



**MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY  
(MMUST)**

**UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR**

**SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION**

**FOR THE DEGREES OF**

**BACHELOR OF SCIENCE (CHEMISTRY)**

**BACHELOR OF INDUSTRIAL CHEMISTRY**

COURSE CODE: SCH 232

COURSE TITLE: CHEMISTRY OF BIOMOLECULES

DATE: <sup>02/08/2022</sup> ~~FRIDAY, 5<sup>TH</sup> AUGUST 2022~~ TIME: <sup>11:00 — 1:00 PM</sup> ~~08:00 — 10:00 AM~~

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**INSTRUCTIONS**

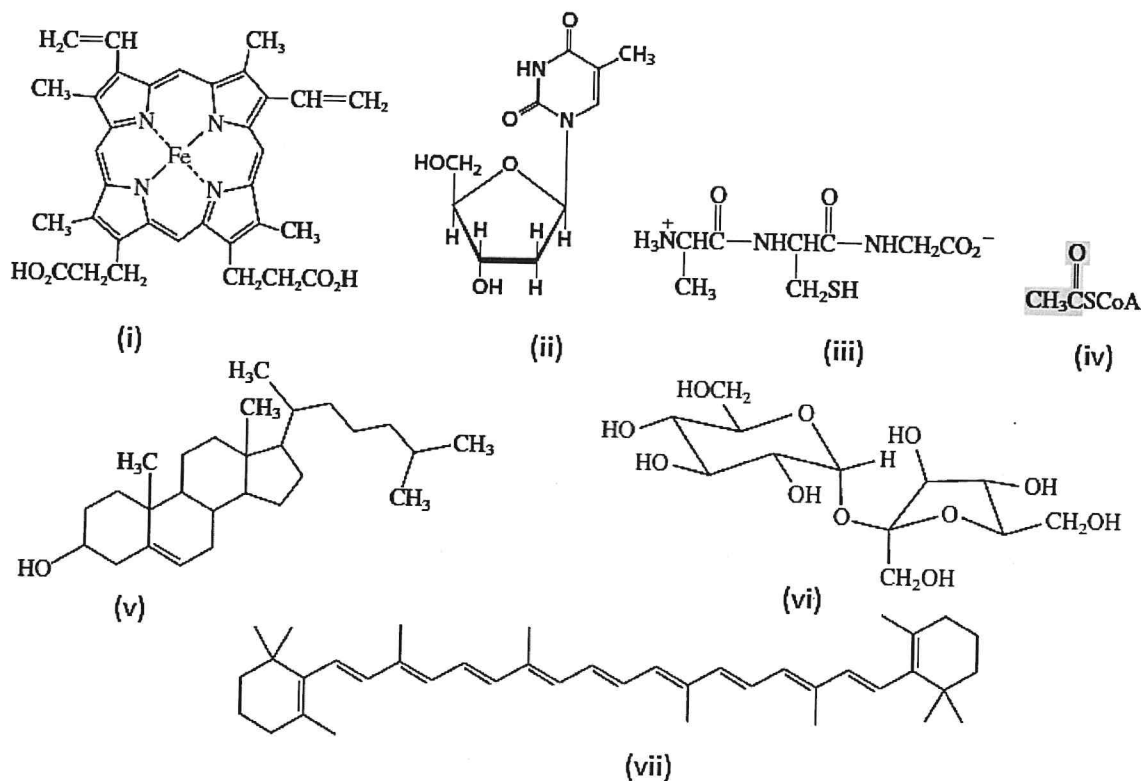
- Answer ALL Questions.

