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Unit III Minitest

26 Questions **30 Minutes**

This minitest is designed to assess your mastery of the content in Chapters 8 and 9 of this volume. The questions have been designed to simulate actual MCAT questions in terms of format and degree of difficulty. They are based on the content categories associated with Foundational Concept 3, which is the theme of this unit. They are also designed to test the scientific inquiry and reasoning skills that the test makers have identified as essential for success in medical school.

In this test, most of the questions are based on short passages that typically describe a laboratory experiment, a research study, or some similar process. There are also some questions that are not based on passages.

Use this test to measure your readiness for the actual MCAT. Try to answer all of the questions within the specified time limit. If you run out of time, you will know that you need to work on improving your pacing.

Complete answer explanations are provided at the end of the minitest. Pay particular attention to the answers for questions you got wrong or skipped. If necessary, go back and review the corresponding chapters or text sections in this unit.

Now turn the page and begin the Unit III Minitest.

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Directions: *Choose the best answer to each of the following questions. Questions 1–4 are not based on a passage.*

1. Which of the following drugs might cause muscle spasms (uncontrolled contractions)?
   A. one that elevates calcium levels
   B. one that prevents the use of ATP
   C. one that elongates the sarcomere
   D. one that prevents attachment of myosin heads to actin

2. Diabetes insipidus is an inherited endocrine disorder that causes the kidneys to produce extreme amounts of urine per day that can severely dehydrate the individual with this condition. Management of this disorder involves hormone therapy. Which of the following is the missing hormone in a person with this disorder?
   A. antidiuretic hormone
   B. thyroid-stimulating hormone
   C. glucagon
   D. calcitonin

3. During pulmonary gas exchange, oxygen and carbon dioxide always move:
   A. into the alveoli
   B. into the blood
   C. from high to low concentration
   D. out of the blood

4. The hypothalamus is part of the:
   A. cerebrum
   B. brain stem
   C. diencephalon
   D. spinal cord

Questions 5–8 are based on the following passage.

Passage I

Guillain-Barré syndrome (GBS) is a rare condition characterized by destruction of the insulating myelin sheath on neurons located in the peripheral nervous system. Many people who develop GBS usually have it happen within days or weeks following recovery from a respiratory or gastrointestinal infection, but the reason GBS develops is uncertain. Others develop GBS following routine surgeries or vaccinations. GBS has been seen in people of all ages, and it affects men and women equally. The symptoms of GBS typically begin as tingling or weakness in the feet that can lead to paralysis that often ascends through the body. Most of the time, GBS is acute and lasts for a relatively brief period of time until remyelination of the peripheral nerves can occur. However, for some people, relapses are common and the condition can be chronic. Rarely, GBS can cause permanent paralysis and respiratory failure.

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During GBS, the immune system produces antibodies to the surface antigens of peripheral myelin. These antibodies facilitate the destruction of the myelin, which leads to the neurological symptoms. While GBS does not have a treatment, procedures such as plasmapheresis, also known as plasma exchange, can be used as a means to alleviate the symptoms of GBS. During plasmapheresis, the blood is removed from the body and separated into cells and plasma. The plasma is discarded so that only the blood cells are returned to the body in donated or synthetic plasma. Another treatment option is the intravenous delivery of immunoglobulin. The antibodies present in the immunoglobulin may block the antibodies produced to the surface antigens of peripheral myelin. Typically, the symptoms of GBS subside within months of their onset when treatments such as plasmapheresis or immunoglobulin are used.

5. GBS affects the myelin of the peripheral nervous system. Which neurons in the body should NOT be affected by GBS?
   A. those in the arms and legs
   B. those in the abdominal cavity
   C. those that innervate the heart
   D. those in the spinal cord

6. GBS can eventually lead to muscle paralysis due to demyelination of peripheral nerves. The BEST explanation for this would be that:
   A. The peripheral nerves can no longer conduct action potentials due to a lack of myelin.
   B. The muscle cells no longer respond to acetylcholine at the neuromuscular junction.
   C. The sodium-potassium pumps in the neurons are not functioning properly.
   D. The brain is failing to send the appropriate signals to the peripheral nerves.

