EMCC Biology Test 2 Practice (Sample)

Study Guide

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Questions

1. What are the structures called that help in moving fluid along the epithelial lining of the lungs?

A. Cilia

B. Microvilli

C. Flagella

D. Filopodia

2. Why is photosynthesis considered an endergonic reaction?

A. It releases energy

B. It absorbs energy from sunlight

C. It is a spontaneous process

D. It does not require light

3. What would happen to a red blood cell placed in a hypertonic solution?

A. The cell will swell and burst

B. The cell will lose water and shrink

C. The cell will remain unchanged

D. The cell will become isotonic

4. Who is credited with first describing cells?

A. Leeuwenhoek

B. Hooke

C. Schleiden

D. Schwann

5. How do changes in membrane potential affect sodium channels during neuronal signaling?

A. They remain closed at all times.

B. They open to allow sodium ions to diffuse into the cell.

C. They facilitate potassium outflow exclusively.

D. They actively pump sodium out of the cell.

6. Which of the following cellular structures lacks a membrane?

A. Nucleus

B. Ribosome

C. Nucleoid

D. Endoplasmic reticulum

7. In which process would a cell take in nutrients secreted by neighboring cells?

A. Endocytosis

B. Exocytosis

C. Pinocytosis

D. Phagocytosis

8. Which of the following correctly describes an essential property of ATP?

A. ATP stores energy primarily in its ribose sugar

B. ATP can easily lose a phosphate group to release energy

C. ATP cannot interact with proteins

D. ATP is a stable molecule that does not participate in reactions

9. The amount of energy available to do work in a biological system is known as what?

A. Potential energy

B. Kinetic energy

C. Activation energy

D. Free energy

10. What mechanism describes the role of AMPK in relation to energy levels in cells?

A. Energy storage mechanism

B. Catalytic mechanism

C. Response to energy deficiency

D. Thermal regulation mechanism

Answers

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

Explanations

1. What are the structures called that help in moving fluid along the epithelial lining of the lungs?

A. Cilia

B. Microvilli

C. Flagella

D. Filopodia

Cilia are hair-like structures that extend from the surface of epithelial cells, particularly in the respiratory tract. Their primary function is to move fluid and mucus along the epithelial lining of the lungs, which is essential for clearing out debris, pathogens, and excess mucus. This coordinated movement helps maintain a clear airway and contributes to respiratory health. Microvilli, while also found on epithelial cells, primarily serve to increase surface area for absorption rather than for moving fluid. Flagella are long, whip-like structures that are primarily used for locomotion in certain cells, such as sperm cells, and are not involved in the movement of fluid along epithelial linings. Filopodia are slender projections that help with cell movement and sensing the environment, but they do not play a role in moving fluids along epithelial surfaces. Thus, cilia are the specialized structures responsible for this function in the lungs.

2. Why is photosynthesis considered an endergonic reaction?

A. It releases energy

B. It absorbs energy from sunlight

C. It is a spontaneous process

D. It does not require light

Photosynthesis is considered an endergonic reaction primarily because it absorbs energy from sunlight to drive the process. During photosynthesis, plants take in carbon dioxide and water, and through a series of chemical reactions that require energy input, specifically from sunlight, they convert these raw materials into glucose and oxygen. The energy from sunlight is captured by chlorophyll in the chloroplasts and is essential for the reactions to occur. This energy requirement means that the overall reaction is not spontaneous; rather, it requires a continuous input of energy to proceed. In addition, the products of photosynthesis have higher energy content than the reactants, demonstrating that energy has been absorbed, in alignment with the characteristics of endergonic reactions. In this context, the photosynthesis process exemplifies how energy transformation is necessary for creating the complex organic molecules that sustain life in plants and, subsequently, in other organisms that rely on them for energy.

