

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 on Monday, November 13.**

Please use dark pencil or ink and write legibly.

Page Points

1 _____
2 _____
3 _____
4 _____
5 _____

Total _____

Points

- (12) 1. When muscle breaks down protein as an energy source, it must dispose of the nitrogen produced in the oxidation of the amino acids.
- (a) Describe two mechanisms by which the nitrogen can be transported to liver.
- (b) Once in the liver, conversion of the nitrogen to ammonia requires the input of energy. Give the reactants, products, and names of the enzymes that utilize ATP, and calculate the ATP cost for each N converted to urea.
- (c) Removal of N from amino acids results in formation of one NADH, however, whether done by glutamate dehydrogenase or conversion of fumarate to oxaloacetate in the urea cycle. Assuming these steps occur in mitochondria, and that each NADH could generate 2.5 ATP's, what then would be the net ATP balance in converting an amino acid N to urea.
- (4) 2. What is meant by a **glucogenic** amino acid?

- (9) 6. Give **each** of the following reaction pathways, giving reactions and products of each step, but structures are not necessary.
- (a) Conversion of UMP to CTP
 - (b) Conversion of CTP to dCTP
 - (d) Conversion of AMP to dATP
- (9) 7. PRPP is the sugar precursor in nucleotide biosynthesis. Identify the reactions for which PRPP is a substrate for each of the following: (Give the other substrates and all products of the reactions.)
- (a) de novo pyrimidine nucleotide biosynthesis
 - (b) de novo purine nucleotide biosynthesis
 - (c) purine salvage pathway
- (8) 8. The enzyme AMP deaminase converts AMP to IMP and NH_4^+ . If this reaction is coupled to the two steps in which synthesis of AMP from IMP occurs (i.e., $\text{IMP} \rightarrow \text{intermediate} \rightarrow \text{AMP}$), the **sum** of the three reactions forms a cycle. Write out these three reaction steps, showing other reactants and products, and then give the **overall reaction** catalyzed by the cycle. (This is called the purine nucleotide cycle, and is believed to play an important metabolic role in muscle.)

- (6) 9. Following are several "C-1" derivatives of tetrahydrofolic acid, followed by statements referring to one or more of these forms. Identify the form or forms referred to in the statement by putting the appropriate letters in the blank next to the statement.

- (a) N₅-formyl THFA (b) N₁₀-formyl-THFA (c) N₅, N₁₀-methenyl THFA
(d) N₅, N₁₀-methylene THFA (e) N₅-methyl THFA

_____ The C-1 is at the oxidation level of formic acid.

_____ The C-1 is at the oxidation level of formaldehyde.

_____ The C-1 is at the oxidation level of methanol.

_____ This derivative furnishes two carbon atoms of the purine ring.

_____ This derivative furnishes the methyl group of thymine.

_____ This derivative is formed when serine is converted to glycine.

- (4) 10. What enzyme is inhibited by the drugs **aminopterin** and **amethopterin**, and why are these drugs effective in blocking the growth of cancer cells?

- (6) 11. What enzyme is deficient in Lesch-Nyhan syndrome, what product accumulates, and how does deficiency of this enzyme cause the accumulation of this product?

- (6) 12. To illustrate the importance of tautomeric structure in the Watson-Crick base pairing, draw base pair structures showing how **cytosine** in the less stable tautomer can base pair with **adenine**, and how **guanine** in a less stable tautomer can base pair with **thymine**.
- (9) 13. A circular DNA plasmid of length 1040 bp is supercoiled with a twist (T) value of 100 and a linking number (L) of 94.
- What is the value of the writhing number (W)?
 - Is the plasmid negatively or positively supercoiled?
 - What effect would topoisomerase I have on L, T, and W?
 - What effect would DNA gyrase and ATP have on L, T, and W?
 - Ethidium bromide is an intercalating agent that inserts between the stacked base pairs, separating the stacks and causing local unwinding that decreases the value of T. What effect would ethidium bromide have on the migration rate of the plasmid during electrophoresis?
 - If part of the plasmid were to undergo a transition from B-DNA to Z-DNA, what would be the effect on L, T, and W?