7. Based on the information provided in the passage, GBS could BEST be described as:
   A. a dominant genetic disorder
   B. a sex-linked genetic disorder
   C. an autoimmune disorder
   D. an infectious disease

8. Plasmapheresis seems to help many patients with GBS. The MOST reasonable explanation for why plasmapheresis would alleviate the symptoms of GBS would be that:
   A. Replacing the plasma would decrease the number of lymphocytes attacking myelin of the peripheral nerves.
   B. There would be less of an attack on peripheral myelin when the antibodies against myelin are removed with the plasma.
   C. Replacing the plasma makes the immune system more capable of fighting the infections that are characteristic of GBS.
   D. Replacing the plasma would remove any toxins responsible for the symptoms.

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Questions 9–12 are based on the following passage.

Passage II

The thyroid gland is best known for its role in the regulation of metabolism via triiodothyronine (T3) and thyroxine (T4). Thyroid-stimulating hormone (TSH) is secreted by the pituitary gland in response to declining levels of T3 and T4. TSH activates the thyroid gland to release T3 and T4, which are stored as thyroglobulin (bound to protein). T3 is about five times more physiologically potent than T4. Thyroglobulin is enzymatically converted to T3, T4, and globulin, and T3 and T4 are released. T4 is converted in the liver to T3 and reverse T3 (RT3). About 80% of T3 comes from T4 conversion and the other 20% comes directly from the thyroid gland. Reverse T3 blocks the action of T3 and T4 by occupying T3 and T4 cell receptor sites.

A symptom of a thyroid hormone abnormality is the swelling of the thyroid that is referred to as a goiter, which can necessitate a portion or even all of the thyroid gland being surgically removed. After the surgery, synthetic hormones are given in an attempt to regulate the metabolism. Because the thyroid also deals with calcium homeostasis, complete removal of the thyroid can cause calcium levels to become extremely low.

The following data was collected from blood drawn to complete a thyroid panel on a patient suffering from a goiter:

	Patient Values	Expected Normal Values
Triiodothyronine (T3)	6.5 pg/mL	2.3–4.2 pg/mL
Thyroxine (T4)	14.2 μg/dL	4.5–12 μg/dL
Thyroid-stimulating hormone (TSH)	0.10 μIU/mL	0.35–2.5 μIU/L

9. Which conclusion is BEST supported by the data?
   - **A.** This individual has hypothyroidism, which is caused by low levels of TSH.
   - **B.** This individual has hypothyroidism, which is caused by abnormally low levels of thyroglobulin.
   - **C.** This individual has hyperthyroidism, which is due to decreased levels of T3.
   - **D.** This individual has hyperthyroidism, which is caused by elevated levels of T3.

10. After complete thyroid removal (which includes removal of the parathyroids), a patient's blood calcium becomes very low. Which of the following responses could potentially help increase calcium levels?
    - **A.** activation of osteoclasts to degrade bone tissue
    - **B.** activation of osteoblasts to build bone tissue
    - **C.** taking synthetic calcitonin
    - **D.** taking synthetic calcitonin in combination with parathyroid hormone

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11. Hyperthyroidism can have multiple causes. All of the following endocrine structures could produce hormones that could potentially be involved with hyperthyroidism EXCEPT:
    A. the hypothalamus
    B. the anterior pituitary gland
    C. the thyroid gland
    D. the adrenal glands

12. An individual is producing normal levels of T3 and T4, but they do not seem to be functioning properly. The MOST likely problem is a deficiency of:
    A. calcium
    B. sodium
    C. potassium
    D. iodine

Questions 13–16 are based on the following passage.

Passage III

The process of induced erythrocythemia, or blood doping, has become common among certain circles of athletes such as cyclists. The purpose of blood doping is to provide an endurance advantage to the athlete. There are several ways to induce erythrocythemia, including the injection of synthetic oxygen carriers, blood transfusions, and the injection of hormones.

