LESSON 5.4

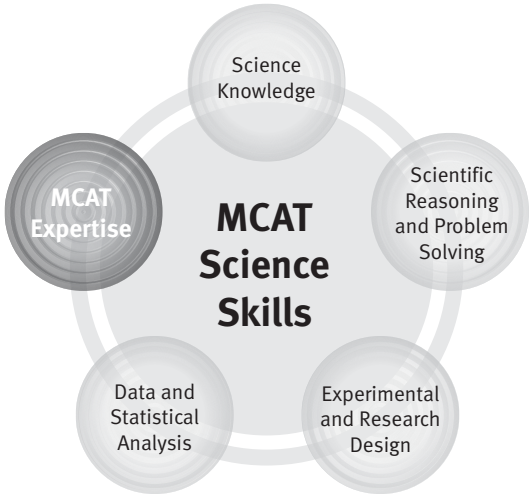
Triage in the Science Sections

In this lesson, you'll learn to:

- Utilize the triaging strategy within a science section of the MCAT
- Use question stems and answer choices to preview and triage MCAT questions
- Determine when a question is a "pseudo-discrete" question

Science Topics:

- The Nervous System
- The Endocrine System



LESSON 5.4, LEARNING GOAL 1:

- Utilize the triaging strategy within a science section of the MCAT

Section Triage Strategy

1. Discrete questions
2. Easiest passages
3. Passages with ambiguous difficulty
4. Hardest passages

Scratchwork Example

P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
–	–	+	+	–	–	+	–	+	–

KAPLAN TIP
Your triaging method should be your own style. Just make sure you have a triaging method for all passages on your MCAT.

Sample Passage I (Questions 1–2)

Appropriate function of the nervous system, especially in regard to locomotion, relies on the ability of motor nerves to communicate with muscle tissue. Pathological conditions that inhibit the ability of neurons to communicate with muscles result in various types of muscular dysfunction. For example, myasthenia gravis (MG) is a disease in which autoantibodies target receptors located at the neuromuscular junction, resulting in the inability of the neuron to communicate with the muscle. Interestingly, many patients with MG also have an abnormal thymus. Treatment often involves pharmaceutical therapy, which generally offers only symptomatic relief. However, definitive treatment can often be achieved with removal of the thymus.

Another disease that causes a decrease in the ability of nerves to communicate with muscles is known as Lambert–Eaton myasthenic syndrome. In this condition, autoantibodies attack the presynaptic calcium channels, diminishing the signal transmitted to the postsynaptic cells. This condition is often associated with small-cell lung cancer.

Myasthenia gravis and Lambert–Eaton syndrome are often characterized by muscle weakness. However, in the absence of additional information, it can be difficult to make a differential diagnosis. One of the ways these two conditions can be distinguished is by the administration of a medication that inhibits acetylcholinesterase. Patients with MG will notice substantial improvement with administration of such a medication, while Lambert–Eaton patients will not. Another way to distinguish the two is by the use of repetitive nerve stimulation (RNS). RNS is performed by electrically stimulating a nerve and measuring the response of the muscle. Figure 1 shows the appearance of RNS muscle response. Each peak indicates a single stimulation event.

Repetitive nerve stimulation

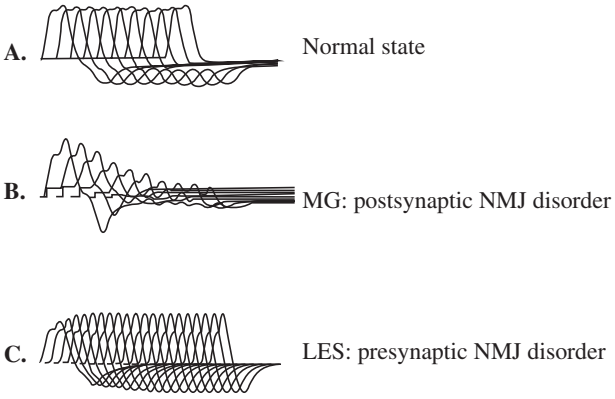


Figure 1. Repetitive nerve stimulation muscle response.

1. Why does the administration of a medication that inhibits acetylcholinesterase improve the symptoms of myasthenia gravis?

- **A.** It inactivates the antibodies against the receptors at the neuromuscular junction preventing the autoantibodies from attacking.
- **B.** It increases the concentration of acetylcholine at the synapse allowing for greater stimulation of unaffected receptors.
- **C.** It decreases the quantity of acetylcholine at the synapse to prevent aberrant signaling.
- **D.** It allows for more efficient opening of calcium channels at the neuromuscular junction.

2. In Lambert–Eaton syndrome, the attack of autoantibodies on calcium channels in presynaptic cells results in muscle weakness. What causes this weakness?

- **A.** Action potential conduction is slowed.
- **B.** Acetylcholine does not bind to receptors.
- **C.** Neurotransmitter release is reduced.
- **D.** Calcium efflux is inhibited.

What is your triage decision?

Sample Passage II (Questions 3–4)

Pituitary adenomas are tumors that form in the pituitary gland. The most common pituitary adenomas are known as lactotroph adenomas. They affect the cells of the anterior pituitary that produce prolactin, a hormone that encourages lactation. The incidence of lactotroph adenomas is estimated at 2.2 cases per 100,000, while the prevalence is approximately 100 cases per 1 million.

As prolactin is the primary hormone produced by a lactotroph adenoma, these adenomas are also known as prolactinomas. One of the major symptoms of these tumors is inappropriate lactation, known as galactorrhea. However, there may be other symptoms resulting simply from the size of the tumor and how it affects the surrounding tissues. When a tumor causes additional symptoms due to its size, it is known as mass effect. As the tumor grows, surrounding cells may become compressed, which results in cessation of physiological function. For example, pituitary tumors often present with changes in vision due to compression of the chiasma.

