IB Biology Practice Exam (Sample)

Study Guide

Everything you need from our exam experts!

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Questions

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1. Which class of carbon compounds primarily serves as a source of energy and structural material?

A. Nucleic acids

B. Proteins

C. Carbohydrates

D. Lipids

2. What role do cyclins play in cell biology?

A. They help in energy production in mitochondria

B. They control the progression of the cell cycle

C. They are involved in protein synthesis

D. They trigger apoptosis in damaged cells

3. What does the property of being a solvent in water enable it to do?

A. Resist temperature fluctuations

B. Concentrate solutes

C. Facilitate enzyme-substrate interaction

D. Dissolve a wide variety of substances

4. Within metabolism, which process typically requires energy input?

A. Catabolism

B. Anabolism

C. Cellular respiration

D. Fermentation

5. What does molecular biology explain?

A. The evolution of different species

B. Living processes in terms of chemical substances involved

C. The structure of complex macromolecules

D. The physical properties of cells

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6. What is the function of Cyclin A during the cell cycle?

A. Triggers apoptosis in cells

B. Inhibits mitosis

C. Activates DNA replication

D. Regulates metabolic pathways

7. What is a change to DNA that can lead to new alleles called?

A. Gene transfer

B. Mutation

C. Recombination

D. Transcription

8. Which of these statements is true regarding condensation reactions?

A. They release water as a byproduct

B. They occur during the hydrolysis of polymers

C. They require water as a substrate

D. They always require high-energy conditions

9. Which of the following is a characteristic of eukaryotic cells?

A. Presence of naked DNA

B. Presence of a nucleus

C. 70S ribosomes

D. Cell wall composed of peptidoglycan

10. Leukemia primarily affects which type of blood cells?

A. White blood cells

B. Platelets

C. Red blood cells

D. Plasma cells

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Answers

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

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Explanations

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1. Which class of carbon compounds primarily serves as a source of energy and structural material?

A. Nucleic acids

B. Proteins

C. Carbohydrates

D. Lipids

Carbohydrates are organic compounds composed of carbon, hydrogen, and oxygen, typically in a ratio that fits the general formula \(C_n(H_2O)_n \). They are primarily recognized as a key source of energy for living organisms, as they can be easily broken down through metabolic processes to release glucose. This glucose can then be utilized by cells for immediate energy or converted to other forms such as glycogen for storage. In addition to their role as an energy source, carbohydrates also serve structural purposes. For example, cellulose, a type of carbohydrate, forms the structural component of the cell wall in plants, making it vital for maintaining cell shape and integrity. Chitin, another carbohydrate, provides structural support in the exoskeletons of arthropods and cell walls of fungi. While proteins and lipids can also serve as energy sources, their primary roles involve building and maintaining cellular structures (for proteins) and long-term energy storage and signaling (for lipids). Nucleic acids, on the other hand, are primarily involved in storing and transmitting genetic information rather than serving as a source of energy or structural materials. Thus, carbohydrates hold a central position in both energy provision and structural support in biology.

2. What role do cyclins play in cell biology?

A. They help in energy production in mitochondria

B. They control the progression of the cell cycle

C. They are involved in protein synthesis

D. They trigger apoptosis in damaged cells

Cyclins are essential regulatory proteins that play a crucial role in controlling the progression of the cell cycle. They are synthesized and degraded in a cyclical manner, which corresponds to the various phases of the cell cycle—G1, S, G2, and M. Cyclins activate cyclin-dependent kinases (CDKs), which are enzymes necessary for the phosphorylation of target proteins that regulate cell cycle transitions. For example, different cyclin-CDK complexes are responsible for moving the cell from the G1 phase into S phase, and from G2 into mitosis. The proper functioning of this system ensures that cells only proceed to the next stage of the cycle when conditions are right, helping to maintain normal cellular function and division. This regulation is crucial for preventing uncontrolled cell proliferation, which could lead to cancer. In contrast, the other options indicate roles that are not associated with cyclins: while energy production in mitochondria and protein synthesis are critical cellular processes, they involve other types of proteins and pathways. Triggering apoptosis is a separate mechanism often mediated by proteins such as caspases rather than cyclins. Thus, the role of cyclins in controlling the progression of the cell cycle is a well-established and critical aspect of cell biology.