Synthetic oxygen carriers are modified proteins that have a relatively high affinity for oxygen. These can provide short-term increases in the oxygen-carrying ability of blood, but they are quickly degraded. Blood transfusions can be used right before an athletic event. The transfused erythrocytes can be homologous in nature, meaning that they are harvested from a donor's blood, or they can be autologous, meaning they are removed from the athlete 5 to 10 weeks before the event and stored. The cells are then reinfused right before an athletic event. Another approach to blood doping involves injections of the hormone erythropoietin (EPO). The EPO used for this purpose is a recombinant molecule. It is available by prescription for certain medical conditions, but it has been widely abused by some athletes.

Testing for blood doping is not always conclusive. For autologous or homologous transfusions, the only indicator of doping is an elevated hematocrit or hemoglobin count, which is not conclusive evidence of doping. If EPO is being used, it can be detected in the urine but only for short periods of time. Further, the recombinant version of EPO is hard to distinguish from the natural version, and certain other proteins present in the urine may resemble EPO.

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13. What sort of benefit would blood doping provide an athlete?
    - **A.** It would increase the number of white blood cells, making the athlete less likely to develop infections.
    - **B.** It would increase the clotting ability of the athlete's blood, making the athlete less likely to lose large volumes of blood in the event of an injury.
    - **C.** It would increase the number of red blood cells that can provide more oxygen to produce more ATP during aerobic cellular respiration.
    - **D.** It would decrease the viscosity of the blood, making it easier for the heart to pump.

14. Some athletes prefer the use of autologous transfusions as compared to homologous transfusions. What would be a potential benefit of an autologous transfusion?
    - **A.** It would provide more erythrocytes, since some of the ones from a homologous transfusion will die while the blood is in storage waiting to be infused.
    - **B.** It would require longer-term advantages in athletic performance as compared to a homologous transfusion.
    - **C.** It would make it easier to train more vigorously right after the blood was removed from the athlete.
    - **D.** It would provide less risk of the transmission of diseases or transfusion reactions as compared to a homologous transfusion.

15. Erythropoietin (EPO) can be a life-saving drug for patients with certain medical conditions. Which of the following conditions could MOST likely be helped by the injection of EPO?
    - **A.** coronary artery disease
    - **B.** hypotension
    - **C.** renal failure
    - **D.** anemia

16. If the autologous doping procedure requires the removal of cells from the athlete and later those cells are reinfused into that same person, how can this provide an advantage?
    - **A.** The athlete has become used to functioning with fewer red blood cells after the removal, so the reinfusion provides an extra boost before a performance.
    - **B.** The erythrocytes removed from the individual have been naturally replaced after the procedure, so the number of erythrocytes in circulation after the reinfusion is greatly increased.
    - **C.** The reinfusion increases the ability for the cells to tolerate anaerobic respiration and lactic acid production for longer periods of time.
    - **D.** The autologous procedure really does not provide any measurable benefits to the athlete.

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Questions 17–20 are not based on a passage.

17. The hormone that is NOT released by the anterior pituitary gland is:
    A. growth hormone
    B. antidiuretic hormone
    C. thyroid-stimulating hormone
    D. follicle-stimulating hormone

18. Curare is an arrow poison that binds to ACh (acetylcholine) receptors and prevents this neurotransmitter from exerting its usual physiological action. The likely effect of curare is:
    A. diminished heart rate
    B. an increase in nerve conduction
    C. paralysis
    D. rapid breathing

19. Oxygen tensions in the alveoli (AL), the pulmonary artery (PA), and the pulmonary vein (PV) are all different. Given the dynamics of gas exchange in the lungs, the appropriate values of partial pressures for each of these three sites are:
    A. AL: 40 mm Hg; PA: 160 mm Hg; PV: 100 mm Hg
    B. AL: 40 mm Hg; PA: 100 mm Hg; PV: 160 mm Hg
    C. AL: 100 mm Hg; PA: 40 mm Hg; PV: 160 mm Hg
    D. AL: 160 mm Hg, PA: 40 mm Hg; PV: 100 mm Hg

20. Venous blood coming from the head area in humans returns to the heart through the:
    A. subclavian vein
    B. vein of Galen
    C. jugular vein
    D. superior vena cava

Questions 21–26 are based on the following passage.

