HESI A2 Biology Practice Test Sample Study Guide

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Questions

1. How many ATP molecules can be produced in the electron transport chain?

A. 4 ATP molecules

B. 10 ATP molecules

C. 34 ATP molecules

D. 38 ATP molecules

2. What is genetic drift?

A. A change in allele frequency due to random sampling effects

B. An increase in population size affecting allele frequency

C. Deliberate selection of traits in a population

D. A form of natural selection with consistent outcomes

3. What type of biological molecule are enzymes classified as?

A. Lipids

B. Carbohydrates

C. Proteins

D. Nucleic Acids

4. What is the primary result of Meiosis I and II through cytokinesis?

A. Two diploid daughter cells

B. Four diploid daughter cells

C. Four haploid daughter cells

D. Two haploid daughter cells

5. Which of the following statements about viruses is true?

A. All viruses can be killed by antibiotics

B. Viruses require a host to reproduce

C. Viruses can survive independently in the environment

D. Viruses possess a complex cellular structure

6. What molecule is primarily responsible for transporting energy within cells?

A. DNA

B. ATP

C. RNA

D. NADH

7. What best describes the genetic material found in prokaryotic cells?

A. Circular DNA

B. Linear DNA

C. Double-stranded RNA

D. Single-stranded RNA

8. The electron transport chain primarily functions to produce what molecule?

A. NADH

B. ATP

C. FADH2

D. GTP

9. Which type of tissue lines the skin, mouth, and esophagus?

A. Cuboidal epithelium

B. Columnar epithelium

C. Stratified squamous epithelium

D. Skeletal epithelium

10. What process describes the division of one bacterium into two identical cells?

A. Mitosis

B. Binary fission

C. Meiosis

D. Cell fusion

Answers

1. C
2. A
3. C
4. C
5. B
6. B
7. A
8. B
9. C
10. B

Explanations

1. How many ATP molecules can be produced in the electron transport chain?

A. 4 ATP molecules

B. 10 ATP molecules

C. 34 ATP molecules

D. 38 ATP molecules

The electron transport chain (ETC) is the final stage of cellular respiration and takes place in the inner mitochondrial membrane. During this process, the high-energy electrons derived from NADH and FADH2 are passed through a series of protein complexes, ultimately leading to the generation of a proton gradient across the mitochondrial membrane. This gradient is utilized by ATP synthase to produce ATP, the energy currency of the cell. The theoretical yield of ATP from the electron transport chain can be remarkably high, often cited as 34 ATP molecules per glucose molecule under optimal conditions. This number arises because each NADH can generate approximately 2.5 ATP, while each FADH2 contributes about 1.5 ATP due to their differing involvement in the electron transport sequence. When you tally the total ATP produced from the complete oxidation of glucose through glycolysis, the Krebs cycle, and the ETC, you arrive at around 38 ATP molecules in total, albeit this includes contributions from earlier stages of respiration. However, the most commonly referenced production solely during the electron transport phase itself focuses on the 34 ATP produced. It reflects the efficiency and output of this specific metabolic pathway, especially as it relates to the proton motive force created during electron transfer. Hence,

2. What is genetic drift?

A. A change in allele frequency due to random sampling effects

B. An increase in population size affecting allele frequency

C. Deliberate selection of traits in a population

D. A form of natural selection with consistent outcomes

Genetic drift refers to the changes in allele frequencies in a population due to random sampling effects, particularly in small populations. This concept is rooted in the idea that allele frequencies can fluctuate by chance rather than through natural selection. For example, if a small group of individuals from a larger population reproduces, the alleles present in this small group may not represent the overall genetic diversity of the larger population. This can lead to certain alleles becoming more or less common purely by chance over generations, which can significantly impact the genetic makeup of the population. In contrast, the other options describe different biological mechanisms. An increase in population size affecting allele frequency typically relates to natural selection or gene flow rather than genetic drift, as larger populations are generally less affected by random sampling effects. The deliberate selection of traits in a population is a direct reference to artificial selection, where humans impose selective pressures rather than randomness. Lastly, while genetic drift can influence allele frequencies, it does not result in consistent outcomes like those associated with natural selection, which typically promotes advantageous traits across generations.

