

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2023

M.Sc-I Semester (BT)

Course Code (Credits): 20MS1BT112 (3)

Max. Marks: 25

Course Name: Cell and Molecular Biology

Course Instructors: Dr. Abhisek

Max. Time: 1 Hour 30 Minutes

**Note:** (a) All questions are compulsory.

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems

1. Answer the following with proper explanations

- a) The start of the coding region for the human  $\beta$ -globin gene reads 5'-ATGGTGCAC-3'. What is the sequence of the complementary strand for this segment of DNA? [1.5]
- b) Upon returning from a recent trip abroad, you explain to the customs agent that you are bringing in a sample of DNA, deoxyribonucleic acid. He is aghast that you want to bring an acid into his country. What is the acid in DNA? Should the customs agent be wary? [1.5]

2. How would you expect the loss of the 3'-to-5' proofreading exonuclease activity of DNA polymerase in *E. coli* to affect the fidelity of DNA synthesis? How would its loss affect the rate of DNA synthesis? Explain your reasoning. Also mention the significance of 5'-3' exonuclease activity of polymerase and its relations with nick translations [5]

3. Answer the following question with detail explanations

- a) DNA isolated from the bacterial virus M13 contains 25% A, 33% T, 22% C, and 20% G. Do these results strike you as peculiar? Why or why not? How might you explain these values? [2]
- b) Human DNA contains 20% C on a molar basis. What are the mole percents of A, G, and T? [2]

4. SSB proteins bind to single-strand DNA at the replication fork and prevent the formation of short hairpin helices that would otherwise impede DNA synthesis. What sorts of sequences in single-strand DNA might be able to form a hairpin helix? Write out an example of a sequence that could form a five-nucleotide hairpin helix, and show the helix. [3]

5. The diploid human genome comprises  $6.4 \times 10^9$  bp and fits into a nucleus that is 6  $\mu$ m in diameter. A. If base pairs occur at intervals of 0.34 nm along the DNA helix, what is the length of DNA in a human cell? [2]

6. When egg white is heated, it hardens. This cooking process cannot be reversed, but hard-boiled egg white can be dissolved by heating it in a solution containing a strong detergent (such as sodium dodecyl sulfate) together with a reducing agent, like 2-mercaptoethanol. Neither reagent alone has any effect. [3]
- Why does boiling an egg white cause it to harden?
  - Why does it require both a detergent and a reducing agent to dissolve the hard-boiled egg white?
7. Proteins imported into mitochondria are usually taken up from the cytosol within seconds or minutes of their release from ribosomes. Mitochondrial proteins are first fully synthesized as mitochondrial precursor proteins in the cytosol and then translocated into mitochondria by a post-translational mechanism. Multisubunit protein complexes (TOM, TIM, OXA etc) that function as protein translocators mediate protein movement across mitochondrial membranes. Illustrate the protein transport mechanism across mitochondrial membrane and mention the role of TOM, TIM, OXA and SAM complex [5]

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