Passage IV

The protein mucin 1 (MUC1) is found on the surface of glandular epithelial cells, typically on the apical surface. MUC1 contributes to the formation of mucus barriers on surfaces. MUC1 displays extensive O-linked glycosylation on its extracellular domain. The functions of MUC1 include cell signaling as well as preventing infection via binding to pathogens on surfaces of the body.

A number of diseases including various carcinomas are associated with overexpression or changes in glycosylation patterns of MUC1. Breast and pancreatic cancers are examples of MUC1-associated carcinomas. These cancers are characterized by a variety of features including excessive binding of growth factors, interference with anti-tumor mechanisms, reduction of p53-mediated apoptosis, increased invasiveness leading to metastasis, and interference with chemotherapeutic agents.

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21. The glycosylated domains of MUC1 can bind to growth factors and concentrate them near their receptors. How might the overexpression of MUC1 be correlated with cancer?
    - **A.** MUC1 acts as a growth factor when overexpressed.
    - **B.** Increased growth factors' access to receptors causes increased cell proliferation.
    - **C.** The binding of growth factors prevents them from signaling the cells.
    - **D.** Growth factor binding prevents immune recognition of the cells, allowing them to proliferate excessively.
22. The overexpression of glycosylated MUC1 seen in various cancers can interfere with access of hydrophobic chemotherapeutic drugs to the cells. Why would this be?
    - **A.** Glycosylation decreases the hydrophilic properties of the MUC1 protein.
    - **B.** Glycosylation increases the efflux pump ability of membrane proteins to remove chemotherapeutic drugs from the cell.
    - **C.** Glycosylation increases the ability of MUC1 to bind chemotherapeutic drugs and prevent them from entering the cell.
    - **D.** Glycosylation increases the hydrophilic properties of the MUC1 protein.
23. MUC1 is typically found on epithelial cells. Which of the following would be expected to express MUC1?
    - **A.** cardiac muscle
    - **B.** liver
    - **C.** lymphocytes
    - **D.** intestinal lining
24. Mucin 1 Kidney Disease (MKD) is caused by an abnormal buildup of MUC1 in kidney cells that leads to progressive kidney failure. Since this protein should normally be directed to the plasma membrane, what organelle is likely to be malfunctioning that would cause the protein to stay in the cell?
    - **A.** smooth endoplasmic reticulum
    - **B.** lysosomes
    - **C.** Golgi apparatus
    - **D.** ribosomes
25. Mucin 1 Kidney Disease (MKD) is caused by a mutation in the MUC1 gene. A single copy of the mutant form of the gene causes symptoms of the disease in men and women. What pattern of inheritance would this indicate?
    - **A.** sex-linked
    - **B.** autosomal dominant
    - **C.** autosomal recessive
    - **D.** mitochondrial

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26. The mutation associated with MKD is caused by a cytosine insertion in the variable number tandem repeat (VNTR) region in MUC1. VNTRs are associated with:
    A. telomeres
    B. satellite DNA
    C. promoter sequences
    D. regulatory elements

This is the end of the Unit III Minitest.

