THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME 2017/2018

LEVEL 5-FINAL EXAMINATION

CYU5304

CHEMISTRY OF BIOMOLECULES

DURATION: 2 HOURS

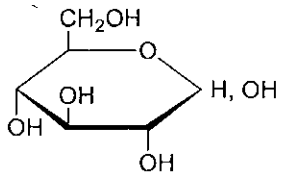
05-10-2018 (Friday) **Time: 2 pm to 4 pm**

ANSWER ALL FOUR QUESTIONS.

1. Answer any **FOUR (04)** parts from (a) – (e).

(a) "Amylose is a polysaccharide with α (1→4) glycosidic linkages of glucose".

(i) Given the structure of glucose is as below, Draw the chemical structure of amylose.

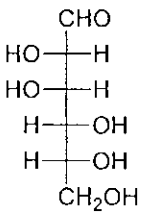


(15 marks)

(ii) Draw the structure of α-monostearin. (stearic acid - 18:0)

(10 marks)

(b) D-glucose is a C-2 epimer of D-mannose. The structure of D-mannose is given below.



D-mannose

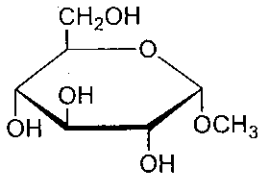
(i) What are epimers? (05 marks)

(ii) Draw the Fischer projection formula and all the possible Haworth projection formulae of D-glucopyranose. (10 marks)

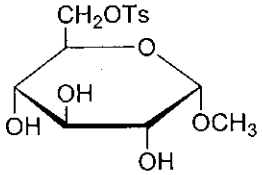
(iii) Draw all the possible Haworth projection formulae of D-glucofuranose.

(10 marks)

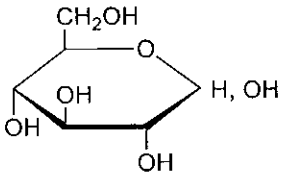
(c) Draw the structures of the products (P - T) of following reactions.

(i) 

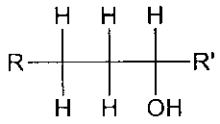
TsCl, Pyridine/ 0 °C → P

(ii) 

(i) NaN_3/ Acetone, H_2O; (ii) $LiAlH_4$ → Q

(iii) 

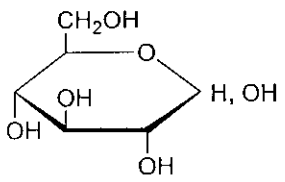
(i) $CH_3SOCH_2^- Na^+$, DMSO, 5h; (ii) CH_3I, 25 °C → R; 8% HCl → S

(iv) 

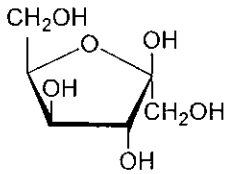
+ HIO_4 → T

(25 marks)

(d) The disaccharide $C_{12}H_{22}O_{11}$ which does not reduce Fehling's solution is hydrolyzed by β-fructosidase. Methylation followed by hydrolysis of this disaccharide yielded 1,3,4,6-tetra-O-methyl-D-fructose and 2,3,4,6-tertra-O-methyl-D-glucose. The structures of D-glucose and D-fructose are shown below.



D-glucose

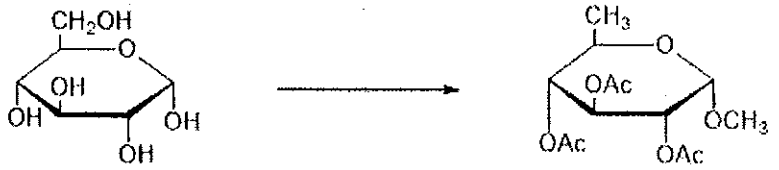


D-fructose

(i) Deduce the structure of the above disaccharide. (15 marks)

(ii) Draw the Haworth projection formulae of the hydrolyzed products of above disaccharide. (10 marks)

(e) How would you attempt to do the following conversion? Indicate the reagents and structures of each step.



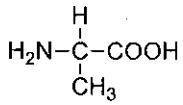
(25 marks)

2. Amino acid titration curves give important information regarding pKa and pI of amino acids.

(a) Define pI (isoelectric point) of an amino acid. (5 marks)

(b) Draw the predominant structural forms of alanine when the pH of the medium is changed from strongly acidic, strongly basic and iso electric point pH.

