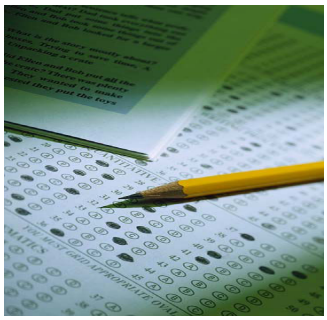
KAPLAN TEST PREP AND ADMISSIONS



USMLE Practice Questions

Directions:
The USMLE Step 1 exam tests the Basic Sciences.
Designed for US Medical Student's in their second year of Medical School, before their Clinical Rotations, International Medical Graduates will often struggle with going back to basics, and thinking like a pre-clinical student, rather than a qualified Physician.
Look at the sample USMLE questions below and explore the sorts of questions you'll face on the exam. The USMLE Step 1 exam questions are in Clinical Vignette format, meaning that you will be asked to pull on information from a number of different disciplines and organ systems and that you will be required to make a number of conclusions based on the limited information provided.
This means if you do not have enough knowledge to make numerous conclusions on a topic then you're likely to get the question wrong.

You will see below a number of USMLE questions with multiple choice answers.
There is one best answer and no negative marking on the USMLE exam, so we recommend you guess if you are unsure or running out of test time. Click on the get answer button to download the answers and explanations.

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Question 1 - Anatomy

A neonate presents with tachycardia, tachypnea, diaphoresis, and poor feeding. On examination, a continuous murmur is auscultated. A patent ductus arteriosus is diagnosed. Which of the following describes the function of the ductus arteriosus during fetal life?

A. It differentiates into the mitral valve
B. It shunts deoxygenated blood from the aorta to the pulmonary artery
C. It shunts deoxygenated blood from the pulmonary artery to the aorta
D. It shunts oxygenated blood from the aorta to the pulmonary artery
E. It shunts oxygenated blood from the pulmonary artery to the aorta

Answers and Explanations

E

The ductus arteriosus shunts oxygenated blood from the pulmonary artery into the aorta. In the fetus, the right ventricle is the "workhorse" of the circulatory system. Highly oxygenated blood from the right ventricle is ejected into the pulmonary artery. From the pulmonary artery, blood moves either into the ductus arteriosus (88%) or into the pulmonary circulation (12%). In the fetus, the venous system carries oxygenated blood. Thus, choices B, C, and D are incorrect.

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Question 2 - Physiology

An experiment is conducted to determine the difference between skeletal and smooth muscle contraction. Isolated guinea pig intestine and skeletal muscle are stimulated, and the contractile properties of each are studied. The two muscle types differ because skeletal muscle contraction, but not smooth muscle contraction, requires which of the following?

A. Actin
B. Calmodulin
C. Myosin
D. Myosin light-chain kinase
E. Troponin

Answers and Explanations

E

Skeletal muscle contractions are initiated by Ca^{2+} binding to troponin, whereas smooth muscle contractions are initiated by myosin light-chain phosphorylation. In skeletal muscle, action potentials in the muscle cells depolarize T tubules. This depolarization opens Ca^{2+} channels on the sarcoplasmic reticulum, causing the release of Ca^{2+} stores into the intracellular fluid. The Ca^{2+} binds troponin on the thin filaments, causing a conformational change in troponin that moves tropomyosin out of the way, allowing myosin and actin to bind. ATP binds to the myosin, causing a conformational change in myosin, which allows myosin to be released from actin. ATP is hydrolyzed to ADP, and ADP remains attached to myosin. Myosin attaches to another site on actin (power stroke) to shorten the sarcomere, then ADP is released and the cycle repeats again as long as Ca^{2+} is bound to troponin.