*This paper consists of 4 printed pages. Please turn over.*



Q1. (a) Purely on structural basis, classify each of the molecules whose chemical structures are given below

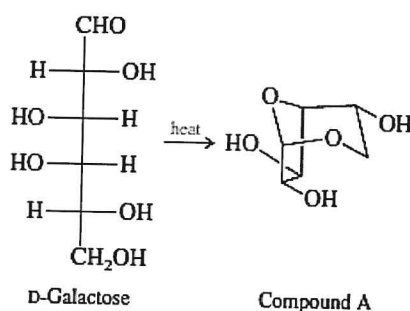
[7]



(b) For each of the molecules ((i) –(vi)) in (a) above, state any one (1) of its natural key function

[3½]

(c) When D-galactose is heated at 165°C, a small amount of compound A is normally isolated:



The structure of compound A may be established, in part, by converting it to known compounds. Treatment of A with excess methyl iodide in the presence of silver oxide, followed by hydrolysis with dilute hydrochloric acid, gave a trimethyl ether of D-galactose. Comparing this trimethyl ether with known trimethyl ethers of D-galactose allowed the structure of compound A to be deduced.

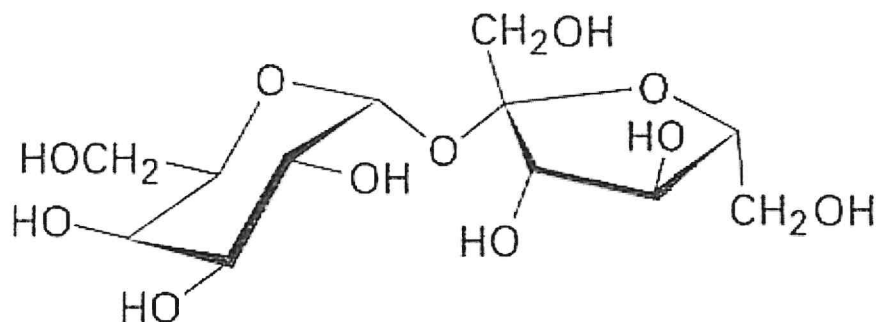
(i) How many trimethyl ethers of D-galactose are there?

[3½]

(ii) Which one of the ethers in (i) is the same as the product derived from compound A?

[5]

**Q2.** You are given the chemical structure of a carbohydrate molecule marked **M** below. Study the molecule carefully and answer the following questions.

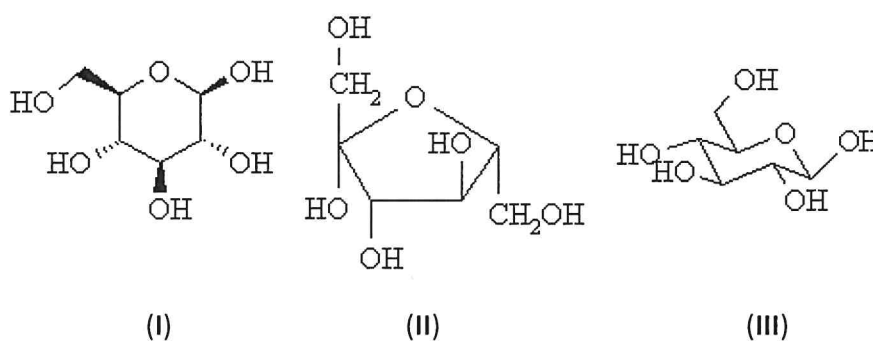


**M**

- (a) What is the class of the above carbohydrate **M**? [1]  
 (b) Identify all the anomeric carbons in **M**. [2]  
 (c) Draw the Fischer projection formulae of the monomeric units in **M**. [2]  
 (d) Show the chemical structures of the products of reaction of the straight chain monomers of **M** above with the following reagents [3]  
 (i) Phenyl hydrazine [3]  
 (ii)  $\text{NaBH}_4$  [2]  
 (iii)  $\text{HNO}_3$  [2]  
 (iv)  $(\text{CH}_3\text{CO})_2\text{O}$  [3]  
 (v)  $\text{HCN}$  [2]  
 (vi) An oxidase enzyme [2]  
 (e) What is the IUPAC nomenclature of the carbohydrate **M**? [2]  
 (f) Explain in detail the nature of the chemical linkage of the monomers of **M**. [2]  
 (g) Using carbohydrate **M**, differentiate between condensation and hydrolysis reactions. [2]