3. What would happen to a red blood cell placed in a hypertonic solution?

A. The cell will swell and burst

B. The cell will lose water and shrink

C. The cell will remain unchanged

D. The cell will become isotonic

When a red blood cell is placed in a hypertonic solution, the concentration of solutes outside the cell is greater than that inside the cell. In response to this difference in solute concentration, water will move out of the cell in an attempt to balance the concentration of solutes on both sides of the membrane. This process is known as osmosis. As water leaves the cell, the red blood cell will lose volume, leading to a decrease in its size—a process referred to as crenation. The shrinking of the cell occurs because it is losing water to the surrounding hypertonic solution, which has a higher osmotic pressure. As a result, the red blood cell becomes smaller and more concentrated. This understanding of osmotic principles is crucial in biology, especially in contexts involving cell behavior in different environments, such as in medical scenarios or when considering the effects of various solutions on cellular integrity.

4. Who is credited with first describing cells?

A. Leeuwenhoek

B. Hooke

C. Schleiden

D. Schwann

The correct attribution for the first description of cells goes to Robert Hooke. He published his findings in the book "Micrographia" in 1665, where he examined cork under a microscope and observed small, hollow structures that he called "cells" due to their resemblance to the cells of a monastery. Hooke's work laid the foundational concept of cell theory, although he was observing dead plant cells and not living organisms. While Antonie van Leeuwenhoek, another key figure in microscopy, was the first to observe living cells such as bacteria and sperm cells at a later time, he did not use the term "cell" or describe them in the way Hooke did. The contributions of Matthias Schleiden and Theodor Schwann further developed cell theory by stating that all plants and animals are composed of cells, but they were building upon the earlier work of Hooke and others, rather than being the initial describers of cells.

5. How do changes in membrane potential affect sodium channels during neuronal signaling?

A. They remain closed at all times.

B. They open to allow sodium ions to diffuse into the cell.

C. They facilitate potassium outflow exclusively.

D. They actively pump sodium out of the cell.

During neuronal signaling, changes in membrane potential play a crucial role in the function of sodium channels. When the membrane potential depolarizes, meaning it becomes less negative, this change triggers the opening of voltage-gated sodium channels. When these channels open, sodium ions rush into the cell, driven by both the concentration gradient and the electrical gradient. This influx of sodium ions is what generates the action potential, which is a key process in the transmission of signals along neurons. The opening of sodium channels in response to depolarization is essential for the rapid changes in voltage that characterize action potentials. As the membrane potential reaches a threshold level, the channels rapidly transition from a closed to an open state, allowing for a significant influx of sodium ions. This process is fundamental to neuronal signaling and underpins the excitability of neurons. The other options do not accurately describe the behavior of sodium channels in the context of neuronal signaling. Sodium channels do not remain closed at all times, do not exclusively facilitate potassium outflow, and do not actively pump sodium out of the cell; rather, they are primarily involved in allowing sodium to flow into the cell during depolarization.

6. Which of the following cellular structures lacks a membrane?

A. Nucleus

B. Ribosome

C. Nucleoid

D. Endoplasmic reticulum

The nucleoid is the correct answer because it is the region within a prokaryotic cell where the genetic material (DNA) is located. Unlike eukaryotic cells, which have a defined nucleus surrounded by a nuclear membrane, the nucleoid does not have a surrounding membrane. Instead, it is simply a concentrated area of DNA in the cytoplasm of the cell. In contrast, the other options all possess membranes. The nucleus, found in eukaryotic cells, is surrounded by a double membrane known as the nuclear envelope, which separates it from the cytoplasm. Ribosomes, while not membrane-bound themselves, are typically found either freely floating in the cytoplasm or attached to the endoplasmic reticulum, which is an extensive membranous network. The endoplasmic reticulum is a system of membranous tubules and sacs that plays a crucial role in the synthesis and transport of proteins and lipids, clearly indicating its membrane-bound nature. Thus, the presence or absence of a membrane clearly differentiates these cellular structures.

