

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



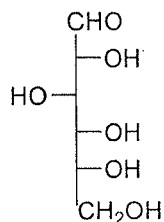
Department	: Chemistry
Level	: 5
Name of the Examination	: Final Examination
Course Code and Title	: CYU5304, Chemistry of Biomolecules
Academic Year	: 2025/2026
Date	: 24/11/2025
Time	: 1.30 p.m.-3.30 p.m.
Duration	: 2 hours

General Instructions

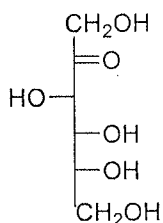
1. Read all instructions carefully before answering the questions.
2. This question paper consists of 4 essay questions in 06 pages.
3. Answer all questions.
4. Answer for each essay question should commence from a new page.
5. Non programmable calculators are permitted.
6. Having any unauthorized documents/ 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 Haworth projections for D-glucose and D-fructose.



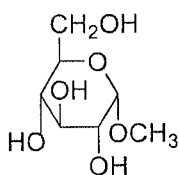
D-glucose



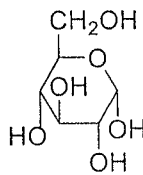
D-fructose

(20 marks)

b) Describe one chemical test which may be used to distinguish between methyl α -D-glucopyranoside (I) and α -D-glucopyranose (II).



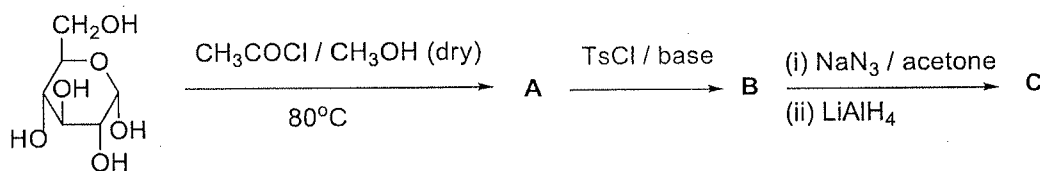
(I)



(II)

(10 marks)

c) Give the structures of the compounds A-C in the following reaction scheme.



(30 marks)

d) Deduce the structure of the disaccharide (E), ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) from the following. Explain each observation using structures where necessary.

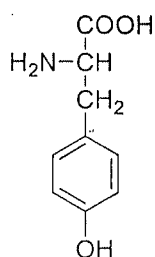
(i) Disaccharide (E) is hydrolysed to D-glucose by maltase, a specific enzyme for α -glycosidase.

- (ii) Compound (E) reduces Fehling's solution, undergoes mutarotation and is oxidized by Br_2 in H_2O to D-maltobionic acid, $\text{C}_{11}\text{H}_{21}\text{O}_{10}\text{COOH}$ (F).
- (iii) Methylation of D-maltobionic acid (F) gives an octamethyl derivative (G) which is hydrolysed to 2,3,4,6-tetra-O-methyl-D-glucopyranose and 2,3,5,6-tetra-O-methyl-D-gluconic acid.
- Give the structures of (E), (F), (G), 2,3,4,6-tetra-O-methyl-D-glucopyranose and 2,3,5,6-tetra-O-methyl-D-gluconic acid.

(40 marks)

2. Answer **all** parts.

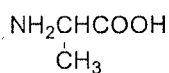
- a) Write the equilibrium equations for the dissociation of tyrosine and calculate the isoelectric pH (pI) given that $\text{pK}_{\text{a}1}=2.20$, $\text{pK}_{\text{a}2}=9.11$ and $\text{pK}_{\text{a}3}=10.07$.



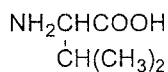
Tyrosine

(20 marks)

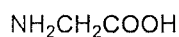
- b) 2,4-Dinitrofluorobenzene and phenyl isothiocyanate are both used for N-terminal analysis of peptides. Write down the reactions involved and explain the most important difference between the two methods. Use the tripeptide, Val.Ala.Gly to illustrate your answer.



