

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCES
BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS
DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

THEORY: METABOLIC PROCESSES LSBB 2102

DECEMBER 2002

2 ½ HOURS (100 marks)

INSTRUCTIONS

Answer Four (4) Questions. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams. **Note that subdivisions a) are multiple choice questions. Choose the one BEST response to each question and briefly justify your answer.**

- 1.(a) Compared to the resting state, vigorously contracting muscle shows:
- A. An increased conversion of pyruvate to lactate
 - B. Decreased oxidation of pyruvate to CO₂ and water
 - C. A decreased NADH/NAD⁺ ratio.
 - D. Decreased concentration of AMP
 - E. Decreased levels of fructose 2,6-bisphosphate
- (3 marks)
- (b) Explain the meaning of the terms redox potential and redox system. Describe the organization of the electron carriers in the inner mitochondrial membrane and the mechanism of oxidative phosphorylation. (22 marks)
- 2.(a) The mobilization of triacylglycerol-bound fatty acids from adipose tissue and their subsequent oxidation by muscle mitochondria require all of the following compounds **EXCEPT**
- A. Serum albumin
 - B. Carnitine
 - C. Acetyl CoA carboxylase
 - D. Hormone-sensitive lipase
 - E. Fatty acyl CoA synthetase
- (3 marks)
- (b) Present the details and characteristics of the synthesis of high energy compounds in the substrate chain. Give examples from various metabolic pathways. (22 marks)
- 3.(a) Which of the following proteins is, in fact, a multifunctional enzyme complex in higher organisms?
- A. Acyl transacylase
 - B. Malonyl transacylase
 - C. β-Ketoacyl-ACP-reductase
 - D. 3-Hydroxyacyl-ACP-dehydrase
 - E. Fatty acid synthetase
- (3 marks)

- 3.(b) List and explain all reactions involved in the conversion of lactic acid to glycogen. Use structural formulae and name the enzymes involved. (22 marks)
- 4.(a) An uncoupler of oxidative phosphorylation such as dinitrophenol:
- A. Inhibits electron transport and ATP synthesis.
 - B. Allows electron transport to proceed without ATP synthesis.
 - C. Inhibits electron transport without impairment of ATP synthesis.
 - D. Specifically inhibits cytochrome b.
 - E. Acts as a competitive inhibitor of NAD^+ -requiring reactions in the mitochondrion. (3 marks)
- (b) Give a full account of complete degradation of glycerol to CO_2 and H_2O . Your answer should include the role of the glycerophosphate shuttle and the energy yield. (22 marks)
- 5.(a) Which one of the following enzymic activities would you expect to be decreased in thiamine deficiency?
- A. Pyruvate carboxylase
 - B. Isocitrate dehydrogenase
 - C. Fumarase
 - D. α -Ketoglutarate dehydrogenase
 - E. Lactate dehydrogenase (3 marks)
- (b) Summarise the essential points of the regulation of glycogen and degradation by dispensing examples and details. (22 marks)
- 6(a) Which one of the following is NOT characteristic of the hexose monophosphate pathway?
- A. It produces CO_2
 - B. It is controlled by inhibition of glucose 6-phosphate dehydrogenase by NADPH
 - C. It requires ATP for phosphorylation
 - D. It produces ribose 5-phosphate
 - E. It involves the breakage and formation of C-C bonds (3 marks)
- (b) Describe de novo synthesis of fatty acids. Your answer should include the enzymes involved. (22 marks)

END OF EXAMINATION QUESTION PAPER