Advanced Concepts in Introductory Biology

Biology · Answer Key · 18 Questions

1. Which of the following is the primary mechanism by which ATP synthase generates ATP during oxidative phosphorylation?

A) Direct phosphorylation of ADP by a substrate molecule.
B) Chemiosmosis, driven by a proton gradient across the inner mitochondrial membrane.
C) Photophosphorylation, using light energy to create a proton gradient.
D) Substrate-level phosphorylation in the cytoplasm during glycolysis.

2. The process of transcription in eukaryotes involves the synthesis of RNA from a DNA template. What is the role of the TATA box binding protein (TBP)?

A) It binds to the promoter region of a gene and recruits other transcription factors.
B) It is responsible for proofreading the newly synthesized RNA strand.
C) It ligates Okazaki fragments during DNA replication.
D) It unwinds the DNA double helix to allow for replication.

3. Which theory of evolution posits that evolutionary change occurs through the accumulation of small, gradual changes over long periods, interspersed with brief, rapid bursts of change?

A) Lamarckian inheritance
B) Gene-flow theory
C) Punctuated equilibrium
D) Genetic drift

4. The endomembrane system in eukaryotic cells includes several organelles. Which of the following is a primary function of the smooth endoplasmic reticulum?

A) Protein synthesis and modification
B) Lipid synthesis, detoxification, and calcium storage
C) Formation of lysosomes and peroxisomes
D) Cellular respiration and ATP production

5. In the context of cellular respiration, what is the net yield of ATP molecules produced per glucose molecule through aerobic respiration, including glycolysis, the Krebs cycle, and oxidative phosphorylation?

A) 2 ATP
B) 4 ATP
C) Approximately 30-32 ATP
D) 64 ATP

6. Which of the following is the central dogma of molecular biology, describing the flow of genetic information?

A) DNA -> RNA -> Protein
B) Protein -> RNA -> DNA
C) RNA -> DNA -> Protein
D) DNA -> Protein -> RNA

7. The process of meiosis is crucial for sexual reproduction. What is a key difference between meiosis I and meiosis II?

A) Meiosis I separates homologous chromosomes, while meiosis II separates sister chromatids.
B) Meiosis II involves crossing over, while meiosis I does not.
C) Meiosis I produces diploid cells, while meiosis II produces haploid cells.
D) Meiosis II is a single division, while meiosis I involves multiple stages.

8. What is the primary function of the electron transport chain (ETC) in cellular respiration?

A) To generate acetyl-CoA from pyruvate.
B) To reduce NAD+ and FAD to NADH and FADH2.
C) To transfer electrons from NADH and FADH2 to oxygen, releasing energy to pump protons.
D) To directly synthesize ATP from ADP and inorganic phosphate.

9. The Hardy-Weinberg principle describes a hypothetical population that is not evolving. Which of the following conditions must be met for a population to be in Hardy-Weinberg equilibrium?

A) Natural selection is acting on the population.
B) There is gene flow between populations.
C) Mutation rates are high.
D) There is no gene flow, no mutation, random mating, no genetic drift, and no natural selection.

10. What is the role of restriction enzymes in molecular biology?

A) To catalyze the formation of phosphodiester bonds in DNA.
B) To unwind the DNA double helix during replication.
C) To cut DNA at specific recognition nucleotide sequences.
D) To synthesize RNA from a DNA template.

11. Which of the following best describes the fluid mosaic model of the cell membrane?

A) A rigid, static structure composed primarily of proteins.
B) A bilayer of phospholipids with embedded proteins that can move laterally.
C) A single layer of proteins controlling what enters and leaves the cell.
D) A solid matrix of carbohydrates that provides structural support.

12. The concept of allopatric speciation involves which of the following?

A) Speciation occurring within the same geographic area.
B) Reproductive isolation arising due to geographic barriers.
C) Hybridization between two different species.
D) Polyploidy leading to instant speciation.

13. What is the primary function of mRNA (messenger RNA)?

A) To carry amino acids to the ribosome.
B) To form the structural and catalytic component of ribosomes.
C) To transfer genetic information from DNA in the nucleus to ribosomes in the cytoplasm.
D) To regulate gene expression by binding to DNA.

14. Which type of mutation involves a change in a single nucleotide base, which may or may not result in a change in the amino acid sequence?

A) Frameshift mutation
B) Chromosomal translocation
C) Point mutation
D) Inversion

15. The Calvin cycle, a part of photosynthesis, occurs in which part of the chloroplast?

A) Thylakoid membranes
B) Outer membrane
C) Inner membrane
D) Stroma

16. What is the term for the evolutionary process where unrelated species independently evolve similar traits or adaptations due to similar environmental pressures?

A) Divergent evolution
B) Convergent evolution
C) Coevolution
D) Adaptive radiation

17. Which of the following is a key characteristic of prokaryotic cells that distinguishes them from eukaryotic cells?

A) Presence of a membrane-bound nucleus
B) Presence of multiple linear chromosomes
C) Absence of a membrane-bound nucleus and organelles
D) Presence of a cell wall made of cellulose

18. The process by which a cell engulfs large particles or other cells is called:

A) Pinocytosis
B) Exocytosis
C) Phagocytosis
D) Endocytosis