

MCAT Biological and Biochemical Foundations of Living Systems

Practice Test 1

MCAT Biological and Biochemical Foundations of Living Systems • Form 1

Directions. This is an original independent practice form designed to mirror the current MCAT section structure. Select the best answer for each question. Do not use the answer fields or explanations until you have completed the form. **Timing.** 95 minutes. The practice form uses the AAMC section timing; it is not an official AAMC form and does not produce an official scaled score. **Blueprint note.** Approximate disciplines: introductory biology 65%, first-semester biochemistry 25%, general chemistry 5%, organic chemistry 5%; Foundational Concepts 1-3; Skills 1-4.

Passage 1: Enzyme kinetics

A research team investigated enzyme activity using a controlled comparison. The investigators varied substrate concentration and kept the other stated conditions as constant as possible. Their working model was that an enzyme-catalyzed reaction approaches a maximum rate as active sites become saturated. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: Velocity rose rapidly at low substrate concentration and approached a plateau at high concentration. The team concluded that finite active-site availability produces saturation behavior. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

1. Which observation from the study most directly supports the proposed relationship involving enzyme activity?
 - A. Velocity continues to rise linearly without approaching a plateau.
 - B. An enzyme-catalyzed reaction approaches a maximum rate as active sites become saturated.
 - C. Velocity decreases immediately as substrate rises for every enzyme.
 - D. Enzyme concentration alone determines velocity regardless of substrate concentration.
2. If substrate concentration increases while the other stated conditions remain fixed, which result best follows from the passage's model?
 - A. Velocity rises at first and then approaches a plateau.
 - B. Velocity decreases immediately as substrate rises for every enzyme.
 - C. Enzyme concentration alone determines velocity regardless of substrate concentration.
 - D. Velocity continues to rise linearly without approaching a plateau.
3. Which comparison would most directly test whether the observed result is caused by substrate concentration rather than by a competing variable?
 - A. Measure the same enzyme with substrate varied and enzyme concentration fixed.
 - B. A velocity-versus-substrate plot rises and approaches a plateau, while a double-reciprocal plot of $1/v$ against $1/[S]$ is linear.
 - C. Velocity decreases immediately as substrate rises for every enzyme.
 - D. Enzyme concentration alone determines velocity regardless of substrate concentration.
4. In a related system, substrate concentration increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?

- A. Velocity rises at first and then approaches a plateau.
 - B. Enzyme concentration alone determines velocity regardless of substrate concentration.
 - C. Velocity decreases immediately as substrate rises for every enzyme.
 - D. Measure the same enzyme with substrate varied and enzyme concentration fixed.
5. Which additional result would most strengthen the claim about enzyme activity?
- A. Velocity continues to rise linearly without approaching a plateau.
 - B. A velocity-versus-substrate plot rises and approaches a plateau, while a double-reciprocal plot of $1/v$ against $1/[S]$ is linear.
 - C. Velocity decreases immediately as substrate rises for every enzyme.
 - D. Enzyme concentration alone determines velocity regardless of substrate concentration.

Passage 2: Gene expression

A research team investigated transcription using a controlled comparison. The investigators varied the availability of an activating transcription factor and kept the other stated conditions as constant as possible. Their working model was that a transcription factor can change rna production by binding a regulatory dna sequence. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: Target-gene RNA increased in cells receiving the activating factor before the encoded protein increased. The team concluded that regulatory proteins influence whether RNA polymerase initiates transcription efficiently. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

6. Which observation from the study most directly supports the proposed relationship involving transcription?
- A. Translation occurs before transcription in a eukaryotic cell.
 - B. Every change in gene expression requires a change in DNA sequence.
 - C. Ribosomes bind regulatory DNA to initiate transcription.
 - D. A transcription factor can change RNA production by binding a regulatory DNA sequence.
7. If the availability of an activating transcription factor increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. Ribosomes bind regulatory DNA to initiate transcription.
 - B. Messenger RNA for the target gene increases when an activating factor is available.
 - C. Translation occurs before transcription in a eukaryotic cell.
 - D. Every change in gene expression requires a change in DNA sequence.
8. Which comparison would most directly test whether the observed result is caused by the availability of an activating transcription factor rather than by a competing variable?
- A. Target-gene RNA rises before the encoded protein increases.
 - B. Translation occurs before transcription in a eukaryotic cell.
 - C. Every change in gene expression requires a change in DNA sequence.

