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UNIVERSITY OF RUHUNA – FACULTY OF ALLIED HEALTH SCIENCES

DEPARTMENT OF PHARMACY

FIRST BPHARM PART I EXAMINATION – JANUARY/FEBRUARY 2023

PH 1123 BIOCHEMISTRY I – SEQ PAPER

TIME: TWO HOURS

INSTRUCTIONS

- There are **four** questions in part **A, B** and **C** in this SEQ paper.
- Answer all questions.
- No paper should be removed from the examination hall.
- Do not use any correction fluid.
- Use illustrations where necessary.

PART A

1.

1.1

1.1.1 What is the actual free energy change ($\Delta G'$) of ATP hydrolysis in the human erythrocytes (cells) where the concentrations of ATP, ADP, Pi are = 2.25, 0.25, and 1.65 mM, respectively? Standard free energy change ($\Delta G^{0'}$) of ATP hydrolysis is -30.5 kJ/mol. ***(20 marks)***

[Note: $\Delta G' = \Delta G^{0'} + RT \ln K'eq$, $R = 8.314\ J\ K^{-1}\ mol^{-1}$ and $T = 310\ K$.]

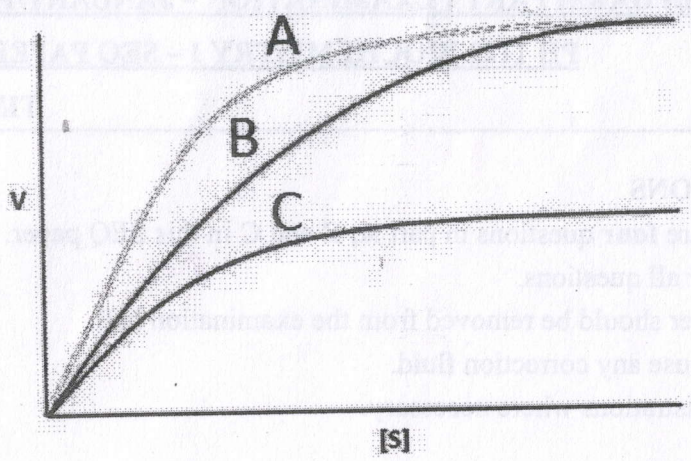
1.1.2 In the hydrolysis of ATP to ADP and P_i, the equilibrium concentration of ATP is too small to be measured accurately. A better way of determining K'eq, and hence $\Delta G^{0'}$ of this reaction, is to break it up into two steps whose values of $\Delta G^{0'}$ can be accurately determined. This has been done using the following pair of reactions

$$ATP + Glu + NH_3 \longrightarrow ADP + Pi + Gln + H^+ \qquad \Delta G_1^{0'} = -16.3\ kJ/mol$$

$$Glu + NH_3 \longrightarrow Gln + H_2O + H^+ \qquad \Delta G_2^{0'} = 14.2\ kJ/mol$$

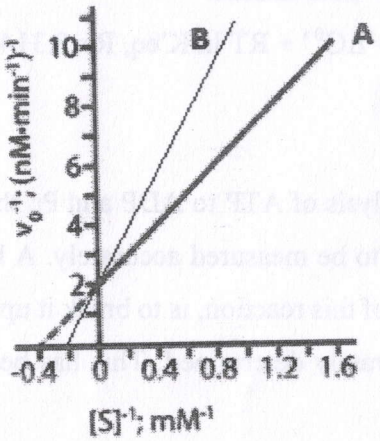
What is the $\Delta G^{0'}$ of ATP hydrolysis according to these data and state whether this reaction is spontaneous? ***(20 marks)***

1.2 In the following Michaelis-Menten graphs, curve **A** is obtained for the normal enzyme, and the other two (**B**, **C**) represent the enzyme kinetics in the presence of two inhibitors.



