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

Department	**: Chemistry**
Level	**: 5**
Name of the Examination	: Final Examination
Course Title and - Code	**: Biochemistry - CYU5306**
Academic Year	**: 2023/2024**
Date	**: 04/04/2024**
Time	**: 1.30 pm – 3.30 pm**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **FOUR** questions in **Six** pages.
3. Answer **All** questions. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary.
6. Involvement in any activity that is considered as an exam offense will lead to punishment
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script

1. Answer any **Two (2)** parts from **A-C**.

A) i) Write down **two** catabolic and two anabolic pathways of glucose.

ii) "Citric acid cycle is very important as an energy provider for the biochemical process in the body". Explain the statement.

iii) "Aconitase is the stereospecific enzyme that is involved in the citric acid cycle."

a) What is the step that uses aconitase enzyme in the citric acid cycle?

b) Write down the chemical reaction for the above-mentioned step.

(Hint: No structures are required)

iv) Name two regulatory steps of the citric acid cycle.

(50 marks)

B) i). Briefly explain the purpose of anaplerotic reaction.

ii) Write down **two (2)** examples of anaplerotic reactions.

iii) Name **two (2)** shuttles that involve the transportation of NADH in the cytosol to mitochondria.

iv) What are the **four (4)** major complexes of the electron transport chain?

v) a) What is the name of the complex V in the electron transport chain?

b) Write down the function of the complex V.

(50 marks)

C) i) Name the **four (4)** steps of the citric acid cycle that lead to the formation of succinyl CoA from acetyl CoA. (no need to write the chemical equations)

ii) Write down a reaction that releases CO_2 as a product among the above steps that you have mentioned.

iii) Briefly explain the term photophosphorylation.

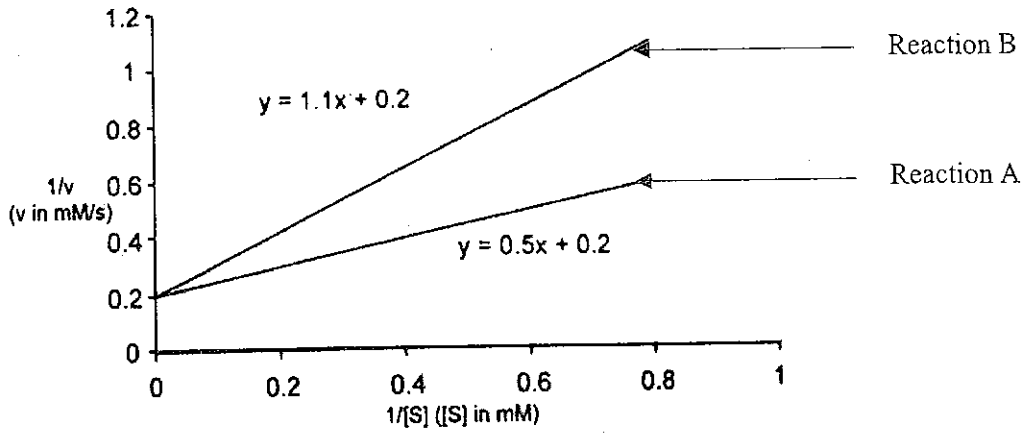
iv) a) Name **two (2)** types of photosystems used in photosynthesis.

b) Write down the balanced overall light-dependent reaction.

(50 marks)

2. Answer any **Two (2)** parts from **A-C**.

A) Below figure is the Lineweaver Burke plot for an enzyme-catalyzed reaction, with and without an inhibitor present.



i) What is the graph (reaction A or B) that represents the reaction with the inhibitor present?

ii) Giving reasons, predict which type of inhibitor is present.

iii) Write down **two (2)** characteristic features of this inhibitor.

iv) Calculate the Km and Vmax for the enzyme reaction in the absence of the inhibitor.

iv) Which parameters of the enzyme reaction (Km and Vmax) are changed in the presence of the inhibitor? Show your calculations.

(50 marks)

B) i) Write down **four (4)** characteristic features of allosteric enzymes.

ii) Name **two (2)** examples of allosteric enzymes.

iii) a) State how covalent modification is important to regulate enzyme activity.

b) Give two well-known examples for the covalent modification.

iv) What is meant by a cascade mechanism?

(50 marks)

C) i) Write down **four (4)** factors that affect the formation of enzyme-substrate complex.

ii) Using appropriate structural representations briefly explain the induced fit model theory to describe the enzyme-substrate binding.

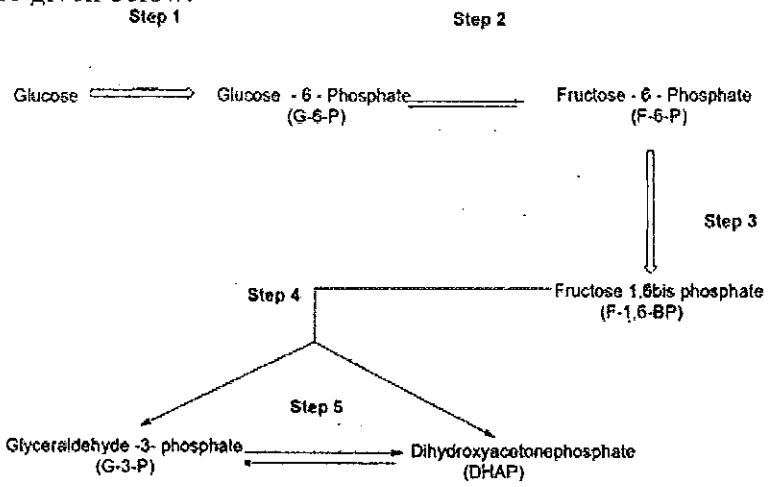
iii) Define the term "turnover number" of an enzyme.

iv) In an enzyme assay, assume Km for the enzyme is 0.5mM and the maximum rate of the reaction is measured as 0.1 mmoles/second. Calculate kcat if the above experiment was conducted in a 1.0 mL reaction volume at an enzyme concentration of 20 nM.