Smooth muscle contraction is different because there is no troponin. Ca^{2+} is released from the sarcoplasmic reticulum and binds calmodulin. The Ca^{2+} -calmodulin complex binds and activates myosin light-chain kinase, which then phosphorylates myosin and allows it to bind the actin. This action results in sarcomere shortening. Therefore, actin (choice A) and myosin (choice C) are incorrect because these are present in both skeletal and smooth muscle. Calmodulin (choice B) and myosin light-chain kinase (choice D) are required for smooth muscle, but not skeletal muscle, contraction.

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Question 3 - Biochemistry

A 57-year-old man has crushing substernal chest pain for several hours. Upon admission to the emergency department, physicians diagnose him with acute myocardial infarction. Subsequent testing in the coronary care unit reveals that this patient has significant hyperhomocysteinemia, which may have contributed to his infarction. Chronic administration of which of the following will lower his serum homocysteine levels and possibly reduce his risk of subsequent infarcts?

A. Arginine
B. Folate
C. Vitamin A
D. Vitamin B_1
E. Vitamin B_6

Answers and Explanations

B

Hyperhomocysteinemia can lead to an increased risk of atherosclerotic disease. One of the primary causes of hyperhomocysteinemia, folate deficiency, has been linked to both conditions. A lack of folate prevents the conversion of homocysteine to methionine with subsequent accumulation of homocysteine. Although elevated serum levels of homocysteine have been linked to atherosclerothic disease, the exact mechanism is not well known. One current hypothesis suggests that homocysteine may have a cytotoxic and desquamative effect on endothelial cells, thus leading to atherosclerosis.

Allthough some scant evidence has shown that increasing intake of arginine (choice A) leads to reduction in the atherosclerosis, increasing serum arginine would not reduce levels of homocysteine.

Vitamin A (choice C), a lipid-soluble vitamin important for vision and skin integrity, is not known to participate in homocysteine metabolism.

Vitamin B_1, or thiamine (choice D), is not associated with hyperhomocysteinemia. Thiamine deficiency results in psychosis, ophthalmoplegia, and ataxia.

Vitamin B_6, or pyridoxine (choice E), does not participate in homocysteine metabolism. It can, however, prevent neurotoxicity associated with isoniazid.

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Question 4 - Microbiology

A bank teller in New York City, who is HIV-positive, is brought into emergency department by his partner. Over the past month, the man has been having increasing episodes of disorientation, and this evening he became aggressive and incoherent. His partner tells the attending physician that the man has been unable to afford the prescribed antiretroviral drugs since he was terminated from his job a year ago. Routine blood testing reveals a CD4 count of 190/mm^3, and a CT scan of the brain demonstrates ring-enhancing lesions. What is the treatment of choice?

A. Amodiquine
B. Iodoquinol
C. Metronidazole
D. Pyrimethamine plus sulfadiazine
E. Trimethoprim sulfamethoxazole

Answers and Explanations

D

This patient is suffering from *Toxoplasma* encephalitis, which is a common infection in full-blown AIDS. *Toxoplasma gondii* is the most common parasitic infection in the United States, with up to 70% of the population seropositive. In normal individuals, it causes a subclinical lymphadenopathy resembling mononucleosis, but in immunodepressed individuals, these inapparent infections can reactivate, most frequently causing damage to brain and retina. The parasites are intracellular in humans, and as they multiply they cause increasing areas of necrosis (ring-enhancing lesions), which are visible by radiology or head CT. The treatment of choice for *Toxoplasma* encephalitis is pyrimethamine plus sulfadiazine, and many HIV-positive patients are put on prophylaxis against this agent when their CD4 count falls below 200.

Amodiaquine (choice A) is a drug used in the treatment of malaria. It is effective in killing the erythrocytic forms of this parasite, which cause the symptoms in humans.

Iodoquinol (choice B) is the drug of choice for treatment of tissue-invasive *Entamoeba histolytica*. Metronidazole is used against the luminal parasites, but if there is evidence of extraintestinal invasion, iodoquinol is necessary.

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Metronidazole (choice C) is the drug of choice for the luminal phases of *Entamoeba histolytica*, as well as *Giardia lamblia* and *Trichomonas vaginalis*.