- D. Compare cells with and without the factor while keeping promoter sequence identical.
9. In a related system, the availability of an activating transcription factor increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Every change in gene expression requires a change in DNA sequence.
 - B. Messenger RNA for the target gene increases when an activating factor is available.
 - C. Compare cells with and without the factor while keeping promoter sequence identical.
 - D. Translation occurs before transcription in a eukaryotic cell.
10. Which additional result would most strengthen the claim about transcription?
- A. Ribosomes bind regulatory DNA to initiate transcription.
 - B. Target-gene RNA rises before the encoded protein increases.
 - C. Translation occurs before transcription in a eukaryotic cell.
 - D. Every change in gene expression requires a change in DNA sequence.

Passage 3: Membrane transport

A research team investigated solute movement using a controlled comparison. The investigators varied the concentration gradient and kept the other stated conditions as constant as possible. Their working model was that passive transport moves solute down its electrochemical gradient without direct ATP use. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: With voltage fixed, increasing the ion concentration ratio increased the initial current through the open channels. The team concluded that net passive flux depends on the gradient, while a finite transporter population can become occupied. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

11. Which observation from the study most directly supports the proposed relationship involving solute movement?
- A. ATP is required for every form of membrane movement.
 - B. Membrane composition cannot affect solute flux.
 - C. Passive transport moves solute down its electrochemical gradient without direct ATP use.
 - D. Passive transport moves solute against its electrochemical gradient without energy input.
12. If the concentration gradient increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. Passive transport moves solute against its electrochemical gradient without energy input.
 - B. ATP is required for every form of membrane movement.
 - C. Membrane composition cannot affect solute flux.
 - D. Net movement increases as the concentration gradient becomes larger, until another transport limit is reached.
13. Which comparison would most directly test whether the observed result is caused by the concentration gradient rather than by a competing variable?

- A. ATP is required for every form of membrane movement.
 - B. Use identical membranes and vary only the starting concentration difference.
 - C. Blocking the transporter reduces flux without changing the gradient.
 - D. Passive transport moves solute against its electrochemical gradient without energy input.
14. In a related system, the concentration gradient increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Use identical membranes and vary only the starting concentration difference.
 - B. ATP is required for every form of membrane movement.
 - C. Net movement increases as the concentration gradient becomes larger, until another transport limit is reached.
 - D. Passive transport moves solute against its electrochemical gradient without energy input.
15. Which additional result would most strengthen the claim about solute movement?
- A. Blocking the transporter reduces flux without changing the gradient.
 - B. Passive transport moves solute against its electrochemical gradient without energy input.
 - C. ATP is required for every form of membrane movement.
 - D. Membrane composition cannot affect solute flux.

Passage 4: Cardiovascular physiology

A research team investigated cardiac output using a controlled comparison. The investigators varied heart rate at fixed stroke volume and kept the other stated conditions as constant as possible. Their working model was that measured cardiac output rises in the same proportion as heart rate across fixed-stroke-volume trials. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: Direct flow measurements matched the product of heart rate and stroke volume during the transient interval studied. The team concluded that the product of rate and volume determines output. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

16. Which observation from the study most directly supports the proposed relationship involving cardiac output?
- A. Measured cardiac output rises in the same proportion as heart rate across fixed-stroke-volume trials.
 - B. Cardiac output equals blood pressure divided by oxygen concentration.
 - C. Heart rate and stroke volume cannot influence the same output.
 - D. Cardiac output is independent of volume ejected per beat.
17. If heart rate at fixed stroke volume increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. Cardiac output equals blood pressure divided by oxygen concentration.
 - B. Heart rate and stroke volume cannot influence the same output.
 - C. Cardiac output is independent of volume ejected per beat.