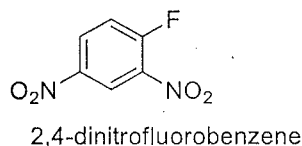
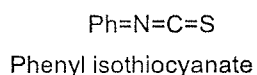
Alanine



Valine



Glycine

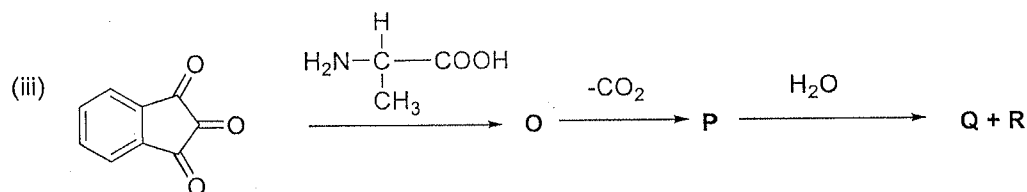
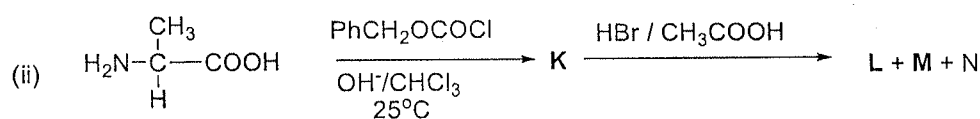
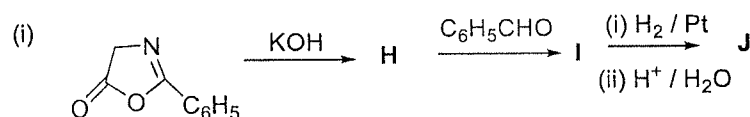


(40 marks)

- c) Briefly explain how a mixture of amino acids is separated and identified by paper electrophoresis.

(10 marks)

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

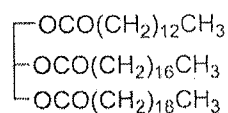


(30 marks)

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

a) i) What are simple lipids?

ii) Give the products of hydrolysis of the following triglyceride.



iii) Classify the following fatty acids as saturated, monounsaturated, or polyunsaturated fatty acids.

a) $\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$

b) $\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_5\text{COOH}$

c) $\text{CH}_3(\text{CH}_2)_8\text{CH}=\text{CH}(\text{CH}_2)_8\text{COOH}$

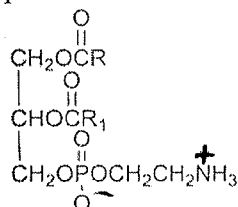
d) $\text{CH}_3(\text{CH}=\text{CHCH}_2\text{CH}_2\text{CH}=\text{CH}(\text{CH}_2)_8\text{COOH}$

iv) Classify the fatty acids b) and d) in question iii) according to the (n-x) system.
(25 marks)

b) i) Give the three main groups of sex hormones.
ii) Briefly explain the roles of three groups mentioned in i).
iii) What are oral contraceptives?
(25 marks)

c) i) Name three intermolecular forces found between fatty acids
ii) Three fatty acids (18:0, 18:1, and 18:2) vary in their melting points in the following manner, $18:0 > 18:1 > 18:2$. Briefly explain the reason/s.
iii) Give the hydrogenated product of $\text{CH}_3(\text{CH}_2)_8\text{CH}=\text{CH}(\text{CH}_2)_8\text{COOH}$, giving the reagents and indicating the mechanism.
(25 marks)

d) i) Name the two main groups of phospholipids. State the basis of each group.
ii) Consider the structure of cephalin given below. Draw the molecule in your answer script and label the polar head and the non-polar tail.



iii) What are gangliosides?
(25 marks)

e) i) Give the three components of a nucleotide.
ii) How does a nucleotide differ from a nucleoside?
iii) Briefly explain the double helical structure of DNA.
iv) Give the complementary DNA strand for 5' GCCTAA 3'.
(25 marks)

4.

a) i. Differentiate between anabolic and catabolic reactions providing one example each.
ii. Explain the distinct roles of enzymes and coenzymes (or cofactors) in metabolic pathways.
iii. Classify metabolic reactions on a thermodynamic basis, giving one example for each type, and explain how thermodynamically unfavorable reactions are driven within the cell.
(43 marks)

b) Using a table, compare the lock-and-key model and the induced-fit model of enzyme action. Include appropriate descriptive illustrations to support your explanation.
(24 marks)

- c) i. Name the vitamin that is produced in the human body by cleavage of β -carotene.
- ii. State two biological functions of the above vitamin and indicate the chemical form of the vitamin responsible for each function.
- iii. Name two health problems due to deficiency and two problems due to overdose of this vitamin.

(33 marks)