

**Time: 2 hours                                                                                         Max Marks: 50**

**This paper contains TWO printed pages and THREE parts**

**PART-A**

**Answer any SEVEN of the following 2m x 7 = 14 marks**

1. What is genome reduction?
2. What is the primary type of bond responsible for each of the following interactions:
3. One DNA strand interacting with another strand of DNA in dsDNA.
4. A dipeptide of two amino acids.
5. A solution contains DNA polymerase and the Mg2+ salts of dATP, dGTP, dCTP, and dTTP. The following DNA molecules are added to aliquots of this solution. Which of them would lead to DNA synthesis and why?

a) A single-stranded (ss) closed circle containing 1000 nucleotide units.

b) A double-stranded (ds) closed circle containing 1000 nucleotide pairs.

c) A single-stranded closed circle of 1000 nucleotides base-paired to a linear strand of 500 nucleotides with a free 3’-OH terminus.

d) A double-stranded linear molecule of 1000 nucleotide pairs with a free 3’-OH group at each end.

1. The antiviral drug Acyclovir (structure below) is used to treat infections caused by double-stranded DNA viruses such as herpes simplex virus. Acyclovir affects viral DNA synthesis.

 

1. A drug company has discovered a natural product, cupramycin that efficiently intercalates into DNA. How might that affect transcription?
2. How does the function of poly-A polymerase differ from RNA polymerase?
3. What are the components of the ternary complex that initiates translation in eukaryotes?
4. What is the unit that has multiple ribosomes translating a single mRNA molecule called? What are the advantages to a cell of having multiple ribosomes translating a single mRNA molecule?
5. In eukaryotes, most genes are normally turned off, and RNA polymerases do not function without activation. In bacteria, RNA polymerase can transcribe almost any gene in the absence of bound inhibitors. Suggest possible reasons for this difference between bacteria and eukaryotes.

**PTO**

**PART B**

**Answer any FOUR of the following:     5m x 4 = 20 marks**

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1. How many rounds of replication would the original Meselson and Stahl experiment need to distinguish between the three models of replication (dispersive, conservative, semiconservative)? Explain your answer using relevant illustrations.
2. In humans, a fetus lacking at least one good copy of a gene encoding any one of dozens of key DNA repair enzymes is usually nonviable. If the fetus has one good copy of the gene and one mutant (inactive) copy, the individual will have a fully functional DNA repair system, but a higher than normal probability of acquiring cancer in middle age. Explain.
3. The sequence of the consensus -10 region is TATAAT. If two genes, tesA and tesB, have identical promoter sequences except in the -10 region, where the tesA sequence is TAATAT and the tesB sequence is TGTCGA, ·which gene do you expect to be more efficiently transcribed, and why?
4. Describe the structure of the prokaryotic RNA Polymerase.
5. How is the *trp* operon regulated by the process of attenuation?
6. *E. coli* cells are growing in a medium containing lactose but no glucose. Indicate whether each of the following changes or conditions would increase, decrease, or not change expression of the *lac* operon. Draw a diagram depicting what is happening in each situation.

(a) Addition of a high concentration of glucose

(b) A mutation that prevents Lac repressor binding to the operator

(c) A mutation that completely inactivates β-galactosidase

(d) A mutation that completely inactivates permease

(e) A mutation that prevents binding of CRP to its binding site near the Lac promoter

**PART C**

**Answer any TWO of the following:              8m x 2 = 16 marks**

1. Compare and contrast the cut-and-paste mechanism of transposition with the replicative mechanism of transposition. Use relevant illustrations.
2. Describe the process of eukaryotic translation initiation.
3. Using a general diagram, explain RNA interference.