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Unit III Minitest Answers and Explanations

1. **The correct answer is A.** During a muscle contraction, the sarcomeres contract as the result of myosin heads attaching to actin and pulling the fibers inward. In order for this to occur, ATP and calcium are required. If there were excessive amounts of calcium, you would expect more contractions to occur.
2. **The correct answer is A.** Of the hormones listed, the only one that is involved with water levels and the kidneys is antidiuretic hormone. The hormone increases water reabsorption in the nephrons, increasing blood volume and pressure, and decreasing urine volume. Thyroid-stimulating hormone acts on the thyroid gland to regulate metabolism. Glucagon stimulates the breakdown of glycogen to increase blood sugar levels. Calcitonin is used to decrease blood calcium levels and stimulate osteoblasts to build new bone matrix.
3. **The correct answer is C.** Pulmonary gas exchange is always based on simple diffusion. Diffusion allows for the movement of a substance from an area of high concentration of the substance to an area of low concentration of the substance. Depending on the concentrations, oxygen and carbon dioxide will move in variable directions. Choices A, B, and D indicate that the movement of gases always occurs in a fixed direction, which is incorrect.
4. **The correct answer is C.** The hypothalamus is located in the brain, which allows choice D to be eliminated immediately. The cerebrum is the largest portion of the brain that is divided into right and left hemispheres, which are connected by the corpus callosum. The processing of conscious thought and sensory information occurs in the cerebrum. The brain stem consists of the pons (connects the spinal cord to the cerebellum), medulla oblongata (reflex centers for vital functions), and reticular activating system (the activating system for the cerebrum). The hypothalamus and thalamus are both located in the diencephalon. The hypothalamus is involved in endocrine regulation as well as regulating conditions such as thirst and hunger.
5. **The correct answer is D.** This question is asking for a simple understanding of the structures of the peripheral nervous system as compared to the central nervous system. The central nervous system is composed of the brain and spinal cord, while the peripheral nervous system is composed of nerves outside of the brain and spinal cord. Because Guillain-Barré syndrome before (GBS) affects only the peripheral nervous system, the neurons in the central nervous system should be unaffected. Of the choices listed, the neurons of the arms and legs, abdominal cavity, and heart are all part of the peripheral nervous system and subject to GBS. The neurons of the spinal cord are part of the central nervous system and should be unaffected by GBS.

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6. **The correct answer is A.** The myelin sheath is used to insulate the axons of neurons. Within the myelin sheath there are gaps, known as nodes of Ranvier, where the myelin is absent. Action potentials move down the axon and jump from one node to the next. When the myelin is removed, the gap from one node to the next becomes so large that the action potential can no longer jump the gap. This means that the action potential never reaches the end of the neuron, and the message is not passed to other neurons. Choice A is most indicative of this problem. Choice B suggests that the problem is with the response of muscle cells to the neurotransmitter acetylcholine. If the action potential never reaches the end of the neuron, acetylcholine will not be released to the neuromuscular junction; therefore, the issue is not with the muscle cells' response. The sodium-potassium pumps are used to maintain resting potential in neurons, and there is nothing in the passage or question that would indicate that there is a problem with this. Because GBS is not a problem with the central nervous system, there would be no logical reason to assume that the problem is with the brain.
7. **The correct answer is C.** The passage described Guillain-Barré syndrome (GBS) as a disorder with unknown causes that leads to the production of antibodies from the immune system that attack the peripheral myelin. Because there was no pattern of inheritance stated and the disease is unpredictable in terms of who it strikes, there would be no reason to think this is a genetic condition. This allows choices A and B to be eliminated. The passage mentions that GBS can follow an infection in some but not all cases. No other evidence was provided to suggest that GBS is an infection. This leaves choice C as the best answer. Autoimmune diseases are characterized by an immune response to self-structures. Because the immune system is producing antibodies against the peripheral myelin, this would count as an autoimmune condition.
8. **The correct answer is B.** The passage described plasmapheresis as the separation of blood and plasma where the plasma is discarded and the blood cells are returned to the patient as donated or synthetic plasma. If this helps with the symptoms of GBS, this would indicate that something in the plasma is causing the problem. The passage indicated that antibodies against myelin cause the demyelination characteristic of GBS. Plasma cells secrete antibodies into fluids of the body, including plasma. By removing the plasma, the antibody concentration is decreased, leading to a reduced level of attack on peripheral myelin.

