BCH 4054 **PRE-TEST 3** **GROUP NAME _____**
October 16, 1998

This test is take-home and open book, and it is intended that all members of the group contribute to completing it. Only one copy is to be submitted by the group, and all members who participated should sign their names below. **Test is due at the end of class on Monday, October 26.**

Please use dark pencil or ink and write legibly.

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Page	Points
1	_____
2	_____
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Total	_____

Points

1. Glutamine synthetase is regulated in bacteria both by allosteric end-product inhibition and by covalent modification.

(2) (a) What type of covalent modification is involved?

(2) (b) Is the modified enzyme the active or inactive form?

(4) (c) The state of the enzyme (modified or unmodified) depends on the concentrations of glutamine and of alpha-ketoglutarate. Explain how these compounds regulate the modification of the enzyme.

(4) 2. Tetrahydrofolic acid (THFA) exists in several derivative forms:

(a) N_{10}-formyl-THFA (b) N_5-N_{10}-methylene-THFA
(c) N_5-N_{10}-methenyl-THFA (d) N_5-methyl-THFA

Which of these forms (identify by putting the correct letter or letters in the blank)

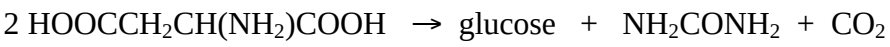
____ is formed in the degradation of serine?

____ furnishes the methyl group in methionine biosynthesis?

____ contains a C-1 group at the oxidation level of methanol?

____ contains a C-1 group at the oxidation level of formaldehyde?

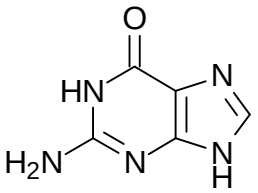
(17) 3. Aspartic Acid is a glucogenic amino acid. The overall reaction by which aspartate is converted to glucose by the liver can be summarized as:



$$2\ HOOCCH_2CH(NH_2)COOH \rightarrow \text{glucose} + NH_2CONH_2 + CO_2$$

Give the overall pathways by which this conversion is accomplished, showing all intermediates by name or structure. Identify steps in which ATP, GTP, NADH, and $CoQH_2$ are produced or used, and summarize the overall stoichiometry of the reaction for these coenzymes. Assuming that each NADH and $CoQH_2$ could produce 2.5 and 1.5 ATP's by oxidative phosphorylation, what would be the net cost of the process in terms of ATP used?

(10) 4. Following are two pairs of identical structures, one of a purine and one of a pyrimidine.
(a) Give the **name** of each structure.
(b) In the first structure of each pair, **circle** each **nitrogen atom** that is derived from **glutamine**, and put an **X** through each **nitrogen atom** that is derived from **aspartate**.
(c) In the second structure of each pair, **circle** each **carbon atom** that is derived from **CO_2**, and put an **X** through each **carbon atom** that is derived from **N_{10}-formyl THFA**.



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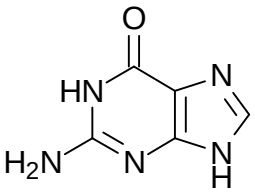

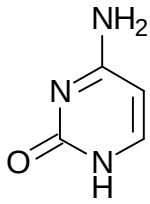

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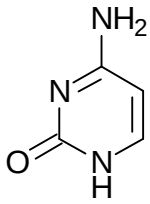

(6) 5. The urea cycle extracts a nitrogen atom from aspartate for the production of urea, the other nitrogen coming from ammonia liberated from glutamate. An alternative way of utilizing the nitrogen of aspartate to form ammonia makes use of two steps of purine biosynthesis (the steps in which IMP is converted to AMP) coupled to the enzyme **AMP deaminase**, which converts AMP to IMP and ammonia. These steps form a cycle that is referred to as the **purine cycle**. Write out these three reaction steps, giving the reactants and products of each step (names or structures okay), and give the overall reaction catalyzed by the purine cycle.

(6) 6. GMP acts as a feedback inhibitor of denovo purine biosynthesis by inhibiting three enzymes of the purine pathway. Identify these enzymes either by name or by reaction catalyzed.

(9) 7. PRPP is the abbreviation for the "activated" form of ribose utilized in N-glycoside bond formation. Identify the following reactions in which an N-glycoside is formed by giving all the reactants and products involved in the reaction. (Names **or** structures are acceptable.)

(a) Formation of the initial nitrogen-containing intermediate in purine biosynthesis.

(b) Formation of the initial N-glycoside bond in pyrimidine biosynthesis.

(c) Reaction of the nucleotide salvage pathway deficient in Lesh-Nyhan syndrome.

(9) 8. Give **each** of the following reaction pathways, giving reactions and products of each step, (structures and enzymes are not necessary.)

(a) Conversion of UMP to CTP
(b) Conversion of CTP to dCTP
(d) Conversion of AMP to dATP

(8) 9. Explain the regulation of ribonucleotide reductase. dATP has two kinds of regulatory effects on this enzyme. Explain them.

(8) 10. List the mammalian tissue characterized by each of the following:

_____ contains a high Km form of hexokinase called glucokinase

_____ uses only glucose as a fuel source except after a period of starvation.

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_____ lacks glucose-6-phosphatase

_____ lacks glycerokinase

_____ stores energy as creatine phosphate

_____ uses lactate and alanine for gluconeogenesis

_____ produces insulin

_____ contains a receptor for glucagon

(15) 11. One hormonal signaling pathway we have studied in some detail in class involves production of adenylcyclase as a second messenger and leads to activation of a cyclic AMP dependent kinase that phosphorylates various cellular proteins. A second signaling pathway involving second messengers has been found to utilize phosphatidylinositol bisphosphate (**PIP2**) as a key intermediate. Describe this **phosphoinositide system**, including the sequence of steps by which a hormonal signal affects the metabolism of **PIP_2**, the second messengers produced by the system, and how these second messengers lead to stimulation of a different protein kinase called **protein kinase C**.