THE OPEN UNIVERSITY OF SRI LANKA

B.Sc./B.Ed. DEGREE PROGRAMME 2021/2022

LEVEL 5-FINAL EXAMINATION

CYU 5304
CHEMISTRY OF BIOMOLECULES

DURATION: 2 HOURS

31st October 2022 1.30 p.m. - 3.30 p.m.

Answer all questions.

1. Answer **all** parts.

   a) What is meant by "mutarotation"? Explain and illustrate the structural changes during mutarotation with D-glucose as an example.

   (20 marks)

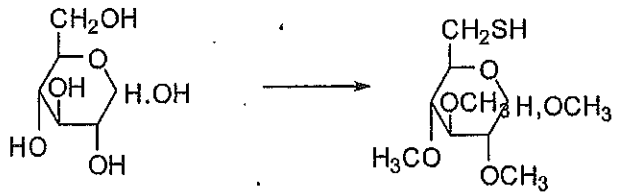
   b) Draw the Fischer projection formulae of (i) D-aldohexoses, (A), which on reduction with $NaBH_4$ produces an optically inactive hexitol and (ii) an isomeric D-aldohexose which produces the osazone of A. Explain your deduction by stating the chemical reactions.

   (20 marks)

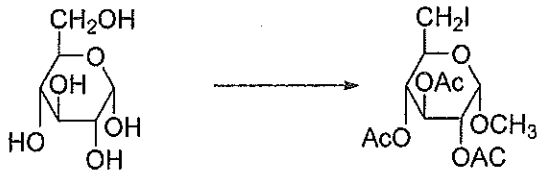
   c) Answer **Part I or Part II.**

How would you effect the following conversions?

Part I



Part II



(30 marks)

d) 1) Stating reasons for the following observations deduce and draw the structure of lactose, a disaccharide which is present in milk.

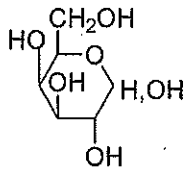
(i) It is hydrolysed by β-galactosidase to D-glucose and D-galactose.

(ii) It is a reducing sugar that mutarotates.

(iii) Its' osazone is hydrolysed to D-galactose and D-glucosazone.

(iv) Methylation followed by hydrolysis of lactose gives 2,3,6-tri-O-methyl-D-glucose and 2,3,4,6-tetra-O-methyl-D-galactose.

2) Write the structural formula for the osazone of lactose.



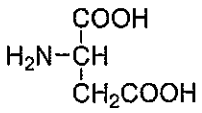
D-galactose

(30 marks)

2. Answer **all** parts.

a) i) Define "isoelectric point" (pI).

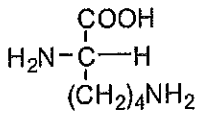
ii) Write the equilibrium equations for the dissociation of aspartic acid and calculate the isoelectric point (pI) given that pK_{a1}=1.88, pK_{a2}=3.65 and pK_{a3}=9.60.



Aspartic acid

(20 marks)

b) Identify the products obtained when lysine is reacted with benzylchloroformate ($C_6H_5CH_2OCOCl$) in polypeptide synthesis.



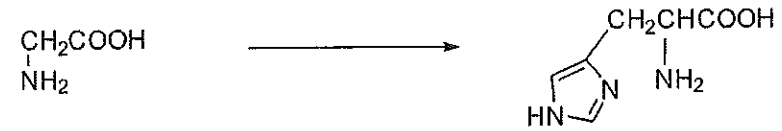
Lysine

(10 marks)

c) Briefly explain how a mixture of amino acids is separated by ion-exchange chromatography.

(20 marks)

d) How would you effect the following transformation? Give the necessary reagents and write the mechanism for the reaction.

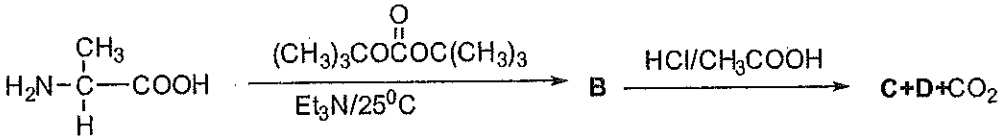


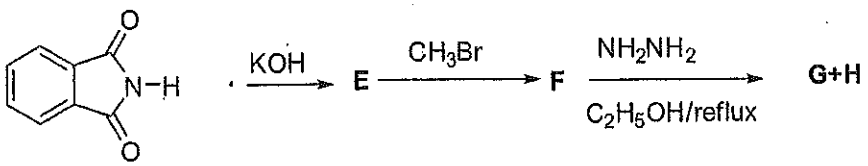
Glycine

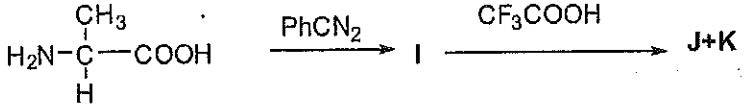
histidine

(30 marks)

e) Draw the structures of the products (**B-K**) you would expect in any **TWO (02)** of the following reactions.

