THE OPEN UNIVERSITY OF SRI LANKA

B. Sc. DEGREE PROGRAMME 2015 / 2016

LEVEL 5 - FINAL EXAMINATION

CMU3126 - BIOCHEMISTRY

DURATION: 02 HOURS

Date: Sunday 22nd January 2017 Time: 1.30-3.30 pm

Instructions to candidates:

This paper consists of six (06) questions. You are required to answer four questions out of six.

1. **(A)** I. a) How do you differentiate anabolism from catabolism?

b) What are the different catabolic pathways of glucose? Explain each pathway briefly by giving end products.

(20 marks)

II. Citric acid cycle is one of the most important cycles functioning in our body.

a) What are the importance of the citric acid cycle?

b) How many steps in above cycle indicate the free energy change ($\Delta G^{\circ\prime}$) values '0' or above? What are they?

c) What is the overall role of the step with $\Delta G^{\circ\prime}$ value '0'?

d) What is meant by substrate level phosphorylation? Explain using one example found in the citric acid cycle.

e) What are anaplerotic reactions? State the importance. Give three examples from the citric acid cycle by indicating their relevant enzymes.

(50 marks)

(B) I. a) NADH produced in the glycolysis transports into mitochondria though two shuttle mechanisms. Describe two shuttles.

b) "When NADH is shuttled through two shuttles, ATP production is different". Justify the statement.

c) Complex V of the respiratory chain is the site for ATP synthesis. Name different functional units of complex V and state their functions.

(30 marks)

2) (A) I. a) Photosynthesis occur in two reaction stages, light reaction and dark reaction. Indicate the location of these two reactions.

b) What is meant by photolysis?

c) Name two photo systems responsible for light absorption in non-cyclic electron flow of the light reaction and state their functions. Briefly describe different events take place when electrons flow through two photo systems.

(20 marks)

II. a) What is an active site of an enzyme? List down five special features of an active site.

b) Explain two models proposed to describe how the substrate binds to the enzyme.

(20 marks)

III. a) What is the effect of an inhibitor?

b) Based on the way that inhibitors bind to enzymes, we can categorize enzymes in different ways. What are they? Explain.

(15 marks)

(B) Michealis-Menten (M-M) equation for enzyme- catalyzed reaction is as follows.

$$V = \frac{V_{max}[S]}{K_m + [S]}$$

a) Sketch Lineweaver – Burke double reciprocal plot using above M-M equation.

b) Compare that plot with M-M plot of V vs [S] and justify which plot is more suitable for the calculation of K_m and V_{max}.

(45 marks)

3) (A) Michealis-Menten equation for competitive inhibition is,

$$V_0 = \frac{V_{max}[S]}{\alpha K_m + [S]}$$

a) Define "α" of the above expression.

b) Consider the enzymatic reaction with α = 1, 2 or 3 and draw the M-M curves for competitively inhibited processes in a one graph.

c) Derive the expression and draw Lineweaver Burke plot to show that the increase in inhibitor concentration does not affect the value of V_{max}.

(35 marks)

(B) a) Derive the M-M equation for uncompetitive inhibition.

b) Draw the Lineweaver Burke plot for an enzyme in the presence of uncompetitive inhibitors.

(40 marks)

(C) a) How does the mixed inhibitor bind to an enzyme?

b) What is meant by the committed step of a biochemical pathway? Give an example from the citric acid cycle.

(25 marks)

4. (A) Activity of some enzymes can be controlled by allosteric regulation.

I. Give four characteristics of an allosteric enzyme.

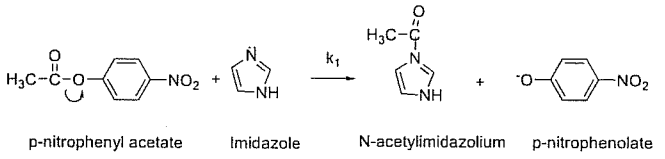
(12 marks)

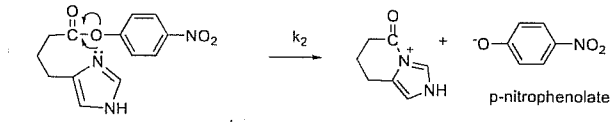
II. a) Explain the sequential model for allosteric regulation in an enzyme.

b) What are the drawbacks of symmetry model for allosteric regulation?

(30 marks)

III. The rate of reaction of p-nitrophenyl acetate with imidazole and 4'-imidazolyl-p-nitrophenyl butyrate was measured experimentally and their rates were $k_1 = 0.0018\ s^{-1}$ and $k_2 = 0.043\ s^{-1}$ respectively.





4'-imidazolyl-p-nitrophenyl butyrate

a) Calculate the ratio of k_2/k_1.

b) How do you explain the catalytic mechanism associated with the above observation?

c) Name four other catalytic mechanisms exhibited by enzymes.

