MCAT Biological and Biochemical Foundations of Living Systems Practice Exam (Sample)

Study Guide

Everything you need from our exam experts!

Table of Contents

Introduction

Preparing for a certification exam can feel overwhelming, but with the right tools, it becomes an opportunity to build confidence, sharpen your skills, and move one step closer to your goals. At Examzify, we believe that effective exam preparation isn't just about memorization, it's about understanding the material, identifying knowledge gaps, and building the test-taking strategies that lead to success.

This guide was designed to help you do exactly that.

Whether you're preparing for a licensing exam, professional certification, or entry-level qualification, this book offers structured practice to reinforce key concepts. You'll find a wide range of multiple-choice questions, each followed by clear explanations to help you understand not just the right answer, but why it's correct.

The content in this guide is based on real-world exam objectives and aligned with the types of questions and topics commonly found on official tests. It's ideal for learners who want to:

- **Practice answering questions under realistic conditions,**
- **Improve accuracy and speed,**
- **Review explanations to strengthen weak areas, and**
- **Approach the exam with greater confidence.**

We recommend using this book not as a stand-alone study tool, but alongside other resources like flashcards, textbooks, or hands-on training. For best results, we recommend working through each question, reflecting on the explanation provided, and revisiting the topics that challenge you most.

Remember: successful test preparation isn't about getting every question right the first time, it's about learning from your mistakes and improving over time. Stay focused, trust the process, and know that every page you turn brings you closer to success.

Let's begin.

How to Use This Guide

This guide is designed to help you study more effectively and approach your exam with confidence. Whether you're reviewing for the first time or doing a final refresh, here's how to get the most out of your Examzify study guide:

1. Start with a Diagnostic Review

Skim through the questions to get a sense of what you know and what you need to focus on. Don't worry about getting everything right, your goal is to identify knowledge gaps early.

2. Study in Short, Focused Sessions

Break your study time into manageable blocks (e.g. 30 – 45 minutes). Review a handful of questions, reflect on the explanations, and take breaks to retain information better.

3. Learn from the Explanations

After answering a question, always read the explanation, even if you got it right. It reinforces key points, corrects misunderstandings, and teaches subtle distinctions between similar answers.

4. Track Your Progress

Use bookmarks or notes (if reading digitally) to mark difficult questions. Revisit these regularly and track improvements over time.

5. Simulate the Real Exam

Once you're comfortable, try taking a full set of questions without pausing. Set a timer and simulate test-day conditions to build confidence and time management skills.

6. Repeat and Review

Don't just study once, repetition builds retention. Re-attempt questions after a few days and revisit explanations to reinforce learning.

7. Use Other Tools

Pair this guide with other Examzify tools like flashcards, and digital practice tests to strengthen your preparation across formats.

There’s no single right way to study, but consistent, thoughtful effort always wins. Use this guide flexibly — adapt the tips above to fit your pace and learning style. You've got this!