For many pituitary adenomas, transphenoidal surgery is the recommended treatment. This involves penetration of the sella turcica via the nasal and sinus passages. However, for prolactinomas, medical treatment is available in the form of medications that mimic the actions of pituitary-inhibiting factor. Generally, the application of these medications results in shrinking the tumor, but not its complete disappearance. Treatment of prolactinomas using medications is usually safer and less expensive than surgery. Surgical intervention is reserved for cases in which the tumor has become too large to be controlled by medications.

3. A researcher seeks to identify how a prolactinoma affects the production of other hormones, but can only take samples from an IV placed in the wrist. Which of the following is unlikely to be measured?

A. Thyroid-stimulating hormone
B. Cortisol-releasing hormone
C. Adrenocorticotropic hormone
D. Follicle-stimulating hormone

4. Within a certain population, the incidence of lactotroph adenomas is consistent with the general population but the prevalence is much higher than expected, at 225 cases per million. Which of the following is likely to account for the increased prevalence in this population?

A. Lactotroph adenomas occur more often due to founder effect.
B. Decreased diagnosis of prolactinomas.
C. Longer life span and better nutrition.
D. Transphenoidal surgery is more common.

What is your triage decision?

Sample Passage III (Questions 5–6)

The simple nervous system of the sea snail *Aplysia* has been used as a model system to explore the processes of short-term memory. When the mollusk's siphon is touched, sensory neurons stimulate motor neurons, causing the animal's gill to withdraw. However, with repeated touching of the siphon, the animal becomes habituated to stimulus and no longer withdraws its gill in response. Electric shock resensitizes the snail and following a shock, it will once again withdraw its gill in response to a touch on the siphon. This resensitization can last for days and is a simple form of short-term memory.

The cause of habituation has been traced to a reduction in the amount of neurotransmitter released by the sensory neurons in response to repeated touching of the siphon. This leads to a decrease in the post-synaptic potential and a consequent decrease in contraction of the gill muscles.

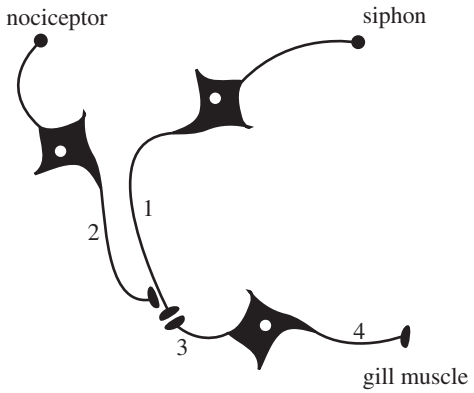


Figure 1. The nerve system of the sea snail *Aplysia.*

5. A researcher gently brushes the *Aplysia* siphon and monitors action potentials in the mollusk's nervous system. The researcher then presses the siphon more forcefully, leading to:

- **A.** larger action potentials at point 1.
- **B.** depolarization at point 2.
- **C.** more frequent action potentials at point 1.
- **D.** fewer action potentials at point 4.

6. Which of the following effects of repeated stimulation of the siphon provides a possible explanation for the habituation mechanism?

- **A.** Repeated stimulation leads to closure of calcium channels in the terminal membrane.
- **B.** Repeated stimulation leads to a decrease in the number of serotonin receptors in the terminal membrane.
- **C.** Repeated stimulation leads to a decrease in concentration of neurotransmitter-degrading enzymes in the siphon/gill muscle–nerve synapse.
- **D.** Repeated stimulation causes neurotransmitter vesicles to fuse with the terminal membrane in response to lower excitatory potentials.

What is your triage decision?

LESSON 5.4, LEARNING GOAL 2:

- Use question stems and answer choices to preview and triage MCAT questions

Practice Passage I (Questions 1–7)

The simple nervous system of the sea snail *Aplysia* has been used as a model system to explore the processes of short-term memory. When the mollusk's siphon is touched, sensory neurons stimulate motor neurons, causing the animal's gill to withdraw. However, with repeated touching of the siphon, the animal becomes habituated to stimulus and no longer withdraws its gill in response. Electric shock resensitizes the snail and following a shock, it will once again withdraw its gill in response to a touch on the siphon. This resensitization can last for days and is a simple form of short-term memory.

The cause of habituation has been traced to a reduction in the amount of neurotransmitter released by the sensory neurons in response to repeated touching of the siphon. This leads to a decrease in the post-synaptic potential and a consequent decrease in contraction of the gill muscles.

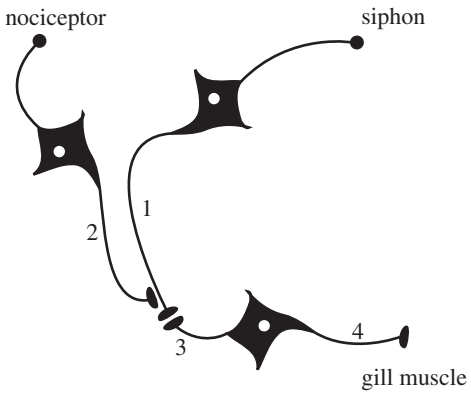


Figure 1. The nerve system of the sea snail *Aplysia*.