Identify the two types of inhibitors depicted by this graph. Justify your answer in terms of K_m and V_{max}. ***(20 marks)***

1.3 The compound, saquinavir, has been developed as a drug that inhibits the enzyme HIV protease, which is necessary for the proper maturation of the virus. The kinetics of the enzyme with (**B**) and without (**A**) the protease inhibitor saquinavir are shown in the graph below.



1.3.1 Does this enzyme obey Michaelis-Menten kinetics? Explain. ***(10 marks)***

1.3.2 What effects does saquinavir have on the K_m and V_{max} of the HIV protease? ***(10 marks)***

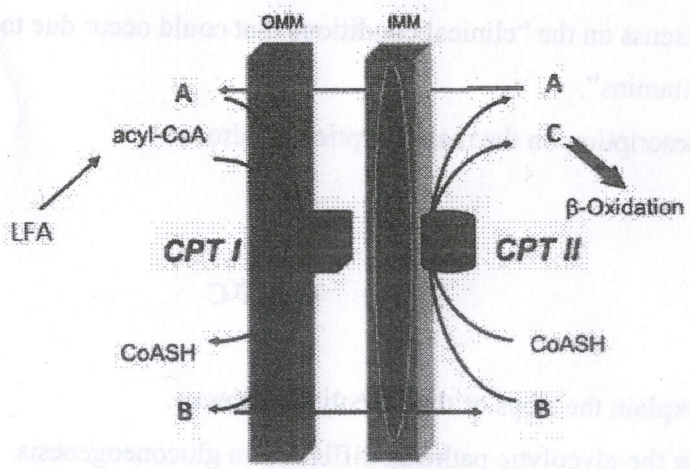
1.3.3 Calculate the V_{max} and K_m for this enzyme with and without saquinavir.

(15 marks)

1.3.4 What type of inhibitor is saquinavir? ***(05 marks)***

2.

2.1 The key regulatory step in the long-chain fatty acid (LFA) oxidation process is the entrance of fatty acids into the mitochondria. This is an active transportation process that requires the assistance of an uncommon amino acid-shuttle enzyme complex. The transport system for esterification of fatty acids through mitochondrial membranes (OMM: outer mitochondrial membrane; IMM: inner mitochondrial membrane) is shown below:



Identify **A**, **B**, **C** of this diagram and give the name of the reaction involved in the conversion of **A** to **B** and **B** to **A.** ***(15 marks)***

2.2

2.2.1 Fatty acids are oxidized to acetyl-CoA in the mitochondria using the fatty acid spiral. The acetyl-CoA is ultimately oxidized using the citric acid cycle and the electron transport chain. Show that the ATP yield **per** oxidation cycle is 14 ATP.

(10 marks)

2.2.2 How does the oxidation of odd-chain fatty acids differ from that of even-chain fatty acids? ***(10 marks)***

2.2.3 Calculate the number of ATP molecules produced from the complete catabolism of palmitic acid (hexadecaonic acid). ***(15 marks)***

PART B

2.3 List four membrane channels which facilitate the transport of molecules across the plasma membrane. (*10 marks*)

2.4 Write a short description on one channel you have mentioned in 2.3. (*15 marks*)

2.5 Describe the mechanisms involved in the transportation of macromolecules across the plasma membrane. (*25 marks*)

3.

3.1 List five different water-soluble vitamins. (*10 marks*)

3.2 What are the three forms of vitamin A? (*15 marks*)

3.3 Write four clinical indications of vitamin A. (*10 marks*)

3.4 Briefly discuss on the "clinical conditions that could occur due to the deficiency of fat-soluble vitamins". (*40 marks*)

3.5 Write a description on the malabsorption syndrome. (*25 marks*)

PART C

4.

4.1 Briefly explain the steps of the glycolytic pathway. (*50 marks*)

4.2 State how the glycolytic pathway differs from gluconeogenesis. (*15 marks*)

4.3 Briefly explain the importance of any three intermediates formed during glycolysis. (*15 marks*)

4.4 Briefly explain the significance of the pentose phosphate pathway in reducing oxidative stress in human cells. (*20 marks*)

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