- D. Cardiac output increases when heart rate rises if stroke volume is unchanged.
18. Which comparison would most directly test whether the observed result is caused by heart rate at fixed stroke volume rather than by a competing variable?
- A. Heart rate and stroke volume cannot influence the same output.
 - B. Measure output while keeping stroke volume and venous return constant.
 - C. Direct flow measurement matches the predicted product.
 - D. Cardiac output equals blood pressure divided by oxygen concentration.
19. In a related system, heart rate at fixed stroke volume increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Cardiac output increases when heart rate rises if stroke volume is unchanged.
 - B. Heart rate and stroke volume cannot influence the same output.
 - C. Cardiac output equals blood pressure divided by oxygen concentration.
 - D. Measure output while keeping stroke volume and venous return constant.
20. Which additional result would most strengthen the claim about cardiac output?
- A. Direct flow measurement matches the predicted product.
 - B. Cardiac output equals blood pressure divided by oxygen concentration.
 - C. Heart rate and stroke volume cannot influence the same output.
 - D. Cardiac output is independent of volume ejected per beat.

Passage 5: Respiratory physiology

A research team investigated oxygen binding using a controlled comparison. The investigators varied blood oxygen partial pressure and kept the other stated conditions as constant as possible. Their working model was that hemoglobin saturation changes with oxygen partial pressure according to a sigmoidal binding curve. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: At matched temperature and pH, hemoglobin saturation increased with oxygen partial pressure, with the steepest change in the middle of the binding curve. The team concluded that cooperative binding creates a curve with plateau and steep regions. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

21. Which observation from the study most directly supports the proposed relationship involving oxygen binding?
- A. pH cannot alter hemoglobin's oxygen affinity.
 - B. Hemoglobin saturation changes with oxygen partial pressure according to a sigmoidal binding curve.
 - C. Hemoglobin saturation changes linearly with oxygen pressure at every range.
 - D. Hemoglobin binds oxygen irreversibly under physiological conditions.
22. If blood oxygen partial pressure increases while the other stated conditions remain fixed, which result best follows from the passage's model?

- A. Hemoglobin binds oxygen irreversibly under physiological conditions.
 - B. pH cannot alter hemoglobin's oxygen affinity.
 - C. At high partial pressure, a moderate increase produces a smaller saturation increase than it would in the steep region.
 - D. Hemoglobin saturation changes linearly with oxygen pressure at every range.
23. Which comparison would most directly test whether the observed result is caused by blood oxygen partial pressure rather than by a competing variable?
- A. Measure saturation with temperature and pH fixed.
 - B. The curve shifts when pH changes at constant oxygen pressure.
 - C. Hemoglobin saturation changes linearly with oxygen pressure at every range.
 - D. Hemoglobin binds oxygen irreversibly under physiological conditions.
24. In a related system, blood oxygen partial pressure increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Hemoglobin saturation changes linearly with oxygen pressure at every range.
 - B. Hemoglobin binds oxygen irreversibly under physiological conditions.
 - C. At high partial pressure, a moderate increase produces a smaller saturation increase than it would in the steep region.
 - D. Measure saturation with temperature and pH fixed.

Passage 6: Genetics

A research team investigated linkage using a controlled comparison. The investigators varied the distance between loci and kept the other stated conditions as constant as possible. Their working model was that recombination frequency generally increases as the distance between linked loci increases. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: The recombinant fraction was larger for the more distant pair of loci in the three-point cross. The team concluded that crossing over is more likely between loci that are farther apart. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

25. Which observation from the study most directly supports the proposed relationship involving linkage?
- A. Recombination frequency is unrelated to the distance between loci.
 - B. Every offspring produced by a linked cross is recombinant.
 - C. Recombination frequency generally increases as the distance between linked loci increases.
 - D. Linked loci always segregate together without recombination.
26. If the distance between loci increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. Linked loci always segregate together without recombination.
 - B. Recombination frequency is unrelated to the distance between loci.
 - C. Every offspring produced by a linked cross is recombinant.

- D. More distant loci produce a larger fraction of recombinant gametes.
27. Which comparison would most directly test whether the observed result is caused by the distance between loci rather than by a competing variable?
- A. Use the same heterozygous parent and score many offspring.
 - B. A three-point cross places the loci in the predicted order.
 - C. Linked loci always segregate together without recombination.
 - D. Recombination frequency is unrelated to the distance between loci.
28. In a related system, the distance between loci increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Recombination frequency is unrelated to the distance between loci.
 - B. More distant loci produce a larger fraction of recombinant gametes.
 - C. Linked loci always segregate together without recombination.
 - D. Use the same heterozygous parent and score many offspring.