In sensitization, an electric shock stimulates nociceptors, which respond to pain stimuli. These neurons synapse on the presynaptic axon terminal of the siphon-touch sense neurons, as shown in Figure 1. The nociceptor terminals release serotonin, which binds to cell-surface receptors on the sensory presynaptic terminal and leads to the production of cAMP within the cell. cAMP activates a protein kinase, which phosphorylates voltage-gated K^+ channels on the membrane and causes them to remain shut. When action potentials arrive at the axon terminal, K^+ channels do not open and K^+ cannot flow out of the cell. Voltage-gated Ca^{++} channels remain open longer, allowing more Ca^{++} to flow into the cell. This leads to a larger release of neurotransmitter and a larger excited post-synaptic potential in the siphon motor neurons.

KAPLAN TIP

Remember, you're taking the MCAT. Don't let the test take you! You don't—and shouldn't—have to do all the questions within a passage in order, but you do have to make strategic decisions about the questions to be efficient with your time and get the most points possible.

1. According to the information presented in the passage, which of the following is true regarding the membrane potential of the siphon axon terminal following sensitization?

Would you do this question now or later?

A. The axon terminal is hyperpolarized.
B. The axon terminal is depolarized.
C. The axon terminal remains polarized longer following action potential.
D. The axon terminal remains depolarized longer following action potential.

2. A researcher gently brushes the *Aplysia* siphon and monitors action potentials in the mollusk's nervous system. The researcher then presses the siphon more forcefully, leading to:

Would you do this question now or later?

A. larger action potentials in the muscle neuron.
B. depolarization at all points along the neuron.
C. more frequent action potentials in the muscle neuron.
D. fewer action potentials in the muscle neuron.

3. Which of the following effects of repeated stimulation of the siphon provides a possible explanation for the habituation mechanism?

Would you do this question now or later?

A. Repeated stimulation leads to closure of calcium channels in the terminal membrane.
B. Repeated stimulation leads to a decrease in the number of serotonin receptors in the terminal membrane.
C. Repeated stimulation leads to a decrease in concentration of neurotransmitter-degrading enzymes in the siphon/gill muscle–nerve synapse.
D. Repeated stimulation causes neurotransmitter vesicles to fuse with the terminal membrane in response to lower excitatory potentials.

4. Which of the following points indicated in Figure 1 are neuron axons?

Would you do this question now or later?

A. 1 and 2 only
B. 1 and 3 only
C. 2, 3, and 4 only
D. 1, 2, and 4 only

KAPLAN TIP

The easier questions can help you understand the passage better now, making you better prepared to answer the harder questions later.

LESSON 5.4, LEARNING GOAL 3:

- Determine when a question is a "pseudo-discrete" question

Practice Passage (Questions 1–7)

The simple nervous system of the sea snail *Aplysia* has been used as a model system to explore the processes of short-term memory. When the mollusk's siphon is touched, sensory neurons stimulate motor neurons, causing the animal's gill to withdraw. However, with repeated touching of the siphon, the animal becomes habituated to stimulus and no longer withdraws its gill in response. Electric shock resensitizes the snail and following a shock, it will once again withdraw its gill in response to a touch on the siphon. This resensitization can last for days and is a simple form of short-term memory.

The cause of habituation has been traced to a reduction in the amount of neurotransmitter released by the sensory neurons in response to repeated touching of the siphon. This leads to a decrease in the post-synaptic potential and a consequent decrease in contraction of the gill muscles.

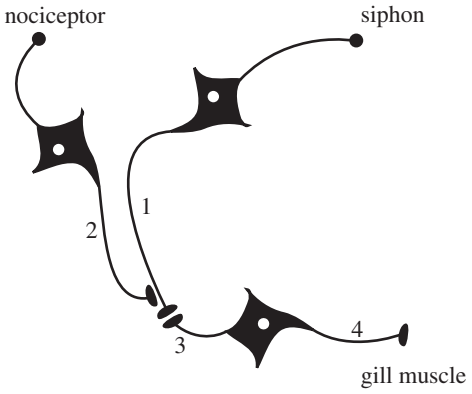


Figure 1. The nerve system of the sea snail *Aplysia.*

In sensitization, an electric shock stimulates nociceptors, which respond to pain stimuli. These neurons synapse on the presynaptic axon terminal of the siphon-touch sense neurons, as shown in Figure 1. The nociceptor terminals release serotonin, which binds to cell-surface receptors on the sensory presynaptic terminal and leads to the production of cAMP within the cell. cAMP activates a protein kinase, which phosphorylates voltage-gated K^+ channels on the membrane and causes them to remain shut. When action potentials arrive at the axon terminal, K^+ channels do not open and K^+ cannot flow out of the cell. Voltage-gated Ca^{++} channels remain open longer, allowing more Ca^{++} to flow into the cell. This leads to a larger release of neurotransmitter and a larger excited post-synaptic potential in the siphon motor neurons.

5. Ca^{++} channels in the sensory presynaptic terminal are likely to stay open longer at what voltage, due to K^+ ions being unable to leave the cell after sensitization?

A. Less than −70 mV
B. −70 mV
C. 0 mV
D. +35 mV

Would you do this question now or later?

What information is needed from the passage to answer this question?

6. A researcher determines the volume of serotonin released by a set of nociceptors to be 0.223 μL over 20 seconds. If this rate continues, how much serotonin could these same nociceptors produce in one hour?

A. 2.007×10^{-3} mL/hr
B. 4.014×10^{-2} mL/hr
C. 8.028×10^{-1} mL/hr
D. 4.014×10^{1} mL/hr

Would you do this question now or later?

What information is needed from the passage to answer this question?

7. Some anesthetics work by blocking voltage-gated Na^+ channels. These drugs work particularly well on sensory neurons, and therefore block the transmission of pain. If an anesthetic like this was applied to the habituated gill of an *Aplysia* followed by electric shock, what would the likely response be and why?