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9. **The correct answer is D.** According to the data, TSH levels are low and T3 and T4 levels are elevated. Choice B suggests that the problem is related to thyroglobulin levels. Because this is not mentioned in the data, choice B can be eliminated. Choice C directly contradicts the data. The data show increased levels of T3 (when compared to expected values) and the choice indicates that T3 levels are decreased. The passage indicates an inverse relationship between TSH and T3/T4. When TSH is high, this is in response to low T3 and T4. When TSH is low, this is in response to high levels of T3 and T4. T3 and T4 directly regulate metabolism, so it makes sense that if their levels are elevated, metabolism increases. This is characteristic of hyperthyroidism. If T3 and T4 levels were decreased, metabolism should slow, indicating hypothyroidism. As a response to this condition, TSH levels would rise. Based on the data given, choice A should be eliminated because hypothyroidism would cause an increase in TSH levels. This leaves choice D as the only option. The elevated levels of T3 would be characteristic of hyperthyroidism.
10. **The correct answer is A.** To answer this question, you need to be familiar with mechanisms used in the body to maintain calcium homeostasis and bone cell action. The hormones calcitonin and parathyroid hormone both regulate blood calcium levels. Calcitonin, secreted by the thyroid gland, decreases blood calcium by storing excess calcium in bone matrix due to the activity of osteoblasts. Parathyroid hormone, secreted by the parathyroid glands located on top of the thyroid, is antagonistic to calcitonin and increases blood calcium levels. Osteoblasts are bone cells that build bone tissue when there is excess calcium. Their activity is regulated by calcitonin. When active, osteoblasts reduce blood calcium levels. Osteoclasts break down bone tissue and are regulated by parathyroid hormone. When active, osteoclasts increase blood calcium levels. If a patient has had his or her thyroid and parathyroids removed, it would be safe to assume that calcitonin and parathyroid levels would be decreased, making it difficult to regulate blood calcium levels. Choice B suggests that activating osteoblasts would help increase calcium levels. Because osteoblasts build bone and decrease blood calcium, this would actually further decrease the calcium levels in the blood. Taking synthetic calcitonin as suggested by choices C and D would only decrease calcium levels further as calcitonin activates osteoblasts. One potential solution to increase blood calcium levels would be to increase bone matrix breakdown as suggested by choice A. Osteoclasts are the bone cells responsible for this response.
11. **The correct answer is D.** This question relies on your knowledge of the endocrine system. The thyroid gland itself produces T3 and T4 that could be involved with hyperthyroidism, thus eliminating choice C. The thyroid is regulated by thyroid-stimulating hormone (TSH) secreted by the anterior pituitary gland, which eliminates choice B. The anterior pituitary gland is regulated by hormones from the hypothalamus, eliminating choice A. Therefore, the hypothalamus, anterior pituitary, and thyroid gland all could potentially have a role in a thyroid problem. The adrenal glands do not secrete any hormones related to thyroid function, making choice D the correct answer.