**Q3.**

(a) Using the following chemical structures of cyclic simple sugars, in each structure



- (i) Count the number of asymmetric carbons in each molecule [1½]  
 (ii) Identify the structures as hemi-acetal, acetal, hemi-ketal or ketal? [1½]  
 (iii) State whether the given structure is a furanose or a pyranose type [1½]

(iv) The number of stereo centres and possible number of stereoisomers [3]

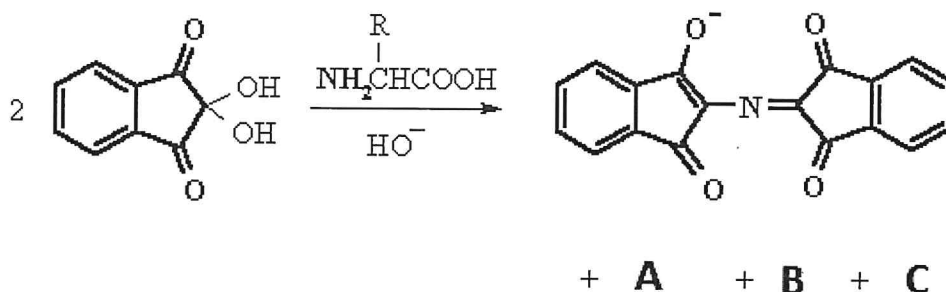
(b) Using your own illustrative examples, briefly explain how the following biochemical techniques may be used to analyse biomolecules

- (i) Ion exchange [2]  
 (ii) Enzymatic methods [2]  
 (iii) HPLC [2]

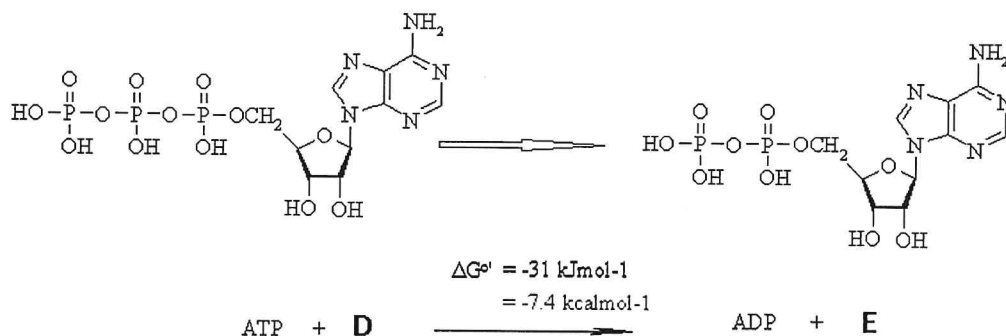
(c) Define any THREE (3) of the following terminologies as used in study of biomolecules giving one (1) relevant example or illustration in each case [6]

- (i) Mutarotation (iii) Zwitterion (v) Epimerization  
 (ii) Phospholipid (iv) Transamination (vi) Chiral biomolecule

Q4. (a) Complete the following reaction by identifying the missing products marked A, B and C [1½]



(b) A key chemical reaction known in bioenergetics is the interconversion of ATP and ADP shown below:



- (i) Give the full names of the terms ATP and ADP [1]  
 (ii) Identify the reactant D and by-product E [1]  
 (iii) Is the bioenergetic reaction above exothermic or endothermic? Explain. [1½]

(c) What are the products of each of the following reactions? Your answer should account for all the amino acid residues in the starting peptides.

- (i) Reaction of Leu-Gly-Ser with 1-fluoro-2,4-dinitrobenzene [1]
- (ii) Hydrolysis of the compound in part (i) in concentrated hydrochloric acid (100°C) [1½]
- (iii) Treatment of Ile-Glu-Phe with  $C_6H_5N=C=S$ , followed by hydrogen bromide in nitromethane [1]
- (iv) Reaction of Asn-Ser-Ala with benzyloxycarbonyl chloride [1]

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