A. The gill muscle would not become resensitized due to no serotonin being released by the nociceptor.
B. The gill muscle would become resensitized due to serotonin being released by the nociceptor.
C. The gill muscle would become habituated due to K^+ channels being open for longer.
D. The gill muscle would become resensitized due to K^+ channels getting phosphorylated.

Would you do this question now or later?

What information is needed from the passage to answer this question?

KAPLAN TIP
Don't waste time doing questions with long calculations first. Save these questions for the end of the section.

LESSON 5.4 REVIEW

Triaging the Section:

1. Discrete questions
2. Ask yourself for each passage:

   How difficult do you find this topic?
   How difficult is the sentence structure and vocabulary?
   Are there figures, tables, graphs, or equations?
   How difficult does the question set look?

   And then do:

   Easiest passages
   Passages with ambiguous difficulty
   Hardest passages

Triaging the Questions:

Characteristics of Easier Questions	Characteristics of Harder Questions
Shorter question stems and answer choices	Longer question stems and answer choices
Little to no passage research required	Heavy passage research required
The way to answer the question is clear	The way to answer the question is not clear and must be figured out
The question requires no calculations	The question requires calculations
The question is testing Skill 1	The question is testing Skill 2

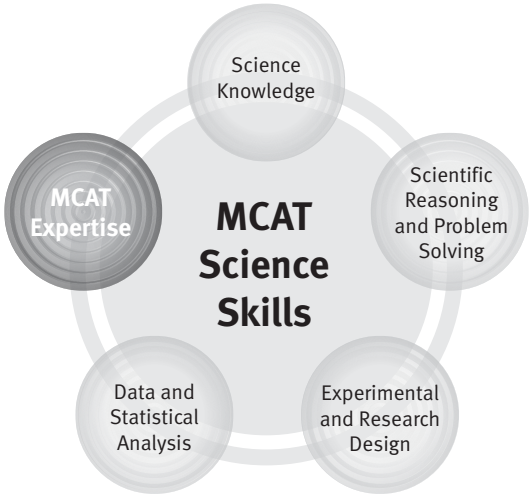
Wrong Answer Types (Sciences)

In this lesson, you'll learn to:

- Eliminate wrong answers quickly using the repetitive structure of answers
- Recognize common wrong answer pathologies for science questions

Science Topics:

- Oxidative Phosphorylation
- Mitosis, Meiosis, and Other Factors Affecting Genetic Variability
- Endocrine System



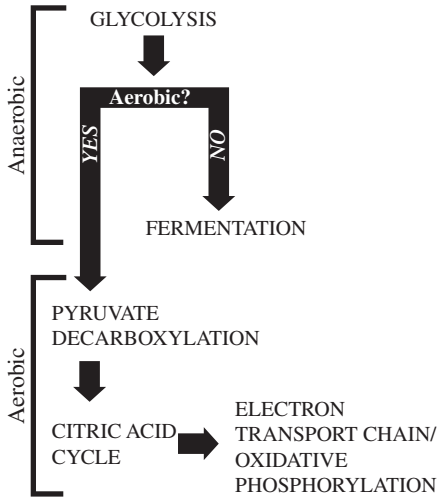
LESSON 5.5, LEARNING GOAL 1:

- Eliminate wrong answers quickly using the repetitive structure of answers

Answer Choices with Little Repetition:

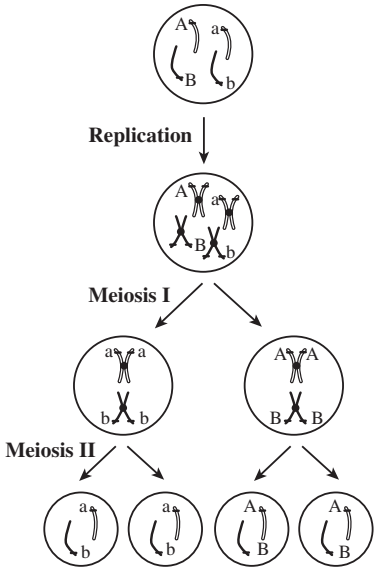
1. Which is the last enzyme in cellular respiration?

A. Hexokinase
B. Pyruvate decarboxylase
C. Alcohol dehydrogenase
D. Cytochrome C oxidase



2. A mutation has occurred in one chromosome of a spermatogonium. This mutation will show up in how many of the gametes produced from this cell?

A. None
B. One-fourth
C. Half
D. All



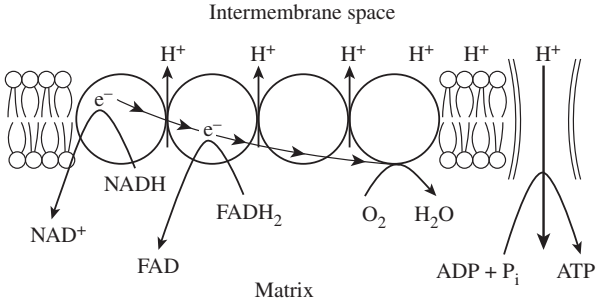
Answer Choices with Repetition:

3. Testosterone is converted to estradiol via aromatase, a member of the CYP450 family of enzymes. Estradiol receptors fall into two classes: ER (further divided into ERα and ERβ) and G protein-coupled receptors (GPR30). Where are these receptors most likely to be located?

A. ERα and ERβ are likely to be embedded in the cell membrane, and GPR30 is likely to be dissolved in the cytosol.
B. ERα and ERβ are likely to be dissolved in the cytosol, and GPR30 is likely to be found embedded in the outer membrane of the nuclear envelope.
C. ERα, ERβ, and GPR30 are all likely to be found dissolved in the cytosol.
D. ERα, ERβ, and GPR30 are all likely to be found embedded in the cell membrane.