Trimethoprim sulfamethoxazole (choice E) is the drug of choice for treatment of *Pneumocystis carinii* pneumonia in full-blown AIDS. It is also used prophylactically in AIDS patients but would not be the drug of choice against *Toxoplasma* encephalitis.

Question 5 - Immunology

A 3-year-old girl is stung by a bee while playing in the yard, and her mother finds her unconscious and cyanotic. She is taken to the emergency department where epinephrine is administered and the girl recovers. Which of the following mediated this girl's reaction to the sting?

A. IgA
B. IgE
C. IgG
D. IgM
E. T cells

Answers and Explanations

B

Many reactions to plant stings, animal stings, or drugs are IgE-mediated responses (type 1, or immediate hypersensitivity reactions). Such reactions include anaphylaxis, urticaria, and angioedema. In such reactions, an initial exposure to the antigen occurs, initiating B-cell proliferation and formation of IgE antibodies. When subsequent exposure occurs, sensitized mast cells and basophils release histamines, kinins, prostaglandins, and leukotrienes. The consequences can be profound, such as the vascular collapse seen in anaphylaxis. Treatment for anaphylaxis is immediate administration of epinephrine.

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IgA (choice A) antibodies are secreted at mucosal surfaces, such as the gut lumen, and in secretions, such as tears and breast milk. They do not participate in type 1 hypersensitivity reactions.

IgG (choice C) and IgM (choice D) participate in circulating humoral immunity with IgM participating in the acute phase of infection and IgG participating in the senescent phase of infection, as well as chronic humoral "maintenance". They do not participate in acute hypersensitivity reactions.

T cells (choice E) are not involved in immediate hypersensitivity reactions.

Question 6 - Pathology

A 6-year-old boy is evaluated for kidney disease. The only significant past medical history is a streptococcal throat infection 3 weeks ago. Light microscopic evaluation of a kidney biopsy is negative for any glomerular pathology. Blood tests demonstrate elevated levels of cholesterol but decreased levels of albumin. Urine tests are positive for protein. On physical examination, blood pressure is 110/70 mm Hg and there is pitting edema in the lower extremities, as well as a small amount of periorbital swelling. The body denies any diarrhea or pain on urination. The patient is treated and makes a full recovery. Which of the following lowing is the most likely diagnosis?

A. Acute nephritic syndrome
B. Acute pyelonephritis
C. Minimal change disease
D. Postinfectious glomerulonephritis
E. Rapidly progressive glomerular nephritis

Answers and Explanations

C

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Minimal change disease (lipoid nephrosis) is the most common cause of nephrotic syndrome in children. Individuals with nephrotic syndrome waste large amounts of protein in the urine (>3 g/day). They also have low serum albumin, edema, and hyperlipidemia. Light microscopic evaluation of minimal change disease, as the name suggests, is unremarkable. On electron microscopy, effacement of the podocyte foot process can be noted.

Acute pyelonephritis (choice B) represents an infection of the collection system. There would be pain on urination, with fever and costovertebral angle tenderness.

Postinfectious glomerulonephritis (choice D) is associated with tea-colored urine; urine may be positive for protein but not to the level seen in nephritic syndrome. On light microscopic evaluation, there is leukocyte infiltration involving all areas of the glomeruli. It is also associated with hypertension, giving the classic nephritic syndrome pattern (choice A).

Rapidly progressive glomerulonephritis (RPGN; choice E) is associated with severe insults to the glomeruli. RPGN II can be postinfectious and is associated with the development of immune complexes.

Question 7 - Pharmacology

A chemist is accidentally exposed to an experimental nerve gas. Within minutes, he begins to experience severe spastic muscular paralysis, hypotension, bradycardia, vomiting, and excessive secretion of tears from his eyes and saliva from his mouth. After quickly administering the antidote, an atropine injection, he soon recovers from his symptoms, although he continues to exhibit muscular spasms for a longer time. Which of the following biochemical events does this nerve gas affect?