(18 marks)

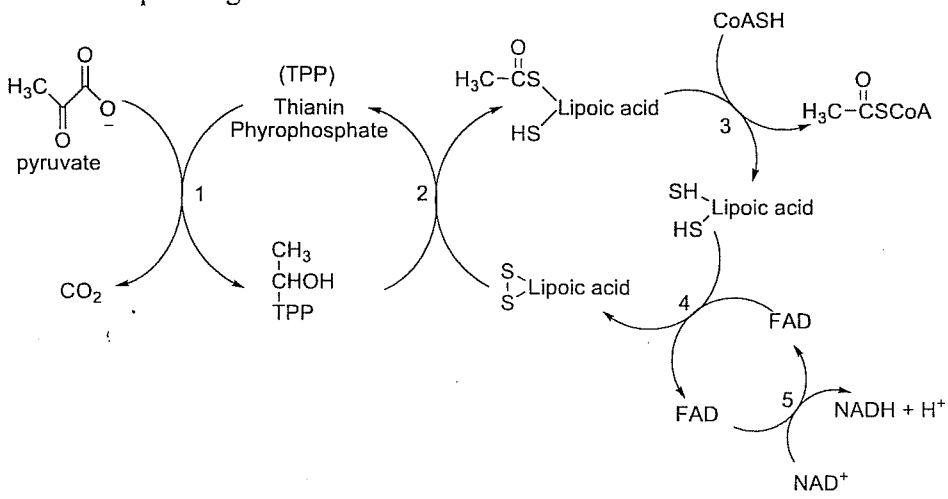
(B) Step one of glycolysis is regulated by hexokinase, which has an isozyme.

I. What is an isozyme?

II. Name the isozyme of hexokinase.

III. How do hexokinase and its isozyme differ?

IV. Name the enzymes (**1 to 5**) required for the conversion of pyruvate to acetyl coenzyme A in the reaction sequence given below.



(40 marks)

4) **(A)** Glucose is synthesized by small molecules by different pathways such as photosynthesis and gluconeogenesis.

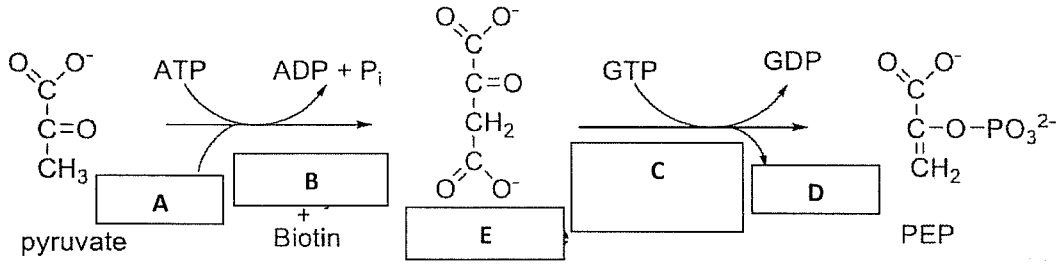
I. How does photosynthesis differ from gluconeogenesis?

(24 marks)

II. Explain why gluconeogenesis pathway is not the reverse of glycolysis.

(6 marks)

III. Identify the compounds/enzymes/molecules labeled from **A to E** in the conversion of pyruvate to PEP.



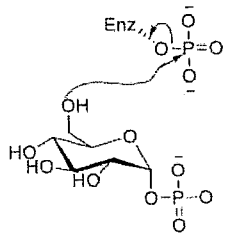
(25 marks)

(B) I. Give the function of the following enzymes used in glycogenolysis.

a) Glycogen phosphorylase
b) Glycogen debranching enzyme
c) phosphoglucomutase

(15 marks)

II. Draw the mechanism of action of phosphoglucomutase in the following reaction using arrows and give the final product/s. The first step of the reaction is given below.



(15 marks)

III. Describe the steps in the synthesis of glycogen.

(15 marks)

6) I. Give the cellular locations of the following reactions.

a) fatty acid synthesis
b) β oxidation
c) formation of fatty acyl CoA
d) formation of ornithine
e) oxidative deamination

(25 marks)

II. Give the products of nitrogen excretion of the following organisms

a) aquatic
b) ureotelic
c) uricotelic

(15 marks)

III. Explain the reactions occur in the trans deamination pathway.

(15 marks)

IV. Urea has the formula of $CO(NH_2)_2$, with one carbon and 2 nitrogen atoms. From which compounds do these three atoms come from?

a) Nitrogen atom (1)
b) Nitrogen atom (2)
c) Carbon atom

(15 marks)

V. a) Name the usual means of transporting nitrogen from tissues to liver in the human body.

b) What is the function of glucose-alanine cycle?

c) Explain the steps in the glucose-alanine cycle.

(30 marks)