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. 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.

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. 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. Which area of the sarcomere contains only actin filaments?

A. A band

B. I band

C. Z line

D. H zone

2. Which hormones does the anterior pituitary gland produce that are relevant in reproductive functions?

A. Estrogen and progesterone

B. FSH and LH

C. Testosterone and ADH

D. Cortisol and aldosterone

3. What condition would most likely result from an accumulation of CO_2 in the blood?

A. Metabolic alkalosis

B. Respiratory acidosis

C. Metabolic acidosis

D. Respiratory alkalosis

4. What occurs when K^+ ions flow out of the cell after depolarization?

A. Hyperpolarization

B. Repolarization

C. Depolarization

D. Resting potential

5. What is the mechanism by which ATP binds to phosphofructokinase-1?

A. Substrate-level phosphorylation

B. Feedback inhibition

C. Allosteric regulation

D. Reaction coupling

6. What describes the arrangement of microtubules in eukaryotic flagella?

A. 9+2 arrangement

B. 4+1 arrangement

C. 8+1 arrangement

D. 10+1 arrangement

7. Which of the following cellular processes does not include an ATP requirement?

A. Active transport

B. Facilitated diffusion

C. Endocytosis

D. Cell signaling

8. In Angelman syndrome, the abnormal chromosome is inherited from which parent?

A. The father

B. The mother

C. Both parents

D. No specific parent

9. What do the vertical segments of the nephron focus on?

A. Secretion and filtration

B. Volume and concentration

C. Identity and reabsorption

D. Concentration and filtration

10. Methionine and tetrahydrofuran are synthesized using which important components of DNA?

A. Deoxyribose and ribonucleic acid

B. Nucleotides and proteins

C. Purines and pyrimidines

D. Amino acids and sugars

Answers

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

Explanations

1. Which area of the sarcomere contains only actin filaments?

A. A band

B. I band

C. Z line

D. H zone

The area of the sarcomere that contains only actin filaments is the I band. The I band is the region that appears lighter under a microscope and is located on either side of the Z line. This band consists solely of thin filaments made of actin, without any overlapping thick filaments, which are primarily composed of myosin. In the context of muscle contraction, the I band shortens as the sarcomere contracts; however, the actin filaments do not change in length. This distinct composition of the I band is essential in understanding the sliding filament model of muscle contraction, where the actin filaments slide over the myosin filaments, facilitating muscle shortening. In contrast, other regions of the sarcomere contain different combinations of actin and myosin. The A band contains the length of the thick filaments (myosin) and overlaps with the thin filaments (actin) at both ends, the Z line serves as the boundary between adjacent sarcomeres and is where the actin filaments are anchored, and the H zone is the central part of the A band where only thick filaments are present without overlapping actin. Understanding these distinctions helps clarify the structural organization of muscle fibers and their function

2. Which hormones does the anterior pituitary gland produce that are relevant in reproductive functions?

A. Estrogen and progesterone

B. FSH and LH

C. Testosterone and ADH

D. Cortisol and aldosterone

The anterior pituitary gland plays a crucial role in the regulation of reproductive functions, primarily through the production of follicle-stimulating hormone (FSH) and luteinizing hormone (LH). These two hormones are key players in the reproductive endocrine system. FSH is vital for the regulation of the menstrual cycle in females, as it stimulates the growth and maturation of ovarian follicles. In males, FSH is important for promoting spermatogenesis and stimulating the Sertoli cells in the testes. LH, on the other hand, is responsible for triggering ovulation and the development of the corpus luteum in females, which produces progesterone. In males, LH stimulates the Leydig cells in the testes to produce testosterone, which is essential for the development of male secondary sexual characteristics and spermatogenesis. The other choices include hormones that are not produced by the anterior pituitary. Estrogen and progesterone are produced by the ovaries and are regulated by FSH and LH, while testosterone is produced in the testes and is influenced by LH. Antidiuretic hormone (ADH) is produced in the hypothalamus and stored in the posterior pituitary, not the anterior pituitary. Cortisol and aldosterone are produced by the adrenal gland,