Passage 7: Metabolism

A research team investigated oxidative phosphorylation using a controlled comparison. The investigators varied the proton gradient across the inner mitochondrial membrane and kept the other stated conditions as constant as possible. Their working model was that atp synthase uses the proton gradient to drive phosphorylation of adp. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: Increasing the usable proton gradient increased ATP output until oxygen delivery became limiting. The team concluded that the gradient stores electrochemical energy used by ATP synthase. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

29. Which observation from the study most directly supports the proposed relationship involving oxidative phosphorylation?
- A. The proton gradient exists only in the nucleus.
 - B. ATP synthase uses the proton gradient to drive phosphorylation of ADP.
 - C. ATP synthase can produce ATP without the proton gradient in this model.
 - D. The inner mitochondrial membrane generates oxygen as its primary product.
30. If the proton gradient across the inner mitochondrial membrane increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. The inner mitochondrial membrane generates oxygen as its primary product.
 - B. The proton gradient exists only in the nucleus.
 - C. Increasing the proton gradient increases ATP production until another component becomes limiting.
 - D. ATP synthase can produce ATP without the proton gradient in this model.

31. Which comparison would most directly test whether the observed result is caused by the proton gradient across the inner mitochondrial membrane rather than by a competing variable?
- A. Maintain oxygen and substrate while varying the gradient within the system's operating range.
 - B. A protonophore lowers ATP output while oxygen consumption initially changes.
 - C. ATP synthase can produce ATP without the proton gradient in this model.
 - D. The inner mitochondrial membrane generates oxygen as its primary product.
32. In a related system, the proton gradient across the inner mitochondrial membrane increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. The inner mitochondrial membrane generates oxygen as its primary product.
 - B. Increasing the proton gradient increases ATP production until another component becomes limiting.
 - C. Maintain oxygen and substrate while varying the gradient within the system's operating range.
 - D. ATP synthase can produce ATP without the proton gradient in this model.

Passage 8: Immune response

A research team investigated clonal selection using a controlled comparison. The investigators varied exposure to a specific antigen and kept the other stated conditions as constant as possible. Their working model was that antigen exposure selects and expands lymphocytes with receptors that bind that antigen. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: The second antigen exposure produced a faster response and a larger concentration of antigen-specific antibody. The team concluded that selection and proliferation amplify cells with matching receptors. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

33. Which observation from the study most directly supports the proposed relationship involving clonal selection?
- A. Antigen exposure selects and expands lymphocytes with receptors that bind that antigen.
 - B. Every lymphocyte responds identically to every antigen.
 - C. Red blood cells are the primary source of antibodies.
 - D. Memory formation requires destruction of all antigen receptors.
34. If exposure to a specific antigen increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. Every lymphocyte responds identically to every antigen.
 - B. Red blood cells are the primary source of antibodies.
 - C. Memory formation requires destruction of all antigen receptors.
 - D. The frequency of antigen-specific clones increases after exposure.
35. Which comparison would most directly test whether the observed result is caused by exposure to a specific antigen rather than by a competing variable?
- A. Every lymphocyte responds identically to every antigen.

- B. Red blood cells are the primary source of antibodies.
 - C. Compare antigen-specific and unrelated lymphocyte populations.
 - D. A second exposure produces a faster and larger response.
36. In a related system, exposure to a specific antigen increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Red blood cells are the primary source of antibodies.
 - B. Every lymphocyte responds identically to every antigen.
 - C. Compare antigen-specific and unrelated lymphocyte populations.
 - D. The frequency of antigen-specific clones increases after exposure.