Questions

1. What does humoral immunity refer to in the immune system?

A. Cell-mediated defense against pathogens

B. B-cells secreting antibodies

C. Phagocytosis of pathogens by macrophages

D. Production of cytokines by helper T cells

2. PFK-2 primarily produces which molecule?

A. Pyruvate

B. Fructose 1,6-bisphosphate

C. Fructose 2,6-bisphosphate

D. NADH

3. Where does post-translational modification take place in the cell?

A. Nucleus

B. Cytoplasm

C. Endoplasmic reticulum

D. Golgi apparatus

4. Do platelets and mature red blood cells possess nuclei?

A. Yes, in both cases

B. No, in both cases

C. Yes, only in platelets

D. No, only in mature RBCs

5. What is the term for the muscle that consists of skeletal muscle and is under voluntary control?

A. internal urethral sphincter

B. external urethral sphincter

C. detrusor muscle

D. pelvic floor muscle

6. What are the fluids found in the cochlea responsible for sound transmission?

A. Endolymph and perilymph

B. Serous fluid and synovial fluid

C. Cerebrospinal fluid and lymph

D. Interstitial fluid and extracellular fluid

7. Where does B-cell maturation primarily occur?

A. Thymus

B. Spleen

C. Liver

D. Bone marrow

8. What process describes the shift back to a resting membrane potential after depolarization?

A. Hyperpolarization

B. Repolarization

C. Restoration

D. Equilibrium

9. Amphitrichous bacteria feature flagella located in which arrangement?

A. Randomly distributed

B. Single flagellum

C. Both ends

D. Surrounding the cell

10. What would be the effect of surfactant deficiency in the lungs?

A. Improved gas exchange

B. Increased surface tension and risk of lung collapse

C. Decreased risk of infection

D. Enhanced lung compliance

Answers

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

Explanations

1. What does humoral immunity refer to in the immune system?

A. Cell-mediated defense against pathogens

B. B-cells secreting antibodies

C. Phagocytosis of pathogens by macrophages

D. Production of cytokines by helper T cells

Humoral immunity specifically refers to the aspect of the immune response that involves B cells and the antibodies they produce. When B cells encounter an antigen that binds to their specific receptor, they are activated and differentiate into plasma cells, which are responsible for secreting large quantities of antibodies. These antibodies are proteins that can directly neutralize pathogens, mark them for destruction, or prevent their entry into cells. This type of immunity is particularly effective against extracellular pathogens, which are those that reside outside of cells, such as bacteria and viruses in their free state. The antibodies produced can circulate in the bloodstream and lymphatic system, providing a means to rapidly respond to infections or foreign substances throughout the body. In contrast, the other options pertain to different immune responses. For instance, cell-mediated immunity is primarily associated with T cells and involves direct cellular attacks on infected or cancerous cells, which is not what humoral immunity encompasses. Phagocytosis by macrophages and cytokine production by helper T cells also belong to immune response mechanisms, but they do not define humoral immunity, which is distinctly characterized by the action of B cells and their antibodies.

2. PFK-2 primarily produces which molecule?

A. Pyruvate

B. Fructose 1,6-bisphosphate

C. Fructose 2,6-bisphosphate

D. NADH

PFK-2, or phosphofructokinase-2, primarily produces fructose 2,6-bisphosphate. This enzyme plays a crucial regulatory role in carbohydrate metabolism. Fructose 2,6-bisphosphate is an important allosteric regulator of phosphofructokinase-1 (PFK-1), the key enzyme in glycolysis. When fructose 2,6-bisphosphate levels are high, PFK-1 becomes activated, promoting the conversion of fructose 6-phosphate to fructose 1,6-bisphosphate and thus enhancing glycolysis. The production of fructose 2,6-bisphosphate is particularly significant because it serves to signal the cell's energy status and has a direct impact on the balance between glycolysis and gluconeogenesis. In conditions where glucose levels are abundant, the activity of PFK-2 increases, leading to higher concentrations of fructose 2,6-bisphosphate, which in turn promotes glycolysis and inhibits gluconeogenesis. Understanding the function of PFK-2 and its product, fructose 2,6-bisphosphate, is key for comprehending how cells regulate their energy production pathways

3. Where does post-translational modification take place in the cell?

A. Nucleus

B. Cytoplasm

C. Endoplasmic reticulum

D. Golgi apparatus

Post-translational modification primarily occurs in the endoplasmic reticulum (ER) and the Golgi apparatus. While the endoplasmic reticulum is integral to the folding and initial modifications of proteins after they have been synthesized in the ribosomes, it continues to play a key role in the modification processes, such as glycosylation and lipidation. In the ER, proteins are properly folded and undergo modifications that are crucial for their stability and function. This includes the addition of carbohydrate groups, which is a common form of modification that influences a protein's activity, localization, and interaction with other molecules. Subsequently, proteins are transported to the Golgi apparatus, where they undergo further modifications. Here, additional glycosylation occurs, as well as sulfonation and other alterations, preparing the proteins for their eventual destinations within or outside the cell. So, while modifications can also take place in the cytoplasm and nucleus to some extent, the question specifically seeks the primary location where significant post-translational modifications occur, making the endoplasmic reticulum the correct choice for this process.

