

Advanced Genetic Principles

Genetics · Answer Key · 12 Questions

1. Which specific protein complex is responsible for the recognition of the promoter region during transcription initiation in eukaryotes?

A) TATA-binding protein (TBP)

B) DNA polymerase alpha

C) RNA helicase

D) Topoisomerase II

2. In the context of epigenetics, which enzyme family is primarily responsible for the removal of acetyl groups from histone tails, leading to chromatin condensation?

A) Histone acetyltransferases (HATs)

B) Histone deacetylases (HDACs)

C) DNA methyltransferases (DNMTs)

D) Histone methyltransferases (HMTs)

3. Which phenomenon describes the unequal expression of genes depending on whether they are inherited from the mother or the father?

A) X-inactivation

B) Genomic imprinting

C) Genetic anticipation

D) Codominance

4. During DNA replication, which enzyme is responsible for relieving torsional strain ahead of the replication fork by creating transient single-strand breaks?

A) DNA ligase

B) DNA primase

C) Topoisomerase I

D) DNA polymerase delta

5. What is the functional consequence of a transition mutation occurring within a protein-coding sequence that results in a redundant codon?

A) Missense mutation

B) Nonsense mutation

C) Frameshift mutation

D) Silent mutation

6. In the lac operon of E. coli, what is the direct role of allolactose?

- A) It acts as a corepressor to activate the repressor
- B) It functions as an inducer by binding to the lac repressor**
- C) It catalyzes the conversion of lactose to glucose
- D) It binds to the operator to block RNA polymerase

7. Which structural motif is characterized by a zinc ion coordinated by cysteine and histidine residues, commonly found in DNA-binding proteins?

- A) Leucine zipper
- B) Helix-turn-helix
- C) Zinc finger**
- D) Homeodomain

8. What is the primary role of the spliceosome in eukaryotic post-transcriptional processing?

- A) Addition of the 5' methylguanosine cap
- B) Polyadenylation of the 3' end
- C) Removal of introns and ligation of exons**
- D) Translation of mRNA into polypeptide chains

9. Which statistical model is used to determine if observed phenotypic ratios in a cross deviate significantly from expected Mendelian ratios?

- A) Chi-square test**
- B) Hardy-Weinberg equilibrium
- C) Standard deviation
- D) Linear regression

10. In human genetics, what describes the inheritance pattern where a mitochondrial DNA mutation is present in only some of the mitochondria within a single cell?

- A) Aneuploidy
- B) Heteroplasmy**
- C) Polyploidy
- D) Translocation

11. Which process involves the exchange of genetic material between non-sister chromatids of homologous chromosomes during prophase I of meiosis?

- A) Independent assortment
- B) Chiasmata formation**
- C) Terminalization
- D) Non-disjunction

12. What is the significance of the Shine-Dalgarno sequence in prokaryotic protein synthesis?

- A) It is the promoter binding site for RNA polymerase
- B) It terminates transcription
- C) It facilitates ribosome binding to the mRNA**
- D) It guides the charging of tRNA