Passage 9: Cell cycle

A research team investigated checkpoint control using a controlled comparison. The investigators varied DNA damage before division and kept the other stated conditions as constant as possible. Their working model was that checkpoint pathways can pause the cell cycle when dna damage is detected. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: A DNA-damage signal increased checkpoint-protein activity before cells entered the next division phase. The team concluded that checkpoints protect genome integrity by delaying division or triggering repair or death. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

37. Which observation from the study most directly supports the proposed relationship involving checkpoint control?
- A. DNA damage always accelerates cell division.
 - B. The cell cycle has no checkpoints that can delay progression.
 - C. DNA damage changes only the cell membrane and not nuclear control.
 - D. Checkpoint pathways can pause the cell cycle when DNA damage is detected.
38. If DNA damage before division increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. DNA damage changes only the cell membrane and not nuclear control.
 - B. Cells with damage spend longer before entering the next phase.
 - C. DNA damage always accelerates cell division.
 - D. The cell cycle has no checkpoints that can delay progression.
39. Which comparison would most directly test whether the observed result is caused by DNA damage before division rather than by a competing variable?
- A. The cell cycle has no checkpoints that can delay progression.
 - B. Compare damaged and undamaged cells with the same growth factors.
 - C. A checkpoint protein becomes active before division is delayed.
 - D. DNA damage always accelerates cell division.

40. In a related system, DNA damage before division increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Compare damaged and undamaged cells with the same growth factors.
 - B. DNA damage always accelerates cell division.
 - C. The cell cycle has no checkpoints that can delay progression.
 - D. Cells with damage spend longer before entering the next phase.

Passage 10: Evolution

A research team investigated selection using a controlled comparison. The investigators varied the frequency of a heritable trait under an environmental pressure and kept the other stated conditions as constant as possible. Their working model was that a heritable trait that improves reproductive success can become more common over generations. The pilot results were not interpreted from a single observation. Replicate samples were measured, the outcome was recorded before and after the manipulation, and a comparison condition was included. Data summary: The heritable phenotype became more common only in populations exposed to the stated selective pressure. The team concluded that differential reproductive success shifts the distribution of heritable variants. The conclusion is limited to the variables measured; it does not establish that every related system behaves identically.

41. Which observation from the study most directly supports the proposed relationship involving selection?
- A. All genetic variation is harmful to a population.
 - B. A heritable trait that improves reproductive success can become more common over generations.
 - C. Individuals acquire directed mutations because they need them.
 - D. Natural selection changes only an individual during its lifetime.
42. If the frequency of a heritable trait under an environmental pressure increases while the other stated conditions remain fixed, which result best follows from the passage's model?
- A. The advantageous phenotype increases in frequency when the pressure persists.
 - B. Individuals acquire directed mutations because they need them.
 - C. Natural selection changes only an individual during its lifetime.
 - D. All genetic variation is harmful to a population.
43. Which comparison would most directly test whether the observed result is caused by the frequency of a heritable trait under an environmental pressure rather than by a competing variable?
- A. The trait is heritable and correlated with offspring number.
 - B. Individuals acquire directed mutations because they need them.
 - C. Natural selection changes only an individual during its lifetime.
 - D. Compare with a population lacking the selective pressure.
44. In a related system, the frequency of a heritable trait under an environmental pressure increases while the other stated conditions remain fixed. Which prediction best transfers the mechanism?
- A. Individuals acquire directed mutations because they need them.
 - B. Compare with a population lacking the selective pressure.

- C. Natural selection changes only an individual during its lifetime.
 - D. The advantageous phenotype increases in frequency when the pressure persists.
45. A competitive inhibitor generally causes:
- A. a decrease in K_m and V_{max}
 - B. an increase in V_{max} only
 - C. complete loss of substrate binding
 - D. an increase in apparent K_m with no change in V_{max}
46. The organelle most directly responsible for ATP production by oxidative phosphorylation is the:
- A. nucleolus
 - B. mitochondrion
 - C. lysosome
 - D. Golgi apparatus
47. During translation, the ribosome reads:
- A. DNA introns only
 - B. lipid tails
 - C. antibody sugars
 - D. mRNA codons
48. A heterozygous individual for a dominant trait has genotype:
- A. Aa
 - B. AA only
 - C. aa only
 - D. A only
49. The nephron segment that normally reabsorbs the greatest fraction of filtered sodium and water is the:
- A. proximal convoluted tubule
 - B. collecting duct only
 - C. Bowman capsule
 - D. glomerular basement membrane
50. A hormone that binds an intracellular receptor is most likely:
- A. a cell-wall polymer
 - B. lipid-soluble
 - C. strongly charged and membrane-impermeable

