BCH 4054 **FINAL EXAM** **NAME_____**
April 22, 2002

Page	Points
1	____
2	____
3	____
4	____
5	____
6	____
Total	_____

This exam consists of six pages. Make sure you have one of each. For questions indicating a choice, answer only one of the choices. (If you answer both, you need to indicate which answer is to be counted, otherwise the first one will be graded.) A seventh page contains the genetic code. You may tear that page off and use it for scratch work.

Good luck, and have a nice summer.

Answer question 1 or 2 (12 points)

1. Mitochondria can oxidize succinate to fumarate by catalyzing the following overall reaction:

succinate + 1/2 O_2 ----> fumarate + H_2O

(a) Calculate $?G^{o'}$ for this reaction (F = 96.5 kJ/volt)
(E'_o succinate/fumarate = 0.031 volt; E'_o H_2O/O_2 = 0.82 volt)

(b) Give the intermediate re-dox carriers which participate in this reaction in the order in which the electrons are passed (not just the complexes, but the components of the complexes).

(c) Explain the reasoning by which one concludes that this process is coupled to the formation of 1.5 moles of ATP.

2. ATP synthesis in chloroplasts has many similarities to that in mitochondrial complex III. Compare and contrast these two systems by drawing diagrams of the mitochondrial inner membrane and the thylakoid membrane showing the **identity**, **location** and **orientation** of the following components in each: a quinone, cytochromes, a peripheral membrane protein, the ATP synthase. How does the nature of the proton motive force differ in the two systems?

Answer question 3 or 4 (10 points)

3. Explain how epinephrine **stimulates** the breakdown of glucose (glycolysis) in muscle. (Note: I am not talking about breakdown of glycogen, but of glucose). Identify the glycolytic enzyme stimulated, the compound causing the stimulation, and all the signaling intermediates involved in producing this compound.
4. IMP is a branch intermediate in the synthesis of AMP and GMP, and each conversion involves two enzymatic steps. Give the reaction steps by which each of these conversions occur, including the **structure** of IMP, AMP, GMP and all nucleotide intermediates, and indicating the other reactants and products of each step.

Answer question 5 or 6 (10 points)

5. Both the **Cori cycle** and the **alanine cycle** involve metabolic interaction between muscle and liver. Diagram this interaction for both cycles, and explain the functional purpose of each.
6. The **urea cycle** converts amino acid nitrogen into urea in the liver. Show the pathway by which nitrogen from two glutamate molecules can be converted into urea, identifying all intermediates by name or structure, and showing the cellular location (mitochondria or cytoplasm) of each step.

Answer question 7 or 8 (8 points)

7. Explain how the starting point for transcription of a gene is recognized in (a) prokaryotes and (b) eukaryotes.
8. The following sequence from the **middle** of a m-RNA could encode three different polypeptide sequences. What are they?

5'-GACUACUGCGGCUAAGUCGCAA-3'

Answer question 9 or 10 (10 points)

9. Identify the component protein domains of fatty acid synthase either by name or reaction catalyzed. Two types of sulfhydryl groups are attached covalently to intermediates of the pathway. Describe the location and function of each sulfhydryl group.
10. Compare eukaryotic fatty acid oxidation with fatty acid synthesis, giving at least five ways in which the two pathways differ from each other.

Answer question 11 or 12 (10 points)

11. Draw the structure of guanine and cytosine, and indicate the source of **each C and N atom** in the structure. (For example, N might be from glutamine, C from CO_2, etc.)
12. Give the pathway by which acetyl-CoA is converted to isopentenyl pyrophosphate, showing the structures of each intermediate. How many ATP's are required for this conversion?

Answer question 13 or 14 (12 points)

13. Propionyl-CoA is a product of catabolism of both odd chain fatty acids and several amino acids. Explain how it is converted to a TCA cycle intermediate, showing all the intermediates in the conversion, and identifying the enzymes involved and their prosthetic groups.
14. Metabolism of amino acids begins with the action of transaminases.
    (a) Give the overall reaction catalyzed by a transaminase.
    (b) What prosthetic group is involved?
    (c) Give the structure of the intermediate formed between this prosthetic group and the amino acid.
    (d) How does the nitrogen atom ultimately get converted to ammonia?

Answer question 15 or 16 (10 points)

15. Identify the **G proteins** that are involved in protein synthesis, describing the function of each.
16. Explain how "proofreading" is accomplished in:
    (a) Synthesis of DNA.
    (b) Synthesis of aminoacyl tRNA.
    (c) Peptide bond formation in protein synthesis.

17. Identify **six** of the following substances, indicating briefly the role each plays in metabolism or signaling, or in the case of an inhibitor what reaction is inhibited. (**18 points)**.

Carnitine

LDL

Biotin

LCAT

Cytochrome c

Dinitrophenol

Lipoic acid

Ketone body