

Advanced Biological Sciences

Biology · Answer Key · 25 Questions

1. During the process of oxidative phosphorylation, which specific complex in the electron transport chain is responsible for the reduction of molecular oxygen to water?

- A) Complex I (NADH dehydrogenase)
- B) Complex II (Succinate dehydrogenase)
- C) Complex III (Cytochrome bc1 complex)
- D) Complex IV (Cytochrome c oxidase)**

2. In the context of the lac operon in E. coli, which protein acts as a negative regulator by binding to the operator site?

- A) cAMP receptor protein (CRP)
- B) Lac repressor (LacI)**
- C) Allolactose
- D) RNA polymerase

3. Which phase of meiosis is characterized by the separation of sister chromatids to opposite poles of the cell?

- A) Anaphase I
- B) Anaphase II**
- C) Metaphase I
- D) Telophase II

4. What is the primary function of the enzyme aminoacyl-tRNA synthetase?

- A) Catalyzing the formation of peptide bonds
- B) Linking specific amino acids to their corresponding tRNAs**
- C) Editing mismatched base pairs during DNA replication
- D) Cleaving introns from pre-mRNA

5. Which hormone is primarily responsible for the stimulation of milk ejection during breastfeeding by contracting myoepithelial cells?

- A) Prolactin
- B) Oxytocin**
- C) Luteinizing hormone
- D) Estrogen

6. In C4 photosynthesis, carbon dioxide is first fixed into which four-carbon compound within the mesophyll cells?

- A) Malate
- B) Oxaloacetate**
- C) Phosphoenolpyruvate
- D) 3-phosphoglycerate

7. What is the defining structural characteristic of a transmembrane protein that allows it to span the hydrophobic lipid bilayer?

- A) An abundance of disulfide bridges
- B) A high concentration of non-polar amino acids in the alpha-helical domain**
- C) A large carbohydrate side chain
- D) An ionic bond between the protein and the lipid head

8. Which signaling molecule is synthesized from the amino acid L-arginine by the enzyme nitric oxide synthase?

- A) Acetylcholine
- B) Nitric oxide**
- C) Dopamine
- D) GABA

9. During DNA replication in eukaryotes, which enzyme is primarily responsible for the synthesis of the leading strand?

- A) DNA polymerase alpha
- B) DNA polymerase delta
- C) DNA polymerase epsilon**
- D) DNA primase

10. What occurs during the phenomenon known as 'genetic hitchhiking'?

- A) A beneficial mutation increases in frequency due to its linkage to a neutral allele
- B) A neutral allele increases in frequency due to linkage with a beneficial mutation**
- C) A deleterious mutation is eliminated by purifying selection
- D) Two loci evolve at the same rate due to high recombination

11. Which component of the cytoskeleton is composed of tubulin dimers and is essential for the formation of the mitotic spindle?

- A) Microfilaments
- B) Intermediate filaments
- C) Microtubules**
- D) Keratin filaments

12. What is the chemical nature of the linkage between the 5' carbon of one deoxyribose sugar and the 3' carbon of another in a DNA strand?

- A) Hydrogen bond
- B) Phosphodiester bond**
- C) Glycosidic bond
- D) Peptide bond

13. In the human visual system, which cells are primarily responsible for color vision and high visual acuity?

- A) Rod cells
- B) Amacrine cells
- C) Cone cells**
- D) Horizontal cells

14. Which type of RNA polymerase is responsible for synthesizing ribosomal RNA (rRNA) in eukaryotic cells?

- A) RNA polymerase I**
- B) RNA polymerase II
- C) RNA polymerase III
- D) RNA polymerase IV

15. What is the effect of the competitive inhibitor on the Michaelis-Menten kinetic parameters of an enzyme?

- A) Decreased V_{max} , unchanged K_m
- B) Increased K_m , unchanged V_{max}**
- C) Decreased V_{max} , increased K_m
- D) Unchanged V_{max} , decreased K_m

16. Which specific domain of the G protein-coupled receptor (GPCR) is responsible for intracellular signal transduction?

- A) N-terminal extracellular domain
- B) C-terminal cytoplasmic tail
- C) Third intracellular loop**
- D) Transmembrane alpha-helices

17. The Hardy-Weinberg equilibrium relies on which of the following assumptions?

- A) Non-random mating
- B) Small population size
- C) No net mutations**
- D) High migration rates

18. What is the function of the proteasome in eukaryotic cells?

- A) Synthesis of lysosomal enzymes
- B) Degradation of tagged, misfolded proteins**
- C) Folding of nascent polypeptide chains
- D) Intracellular transport of vesicles

19. In the context of plant physiology, what is the function of the Casparian strip in the endodermis?

- A) To facilitate symplastic transport
- B) To prevent water loss via evaporation
- C) To force water and solutes into the protoplast for selective uptake**
- D) To provide structural support for the vascular bundle

20. Which immunoglobulin class is the first to be produced by B cells during a primary immune response?

- A) IgG
- B) IgA
- C) IgM**
- D) IgE

21. What is the role of the enzyme telomerase in germ cells?

- A) Replicating the entire chromosome
- B) Adding hexameric repeats to the ends of chromosomes**
- C) Proofreading the DNA sequence
- D) Binding transcription factors to the promoter

22. Which neurotransmitter is the primary excitatory signaling molecule in the mammalian central nervous system?

- A) GABA
- B) Glycine
- C) Glutamate**
- D) Serotonin

23. In epigenetic regulation, what is the primary consequence of DNA methylation at CpG islands in promoter regions?

- A) Increased transcription initiation
- B) Chromatin remodeling to an open state
- C) Transcriptional repression**
- D) Enhanced binding of RNA polymerase

24. What is the major product of the pentose phosphate pathway that is essential for reductive biosynthesis?

A) NADH

B) NADPH

C) ATP

D) FADH₂

25. Which process involves the movement of water across a semipermeable membrane down its water potential gradient?

A) Active transport

B) Facilitated diffusion

C) Osmosis

D) Pinocytosis