D. a ribosomal RNA

51. The immediate result of depolarization of a typical neuron is:

- A. the membrane potential becomes infinitely negative
- B. all ion gradients disappear
- C. ATP synthesis stops
- D. the membrane potential becomes less negative

52. A mutation that inserts one nucleotide into a coding sequence is most likely to cause:

- A. a silent substitution only
- B. no possible effect
- C. a whole-genome duplication
- D. a frameshift

53. A steroid hormone commonly changes gene expression by:

- A. destroying all mRNA
- B. opening every ion channel
- C. binding an intracellular receptor that regulates transcription
- D. binding a ribosome and changing codons

54. During mitosis, sister chromatids separate during:

- A. anaphase
- B. prophase
- C. metaphase
- D. telophase only

55. The primary structure of a protein is its:

- A. amino acid sequence
- B. three-dimensional fold
- C. association of subunits
- D. pattern of membrane insertion

56. If a cell is placed in a hypertonic solution, it generally:

- A. keeps all water because membranes are rigid
- B. divides immediately
- C. loses water and shrinks
- D. gains water and swells

57. A study with random assignment primarily improves:
- A. the accuracy of every measurement
 - B. the sample size automatically
 - C. internal validity for causal comparisons
 - D. representativeness of the sample
58. The antibody-producing descendants of activated B cells are:
- A. osteoclasts
 - B. motor neurons
 - C. plasma cells
 - D. platelets
59. A population bottleneck can reduce:
- A. genetic variation
 - B. the need for DNA
 - C. the number of chromosomes in every organism
 - D. all natural selection

Answer Key and Explanations

1. **Answer: B.** The supporting observation must address enzyme activity and preserve the controls described in the passage.
2. **Answer: A.** The direction follows from the reported mechanism: finite active-site availability produces saturation behavior.
3. **Answer: A.** The comparison changes the proposed variable while controlling the alternatives relevant to enzyme activity.
4. **Answer: A.** The transferred prediction follows the same mechanism without adding an unsupported claim: finite active-site availability produces saturation behavior.
5. **Answer: B.** The selected measurement directly checks the proposed relationship involving enzyme activity rather than recording an unrelated observation.
6. **Answer: D.** The supporting observation must address transcription and preserve the controls described in the passage.
7. **Answer: B.** The direction follows from the reported mechanism: regulatory proteins influence whether RNA polymerase initiates transcription efficiently.
8. **Answer: D.** The comparison changes the proposed variable while controlling the alternatives relevant to transcription.
9. **Answer: B.** The transferred prediction follows the same mechanism without adding an unsupported claim: regulatory proteins influence whether RNA polymerase initiates transcription efficiently.
10. **Answer: B.** The selected measurement directly checks the proposed relationship involving transcription rather than recording an unrelated observation.
11. **Answer: C.** The supporting observation must address solute movement and preserve the controls described in the passage.
12. **Answer: D.** The direction follows from the reported mechanism: net passive flux depends on the gradient, while a finite transporter population can become occupied.
13. **Answer: B.** The comparison changes the proposed variable while controlling the alternatives relevant to solute movement.
14. **Answer: C.** The transferred prediction follows the same mechanism without adding an unsupported claim: net passive flux depends on the gradient, while a finite transporter population can become occupied.
15. **Answer: A.** The selected measurement directly checks the proposed relationship involving solute movement rather than recording an unrelated observation.

