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

(6) 2. 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.)

(7) 3. You have prepared DNA from two organisms isolated from the swamps of south Georgia, designated **culture A** and **culture B**. DNA from **culture A** contains 27% G, while DNA from **culture B** contains 31% G. Complete the following table for the expected composition of the other purine and pyrimidine bases.

	%G	%A	%T	%C	Total
Culture A	27	_____	_____	_____	100%
Culture B	31	_____	_____	_____	100%

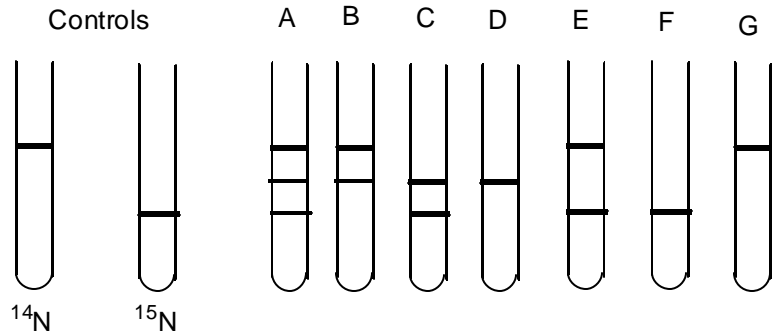
DNA from which organism will have the higher melting temperature?

(6) 4. Complete the following table by identifying the DNA structures described:

Helix Direction:	Right	Right	Left
Base Pairs/Turn	11	10.4	12
Base Tilt	19°	1.2°	9°
Diameter (Å)	2.55	2.37	1.84
Name of Structure	_____	_____	_____

Which helical structure does double stranded RNA form?

- (10) 5. In the Meselson-Stahl experiment, bacteria were grown in culture media labeled with ^{15}N , then transferred to ^{14}N media, and cells were harvested at various times after transfer. The DNA was isolated and analyzed in a density-gradient ultracentrifugation experiment where heavy (^{15}N labeled), light (^{14}N labeled), and hybrid (mixed labeling) DNA can be separated. The diagram shows control centrifugation tubes indicating the banding positions of light and heavy DNA. The other tubes represent several possible banding patterns that might have been observed in the experiment. (DNA quantities in each band are not represented).



Identify the banding pattern observed under the following conditions. (Put the letter of the appropriate tube in the blank next to the condition).

- _____ DNA taken from cells before transfer to the ^{14}N media.
- _____ DNA taken from cells one generation after transfer.
- _____ DNA taken from cells two generations after transfer.

The banding patterns observed supported the **semiconservative model** for DNA replication. Suppose that instead DNA was replicated by the **conservative model**. Then predict what the banding pattern would be for:

- _____ DNA taken from cells one generation after transfer.
- _____ DNA taken from cells two generations after transfer.

- (6) 6. Suppose that negatively supercoiled DNA with $L=23$, $T=25$, and $W=-2$ is acted upon by topoisomerase I. After one catalytic cycle, what would be the values of L , T , and W ?

Suppose that negatively supercoiled DNA with $L=23$, $T=25$, and $W=-2$ is acted upon by DNA gyrase (a type II topoisomerase) and ATP. After one catalytic cycle, what would be the values of L , T , and W ?

- (8) 7. DNA Polymerase I from bacteria has three enzymatic activities.
- (a) Explain what each does during DNA replication:
- 5'-3' polymerase
- 3'-5' exonuclease
- 5'-3' exonuclease
- (b) Explain how Polymerase I participates in the normal DNA replication process in bacteria.
- (6) 8. When DNA polymerase inserts a new nucleotide into the growing DNA chain, a mistake in base pairing can be made if the base happens to be in the wrong tautomeric form. There are two mechanisms to correct this mistake. Describe them.
- (5) 9. Diagram a Holliday junction between two DNA double strands, labeling the 5'- and 3'- ends of each of the four DNA strands. (You need not draw a helix, but show where two strands are complementary and form a helix.)

- (9) 10. Deamination of bases can be a source of mutations in DNA. For each of the following possible deaminations, explain what type of mutation would occur in the DNA sequence (i.e. AT → GC transition, GC → AT transition, purine → pyrimidine transversion, pyrimidine → purine transversion, insertion, or deletion)
- (a) Deamination of Cytosine
- (b) Deamination of Adenine
- (c) Deamination of Guanine
- (9) 11. Eucaryotic cells have three types of RNA polymerase. Give the function of each and the sensitivity of each to α -amanitin.
- (4) 12. What is the role of the sigma subunit in procaryotic RNA polymerase?

- (6) 13. Eucaryotic DNA is linear rather than circular. What problem does that cause in the replicaton process, and how is the problem solved?
- (12) 14. Eucaryotic mRNA is processed before it is used as a template for protein synthesis. Describe the processing reactions, showing some detail of the chemistry involved.