3. What type of biological molecule are enzymes classified as?

A. Lipids

B. Carbohydrates

C. Proteins

D. Nucleic Acids

Enzymes are classified as proteins due to their structure and function. Proteins are composed of long chains of amino acids, which fold into specific shapes that are crucial for their activity. Enzymes act as biological catalysts, facilitating chemical reactions by lowering the activation energy required for these reactions to occur. The specificity of enzymes, meaning that each enzyme typically catalyzes only one type of reaction or a group of closely related reactions, is governed by their unique three-dimensional structure, which is derived from their amino acid sequence. In enzymatic reactions, the substrate binds to the active site of the enzyme, resulting in a temporary enzyme-substrate complex that enables the conversion of substrate into products. This process underlines the importance of proteins in biological systems, where enzymes play critical roles in metabolism, signal transduction, and numerous other cellular processes. While lipids, carbohydrates, and nucleic acids are essential biomolecules with vital roles in energy storage, structural components, and genetic information, they do not possess the catalytic functions that enzymes provide. This distinctive feature identifies enzymes specifically as proteins, emphasizing their role in biological catalysis.

4. What is the primary result of Meiosis I and II through cytokinesis?

A. Two diploid daughter cells

B. Four diploid daughter cells

C. Four haploid daughter cells

D. Two haploid daughter cells

Meiosis consists of two rounds of cell division: Meiosis I and Meiosis II, culminating in cytokinesis. The primary result of these processes is the formation of four haploid daughter cells. During Meiosis I, homologous chromosomes are separated into two different daughter cells. This reduction division reduces the chromosome number from diploid (two sets of chromosomes) to haploid (one set). Following Meiosis I, cytokinesis occurs, resulting in two haploid cells. Then, during Meiosis II, similar to mitosis, the two haploid cells undergo a second round of division where the sister chromatids of each chromosome are separated. This again concludes with cytokinesis, producing a total of four haploid daughter cells. Therefore, the correct choice reflects that the end result of meiosis and subsequent cytokinesis is indeed four haploid daughter cells, which have half the chromosome number of the original cell. This outcome is essential for sexual reproduction, allowing for genetic diversity when gametes (sperm and egg) combine during fertilization.

5. Which of the following statements about viruses is true?

A. All viruses can be killed by antibiotics

B. Viruses require a host to reproduce

C. Viruses can survive independently in the environment

D. Viruses possess a complex cellular structure

Viruses are unique and fundamentally different from living organisms in how they reproduce. They lack the cellular machinery required to replicate on their own, which means they must invade a host cell in order to reproduce. Once inside a host cell, a virus can hijack the cell's machinery to produce new viral particles, effectively making the host cell a factory for replicating the virus. This characteristic of needing a host to reproduce is a defining feature of viruses and underscores their dependence on living organisms for propagation. Options that suggest viruses can be killed by antibiotics, survive independently, or possess a complex cellular structure do not accurately describe their nature. Antibiotics are designed to target bacterial infections and have no effect on viruses. Viruses are not equipped to survive independently; they can only exist in a dormant state outside of host organisms and need to infect a host for reproduction. Lastly, viruses are not considered complex cellular entities; they lack cellular structure, containing only a simple composition of genetic material surrounded by a protein coat.

6. What molecule is primarily responsible for transporting energy within cells?

A. DNA

B. ATP

C. RNA

D. NADH

Adenosine triphosphate, or ATP, is the molecule primarily responsible for transporting energy within cells. It serves as the main energy currency of the cell, allowing for the transfer and storage of energy necessary for various cellular processes. ATP consists of three phosphate groups, and when one of these phosphate bonds is broken through hydrolysis, a substantial amount of energy is released. This energy can then be harnessed for cellular activities such as muscle contraction, nerve impulse propagation, and biochemical synthesis. In contrast, DNA carries genetic information and provides the instructions for building proteins but does not play a direct role in energy transport. RNA is primarily involved in the synthesis of proteins and does not have the same direct energy-transferring capabilities as ATP. NADH (nicotinamide adenine dinucleotide) plays a crucial role in the electron transport chain, helping to transfer electrons during cellular respiration, but it is not the primary energy currency of the cell like ATP. Thus, ATP is distinctly recognized as the key molecule in energy transport within cellular metabolism.

