

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SBB 2102

FACULTY OF APPLIED SCIENCES
BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS
DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY
SUPPLEMENTARY EXAMINATION: METABOLIC PROCESSES 1 SBB 2102

JULY 2003

2 ½ Hours (100 Marks)

INSTRUCTIONS

Answer **Four** (4) questions. Each question carries 25 marks. Where a question contains subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labeled diagrams.

Note that subdivisions a) are multiple choice questions and more than one answer may be true. Choose the correct response to each question and briefly justify your answer.

1. (a) Which of the following 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)

1. (b) Compared to the resting state, vigorously contracting muscle shows:

- A. an increased conversion of pyruvate to lactate
- B. decreased oxidation of pyruvate to CO_2 and water
- C. a decreased NAHD/NAD⁺ ratio
- D. decreased concentration of AMP
- E. decreased level of fructose 2, 6 - bisphosphate

(3 marks)

1. (c) Outline the regulation of citric acid cycle and the important control points. Name the enzymes involved.

(19 marks)

2. (a) All of the following statements about the enzymic complex that carries out the synthesis of ATP during oxidative phosphorylation are correct EXCEPT.

- A. It is located on the matrix side of the inner mitochondrial membrane.
- B. It is inhibited oligomycin
- C. It contains a proton channel
- D. It can exhibit ATPase activity

- E. It can bind molecular oxygen (3 marks)
- (b) Write a full account of glycerol breakdown and synthesis (8 marks)
- (c) Describe the process of gluconeogenesis and its regulation. Your answer should indicate the important control points and the enzymes involved. (14 marks)
3. (a) Which one of the following compounds cannot give rise to the net synthesis of glucose?
- A. Lactate
 - B. Glycerol
 - C. α -Ketoglutarate
 - D. Oxaloacetate
 - E. Acetyl CoA
- (b) Outline the regulation of the pyruvate dehydrogenase enzyme complex. (7 marks)
- (c) Give a full account of the transport of activated fatty acids into the mitochondrial matrix and β – oxidation of fatty acids. (15 marks)
4. (a) The following statements relate to the citric acid cycle. Are they true or false? Briefly explain your choice.
- i) Acetyl-CoA and oxalacetate react to form citrate.
 - ii) The cycle reforms oxaloacetate.
 - iii) CO_2 evolved in one turn of the cycle originates from the 2 C-atoms of the acetyl group in acetyl-CoA used to form citrate.
 - iv) It is involved in gluconeogenesis from glutamate.
 - v) It is the main source of NADPH for fatty acid synthesis. (5 marks)
- (b) Outline the regulation of the reactions of gluconeogenesis. Your answer should indicate the important control points and the enzymes involved. (11 marks)
- (c) Outline the pathways of ketone body formation. (9 marks)
5. (a) Many metabolic transformations involve the oxidation or reduction of nicotinamide adenine dinucleotides. Which of the following statements are true and which are false? Briefly justify your answer.

- i) Conversion of dihydroxyacetone phosphate to α -glycerophosphate involves the oxidation of NADPH.
- ii) Conversion of glucose 6-phosphogluconate involves the reduction of NADP⁺.
- iii) Synthesis of long-chain fatty acids from acetyl-Co A involves oxidation of NADPH.
- iv) Formation of fumarate from succinate involves the oxidation of NADH.
- v) Conversion of pyruvate to acetyl groups in acetyl-Co A involves the reduction of NAD⁺.

(5 marks)

- (b) Describe Pentose Phosphate Pathway and discuss its biological role.

(20 marks)

- 6. (a) Fluoroacetate (FCH₂COO⁻) inhibits the operation of the citric acid cycle because:

- i) It inactivates SH groups in enzymes.
- ii) It prevents the formation of citrate by the condensing enzyme.
- iii) Its structure is sufficiently like succinate to inhibit succinate dehydrogenase.
- iv) Fluoride is a general enzyme poison
- v) Fluorocitrate is a competitive inhibitor of aconitase.

(3 marks)

- (b) Discuss and contrast the important features of degradation and biosynthesis of fatty acids.

(8 marks)

- (c) Why does the respiratory chain have two main gates? Give examples of substrates (using formulae) that are oxidized entering these gates.

(7 marks)

- (d) Outline the regulation of the pyruvate dehydrogenase enzyme complex.

(7 marks)