The structure of alanine is given below.



alanine

(15 marks)

(c) Following is a titration curve of an amino acid with an ionizable side chain. Identify the amino acid using the graph and information given in Table 1 with explanation.

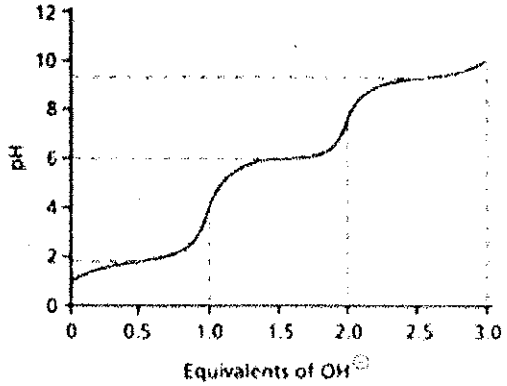


Table 1: pk_a of α-COOH, α-NH_3 and side chains of selected amino acids

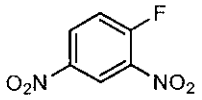
Amino acid	pk_a of α-COOH	pk_a of α-NH_3	pk_a of the side chain
Arginine	2.1	9.0	12.5
Aspartic acid	2.1	9.8	3.9
Cysteine	1.7	10.4	8.3
Glutamic acid	2.2	9.7	4.3
Histidine	1.8	9.2	6.0
Lysine	2.2	9.0	10.5
Tyrosine	2.2	9.1	10.1

(20 marks)

(d) You are provided with a mixture of three proteins with isoelectric points 3.2, 4.1 and 7.2 respectively and a cation exchange column for further purification of the mixture of proteins. Explain the elution pattern of the proteins when the column is first eluted with a buffer of pH 6.5 and then with a buffer of higher pH.

(10 marks)

(e) Explain how you would use Sanger's method with 2,4-dinitroflurobenzene for the analysis of N-terminal of an unknown protein with relevant chemical reactions.

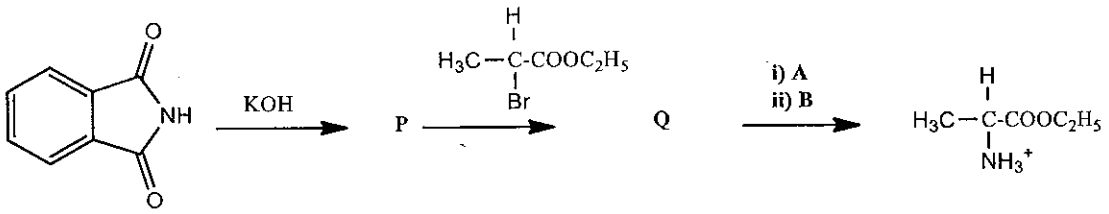


2,4-dinitroflurobenzene

(10 marks)

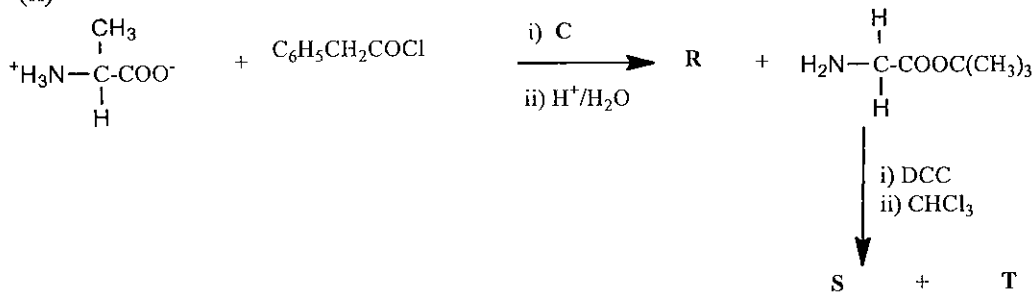
(f) Give the missing reagents (**A – C**) and products (**P – Y**) for any **TWO (02)** of the following transformations.