4. During the generation of the proton-motive force:

A. the pH of the mitochondrial matrix decreases and the pH of the intermembrane space increases.
B. the pH of the mitochondrial matrix decreases and the pH of the intermembrane space decreases.
C. the pH of the mitochondrial matrix increases and the pH of the intermembrane space increases.
D. the pH of the mitochondrial matrix increases and the pH of the intermembrane space decreases.



5. Crossing over, a contributor to genetic variation, most commonly occurs between:

A. homologous chromosomes during prophase I of mitosis.
B. homologous chromosomes during prophase I of meiosis.
C. nonhomologous chromosomes during prophase I of mitosis.
D. nonhomologous chromosomes during prophase I of meiosis.

KAPLAN TIP
Use the Assess Step to gain a "repetitive" advantage!

LESSON 5.5, LEARNING GOAL 2:

- Recognize common wrong answer pathologies for science questions

Common Wrong Answer Pathologies:

1. Which of the following occurs in a normal, healthy adult male?

Wrong Answer Choice	FUD	OPP	OS	DIST/EXT
ADH, released in response to high plasma osmolarity, is synthesized in the hypothalamus and transported to the posterior pituitary for storage by the body's only portal system.				
GnRH stimulates the anterior pituitary to release FSH and LH, which act primarily on the Leydig and Sertoli cells, respectively.				
The presence of testosterone and its derivatives induce the development of the Wolffian duct, a key component in male sexual differentiation.				
Prolactin and oxytocin, whose secretion is increased during pregnancy, act to stimulate milk production and let down.				
During times of inadequate iodine intake, TSH levels are reduced, because iodine is necessary to produce the thyroid hormones.				
After a meal, insulin is secreted by beta cells in the pancreas, thereby maintaining elevated plasma glucose levels.				

FUD = faulty use of detail; OPP = opposite; OS= out of scope; DIST/EXT = distortion or extreme

Miscalculations:

6. Given the reduction potentials below and $\Delta G^{\circ\prime} = -nF\Delta E_0'$ (n = moles of e^- transferred and $F = 96.48\ \text{kJ mol}^{-1}\ \text{V}^{-1}$), approximately how much energy is released by each molecule of NADH during the reduction of oxygen?

$$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O \qquad E_0' = +0.82\,V$$
$$NAD_+ + H^+ + 2e^- \rightarrow NADH \qquad E_0' = -0.32\,V$$

A. $1.6 \times 10^{-19}\ \text{J}$
B. $1.8 \times 10^{-19}\ \text{J}$
C. $3.6 \times 10^{-19}\ \text{J}$
D. $3.6 \times 10^{-22}\ \text{J}$

The correct calculations:

$$\frac{1}{2}O_2 + NADH + H^+ \rightarrow H_2O + NAD^+$$

$$\Delta E_0' = \boldsymbol{E_0'}\ \textbf{(reduction)} - \boldsymbol{E_0'}\ \textbf{(oxidation)}$$
$$\Delta E_0' = +.82 - (-.32)$$
$$\Delta E_0' = +1.14\,V$$

$$\Delta G^{\circ\prime} = -(2)\left(96.48\ \text{kJ mol}^{-1}\ V^{-1}\right)(1.14\ V)$$
$$\Delta G^{\circ\prime} = -220\ \text{kJ mol}^{-1}$$

$$\frac{220\ \text{kJ}}{\text{mol NADH}} \times \frac{1\ \text{mol NADH}}{6.02 \times 10^{23}\ \text{molecules NADH}}$$
$$= \frac{220\ \text{kJ}}{6.02 \times 10^{23}\ \text{molecules NADH}}$$
$$= 36 \times 10^{-23}\ \frac{\textbf{kJ}}{\textbf{molecule}}$$

$$3.6 \times 10^{-23}\ \frac{\text{kJ}}{\text{molecule}} \times \frac{1000\ \text{J}}{1\ \text{kJ}}$$
$$= 3.6 \times 10^{-19}\ \frac{\text{J}}{\text{molecule}}$$

Common miscalculations:

(A) is derived by confusing sign convention.

$$\Delta E_0' = +.82 + (-.32)$$
$$\Delta E_0' = +.\mathbf{50}\,V$$

(B) may be obtained by incorrectly substituting 1 for *n*.

(D) results from a failure to convert units.

KAPLAN TIP

Analysis of the relationships among the answer choices may help elucidate key points in the solution.

Practice Passage (Questions 7–10)

Many genetically inherited disorders result from chromosomal abnormalities involving autosomes, sex chromosomes, or both. The abnormalities can be classified as either structural or numerical.

Structural abnormalities result from chromosome breakage and subsequent reconstitution in an abnormal combination. This often results in a translocation—the rearrangement of genetic material from one chromosome to another. The most common outcome of a translocation is a balanced rearrangement resulting in chromosome sets with the normal complement of genetic information arranged in different positions. An unbalanced rearrangement results in chromosome sets that contain additional or missing genetic information. Figure 1 shows a specific type of balanced translocation, a Robertsonian translocation.

Numerical abnormalities result when an individual is either missing a chromosome from a pair (monosomy) or has more than two chromosomes (trisomy denotes three representatives of a particular chromosome). Partial trisomy refers to trisomy for only a portion of a chromosome. The causes of these abnormalities are not entirely understood. It is supposed that most cases result from meiotic nondisjunction—the failure of a pair of chromosomes to separate normally during one of the two meiotic divisions, most often during meiosis I.

Trisomy or monosomy for a whole chromosome rarely results in a viable phenotype. Trisomy 21 (Down syndrome), trisomy 18, and trisomy 13 are the only well-defined instances of autosomal trisomy that are observed in postnatal infants, and each of these results in an abnormal phenotype. Monosomy for an entire chromosome in a live birth is only observed for the X chromosome, a condition known as Turner's syndrome. It is interesting to note that although the great majority of Down syndrome cases have 47 chromosomes, approximately 5% of Down syndrome cases have the normal chromosome number with the third copy of chromosome 21 translocated onto and fused with another chromosome.