4. Do platelets and mature red blood cells possess nuclei?

A. Yes, in both cases

B. No, in both cases

C. Yes, only in platelets

D. No, only in mature RBCs

Mature red blood cells (RBCs) and platelets both do not possess nuclei. Mature RBCs are unique among human cells because they lose their nuclei during maturation in order to maximize space for hemoglobin, which is essential for oxygen transport. This adaptation allows for greater efficiency in carrying oxygen throughout the body. Platelets, on the other hand, are actually fragments of larger cells called megakaryocytes within the bone marrow. While megakaryocytes possess nuclei, the platelets that are released into the bloodstream are anucleate, meaning they do not contain a nucleus. This absence of a nucleus in platelets contributes to their primary function in clotting and wound repair, as they are primarily involved in the aggregation and formation of a temporary seal at sites of vascular injury. Therefore, the statement that neither mature RBCs nor platelets contain nuclei is accurate, confirming that the correct answer reflects the anucleate nature of both cell types.

5. What is the term for the muscle that consists of skeletal muscle and is under voluntary control?

A. internal urethral sphincter

B. external urethral sphincter

C. detrusor muscle

D. pelvic floor muscle

The external urethral sphincter is the muscle that consists of skeletal muscle and is under voluntary control. This muscle surrounds the urethra and plays an essential role in the control of urination. Unlike smooth muscles, which are involuntary and controlled by the autonomic nervous system, skeletal muscles, including the external urethral sphincter, are innervated by the somatic nervous system and can be consciously activated or relaxed. During periods of urinary retention, voluntary contraction of the external urethral sphincter prevents urine from flowing out of the bladder. This ability to consciously control the sphincter is critical for appropriate bladder function. In contrast, the other options, such as the internal urethral sphincter, are composed of smooth muscle and are not under voluntary control, instead being regulated by the autonomic nervous system. The detrusor muscle, which is responsible for bladder contraction, also consists of smooth muscle and is likewise involuntarily controlled. Pelvic floor muscles are generally a mix of skeletal and smooth muscle, but the specific context here directs attention to the voluntary component, emphasizing the external urethral sphincter's unique role.

6. What are the fluids found in the cochlea responsible for sound transmission?

A. Endolymph and perilymph

B. Serous fluid and synovial fluid

C. Cerebrospinal fluid and lymph

D. Interstitial fluid and extracellular fluid

The fluids found in the cochlea that are responsible for sound transmission are endolymph and perilymph. The cochlea is a spiral-shaped structure in the inner ear that is essential for hearing. It contains two main types of fluid: endolymph, which fills the cochlear duct (scala media), and perilymph, which fills the spaces surrounding it (scala vestibuli and scala tympani). Endolymph is an ionic fluid that is rich in potassium and plays a critical role in the transduction of sound waves into electrical signals. It creates a unique electrochemical environment that is crucial for the function of hair cells, which are the sensory receptors for hearing. When sound waves cause the fluid to move, it leads to the bending of hair cell stereocilia and the subsequent generation of nerve impulses that are sent to the brain. Perilymph, on the other hand, is similar in composition to extracellular fluid and surrounds the cochlear duct. It serves as a hydraulic medium that transmits sound waves from the stapes (the ossicle in the middle ear) to the inner structures of the cochlea. Together, these two types of fluid work in concert to facilitate sound transmission and the conversion of acoustic signals into neural signals that