A. Breakdown of a neurotransmitter
B. Packaging of a neurotransmitter
C. Receptor binding of a neurotransmitter
D. Reuptake of a neurotransmitter
E. Synaptic release of a neurotransmitter
F. Synthesis of a neurotransmitter

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Answers and Explanations

A

The nerve gas described is an acetylcholinesterase inhebitor, which shares a biochemical mechanism with many insecticides, as well as such potent nerve gases as sarin or VX gas. These drugs inhibit the breakdown of acetylcholine (ACh), thereby potentiating the effects of this neurotransmitter. Among the actions of this neurotransmitter are stimulation of neuromuscular junctions via nicotinic ACh receptors, as well as the activation of parasympathetic effector sites via muscarinic ACh receptors. Therefore, the nerve gas would be expected to stimulate the neuromuscular junction, causing spastic paralysis of skeletal muscles (versus flaccid paralysis, which would occur if neuromuscular activity is blocked) and overstimulation of parasympathetic responses, including the reduction in heart rate and increased gastrointestinal motility, as well as salivation and lacrimation. The parasympathetic effects can be reversed by the use of atropine, which is an antagonist at muscarinic ACh receptors. Because nicotinic receptors are not affected by atropine, the chemist will continue to manifest skeletal muscle effects until the drug is eliminated.

Vesamicol prevents the packaging of ACh into synaptic vesicles (choice B).

Receptor antagonists would prevent the binding of a neurotransmitter to a receptor (choice C).

Acetylcholine is usually returned to the synapse in its metabolized form as choline. Drugs such as hemicholinium affect choline reuptake (choice D).

An agent that prevents the synaptic release of acetylcholine (choice E), causing flaccid paralysis, is botulinum toxin, which is produced by *Clostridium botulinum* and is associated with home-canned food.

The synthesis of ACh can be blocked by bromoacetylcholine (choice F).

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Question 8 – Behavioral Science and Biostatistics

A total of 1000 individuals with a body mass index (BMI) greater than 30 are recruited for a multicenter study focused on testing methods for controlling obesity. Study participants are randomly assigned to one of two groups: a treatment group, which is enrolled in a mentored weight loss program, or a control group, which is shown an educational video and given instructions on wight loss methods. Both groups have the same average weight at the start of the study. The weight of all study participants is assessed at the end of a 6-month trial, and the average weights of treatment and control groups are compared. Before formal statistical analyses are conducted, however, the researchers examine the general properties of the resulting data. This examination reveals the following results:

	95% of Sample in This Range	
	Low	High
Control group	154 lb	213 lb
Treatment group	133 lb	192 lb

Using this information, the researchers decide to make some determinations about the standard deviation and the variance for the two groups. An examination of the interval containing 95% of each group suggests which of the following?

A. Definitive conclusions about the standard deviations and the variances cannot be made without additional data
B. The standard deviations and the variances of both samples are different
C. The standard deviations and the variances of both samples are equal
D. The standard deviation of both samples is equal, but the variances are different
E. The standard deviations of both samples are different, but the variances are equal

Answers and Explanations

C

This questions tests the student's understanding of the concepts of standard deviation (s), variance (s^2), and the constant percentage of cases within 2 standard

deviations of the mean in the normal distribution. First, recall that the variance = (standard deviation)^2. This means that if 2 standard deviations are the same, then their variances must be the same as well (if $s_1 = s_2$, then $s_1^2 = s_2^2$). Next, recall that approximately 95% of cases in a normal curve will fall within 2 standard deviations of the mean. This suggests that the ranges presented in the above table constitute mean ±2s. In both groups, this range is 59; therefore, for both groups, mean ±2s = 59 (or 4 standard deviations total). Because these presented ranges are the same, the standard deviations (and the variances) for both groups must be the same.

The question does not ask for it, but notice that the standard deviation in both groups is 14.75 (or 59/4), and the variance is =217.56.

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