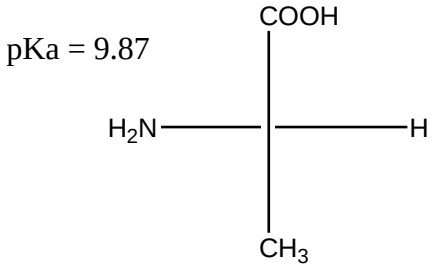
(III) Draw and name the structure of the disaccharide (with linkage at 1 → 4) formed by the anomers above. **(3marks)**

QUESTION THREE

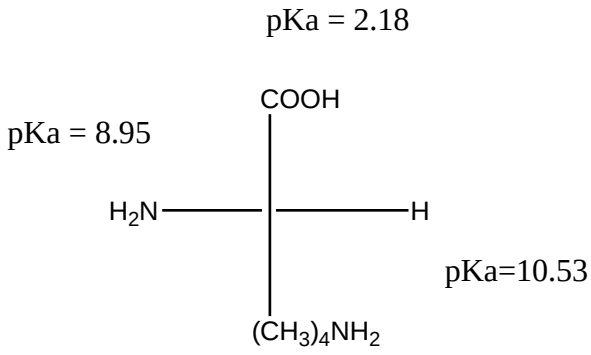
Discuss the functions of proteins in living organisms, giving an example in each. **(20marks)**

QUESTION FOUR

Alanine (ala) and lysine (lys) are two amino acids with the structures given below as Fischer projections. The pKa values of the conjugate acid forms of the different functional groups are indicated.



ala



lys

a) Draw the structure of the dipeptide ala-lys in its Zwitterionic form **(2marks)**
b) What would be the solubility of the dipeptide in water? Explain **(3marks)**
c) With a reason state whether the dipeptide will be acidic, basic or neutral **(3marks)**
d) Estimate the isoelectric point of the dipeptide **(3marks)**
e) Give the names of the nonpolar standard amino acids **(9marks)**

QUESTION FIVE

Give brief account of each of the following with reference to at least two named examples

(a) Storage polysaccharides
(b) Structural polysaccharides

(20marks)