(i) 

(ii) 

(iii) 

(20 marks)

3) Answer any **Four (04)** parts from (a) – (e).

a) i) Name three major lipids based on the classification of the products of hydrolysis.

ii) Classify the following lipids to the classification mentioned in a) i).

Phospholipid, steroid, bees wax, alcohols, sphingolipids.

iii) Briefly describe the biological functions of lipids.

(25 marks)

b) i) Name the following fatty acids according to both IUPAC and Δ nomenclature systems. Consider all the double bonds as *cis*.

$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$

$CH_3(CH_2)_4CH=CHCH_2CH=CH(CH_2)_7COOH$

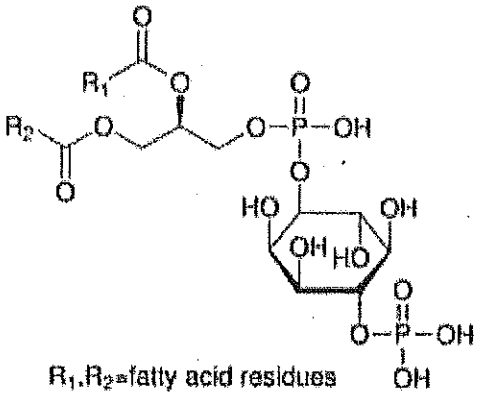
ii) What is meant by "essential fatty acids"?

iii) State the dietary sources of essential fatty acids.

iv) Briefly describe "waxes".

(25 marks)

c) i) Give the products of hydrolysis of glycerophospholipid, phosphatidylinositol 4-monophosphate.



R_1,R_2=fatty acid residues

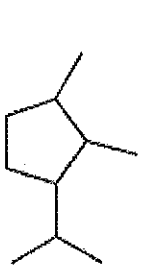
ii) Briefly account for eicosanoids including their functions.

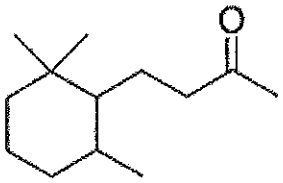
iii) What are PGE2 prostaglandins?

iv) List three functions of PGE2 prostaglandins.

(25 marks)

d) i) Classify the following terpenes into isoprene units and indicate clearly the head and tail units.



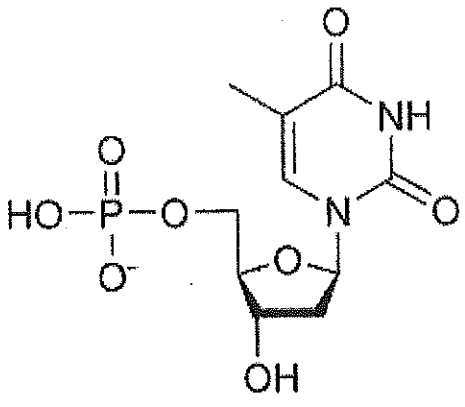


ii) What are the main groups of lipids found in the cell membrane?

iii) Explain how cell membranes achieve mobility and contribute to signaling process.

(25 marks)

e) i) Identify the following nucleotide and its components.



ii) Indicate the complementary sequence of the nucleotide, GATAAGCCAT

iii) Briefly describe the double helical structure of DNA.

iv) Name the three major RNA types found in our body. State their functions.

(25 marks)

4. Answer **all** parts.

(a) In biological systems there are different types of metabolic reactions such as group transfer, redox reaction, rearrangement etc.

i. Name three functional groups which are commonly encountered in group transfer reactions.

ii. Name two coenzymes which take part in redox reactions.

(25 marks)

(b) The Gibbs free energy ($\Delta G°$) for the hydrolysis of acetyl CoA ($CH_3COSCoA \rightarrow$ acetate + CoA) is -31.5 kJ/mol.

i. State why this reaction has a negative $\Delta G°$ value.

ii. Calculate the $\Delta G°$ value for the following reaction.

Acetate + ATP $\rightarrow$ Acetyl CoA + AMP + PP_i

Consider $\Delta G° = -30.5$ kJ/mol for the hydrolysis of ATP (ATP $\rightarrow$ AMP + PP_i).

iii. Write the mechanism for formation of acetoacetyl CoA from acetyl CoA.

(30 marks)

(c) Enzymes are capable of catalyzing a specific reaction.

i. Categorize the enzymes according to their specificity.

ii. Give one example for each type.

(20 marks)

(d) Vitamin C (ascorbic acid) which is a water soluble vitamin, plays a major role in the biological activities of the human body as a reducing agent.

i. List down three biological activities of vitamin C as a reducing agent.

ii. Although vitamin C is water soluble, intake of large excess is not recommended. State the reason.

(25 marks)