BCH 4054 **FINAL EXAM** **NAME**_____
December 13, 1999

Page	Points
1	____
2	____
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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 Christmas.

Answer question 1 or 2 (10 points)

1. 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.

2, The liver cannot synthesize glucose from fatty acids, but it can make some glucose from fat by metabolizing glycerol. Glycerol released from adipose tissue when fats are hydrolyzed can be taken up by liver and converted to glycerol-3-phosphate by the enzyme **glycerokinase**. Show the overall pathway by which the following reaction can occur, giving all intermediates involved (names or structures), and summarize the overall stoichiometry (i.e. net production or utilization of NADH, $CoQH_2$, ATP, and GTP).

2 glycerol $\rightarrow$ glucose

Answer question 3 or 4 (8 points)

3. The **Calvin Benson Cycle** converts CO_2 into carbohydrate. The pathway requires NADPH and ATP and involves an enzyme found in the pentose phosphate pathway. Identify the following steps of the cycle by giving the reactants and products of each reaction:
   (a) The step fixing CO_2.
   (b) The two steps requiring ATP.
   (c) The step requiring NADPH.
   (d) A step catalyzed by the enzyme **transketolase**.
4. 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 5 or 6 (9 points)

5. Identify the enzyme catalyzing the **regulatory step** for each of the following pathways, and the substance(s) that activate or inhibit the enzyme.
   (a) cholesterol biosynthesis **(b) fatty acid biosynthesis** **(c) pyrimidine biosynthesis**
6. In each of the following tissues, the **absence** of a particular enzyme normally found in other tissues has a consequence on the metabolism in the tissue. For each, identify the missing enzyme and explain how its lack affects the tissue.
   (a) muscle **(b) liver** **(c) adipose tissue**

Answer question 7 or 8 (8 points)

7. 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.
8. 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 9 or 10 (8 points)

9. There are two HMG-CoA synthase enzymes, one in mitochondria and one in the cytoplasm. Give the reaction catalyzed by this enzyme, including all reactants and products, and the metabolic role of each enzyme.
10. There are two carbamoyl phosphate synthases, one in mitochondria and one in the cytoplasm. Give the reaction catalyzed by each of them, including all reactants and products, and the metabolic role of each enzyme.

Answer question 11 or 12 (8 points)

11. Diagram a chloroplast including the thylakoid membrane. Indicate on the diagram the location and orientation of: (a) pigment system I (b) pigment system II (c) ATPase (d) cytochrome b/f complex (e) Rubisco
12. Describe an Okasaki fragment. When and where is it made, what is its structure, and what happens to it? (Use a diagram to clarify your answer).

Answer 13 or 14 (8 points)

13. Explain how the starting point for transcription of a gene is recognized in (a) prokaryotes and (b) eukaryotes.
14. Explain how the starting point for translation of a message is recognized in (a) prokaryotes and (b) eukaryotes.

Answer 15 or 16 (8 points)

15. There are mechanisms of "proofreading" during protein synthesis even though translation is not as error free as replication. Describe the proofreading at the two "recognition" steps of translation: (a) attachment of the correct amino acid to t-RNA and (b) insertion of the correct amino acyl t-RNA onto the A site of the ribosome.
16. Cyclic AMP has been called "an ancient hunger signal". Explain how this concept applies to its action in both bacteria and animals.

Answer <u>BOTH</u> questions 17 <u>AND</u> question 18 (6 points each)

17 Circle the following mutations which could result from a single base substitution. Give a codon change that could be responsible for the mutation.

Thr ® Glu **Gly ® Terminate (stop)** **Met ® Lys**

Ala ® Val **His ® Thr** **Cys ® Ser**

18. The following sequence from the **middle** of a m-RNA could encode three different polypeptide sequences. What are they?

5'-GACUACUGCGGCUAAGUCGCAA-3'

19. Identify **seven** of the following substances, indicating briefly the role each plays in metabolism or signaling. **(21 points)**

carnitine

ganglioside

pyridoxal phosphate

G protein

HDL

phosphopantetheine

inositol triphosphate

cytochrome a

sigma factor in prokaryotic transcription

The Genetic Code (mRNA)

Second position

First position	U	C	A	G	Third position
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G