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3. What does the property of being a solvent in water enable it to do?

A. Resist temperature fluctuations

B. Concentrate solutes

C. Facilitate enzyme-substrate interaction

D. Dissolve a wide variety of substances

Water is often referred to as a universal solvent, which is primarily due to its polar nature. The polarity of water molecules allows them to form hydrogen bonds with various substances, effectively separating and surrounding particles that dissolve in water. This property enables water to dissolve a wide variety of ionic compounds and polar molecules, such as salts and sugars. When substances dissolve in water, the solute particles are surrounded by water molecules, which helps to break down the solid structure of the solute. This characteristic is crucial for many biological processes, as it allows nutrients and other important molecules to be transported throughout an organism's body in solution. This ability to dissolve a wide range of substances is fundamental to life, as it facilitates numerous biochemical reactions and interactions that are essential for maintaining cellular functions and overall homeostasis. Thus, the capacity of water to act as a solvent is critically important in biological and ecological contexts.

4. Within metabolism, which process typically requires energy input?

A. Catabolism

B. Anabolism

C. Cellular respiration

D. Fermentation

Anabolism is the process that typically requires energy input because it involves the synthesis of complex molecules from simpler ones. This is essential for growth, repair, and the maintenance of cells, as it allows for the construction of macromolecules such as proteins, nucleic acids, carbohydrates, and lipids. During anabolic reactions, energy is often derived from adenosine triphosphate (ATP) or other high-energy molecules. For instance, when amino acids are linked together to form proteins, or when glucose molecules are combined to form glycogen, energy must be supplied to drive these reactions forward, against the thermodynamic tendency toward disorder. In contrast, catabolism breaks down complex molecules into simpler ones, releasing energy in the process. Cellular respiration and fermentation are also processes that either release or harness energy from organic compounds, but do not typically require energy input in the manner that anabolic processes do. Therefore, the focus on building and synthesizing new structures makes anabolism distinctly energy-dependent.

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5. What does molecular biology explain?

A. The evolution of different species

B. Living processes in terms of chemical substances involved

C. The structure of complex macromolecules

D. The physical properties of cells

Molecular biology focuses on the fundamental processes of life by examining biological activity at a molecular level, particularly through the interactions between various cellular systems and the molecules that compose them, such as DNA, RNA, and proteins. This branch of biology seeks to elucidate how these chemical substances participate in biological processes, including replication, transcription, translation, and cellular signaling. The emphasis on chemical substances and their interactions allows for a detailed understanding of how life functions in terms of molecular mechanisms, thereby providing insight into broader biological phenomena. This approach is vital for areas such as genetics, biochemistry, and cell biology, where these molecular interactions are foundational to the overall functioning of living organisms.

6. What is the function of Cyclin A during the cell cycle?

A. Triggers apoptosis in cells

B. Inhibits mitosis

C. Activates DNA replication

D. Regulates metabolic pathways

Cyclin A plays a crucial role during the cell cycle, specifically in the regulation of DNA replication. It acts by activating cyclin-dependent kinases (CDKs), particularly CDK2, which is essential for the transition from the G1 phase to the S phase. During the S phase of the cell cycle, Cyclin A-CDK2 complexes facilitate the initiation and progression of DNA replication, ensuring that the genetic material is accurately copied before the cell divides. This activation is a key regulatory mechanism that ensures the cell is adequately prepared for mitosis, marking the importance of Cyclin A in maintaining the integrity of cell division. Hence, option C accurately describes the function of Cyclin A by highlighting its role in activating DNA replication.

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7. What is a change to DNA that can lead to new alleles called?

