

UNIVERSITY OF FORT HARE

BCH223

SUPPLEMENTARY EXAMINATIONS

JANUARY 2019

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Time: 3 HOURS

Subject: Metabolism and Enzymology

Marks: 100

This paper consists of 3 pages including cover page

Internal Examiner

External Examiner

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Instructions

Answer all the questions.

Question 1 (20 marks)

- a) How are enzymes grouped into classes? Give two examples and explain your answer. (5)
- b) Use an enzyme's V_{max} and K_m values (i.e. with and without inhibitor), deduce the type of inhibition the enzyme is experiencing. Include diagram(s) in your answer. (4)
- c) In a 2nd order reaction, the substrates must meet, collide, and collide the correct way in order for the reaction to take place. Fully describe how the enzyme facilitates all these steps. (4)
- d) Fully describe how an enzyme is regulated by controlling its substrate concentration and by using compartments of the cell. (3)
- e) Different enzymes may act on the same substrate with different efficiencies. Explain why these enzymes are designed in that way, and why this is important for living organisms in order to regulate their activity? (4)

Question 2 (20 marks)

- a) Describe in full what happens to pyruvate when oxygen supply is not adequate for muscle activity. (4)
- b) List all the glycolysis pathway enzymes into enzyme classes. Use 2 examples from the different enzyme classes you've listed to explain why you classified these enzymes in this way (**Hint:** Write down the enzyme reaction and explain the mechanism occurring in the reaction). (6)
- a) What serves as an energy currency in the cells of living organisms? Write down in full the reactions that produce energy in glycolysis? Give the name(s) of, and describe the process(es) by which these reactions produce energy. (5)
- a) Several allosteric regulators of glycolysis are products of other metabolic pathways or are made in other metabolic pathways. Why is this so? Name just one example of a regulator that is a product of glycolysis, and its involvement in the regulation of glycolysis. (4)

Question 3 (30 marks)

- a) $NAD^+/NADH$ ratio is one of the important ways to control or regulate citric acid cycle. Explain how this is achieved. (3)
- b) Fully describe the process of producing an ATP equivalent in Krebs cycle. (4)
- c) Using names only, write down enzymes that catalyse reactions in the citric acid cycle in which NADH is produced. Besides producing NADH, explain what else are these reactions involved in. None of these reactions use molecular oxygen (O_2), but all three reactions are strongly inhibited by anaerobic conditions; explain why. What is the reaction mechanism exhibited in all these reactions? (6)
- d) How do microorganisms use a 2 carbon containing fatty acid to make carbohydrates? (5)
- e) Why is the arrangement of the ETS components enabling an electron to keep passing from one component to the other? (2)
- f) How is it possible for the transport of electrons and protons to ultimately generate ATP? (4)
- g) Why is the ATP production different between the two shuttles used to transport the cytosolic NADH? Add a drawing of a sketch of each cycle to illustrate your answer. (6)

Question 4 (20 marks)

- a) It has been found that migrating animals eat or drink very rarely. Using the knowledge you acquired, map out how a hibernating animal uses stored fats to provide for its energy and water needs. (5)
- b) Why do birds prefer to store fats as a source of energy instead of carbohydrates? (2)
- c) Why is it that humans tend to get fat when they eat a lot of carbohydrates? (4)
- d) A doctor smelt an acetone odour from his patient's mouth. He immediately carried out a battery of tests. Explain in detail what the doctor may find out and why? (6)
- e) Pharmaceutical companies usually add a certain amino acid in slimming pills. What is the name of this 'amino acid', and why do they do this? (3)

Question 5 (10 marks)

- a) A certain researcher thought that in order for a tree to grow and gain mass, it must find food somewhere. He carefully weighed a tree and soil that he planted the tree in. Time passed, and the tree grew. After some time, he reweighed the tree, which had grown quite large, and the soil. To his surprise, the soil weighed basically the same amount, suggesting to him that the plant couldn't be gaining mass from the soil. Where do you think the extra mass of the tree was coming from, and why? (3)
- b) Where in a plant cell does the process of trapping light occur? Give a reason why that plant part is suited for this process? (2)
- c) What are two similarities between the structure (and function) of chloroplast and mitochondrion? (2)
- d) In an attempt to find a suitable plant to grow in certain climatic conditions, some researchers looked at a variety of plants. They found that there were some differences in the growth patterns between C₃ and C₄ plants. Explain why this was the case, and under conditions were suitable for each of these plant types? (3)

End of examinations