(i)



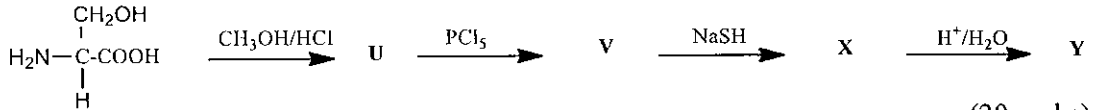
(20 marks)

(ii)



(20 marks)

(iii)



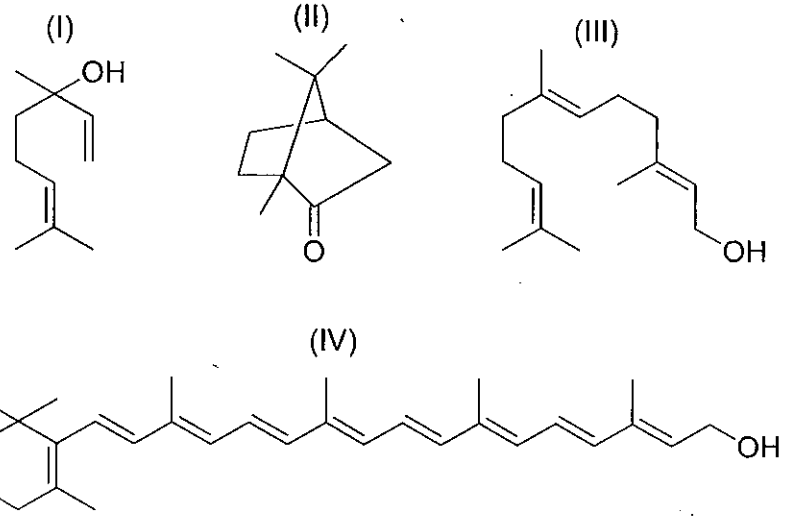
(20marks)

3. (a) (i) Draw the structure of β-oleoyl-α-palmitylstearin, which gives one molecule of oleic acid 18:1 (n-9) and one molecule of palmitic acid 16:0 and one molecule of strearic acid 18:0 on hydrolysis. (15 marks)

(ii) Draw the short hand notation of the triglyceride you have drawn in Q3 (a) (i) above. (05 marks)

(b) (i) State the isoprene rule. (08 marks)

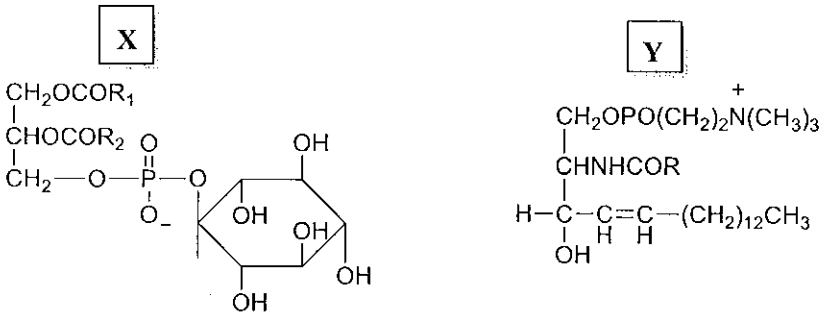
(ii) Dissect the following terpenes (I) - (IV) (by indicating the head and tail) into isoprene units. (20 marks)



(iii) State the class of terpenes of the above structures (I) - (IV). (12 marks)

(c) (i) What are glycerophospholipids? (10 marks)

(ii) Identify the products of hydrolysis of X and Y given below.



(24 marks)

(iii) Name the subgroup of phospholipid the compound Y belongs to. (06 marks)

4. (a) Answer any **one (01)** part.

(i) Describe what are anabolic and catabolic reactions giving examples.

(ii) What are endergonic and exergonic reactions? Give the relationship between them in biochemical pathways.

(30 marks)

(b) Indicate the reaction of the following coenzymes (cofactors) which are involved in the enzymatic reaction.

(i) Coenzyme A

(ii) Nicotinamide adenine dinucleotide (NAD^+)

(iii) Pyridoxal phosphate (PLP)

(iv) Thiamine pyrophosphate (TPP)

(20 marks)

(c) Compare any **two (02)** of the following pairs.

(i) Noncompetitive inhibition and uncompetitive inhibition in metabolic reactions

(ii) Metalloenzymes and metal-activated enzymes

(iii) Co-substrate and prosthetic group

(20 marks)

(d) Answer all 04 parts.

(i) What is meant by 'hypovitaminosis'? (04 marks)

(ii) Name four vitamins that cause 'hypovitaminosis'. (08 marks)

(iii) List two important roles played by vitamin B_{12} in the body. (12 marks)

(iv) Explain why people who are solely on vegetarian diet prone to vitamin B_{12} deficiency. (06 marks)