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12. **The correct answer is D.** This question requires an understanding of the requirements of T3 and T4. Without a certain mineral, neither hormone can function properly. Both T3 and T4 require iodine from the diet to function.
13. **The correct answer is C.** The passage explains that blood doping is used to increase erythrocyte counts in the athlete. Since the function of erythrocytes and hemoglobin is to carry oxygen, it would be expected that an increase in red blood cell count would allow for more oxygen to be transported. This oxygen would be used for electron transport in aerobic cellular respiration, which produces ATP to be used by the athlete.
14. **The correct answer is D.** You know that autologous transfusions come from the athlete's own blood and homologous transfusions come from someone else's blood. Just as is the case with any type of transfusion, there can be problems with incompatibilities or with infectious agents that can be transmitted by infected tissues. Whether the blood transfusion is homologous or autologous, there would be no difference in the ability to carry oxygen by the erythrocytes that would provide an athletic advantage. Autologous transfusions would provide no more erythrocytes than a homologous transfusion. In fact, autologous transfusions often contain fewer cells.
15. **The correct answer is D.** Erythropoietin (EPO) stimulates the cells of the bone marrow to differentiate into new red blood cells. Of the conditions listed, anemia is characterized by a low erythrocyte or hemoglobin count. In this case, additional EPO could stimulate the production of more erythrocytes to correct the condition. Coronary artery disease, hypotension, and renal failure are not associated with erythrocyte deficiencies.
16. **The correct answer is B.** Once the erythrocytes have been collected, the athlete has a low erythrocyte count. His or her own erythropoietin (EPO) is released to stimulate the production of new cells and return the erythrocyte count to normal within a few weeks (similar to what happens to anyone who donates blood). When the erythrocytes are reinfused in the athlete who already has a normal count, they now have extra erythrocytes that can carry more oxygen in the body and perhaps provide an athletic advantage.
17. **The correct answer is B.** The hormones released by the anterior pituitary gland include: growth hormone, prolactin, melanocyte-stimulating hormone, endorphins, enkephalins, thyroid-stimulating hormone, adrenocorticotropic hormone, follicle-stimulating hormone, and luteininzing hormone. The hormones released by the posterior pituitary gland include oxytocin and antidiuretic hormone.
18. **The correct answer is C.** Acetylcholine is a neurotransmitter found in both the central nervous system (CNS) and the peripheral nervous system (PNS). Because of its presence and function in the CNS and PNS, the impairment of acetylcholine as a direct result of curare exerts a devastating effect on the human body, that is, paralysis.

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19. **The correct answer is D.** The pulmonary artery carries deoxygenated blood to the lungs. One would therefore expect it to have the lowest oxygen tension. Blood entering the capillaries around the alveoli from the pulmonary artery does, in fact, have a pO_2 of around 40 mm Hg. Not surprisingly, since it is the source of the O_2 used by the body, inspired air in the alveoli has the highest of the partial pressures, 160 mm Hg. By the time the blood has passed through the capillary beds around the alveoli and into the pulmonary vein, its pO_2 has been raised from 40 mm Hg to 100 mm Hg, which is also the average pO_2 of the air in the alveoli. So the correct values of partial pressures with the corresponding sites are AL: 160 mm Hg, PA: 40 mm Hg; PV: 100 mm Hg.
20. **The correct answer is D.** Veins are vessels that carry deoxygenated blood (with the exception of the pulmonary vein) from the systemic circulation to the heart. The subclavian veins, found underneath the clavicle or collarbone, return blood from the arms to the heart. The jugular veins, found in the neck, drain blood from the head into the subclavian veins. The superior vena cava is the vein that directly returns blood into the right atrium of the heart. The vein of Galen drains blood from the deep parts of the brain.
21. **The correct answer is B.** The cell cycle is stimulated by growth factors that allow cells to progress past checkpoints in the cell cycle. Increasing the ability of growth factors to bind their receptors will serve as a signal for increased cell cycle activity. This will lead to increased cell proliferation which is one characteristic of cancerous cells.
22. **The correct answer is D.** Glycosylation of MUC1 will increase the hydrophilic property of the molecule. Because the question specifies hydrophobic chemotherapeutic agents, the properties of these molecules would cause problems in interactions with the hydrophilic regions of MUC1.
23. **The correct answer is D.** This question relies on recollection of epithelial tissues. Of those listed, the intestinal lining cells are the only ones classified as epithelial cells.
24. **The correct answer is C.** If the MUC1 protein is meant to be directed to the plasma membrane but it being retained in the cell, something has signaled the Golgi apparatus to direct the protein to the wrong location. While the glycosylation would occur in the endoplasmic reticulum, the sorting and directing would occur in the Golgi apparatus.
25. **The correct answer is B.** In this case, a heterozygous individual expresses symptoms of the disease. Because a single copy of the mutant allele leads to disease, this would indicate that the mutant allele behaves according to a dominant pattern of inheritance. Since a gender imbalance was not mentioned, it can be assumed that this is not a sex-linked pattern of inheritance.
26. **The correct answer is B.** Variable number tandem repeats (VNTRs) are satellite DNA sequences. These are often found in centromeres and telomeres.

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