The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

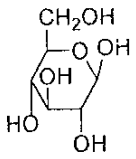
Department	: Chemistry
Level	: 5
Name of the Examination	: Final Examination
Course Code and Title	: CYU5304, Chemistry of Biomolecules
Academic Year	: 2024/2025
Date	: 07/12/2024
Time	: 1.30 p.m.-3.30 p.m.
Duration	: 2 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 4 essay questions in 06 pages.
3. Answer all questions.
4. Answer for each essay question should commence from a new page.
5. Non programmable calculators are permitted.
6. Having any unauthorized documents/ mobile phones in your possession is a punishable offense
7. Use blue or black ink to answer the questions.
8. Circle the number of the questions you answered in the front cover of your answer script.
9. Clearly state your index number in your answer script

1. Answer **all** parts.

a) Draw the structures of the major product when β-D-glucopyranose is treated with
   (i) CH_3COCl, dry CH_3OH, 80°C
   (ii) Excess Ac_2O, pyridine, 120°C



β-D-glucopyranose

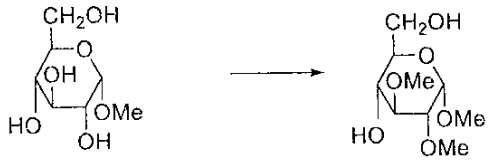
(20 marks)

b) Write the Fischer projection formulae of the D-pentose with the structural formula, $OHC(CHOH)_3CH_2OH$. Which of these on oxidation with nitric acid produce optically inactive dicarboxylic acids? Explain the answer.

(20 marks)

c) Answer **Part I or Part II**.
State the conditions required for the following conversions.

Part I



Part II

(30 marks)

d) Deduce the structure of the disaccharide, ($C_{12}H_{22}O_{11}$) from the following. Explain each observation using structures where necessary.

(i) It does not reduce Fehling's reagent and does not mutarotate.

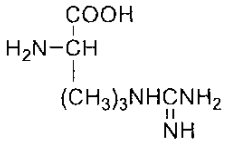
(ii) It is hydrolysed by maltase to D-glucose and D-fructose.

(iii) Methylation followed by hydrolysis gives 2,3,4,6-tetra-O-methyl-D-glucopyranose and 1,3,4,6-tetra-O-methyl-D-fructofuranose.

(30 marks)

2. Answer **all** parts.

a) Write the equilibrium equations for the dissociation of arginine and calculate the isoelectric point (pI) given that pK_{a1}=2.2, pK_{a2}=9.0 and pK_{a3}=10.5.



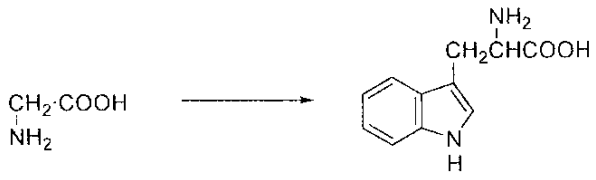
arginine

(20 marks)

b) Give the major steps involved in the synthesis of a dipeptide gly.ala using Merrifield automated solid phase synthesis.

(20 marks)

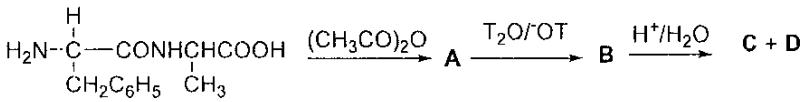
c) Giving the necessary reagents and the mechanism indicate how the following transformation could be achieved.

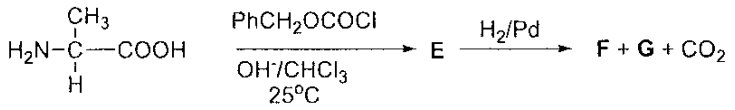


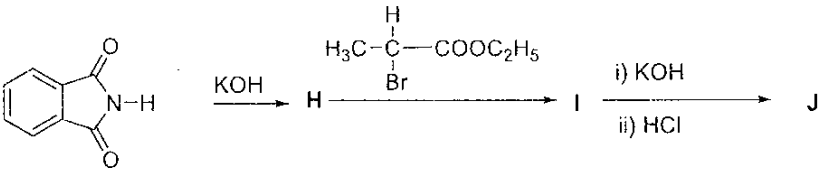
Tryptophan

(30 marks)

d) Draw the structures of the products (**A-J**) in any **TWO (02)** of the following reactions.

(i) 

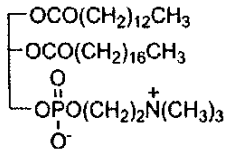
(ii) 

(iii) 

(30 marks)

3. Answer any **four (4)** parts of a) to e).

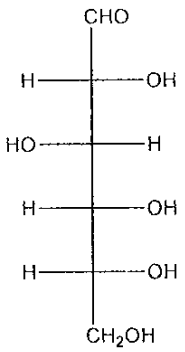
a) i) What are lipids?
ii) Classify derived lipids based on the nature of the products of hydrolysis.
iii) Give the products of hydrolysis of the following phosphotriglyceraldehyde.



(25 marks)

b) i) Give three examples each for simple monomeric molecules found in biomolecules and supramolecular complexes formed from biomolecules.

ii) The linear structure of D-glucose is given below. Draw the cyclic structure of α-D-glucofuranose.



D-glucose

iii) Name the linkage found between two monosaccharide units.

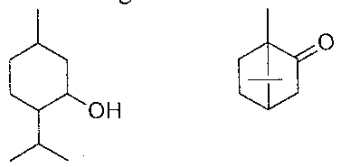
(25 marks)

c) i) What factors affect the melting point of fatty acids?
ii) Briefly explain how cis-trans isomerism of fatty acids affects the melting point of a lipid.
iii) Catalytic hydrogenation of unsaturated fatty acids is important in lipid-based products. Name three heterogeneous catalysts that are used for catalytic hydrogenation.

(25 marks)

d) i) Name the two types of adrenocorticoids present in the body.
ii) State three functions of one of the adrenocorticoid mentioned in d) i).

iii) Dissect the following terpene into isoprene units and indicate the head and tail in each isoprene unit using numbers.



(25 marks)

e) i) Give the three components of a nucleotide.
ii) Briefly explain the double helical structure of DNA.
iii) Name the different types of RNA in the cells.

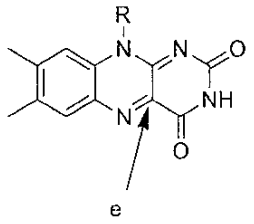
(25 marks)

4. a) i) Name two processes that provide energy for metabolic reactions.
ii) Briefly explain three major methods for extraction of energy from food.
iii) Draw the free energy diagram for an endergonic reaction. Denote the activation energy by $E^{\#}$ and label the reactants, products, and axes properly.

(36 marks)

b) i) Briefly explain two major types of inorganic cofactors.
ii) Name three organic cofactors used in chemical reactions in the body.

iii) The cofactor flavin adenine dinucleotide, FAD (Structure X) is converted to $FADH_2$ by an electron transfer mechanism. Give the mechanism for the conversion of FAD to $FADH_2$. (The initiation step of the reaction is given below)



(Structure X)

iv) Name three fat-soluble vitamins and give three food sources for each fat-soluble vitamin.

(44 marks)

v) Briefly explain how vitamins A and C are identified in a laboratory. Give the colour change and the reagent used for identification.

(20 marks)