7. In which process would a cell take in nutrients secreted by neighboring cells?

A. Endocytosis

B. Exocytosis

C. Pinocytosis

D. Phagocytosis

The process in which a cell takes in nutrients secreted by neighboring cells is known as pinocytosis. Pinocytosis, often referred to as "cell drinking," is a form of endocytosis where the cell engulfs extracellular fluid and any dissolved nutrients or solutes present within it. This mechanism allows cells to intake small particles, including nutrients that are in solution, making it especially important for cells that rely on the absorption of substances from their immediate environment. In contrast to pinocytosis, endocytosis encompasses various methods of taking substances into a cell, but specifically pinocytosis refers to the uptake of liquid. Exocytosis, on the other hand, is the process by which cells expel materials, the opposite of what is being asked in the question. Phagocytosis involves the ingestion of large particles or even other cells, which is not applicable when discussing the uptake of dissolved nutrients. Thus, pinocytosis is the specialized process that captures small, liquid nutrients released by neighboring cells effectively.

8. Which of the following correctly describes an essential property of ATP?

A. ATP stores energy primarily in its ribose sugar

B. ATP can easily lose a phosphate group to release energy

C. ATP cannot interact with proteins

D. ATP is a stable molecule that does not participate in reactions

ATP, or adenosine triphosphate, is often described as the "energy currency" of the cell because of its critical role in energy transfer within biological systems. One of its essential properties is that it can easily lose a phosphate group through a process called hydrolysis. When ATP loses one of its three phosphate groups, it converts into ADP (adenosine diphosphate) and releases energy that can be used by cells to perform work, such as muscle contraction, cell division, and active transport. This ability to release energy is fundamental to the functioning of all living organisms, as it allows cells to perform various metabolic processes efficiently. The energy released from the breaking of the high-energy bond between the second and third phosphates is what powers cellular activities. This characteristic of ATP highlights its role in energy metabolism and its importance as a mediator of energy transfer within cells. The other options do not accurately capture the essential properties of ATP, as they either misattribute the location of energy storage, suggest limitations in ATP's interactions with proteins, or portray ATP as a stable molecule that does not participate in biochemical reactions, which contradicts its dynamic role in cellular metabolism.

9. The amount of energy available to do work in a biological system is known as what?

A. Potential energy

B. Kinetic energy

C. Activation energy

D. Free energy

The correct term for the amount of energy available to do work in a biological system is free energy. Free energy, often represented as Gibbs free energy in biological contexts, is the energy that can be harnessed to perform work during a chemical reaction. This concept is crucial in understanding how biological processes like metabolic reactions function, as it accounts for the energy that can be converted into useful work while taking into consideration the entropy of the system. Potential energy refers to the stored energy in an object or system due to its position or configuration, while kinetic energy is the energy of motion. Both of these concepts are foundational in physics but do not directly relate to the specific energy available for work in biochemical processes. Activation energy, on the other hand, is the energy required to initiate a reaction, rather than the energy available for work after the reaction has occurred. Therefore, free energy is the most accurate term for describing the energy available to do work within biological systems.

10. What mechanism describes the role of AMPK in relation to energy levels in cells?

A. Energy storage mechanism

B. Catalytic mechanism

C. Response to energy deficiency

D. Thermal regulation mechanism

AMP-activated protein kinase (AMPK) functions as a key energy sensor within cells and plays a vital role in responding to energy deficiency. When cellular energy levels fall, indicated by increased AMP (adenosine monophosphate) and decreased ATP (adenosine triphosphate), AMPK activation occurs. This activation signals the cell to adjust its metabolic pathways to restore energy balance. AMPK facilitates energy conservation by promoting catabolic processes that generate ATP, such as fatty acid oxidation and glucose uptake, while simultaneously inhibiting anabolic processes that consume energy, like lipid synthesis and protein biosynthesis. By activating these pathways, AMPK helps to enhance energy production and decrease energy expenditure, effectively allowing the cell to survive and function during times of low energy availability. Its role is fundamentally about ensuring that the cell adequately responds to energy deficiencies, making it a crucial player in maintaining metabolic homeostasis.