(50 marks)

3. Answer any **Two (2)** parts from **A-C**.

A) Glycolysis is one of the major catabolic pathways in our body. The reactions 1-5 in glycolysis are given below.



i) Identify the phase of the glycolysis given above.

ii) Name the step/s that use ATP in the reaction/sgiven above.

iii) Identify the committed step of this pathway and give the enzyme responsible for that step.

iv) Give the enzymes in steps 4 and 5.

v) Explain why gluconeogenesis is NOT the reverse of glycolysis.

vi) Explain how to overcome the issue in gluconeogenesis you explained in v) with proper equations for step 3.

(Hint: No structures are required)

(50 marks)

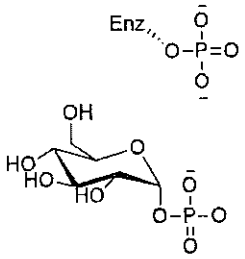
B) Glycogen is one of the major energy stores in our body.

i) Why is glycogen considered as a store for energy production rather than fat stores?

ii) Explain the structure of glycogen. (Hint: No structures are required)

iii) Name the three major enzymes involved in glycogenolysis.

iv) Give the enzymatic mechanism for the conversion of Glucose-1-phosphate to Glucose-6-phosphate during glycogenolysis.



(50 Marks)

C) Glycogen is the main form of storing carbohydrates in our body.

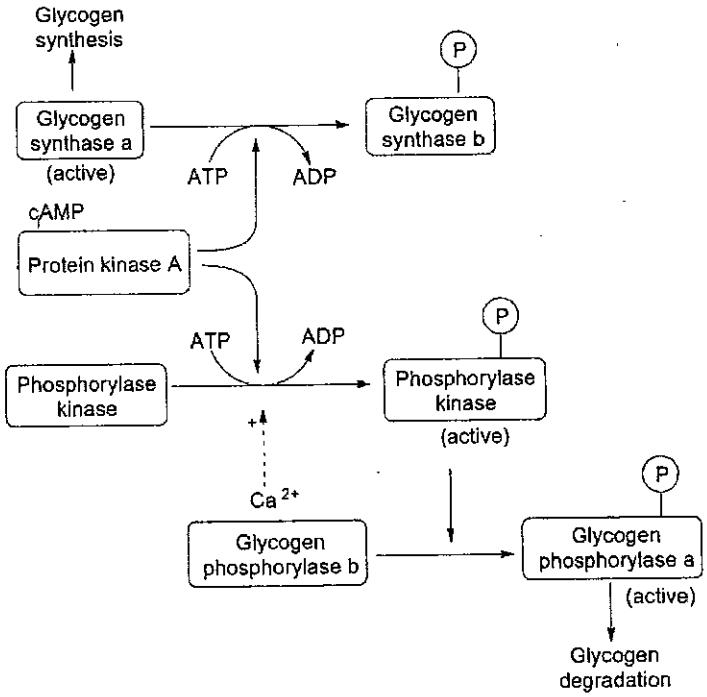
i) Give a sketch diagram for the conversion of glucose to glycogen. Name the major enzymes involved and give the products.

(Hint: No explanation is required)

ii) What is the purpose of UTP in glycogen synthesis?

iii) Name the enzyme that exists in isozymes in the diagram you have given in i).

iv) Consider the following pathway for glycogen metabolism. Briefly explain the net effect of the hormonal action of glucagon on this pathway.

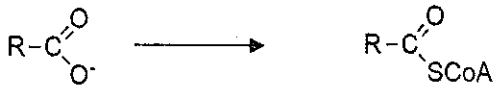


(50 Marks)

4. A) The β-oxidation of fatty acids occurs in mitochondria.

i) What do you mean by β-oxidation in fatty acids?

ii) Consider the following reaction in β-oxidation.



a) What is the importance of this reaction?

b) Briefly explain this reaction by giving the intermediates, enzymes, and other relevant compounds needed for the completion of the reaction.

c) Briefly explain one cycle of β-oxidation in the oxidation pathway if R=$CH_3(CH_2)_3$. Give all the structures, enzymes, and products.

(Hint: No need to name the substrates or products)

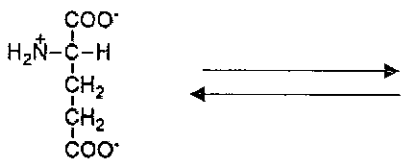
(50 marks)

B) Amino acids are an important source of nitrogen for many processes in the body

i) Give **four (4)** products of the carbon skeletons of amino acids that enter the citric acid cycle.

ii) a) What is Oxidative deamination?

b) Complete the following reaction of the oxidative deamination with glutamate as substrate. Give chemical structures of all the product/s, cofactor/s, and enzyme/s involved.



Glutamate

c) Is glutamate the only amino acid undergoing oxidative deamination? Explain.

iii) The urea cycle and the citric acid cycle are linked by the aspartate-argininosuccinate shunt. Briefly explain the aspartate-argininosuccinate shunt.

(Hint: No structures are required)

(50 marks)

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