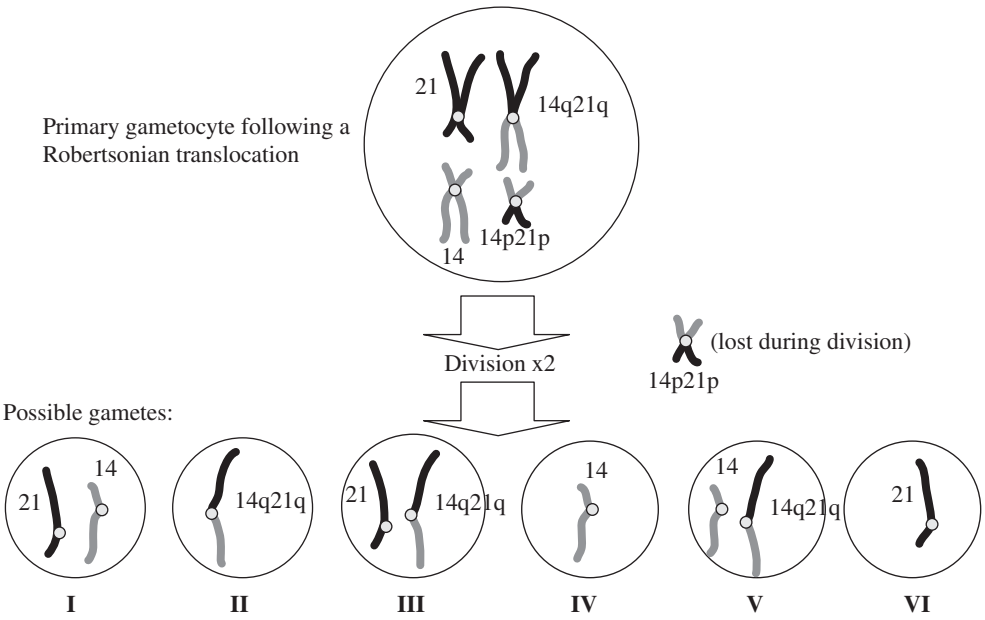


Figure 1. Diagram of segregation after a Robertsonian translocation; the 14p21p fragment is lost during division with no phenotypic effect (the genes on this fragment are also found on other chromosomes).

7. In Figure 1, which of the gametes (I, II, III, IV, V, VI) will most likely produce a viable, normal phenotype?

A. I and II
B. I and III
C. I, II, and III
D. I, II, and IV

What do you notice in the answer choices?

8. Which of the following events would most likely lead to partial trisomy?

A. A base substitution in the DNA of a pluripotent cell
B. An unbalanced rearrangement in germ line tissue
C. An inversion of a single segment of an autosome
D. The deletion of a portion of a sex chromosome

What do you notice in the answer choices?

9. Which of the following hypotheses might explain the disproportionate number of babies with Down syndrome born to mothers over 35 years of age?

A. Older eggs require fertilization by multiple sperm.
B. Older eggs contain a higher percentage of mutated chromosomes.
C. Older eggs are more likely to disjoin incorrectly.
D. Older eggs are not susceptible to translocations.

What do you notice in the answer choices?

10. Robertsonian translocation carriers contain all essential DNA and are phenotypically normal, even though they inherited two chromosomes fused together because of the Robertsonian translocation. Are zygotes fertilized by a Robertsonian translocation carrier at greater than average risk for trisomy?

A. Yes, because the carrier's chromosomal mutation will be transmitted to all of their offspring.
B. Yes, because of increased odds that the carrier will pass on two copies of the same chromosome.
C. Yes, because in addition to the risk of meiotic nondisjunction, the zygote has a 5% chance of developing trisomy from a Robertsonian translocation.
D. No, because the carrier has the normal complement of DNA and is phenotypically normal.

What do you notice in the answer choices?

KAPLAN TIP
Wrong answer pathologies often show up in the science sections of the MCAT and looking for them will help the process of elimination.

LESSON 5.5 REVIEW

Wrong Answer Types (Sciences)

Miscalculation

- Is wrong because
  - It has values or units inconsistent with the correct answer
  - Often follows from common mathematical errors

Faulty Use of Detail (FUD)

- Is wrong because
  - It misrepresents information in the passage or question stem
  - Does not answer the question that was asked

Opposite (OPP)

- Is wrong because
  - It is the exact opposite concept/idea from the correct answer
  - May confuse a relationship (i.e. increase *vs.* decrease)

Out of Scope (OS)

- Is wrong because
  - It presents information irrelevant to the question

Distortion or Extreme (DIST/EXT)

- Is wrong because
  - It manipulates factual information, altering its validity

Biology and Biochemistry 2: Section Triage and Answer Choice Analysis

PASSAGE I (QUESTIONS 1–5)

Pituitary adenomas are tumors that form in the pituitary gland. The most common pituitary adenomas are known as lactotroph adenomas. They affect the cells of the anterior pituitary that produce prolactin, a hormone that encourages lactation. The incidence of lactotroph adenomas is estimated at 2.2 cases per 100,000, while the prevalence is approximately 100 cases per 1 million.

As prolactin is the primary hormone produced by a lactotroph adenoma, these adenomas are also known as prolactinomas. One of the major symptoms of these tumors is inappropriate lactation, known as galactorrhea. However, there may be other symptoms resulting simply from the size of the tumor and how it affects the surrounding tissues. When a tumor causes additional symptoms due to its size, it is known as mass effect. As the tumor grows, surrounding cells may become compressed, which results in cessation of physiological function. For example, pituitary tumors often present with changes in vision due to compression of the chiasma.