A. Gene transfer

B. Mutation

C. Recombination

D. Transcription

A change to DNA that can lead to new alleles is referred to as a mutation. Mutations are alterations in the nucleotide sequence of the DNA, which can occur due to various factors such as errors during DNA replication, exposure to radiation, or chemical agents. When mutations affect the coding regions of genes, they can lead to changes in the protein that the gene encodes, potentially resulting in new traits that contribute to genetic variation within a population. This genetic variation is crucial for evolution, as it provides the raw material for natural selection. The introduction of new alleles through mutations can affect an organism's phenotype and influence its adaptability to environmental changes. In contrast, gene transfer involves the movement of genetic material between organisms, recombination refers to the mixing of genetic material during sexual reproduction, and transcription is the process of converting DNA into RNA, none of which directly result in the creation of new alleles.

8. Which of these statements is true regarding condensation reactions?

A. They release water as a byproduct

B. They occur during the hydrolysis of polymers

C. They require water as a substrate

D. They always require high-energy conditions

Condensation reactions are a type of chemical process in which two molecules combine to form a larger molecule, with the elimination of a smaller molecule, typically water. This process is fundamental in the synthesis of polymers, such as proteins, nucleic acids, and polysaccharides. In the context of biological systems, condensation reactions link monomers together through covalent bonds, contributing to the formation of complex macromolecules. The release of water as a byproduct is a key characteristic of condensation reactions. As two reactant molecules join together, a hydroxyl group (-OH) from one molecule and a hydrogen atom (H) from another come together to form a water molecule (H_2O) while the remaining parts form a covalent bond. This is why option A is correct: condensation reactions indeed release water as a byproduct, which is a significant feature of these types of reactions. The other statements do not accurately describe condensation reactions. They do not occur during hydrolysis, which is the process of breaking down polymers into monomers and requires the addition of water. Condensation reactions do not require water as a substrate; in fact, they remove water from the reacting molecules. Finally, they do not always require high-energy conditions, as many can occur under

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9. Which of the following is a characteristic of eukaryotic cells?

A. Presence of naked DNA

B. Presence of a nucleus

C. 70S ribosomes

D. Cell wall composed of peptidoglycan

Eukaryotic cells are defined by several distinct characteristics, one of the most significant being the presence of a nucleus. This nucleus serves as a membrane-bound compartment where the cell's genetic material is housed and protected from the cytoplasm. In eukaryotic organisms, the DNA is organized into linear chromosomes and is associated with histone proteins, allowing for a complex level of regulation of gene expression and DNA replication. Unlike prokaryotic cells, which contain naked DNA located in a region called the nucleoid, eukaryotic cells have a well-defined nucleus. This characteristic not only differentiates eukaryotes from prokaryotes but also allows for more sophisticated cellular functions and processes. The presence of a nucleus plays a crucial role in the overall complexity and functionality of eukaryotic cells. In contrast, other options reflect characteristics that are either associated with prokaryotic cells or specific to certain types of cells. Naked DNA and 70S ribosomes are indeed features of prokaryotes, while peptidoglycan, which is a component of bacterial cell walls, is not generally found in eukaryotic organisms.

10. Leukemia primarily affects which type of blood cells?

A. White blood cells

B. Platelets

C. Red blood cells

D. Plasma cells

Leukemia primarily affects white blood cells, which are crucial components of the immune system. In leukemia, there is an abnormal proliferation of these cells, leading to an increase in immature or dysfunctional white blood cells. This overproduction can disrupt the balance of blood cell types, impairing the body's ability to fight infections and perform other critical functions. White blood cells include various types, such as lymphocytes and myeloid cells, and in leukemia, these can become cancerous. The disease primarily interferes with the normal functioning of the bone marrow, where blood cells are produced, ultimately leading to reduced levels of red blood cells and platelets as well. Other blood components, such as platelets and red blood cells, are affected indirectly as the white blood cell overproduction can hinder their proper formation. Plasma cells, which are derived from B lymphocytes and are responsible for producing antibodies, are also not the primary target in leukemia. Thus, the correct association of leukemia with white blood cells highlights the disease's nature and its impact on the blood and immune system.

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