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College Level Examination Program: Biology

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Question: 1

In a strenuously exercising muscle, NADH begins to accumulate in high concentration. Which of the following metabolic processes will be activated to reduce the concentration of NADH?

- A. Glycolysis
- B. The Krebs cycle
- C. Lactic acid fermentation
- D. Oxidative phosphorylation
- E. Acetyl CoA synthesis

Answer: C

Explanation:

Lactic acid fermentation converts pyruvate into lactate using high-energy electrons from NADH. This process allows ATP production to continue in anaerobic conditions by providing NAD⁺ so that ATP can be made in glycolysis.

Question: 2

Which of the following statements regarding chemiosmosis in mitochondria is NOT correct?

- A. ATP synthase is powered by protons flowing through membrane channels
- B. Energy from ATP is used to transport protons to the intermembrane space
- C. Energy from the electron transport chain is used to transport protons to the intermembrane space
- D. An electrical gradient and a pH gradient both exist across the inner membrane
- E. The waste product of chemiosmosis is water

Answer: B

Explanation:

Proteins in the inner membrane of the mitochondrion accept high-energy electrons from NAD and FADH₂, and in turn transport protons from the matrix to the intermembrane space. The high proton concentration in the intermembrane space creates a gradient, which is harnessed by ATP synthase to produce ATP.

Question: 3

In photosynthesis, high-energy electrons move through electron transport chains to produce ATP and NADPH. Which of the following provides the energy to create high energy electrons?

- A. NADH
- B. NADP⁺
- C. O₂
- D. Water
- E. Light

Answer: E

Explanation:

Electrons trapped by the chlorophyll P680 molecule in photosystem II are energized by light. They are then transferred to electron acceptors in an electron transport chain.

Question: 4

Which of the following kinds of plants is most likely to perform CAM photosynthesis?

- A. Mosses
- B. Grasses
- C. Deciduous trees
- D. Cacti
- E. Legumes

Answer: D

Explanation:

Crassulacean acid metabolism (CAM) photosynthesis occurs in plants that grow where water loss must be minimized, such as cacti. These plants open their stomata and fix CO₂ at night. During the day, stomata are closed, reducing water loss. Thus, photosynthesis can proceed without water loss.

Question: 5

The combination of DNA with histones is called

- A. A centromere
- B. Chromatin
- C. A chromatid
- D. Nucleoli
- E. A plasmid

Answer: B

Explanation:

DNA wrapped around histone proteins is called chromatin. In a eukaryotic cell, DNA is always associated with protein; it is not "naked" as with prokaryotic cells.

Question: 6

How many chromosomes does a human cell have after meiosis I?

- A. 92
- B. 46
- C. 23
- D. 22
- E. 12

Answer: C

Explanation:

The diploid chromosome number for humans is 46. After DNA duplication but before the first cell division of meiosis, there are 92 chromatids (46 chromosomes). After meiosis I is completed, the chromosome number is halved and equals 23. Each daughter cell is haploid, but the chromosomes are still paired (sister chromatids). During meiosis II, the two sister chromatids of each chromosome separate, resulting in 23 haploid chromosomes per germ cell.

Question: 7

In plants and animals, genetic variation is introduced during

- A. Crossing over in mitosis
- B. Chromosome segregation in mitosis
- C. Cytokinesis of meiosis
- D. Anaphase I of meiosis
- E. Anaphase II of meiosis

Answer: D

Explanation:

In anaphase I, homologous chromosome pairs segregate randomly into daughter cells. This means that each daughter cell contains a unique combination of chromosomes that is different from the mother cell and different from its cognate daughter cell.

Question: 8

DNA replication occurs during which of the following phases?

- A. Prophase I
- B. Prophase II
- C. Interphase I
- D. Interphase II

E. Telophase I

Answer: C

Explanation:

Although there are two cell divisions in meiosis, DNA replication occurs only once. It occurs in interphase I, before M phase begins.

Question: 9

The synaptonemal complex is present in which of the following phases of the cell cycle?

- A. Metaphase of mitosis
- B. Prophase of meiosis I
- C. Telophase of meiosis I
- D. Metaphase of meiosis II
- E. Telophase of meiosis II

Answer: B

Explanation:

The synaptonemal complex is the point of contact between homologous chromatids. It is formed when non-sister chromatids exchange genetic material through crossing over. Once prophase of meiosis I has completed, crossovers have resolved and the synaptonemal complex no longer exists. Rather, sister chromatids are held together at their centromeres prior to separation in anaphase II.

Question: 10

A length of DNA coding for a particular protein is called a(n)

- A. Allele
- B. Genome
- C. Gene
- D. Transcript
- E. Codon

Answer: C

Explanation:

Genes code for proteins, and genes are discrete lengths of DNA on chromosomes. An allele is a variant of a gene (different DNA sequence). In diploid organisms, there may be two versions of each gene.

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