3. What condition would most likely result from an accumulation of CO_2 in the blood?

A. Metabolic alkalosis

B. Respiratory acidosis

C. Metabolic acidosis

D. Respiratory alkalosis

An accumulation of carbon dioxide (CO_2) in the blood primarily leads to respiratory acidosis. This condition occurs when CO_2 levels increase, often due to factors like hypoventilation, where the lungs do not adequately expel CO_2. As CO_2 builds up, it reacts with water in the blood to form carbonic acid, which subsequently dissociates into bicarbonate and hydrogen ions. This increase in hydrogen ions decreases the pH of the blood, resulting in acidosis. In respiratory acidosis, the body may attempt to compensate through metabolic processes, but if CO_2 levels remain elevated, the acidosis can become chronic. The importance of understanding this condition lies in recognizing how impaired lung function or insufficient breathing can disrupt the acid-base balance, leading to significant physiological effects. In contrast, conditions like metabolic acidosis, metabolic alkalosis, and respiratory alkalosis arise from different paths of acid-base regulation and do not directly relate to CO_2 accumulation in the same way.

4. What occurs when K^+ ions flow out of the cell after depolarization?

A. Hyperpolarization

B. Repolarization

C. Depolarization

D. Resting potential

When potassium ions (K^+) flow out of the cell after depolarization, this process is essential in returning the membrane potential back to its resting state, a process known as repolarization. During depolarization, the membrane potential becomes more positive as sodium ions (Na^+) rush into the cell. Once the depolarization reaches a certain threshold, the voltage-gated sodium channels close, and the voltage-gated potassium channels open, allowing K^+ ions to exit the cell. As K^+ ions move out, the positive charge within the cell decreases, causing the membrane potential to drop back toward a negative value, effectively moving it back towards the resting potential. This process is critical for the resetting of the neuron after an action potential, allowing it to be ready for subsequent depolarizations. While hyperpolarization can occur if the membrane potential becomes more negative than the resting potential due to an excessive efflux of K^+ or opening of other anion channels, the immediate event resulting directly from the outflow of K^+ post-depolarization is specifically classified as repolarization. This physiological process is necessary for the proper functioning of neurons and muscle cells.

5. What is the mechanism by which ATP binds to phosphofructokinase-1?

A. Substrate-level phosphorylation

B. Feedback inhibition

C. Allosteric regulation

D. Reaction coupling

Phosphofructokinase-1 (PFK-1) plays a crucial role in the regulation of glycolysis, and its activity is influenced by the binding of various molecules, including ATP. The correct mechanism through which ATP binds to PFK-1 is allosteric regulation. Allosteric regulation refers to the process where the binding of an effector molecule at a site other than the active site of an enzyme induces a conformational change that affects the enzyme's activity. In the case of PFK-1, ATP serves as an allosteric inhibitor at higher concentrations. When ATP binds to the allosteric site of PFK-1, it stabilizes the enzyme in a less active form, thereby reducing its affinity for fructose 6-phosphate, which is its primary substrate. This feedback mechanism ensures that PFK-1 activity decreases when energy levels are high (indicated by high ATP levels), preventing excessive glycolysis when the cell does not need to produce additional ATP. In this context, substrate-level phosphorylation refers to a different mechanism of ATP generation that occurs in the glycolysis pathway, where a phosphate group is directly transferred to ADP from a phosphorylated intermediate. Feedback inhibition is a broader concept involving the inhibition

6. What describes the arrangement of microtubules in eukaryotic flagella?

A. 9+2 arrangement

B. 4+1 arrangement

C. 8+1 arrangement

D. 10+1 arrangement

The arrangement of microtubules in eukaryotic flagella is known as the "9+2 arrangement." This configuration refers to the presence of nine doublet microtubules that form a ring around two central microtubules. This structure is essential for the movement of flagella and cilia in eukaryotic cells, as it facilitates the sliding motion of the microtubules that enables these organelles to propel the cell. In eukaryotic flagella, the outer doublets interact with motor proteins, such as dynein, facilitating this movement. The central pair of microtubules remains connected to the outer doublet structure, contributing to the stability of the entire assembly. This arrangement is critical for the effective functioning of flagella and cilia, allowing them to generate force and move in a coordinated manner. Other configurations, such as the 4+1, 8+1, or 10+1 arrangements, do not accurately reflect the known structural organization of microtubules in eukaryotic flagella, which is why they are incorrect. The distinctive 9+2 arrangement is a hallmark feature of many motile cilia and flagella in eukaryotic organisms.

