C485 Exam III Fall '09

Name ____________________________
Legible please!

Do not use acronyms. Use structures whenever they are asked for, or appropriate. Your explanations should be brief. Overly lengthy answers with irrelevant or erroneous material will receive deductions. GOOD LUCK

1. (8 Pts) What are the requirements for biological nitrogen fixation in terms of electrons/nitrogen molecule and ATP consumed/nitrogen molecule fixed. Does the reaction require the same amount of electrons as chemical fixation? If not, how do these numbers differ and why are they different?

8 e 16 ATP chemical reaction requires 6 e

2. (8pts) Name the cofactor required for hydroxylation of phenylalanine. Draw the structures of the three commonly observed forms of this cofactor. How are they related?

3. (6pts) What are the two major multicarbon degradation products of tryptophan? (structure or name acceptable)

4. (6 pts) Which of the following are intermediates in the pathway for the biosynthesis of both phenylalanine and tryptophan? circle your answer(s)

(a) anthranilate (b) chorismate (c) shikimate (d) prephenate

5. (12 Pts) Please link the amino acid on the left to the appropriate carbon precursor on the right. Precursors may be used more than once. Put only one letter next to each amino acid (if you put more, it will be marked incorrect). All precursors listed will not be used.

Glutamine E
Alanine G
Phenylalanine D
Proline E
Threonine F
Arginine E

A. 3-Phosphoglycerate
B. Acetyl CoA
C. Cytosine
D. Erythrose 4-phosphate + PEP
E. alpha-ketoglutarate
F. Oxaloacetate
G. Pyruvate
6. (12 Pts) Draw the pathway used for the biosynthesis of valine. Show starting molecule(s) and all stable intermediates. Note the participation of any cofactors in specific steps. Show the mechanism (curly arrows and structures please) of the first step of the pathway.

7. (15 pts) Shown below are the structures of two nucleosides. Specific atoms have numbers next to them. In the appropriate place, please show where these atoms originate. Draw the structure of the molecule of origin and indicate the relevant atom. (Hint- the answers should all be parts of amino acids.)
8. (7 Pts) A number of anticancer treatments target dihydrofolate reductase (DHFR). What role does DHFR play in nucleotide biosynthesis and why is it a useful target for antitumor therapy?

Reduces DHF to THF allowing incorporation of a new carbon
N-methyl THF provides the group of Thymidine. Inhibits DHFR
ultimately inhibits DNA synthesis and DNA replication

9. (10 Pts) Describe the two general mechanisms used by cells to replace a carbonyl group with an amino group in nucleotide biosynthesis. (Hint, this is somewhat similar to the two strategies used to install side chain amides in amino acids.) You must illustrate your answer with a relevant structure for each mechanism.

10. (8 Pts) The nonaromatic carbons of tryptophan are derived from what precursor? What cofactor is involved in this reaction?

\[ \text{Serine} \rightarrow \text{Pyridoxal phosphate} \]

11. (8 Pts) Inhibition of a key enzyme activity by the end product of a biosynthetic pathway is known as what? Why is it useful to have multiple isozymes of enzymes that comprise common pathways to multiple amino acids? (Brief answer please)

Feedback inhibition

Extra credit: 10 Pts each.
These questions are based on biochemical reactions you have not seen, but you know something about. These are tough questions. If you get either one, it is terrific. If you get them both, you are way over the top....!

**EC 1** (No partial credit) The biosynthesis of myoinositol phosphate (MIP) catalyzed by MIP synthase starts with the glucose 6-phosphate and gives the indicated product. The synthase contains a tightly bound NAD+ that is not turned over. Suggest a mechanism for the reaction.
EC2 (No partial credit) The molecule below has been suggested for use as an antitumor agent and inactivator of a key enzyme in nucleotide biosynthesis. It is similar (but not identical) to a molecule currently used clinically. Explain the likely mechanism for how this would work.