For many pituitary adenomas, transphenoidal surgery is the recommended treatment. This involves penetration of the sella turcica via the nasal and sinus passages. However, for prolactinomas, medical treatment is available in the form of medications that mimic the actions of pituitary-inhibiting factor. Generally, the application of these medications results in shrinking the tumor, but not its complete disappearance. Treatment of prolactinomas using medications is usually safer and less expensive than surgery. Surgical intervention is reserved for cases in which the tumor has become too large to be controlled by medications.

1. A researcher seeks to identify how a prolactinoma affects the production of other hormones, but can only take samples from an IV placed in the wrist. Which of the following is unlikely to be measured?

A. Thyroid-stimulating hormone
B. Cortisol-releasing hormone
C. Adrenocorticotropic hormone
D. Follicle-stimulating hormone

2. Within a certain population, the incidence of lactotroph adenomas is consistent with the general population, but the prevalence is much higher than expected at 225 cases per million. Which of the following is likely to account for the increased prevalence in this population?

A. Lactotroph adenomas occur more often due to founder effect.
B. Decreased diagnosis of prolactinomas.
C. Longer life span and better nutrition.
D. Transphenoidal surgery is more common.

3. A disease known as Conn's syndrome causes large amounts of mineralocorticoids to be secreted. Which is a likely indicator of this disease?

A. High blood pressure
B. Galactorrhea
C. High blood glucose
D. Low blood sodium

4. A study is designed to determine if people with a thyroid tumor are also more likely than the general population to develop a pituitary tumor. Which of the following study designs is least likely to provide information to confirm or deny the correlation?

A. A longitudinal study in which a large population is followed to identify those who develop thyroid tumors and subsequently develop a pituitary tumor.
B. A retrospective study in which 2,000 patients with known thyroid tumors are surveyed to determine how many also developed pituitary tumors.
C. A series of case studies that identifies ten cases in which patients first developed thyroid tumors and were later diagnosed with pituitary tumors.
D. A study in multiple medical centers over several years that tracks the development of thyroid tumors and pituitary tumors in a multicultural population.

5. As a prolactinoma becomes larger, it begins to exhibit mass effect. Which of the following hormones are likely to be diminished in a patient experiencing mass effect from a prolactinoma?

A. Antidiuretic hormone
B. Thyroid-stimulating hormone
C. Oxytocin
D. Serotonin

PASSAGE II (QUESTIONS 1–6)

Appropriate function of the nervous system, especially in regard to locomotion, relies on the ability of motor nerves to communicate with muscle tissue. Pathological conditions that inhibit the ability of neurons to communicate with muscles result in various types of muscular dysfunction. For example, myasthenia gravis (MG) is a disease in which autoantibodies target receptors located at the neuromuscular junction, resulting in the inability of the neuron to communicate with the muscle. Interestingly, many patients with MG also have an abnormal thymus. Treatment often involves pharmaceutical therapy, which generally offers only symptomatic relief. However, definitive treatment can often be achieved with removal of the thymus.

Another disease that causes a decrease in the ability of nerves to communicate with muscles is known as Lambert–Eaton myasthenic syndrome. In this condition, autoantibodies attack the presynaptic calcium channels, diminishing the signal transmitted to the postsynaptic cells. This condition is often associated with small-cell lung cancer.

Myasthenia gravis and Lambert–Eaton syndrome are often characterized by muscle weakness. However, in the absence of additional information, it can be difficult to make a differential diagnosis. One of the ways these two conditions can be distinguished is by the administration of a medication that inhibits acetylcholinesterase. Patients with MG will notice substantial improvement with administration of such a medication, while Lambert–Eaton patients will not. Another way to distinguish the two is by the use of repetitive nerve stimulation (RNS). RNS is performed by electrically stimulating a nerve and measuring the response of the muscle. Figure 1 shows the appearance of RNS muscle response. Each peak indicates a single stimulation event.

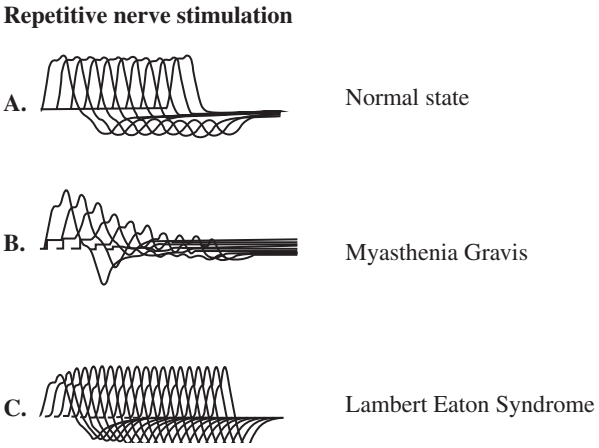


Figure 1. Repetitive nerve stimulation muscle response.

1. Why does the administration of a medication that inhibits acetylcholinesterase improve the symptoms of myasthenia gravis?

A. Inactivates the antibodies against the receptors at the neuromuscular junction, preventing the autoantibodies from attacking
B. Increases the concentration of acetylcholine at the synapse, allowing for greater stimulation of unaffected receptors
C. Decreases the quantity of acetylcholine at the synapse to prevent aberrant signaling
D. Allows for more efficient opening of calcium channels at the neuromuscular junction

2. In Lambert–Eaton syndrome, the attack of autoantibodies on calcium channels in presynaptic cells results in muscle weakness. What causes this weakness?