7. Which of the following cellular processes does not include an ATP requirement?

A. Active transport

B. Facilitated diffusion

C. Endocytosis

D. Cell signaling

Facilitated diffusion is a process that allows molecules to cross cell membranes with the assistance of special proteins, known as transport proteins. This process occurs down the concentration gradient, meaning it moves substances from an area of higher concentration to an area of lower concentration. Since it relies on the natural kinetic energy of the molecules rather than consuming energy in the form of ATP, facilitated diffusion does not require any ATP. In contrast, active transport and endocytosis both necessitate ATP. Active transport involves moving substances against their concentration gradient, which requires energy input, typically in the form of ATP. Endocytosis, where cells engulf materials from outside their membrane, also consumes ATP to facilitate the cellular machinery involved in membrane dynamics and vesicle formation. Cell signaling often does not directly require ATP; however, many signal transduction pathways may utilize ATP in downstream processes to propagate the signal. Thus, the unique characteristic of facilitated diffusion is its reliance on passive transport mechanisms that utilize existing concentration gradients, making it the correct answer as the process that does not require ATP.

8. In Angelman syndrome, the abnormal chromosome is inherited from which parent?

A. The father

B. The mother

C. Both parents

D. No specific parent

Angelman syndrome is caused by a loss of function of the UBE3A gene, which is located on chromosome 15. In healthy individuals, this gene is expressed from the allele inherited from the mother, while the paternal allele is typically silenced due to genomic imprinting. In Angelman syndrome, the most common cause is a deletion or mutation of the maternal UBE3A gene, leading to a lack of functional protein. Therefore, the abnormal chromosome that leads to Angelman syndrome is inherited from the mother. This maternal inheritance is essential because without the maternal expression of the UBE3A gene, the neuronal functions that require this protein are compromised, resulting in the symptoms of the syndrome. The mechanisms behind this syndrome highlight the importance of genomic imprinting, where certain genes are expressed in a parent-of-origin-specific manner. Understanding this parent-specific gene expression illustrates why the maternal origin of the abnormal chromosome is pivotal in Angelman syndrome.

9. What do the vertical segments of the nephron focus on?

A. Secretion and filtration

B. Volume and concentration

C. Identity and reabsorption

D. Concentration and filtration

The correct focus of the vertical segments of the nephron is on volume and concentration. This part of the nephron includes the loops of Henle and the collecting ducts, which play crucial roles in concentrating urine and regulating water balance in the body. In the descending loop of Henle, water is reabsorbed while solutes remain in the tubular fluid, thus concentrating the urine. In the ascending loop, solutes such as sodium and chloride are reabsorbed but are impermeable to water, leading to dilution of the tubular fluid. The collecting duct further fine-tunes water reabsorption based on the body's needs, influenced by hormones like antidiuretic hormone (ADH). Therefore, the vertical segments primarily adjust the volume of water reabsorbed and help to create urine that is concentrated or diluted based on the hydration status of the individual. This focus is key for homeostasis, particularly in maintaining electrolyte balance and overall fluid balance in the body, highlighting the important roles these nephron parts play in regulating body fluid dynamics.

10. Methionine and tetrahydrofuran are synthesized using which important components of DNA?

A. Deoxyribose and ribonucleic acid

B. Nucleotides and proteins

C. Purines and pyrimidines

D. Amino acids and sugars

Methionine and tetrahydrofuran derive from critical components of cellular metabolism rather than being direct products of DNA. However, the synthesis pathways for amino acids and other biomolecules often involve precursors that are products of nucleic acid metabolism. The correct choice involves purines and pyrimidines, which are the building blocks of nucleotides. Nucleotides, in turn, play a crucial role in various cellular processes, including acting as energy carriers and being involved in the synthesis of nucleic acids. Methionine is an amino acid that can be synthesized from precursors ultimately derived from nucleotide metabolism, particularly from the breakdown products of purines. Tetrahydrofuran, which can be seen in various biochemical contexts as a cosubstrate or structural component in biological reactions, may have connections to the synthesis pathways influenced by the nucleotide precursors. In contrast, while ribonucleic acid and deoxyribose also have important biochemical roles, they do not directly connect to the synthesis of methionine and tetrahydrofuran in the way that purines and pyrimidines do. Likewise, nucleotides and proteins, while significant in their functions, do not encapsulate the specific components that lead to the synthesis of these

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!