7. Where does B-cell maturation primarily occur?

A. Thymus

B. Spleen

C. Liver

D. Bone marrow

B-cell maturation primarily occurs in the bone marrow. This is the key site where B-cells, a type of lymphocyte responsible for humoral immune responses, develop from hematopoietic stem cells. During their time in the bone marrow, these precursor B-cells undergo several stages of development, including heavy and light chain gene rearrangement, which is essential for the generation of a diverse repertoire of antibodies. After completing their maturation process, B-cells that successfully express functional B-cell receptors leave the bone marrow and move to peripheral lymphoid organs, including the spleen, where they can encounter antigens and participate in immune responses. The spleen serves as an important site for B-cell activation and proliferation after they leave the bone marrow, but they do not mature there. The thymus, in contrast, is primarily involved in T-cell maturation, while the liver does not play a direct role in B-cell development. Thus, the bone marrow is the definitive site for B-cell maturation.

8. What process describes the shift back to a resting membrane potential after depolarization?

A. Hyperpolarization

B. Repolarization

C. Restoration

D. Equilibrium

The process that describes the shift back to a resting membrane potential after depolarization is known as repolarization. During depolarization, the membrane potential becomes more positive due to the influx of sodium ions into the neuron. To return to a resting state, the cell must be repolarized. This is achieved primarily through the efflux of potassium ions from the cell, which occurs when voltage-gated potassium channels open. As potassium ions leave the cell, the internal environment becomes less positive, thus returning the membrane potential toward its resting level. Repolarization is a crucial part of the action potential mechanism in neurons and muscle cells, ensuring that the cells can properly reset after an excitatory event. Understanding this process is fundamental in studying how signals are transmitted in excitable tissues.

9. Amphitrichous bacteria feature flagella located in which arrangement?

A. Randomly distributed

B. Single flagellum

C. Both ends

D. Surrounding the cell

Amphitrichous bacteria are characterized by having flagella at both ends of the cell. This arrangement allows for directional movement, enabling such bacteria to navigate through their aquatic environments effectively. The presence of flagella at both poles can enhance a bacterium's ability to move toward or away from stimuli, promoting successful survival and colonization. In contrast, randomly distributed flagella are typically found in peritrichous bacteria, while a single flagellum arrangement is indicative of monotrichous bacteria. The phrase "surrounding the cell" would apply to peritrichous bacteria, which have flagella distributed over the entire surface. Understanding these structural characteristics is essential for differentiating various types of bacteria based on their modes of movement.

10. What would be the effect of surfactant deficiency in the lungs?

A. Improved gas exchange

B. Increased surface tension and risk of lung collapse

C. Decreased risk of infection

D. Enhanced lung compliance

Surfactant plays a critical role in the functioning of the lungs, particularly in maintaining proper surface tension at the air-liquid interface within the alveoli. When there is a deficiency of surfactant, it leads to increased surface tension in the alveoli. This increased tension can make it more difficult for the alveoli to expand during inhalation, contributing to a higher risk of alveolar collapse, or atelectasis. Surfactant is produced by type II alveolar cells and works to reduce the cohesive forces between water molecules, thus stabilizing the alveoli and preventing them from collapsing under low lung volumes. In the absence of sufficient surfactant, smaller alveoli may collapse, leading to impaired gas exchange and reduced lung compliance. This ultimately means that the lungs require increased effort to inflate and draw in air, exacerbating breathing difficulties and compromising oxygenation. The physiological effects of surfactant deficiency underscore the importance of surfactant in respiratory mechanics, gas exchange efficiency, and overall lung function.

Next Steps

Congratulations on reaching the final section of this guide. You've taken a meaningful step toward passing your certification exam and advancing your career.

As you continue preparing, remember that consistent practice, review, and self-reflection are key to success. Make time to revisit difficult topics, simulate exam conditions, and track your progress along the way.

If you need help, have suggestions, or want to share feedback, we'd love to hear from you. Reach out to our team at hello@examzify.com.

Or visit your dedicated course page for more study tools and resources:

https://mcat-bioandbiochemfoundationsoflivingsystems.examzify.com

We wish you the very best on your exam journey. You've got this!