16. **Answer: A.** The supporting observation must address cardiac output and preserve the controls described in the passage.
17. **Answer: D.** The direction follows from the reported mechanism: the product of rate and volume determines output.
18. **Answer: B.** The comparison changes the proposed variable while controlling the alternatives relevant to cardiac output.
19. **Answer: A.** The transferred prediction follows the same mechanism without adding an unsupported claim: the product of rate and volume determines output.
20. **Answer: A.** The selected measurement directly checks the proposed relationship involving cardiac output rather than recording an unrelated observation.
21. **Answer: B.** The supporting observation must address oxygen binding and preserve the controls described in the passage.
22. **Answer: C.** The direction follows from the reported mechanism: cooperative binding creates a curve with plateau and steep regions.
23. **Answer: A.** The comparison changes the proposed variable while controlling the alternatives relevant to oxygen binding.
24. **Answer: C.** The transferred prediction follows the same mechanism without adding an unsupported claim: cooperative binding creates a curve with plateau and steep regions.
25. **Answer: C.** The supporting observation must address linkage and preserve the controls described in the passage.
26. **Answer: D.** The direction follows from the reported mechanism: crossing over is more likely between loci that are farther apart.
27. **Answer: A.** The comparison changes the proposed variable while controlling the alternatives relevant to linkage.
28. **Answer: B.** The transferred prediction follows the same mechanism without adding an unsupported claim: crossing over is more likely between loci that are farther apart.
29. **Answer: B.** The supporting observation must address oxidative phosphorylation and preserve the controls described in the passage.
30. **Answer: C.** The direction follows from the reported mechanism: the gradient stores electrochemical energy used by ATP synthase.
31. **Answer: A.** The comparison changes the proposed variable while controlling the alternatives relevant to oxidative phosphorylation.

- 32. Answer: B.** The transferred prediction follows the same mechanism without adding an unsupported claim: the gradient stores electrochemical energy used by ATP synthase.
- 33. Answer: A.** The supporting observation must address clonal selection and preserve the controls described in the passage.
- 34. Answer: D.** The direction follows from the reported mechanism: selection and proliferation amplify cells with matching receptors.
- 35. Answer: C.** The comparison changes the proposed variable while controlling the alternatives relevant to clonal selection.
- 36. Answer: D.** The transferred prediction follows the same mechanism without adding an unsupported claim: selection and proliferation amplify cells with matching receptors.
- 37. Answer: D.** The supporting observation must address checkpoint control and preserve the controls described in the passage.
- 38. Answer: B.** The direction follows from the reported mechanism: checkpoints protect genome integrity by delaying division or triggering repair or death.
- 39. Answer: B.** The comparison changes the proposed variable while controlling the alternatives relevant to checkpoint control.
- 40. Answer: D.** The transferred prediction follows the same mechanism without adding an unsupported claim: checkpoints protect genome integrity by delaying division or triggering repair or death.
- 41. Answer: B.** The supporting observation must address selection and preserve the controls described in the passage.
- 42. Answer: A.** The direction follows from the reported mechanism: differential reproductive success shifts the distribution of heritable variants.
- 43. Answer: D.** The comparison changes the proposed variable while controlling the alternatives relevant to selection.
- 44. Answer: D.** The transferred prediction follows the same mechanism without adding an unsupported claim: differential reproductive success shifts the distribution of heritable variants.
- 45. Answer: D.** Competitive inhibition can be overcome at high substrate, so apparent K_m rises while V_{max} remains unchanged.
- 46. Answer: B.** The inner mitochondrial membrane contains the electron transport chain and ATP synthase.
- 47. Answer: D.** Ribosomes use mRNA codons to specify the amino acid sequence.
- 48. Answer: A.** Heterozygous means two different alleles, here A and a.

- 49. Answer: A.** The proximal tubule performs extensive bulk reabsorption of filtered solutes and water.
- 50. Answer: B.** Lipid-soluble hormones can cross the phospholipid bilayer and bind intracellular receptors.
- 51. Answer: D.** Depolarization means the membrane potential moves toward a less negative value.
- 52. Answer: D.** A single-nucleotide insertion can shift the reading frame downstream of the insertion.
- 53. Answer: C.** The hormone-receptor complex can bind regulatory DNA and alter transcription.
- 54. Answer: A.** Sister chromatids are pulled to opposite poles during anaphase.
- 55. Answer: A.** Primary structure is the linear amino acid sequence.
- 56. Answer: C.** Water leaves the cell toward the higher effective solute concentration.
- 57. Answer: C.** Random assignment balances preexisting differences on average, strengthening causal inference.
- 58. Answer: C.** Activated B cells can differentiate into plasma cells that secrete antibodies.
- 59. Answer: A.** A bottleneck randomly removes individuals and can remove alleles from the population.