A. Action potential conduction is slowed.
B. Acetylcholine does not bind to receptors.
C. Neurotransmitter release is reduced.
D. Calcium efflux is inhibited.

3. In myasthenia gravis, the speed at which an action potential travels down the axon is unchanged. Which of the following is likely to result in slower conduction of action potentials down the axon?

A. Saltatory conduction
B. Loss of myelin from axons
C. Increased extracellular sodium
D. Autoantibodies to calcium channels

4. A researcher is planning a study to determine the effect of a new medication on signal transmission at the synapse in patients with myasthenia gravis. Which of the following control groups would provide the most accurate information to help determine the efficacy of this new medication?

A. People who do not have myasthenia gravis and have normal nerve conduction
B. People who have Lambert–Eaton syndrome and have not been treated
C. People who have myasthenia gravis and have been treated with another drug
D. People with myasthenia gravis who have not been treated with another drug

5. Which of the following is a possible interpretation of the repetitive nerve stimulation studies in Figure 1?

A. People with Lambert–Eaton syndrome experience increasing weakness with repetitive stimulation.
B. People with myasthenia gravis experience increasing weakness with repetitive nerve stimulation.
C. People with myasthenia gravis experience decreasing weakness with repetitive nerve stimulation.
D. People with Lambert–Eaton syndrome experience slower nerve conduction than people with myasthenia gravis.

6. A nerve conducts an action potential, but is unable to conduct a second action potential due to a highly negative membrane potential. What is this phenomenon known as?

A. Depolarization
B. Repolarization
C. Refractory period
D. Threshold

DISCRETE PRACTICE QUESTIONS (QUESTIONS 1–14)

1. A hormone enters a cell and binds with an intracellular receptor. The receptor-hormone complex then enters the cell and causes a change in DNA expression. What is an essential characteristic of this hormone?

A. Synthesized from amino acids
B. Triggers a signaling cascade
C. Requires cholesterol as a precursor
D. Causes a rapid change in physiology

2. A tumor located in the adrenal medulla results in high blood pressure that is resistant to treatment with multiple medications. Which hormone is likely to account for this effect?

A. Aldosterone
B. Cortisol
C. Estrogens
D. Epinephrine

3. In order for a zygote to have the appropriate number of genes, each gamete must be haploid. During what stage of cell division does this occur?

A. Mitosis
B. Meiosis I
C. Meiosis II
D. Cytokinesis

4. A mutated protein contains all of the correct amino acids until the middle of the protein; the rest of the protein is prematurely truncated and substantially altered in terms of the amino acid sequence. Which of the following best accounts all of the changes that resulted from the mutation?

A. Insertion
B. Substitution
C. Nonsense
D. Missense

5. Which of the following is NOT a mechanism by which genetic variability may be decreased?

A. Founder effect
B. Inbreeding
C. Point mutation
D. Aneuploidy

6. A cell is treated with a cancer drug that stabilizes microtubules, preventing degradation. Which phase of mitosis is this drug targeting?

A. Prophase
B. Metaphase
C. Anaphase
D. Telophase

7. Mitochondrial inheritance has been used to trace genetic lineage for certain groups. Which of the following relationships may be supported by similarities in mitochondrial DNA?

A. Maternal grandmother–grandchild
B. Maternal grandfather–grandchild
C. Paternal grandmother–grandchild
D. Paternal grandfather–grandchild

8. A known disease is characterized by a prolonged startle response. Which division of the nervous system is responsible for the inability of a person to terminate the startle response?

A. Somatic nervous system
B. Central nervous system
C. Parasympathetic nervous system
D. Peripheral nervous system

9. In order to transmit an action potential, a neuron requires stimulation from multiple presynaptic cells at the same time. Which of the following concepts best describes this phenomenon?

A. Threshold potential
B. Dendritic stimulation
C. Temporal summation
D. Spatial summation

10. Anaerobic exercise causes cessation of oxidative phosphorylation and falling pH within muscle tissue. Why does this occur?

A. Pyruvate cannot enter the citric acid cycle and is converted to ethanol.
B. Pyruvate cannot enter the citric acid cycle and is converted to lactic acid.
C. The protons in the inner membrane of the mitochondria leak into the cytoplasm.
D. ATP synthase is inhibited because electrons cannot be transferred to oxygen.

11. Apoptosis is induced in a cell and small pores are created in the mitochondrial membrane. What is the effect of this process on oxidative phosphorylation?

A. Oxidative phosphorylation will continue because parts of the membrane are still intact.
B. Oxidative phosphorylation will continue because ATP is required for apoptosis.
C. Oxidative phosphorylation will cease because the electrochemical gradient required will not be present.
D. Oxidative phosphorylation will cease because cell death causes a lack of oxygen and ATP.

12. Re-feeding syndrome is a life-threatening complication that occurs when people with severe malnutrition are given large quantities of nutrition very quickly, in the form of oral intake or nutrition delivered by IV. Which element is likely to be depleted specifically by this condition?

A. Iron
B. Nitrogen
C. Glucose
D. Phosphorus

13. Increased levels of ADP trigger an increase in ATP synthesis. What is the mechanism by which this occurs?

A. Increased ADP triggers increased activity of ATP synthase.
B. Increased ADP causes an increase in production of NADH.
C. Decreased ATP activates isocitrate dehydrogenase.
D. Decreased ATP increases available NAD^{+} and FAD^{2+}.

14. Which of the following is TRUE regarding ATP synthesis?

A. The formation of ATP is exergonic and electron transport is endergonic.
B. The formation of ATP is endergonic and electron transport is exergonic.
C. The formation of ATP is exothermic and electron transport is endothermic.
D. The formation of ATP is spontaneous while electron transport is nonspontaneous.