

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, November 15.**

Please use dark pencil or ink and write legibly.

Page Points

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2 _____
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Total _____

Points

(6) 1. 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.

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

- (9) 3. 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.
- (4) 4. Describe how ATP affects GTP synthesis and GTP affects ATP synthesis.
- (6) 5. Identify the two reactions of pyrimidine biosynthesis in which glutamine is a substrate. (Give all of the reactants and products of each reaction—names or structures are okay.)

- (9) 6. 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
- (6) 7. Following are some properties of a tissue that are consequences of the **absence** of a particular enzyme in that tissue. Identify the missing enzyme, either by name or by reaction catalyzed.
- (a) Muscle cannot produce glucose, even by breaking down protein.
 - (b) Adipose tissue cannot synthesize triglyceride in the absence of glucose.
 - (c) Liver cannot oxidize ketone bodies.
- (6) 8. Compare and contrast **steroid hormone** receptors with **peptide hormone** receptors with respect to location in the cell and mechanism of transmitting the hormonal signal.

- (9) 9. At least three types of protein kinases have been implicated in hormonal signaling. Give an example of each, describing in each case (a) how the kinase is activated, (b) the protein target for kinase action, and (c) the cellular response to the hormonal signal as a result of the protein phosphorylation.
- (8) 10. G proteins are intermediates in a number of signaling pathways involved in cellular regulation. They are often activated by some hormonal stimulation and in turn activate or inhibit some subsequent reaction. Answer the following questions concerning G proteins:
- (a) Describe the subunit structure and method of membrane attachment of G proteins.
 - (b) How are G proteins deactivated once activated?
 - (c) How does cholera toxin affect this deactivation process?
 - (d) How does the *ras* oncogene mutation affect this deactivation?

- (9) 11. A circular DNA plasmid of length 1040 bp is supercoiled with a twist (T) value of 100 and a linking number (L) of 94.
- (a) What is the value of the writhing number (W)?
 - (b) Is the plasmid negatively or positively supercoiled?
 - (c) What effect would topoisomerase I have on L, T, and W?
 - (d) What effect would DNA gyrase and ATP have on L, T, and W?
 - (e) 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?
 - (f) 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?
- (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**.
- (4) 13. Bacteriophage M13 DNA has the following base composition: A, 23%; T, 36%; G, 21%, and C, 20%. What does this information tell you about the DNA for this phage?

Following is a list of proteins that play some role in bacterial DNA replication. Choose items from this list to answer question 12.

DNA Polymerase I	DNA Ligase	dnaB protein
DNA Polymerase II	gyrase	dnaA protein
DNA Polymerase III	SSB protein	Primase
topoisomerase I		

- (12) 14. Identify the **protein** or **proteins** from the above list which are referred to in each of the following statements (more than one answer may apply):
- (a) Has 3'-5' exonuclease activity.
 - (b) Has 5'-3' exonuclease activity.
 - (c) Binds to single stranded DNA.
 - (d) Requires ATP to catalyze the unwinding of DNA.
 - (e) Synthesizes the bulk of DNA during bacterial replication.
 - (f) Catalyzes RNA synthesis.
 - (g) Uses NAD^+ to form phosphodiester bonds.
 - (h) Removes the primer and fills in gaps during replication.