7. What best describes the genetic material found in prokaryotic cells?

A. Circular DNA

B. Linear DNA

C. Double-stranded RNA

D. Single-stranded RNA

Prokaryotic cells are characterized by their relatively simple structure compared to eukaryotic cells, particularly in their DNA organization. The genetic material in prokaryotic cells is typically found as a single, circular molecule of DNA. This circular DNA is located in a region of the cell called the nucleoid and is not enclosed within a membrane, which distinguishes prokaryotes from eukaryotic cells, where the DNA is linear and located within a nucleus. The circular form of DNA in prokaryotes allows for efficient replication and transcription processes. Additionally, prokaryotic genomes often contain plasmids, which are small, circular DNA molecules separate from the chromosomal DNA that can carry additional genetic information beneficial for survival. In contrast, linear DNA is typically found in eukaryotic organisms, and both double-stranded RNA and single-stranded RNA do not serve as the primary genetic material for prokaryotic cells. Prokaryotes primarily utilize double-stranded DNA for their genetic instructions, making the description of their DNA as circular the most accurate representation.

8. The electron transport chain primarily functions to produce what molecule?

A. NADH

B. ATP

C. FADH2

D. GTP

The electron transport chain (ETC) primarily functions to produce ATP, which is the main energy currency of the cell. This process occurs in the inner mitochondrial membrane during cellular respiration. As electrons are passed along the chain from electron donors such as NADH and FADH2, their energy is used to pump protons (H+) from the mitochondrial matrix into the intermembrane space, creating a proton gradient. This gradient generates potential energy, akin to water behind a dam. Protons then flow back into the matrix through ATP synthase, an enzyme that harnesses this flow to convert adenosine diphosphate (ADP) and inorganic phosphate (Pi) into ATP. This chemiosmotic mechanism is known as oxidative phosphorylation, and it accounts for the majority of ATP produced during cellular respiration. While other options are related to energy metabolism—such as NADH and FADH2, which are important electron carriers, and GTP, which is a nucleotide involved in protein synthesis and signaling—the primary goal of the ETC is the synthesis of ATP through the energy derived from the flow of electrons.

9. Which type of tissue lines the skin, mouth, and esophagus?

A. Cuboidal epithelium

B. Columnar epithelium

C. Stratified squamous epithelium

D. Skeletal epithelium

Stratified squamous epithelium is the correct type of tissue that lines the skin, mouth, and esophagus due to its structure and function. This type of epithelium consists of multiple layers of cells, with the outermost layer being flat or squamous in shape. This makes it particularly effective at providing protection against mechanical stress, abrasion, and the harsh conditions that can occur in areas like the mouth and esophagus where food and other substances pass. In the skin, the stratified squamous epithelium serves a critical role in maintaining a barrier against pathogens and preventing water loss. Similarly, in the mouth and esophagus, this tissue helps protect underlying tissues from the friction of food and other materials during eating and swallowing. The other types of epithelium mentioned do not provide the same protective qualities. Cuboidal epithelium, typically found in glandular tissues, functions in secretion and absorption, but lacks the protective features needed for the areas mentioned. Columnar epithelium, which often lines the digestive tract, is specialized for absorption and secretion but again does not offer the same level of protection as stratified squamous epithelium. Skeletal epithelium does not exist; rather

10. What process describes the division of one bacterium into two identical cells?

A. Mitosis

B. Binary fission

C. Meiosis

D. Cell fusion

The process that describes the division of one bacterium into two identical cells is binary fission. This is a form of asexual reproduction commonly seen in prokaryotic organisms such as bacteria. In binary fission, a bacterium grows to a certain size, replicates its genetic material, and then divides into two equal parts, resulting in two genetically identical daughter cells. During binary fission, the cell's DNA is copied, and as the cell prepares to divide, the two DNA molecules are separated, followed by the constriction of the cell membrane and cell wall. This results in two cells that are clones of the original, each containing identical genetic information. This method of reproduction allows for rapid population growth under favorable conditions, as a single bacterium can divide several times in a short period, exponentially increasing the number of bacteria.