

USMLE-STEP-1^{Q&As}

United States Medical Licensing Step 1

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QUESTION 1

If the DNA strand shown below is used as a template for RNA polymerase, what would be the sequence of the resultant mRNA following transcription?

5'-CATTCCATAGCATGT-3'

A. 5'-ACAUGCUAUGGAAUG-3'

B. 5'-CAUUCCAUAGCAUGU-3'

C. 5'-GUAAGGUAUCGUACA-3'

D. 5'-UGUACGAUACCUUAC-3'

Correct Answer: A

Section: Biochemistry Transcription occurs in the 5' to 3' direction, and during this process RNA polymerase will move in the 3' to 5' direction relative to the template DNA strand. Therefore, the correct transcriptional product from the DNA template begins with its 5' ribonucleotide corresponding to the complementary deoxyribonucleotide of the 3' end of the template. None of the other RNA strands (choices B, C, D, and E) could be products generated from the template shown.

QUESTION 2

A member of a college fraternity, who had consumed a large amount of alcohol on a dare, is brought to the emergency room with vomiting and severe abdominal pain. Blood tests reveal that he has elevated serum levels of amylase and lipase. A tentative diagnosis of acute hemorrhagic pancreatitis is formulated. Which cells of the pancreas are directly involved in this condition?

A. alpha cells

B. beta cells

C. centroacinar cells

D. delta cells

E. F cells

Correct Answer: C

Section: Anatomy Centroacinar cells are components of the exocrine pancreas and they contain zymogen granules, which are released under the action of cholecystokinin from the duodenum. The zymogen granules contain inactive proenzymes that normally become activated within the duodenum. Premature activation of the pancreatic enzymes, such as trypsin, leads to autodigestion of the centroacinar cells of the pancreatic acini, which secrete these enzymes. This results in acute hemorrhagic pancreatitis which can be caused by excessive alcohol ingestion. All the other choices are cells of the endocrine pancreas, which secrete hormones. Alpha cells (choice A) secrete glucagon whereas beta cells (choice B) produce insulin. Delta cells (choice C) synthesize gastrin and somatostatin. F cells produce pancreatic polypeptide.

QUESTION 3

A 3-year-old girl develops gastroenteritis and a number of other children at the day care nursery that she attends are also affected. This was most likely caused by which of the following agents?

- A. *Balantidium coli*
- B. *Cryptosporidium parvum*
- C. *Entamoeba histolytica*
- D. *Giardia lamblia*
- E. rotavirus

Correct Answer: E

Section: Pathology and Path physiology Rotavirus is the most common cause of severe diarrhea worldwide and is most widespread in very young children. It is passed readily to others and can result in outbreaks such as described here. *B. coli* (choice A) is a ciliated intestinal protozoal parasite that is found mostly in the tropics. It is a rare cause of diarrhea in the United States. *C. parvum* (choice B) is a spore-forming protozoan that can cause severe diarrhea in immunocompromised individuals. *E. histolytica* (choice C) is another protozoan parasite. It infests the colon forming flask-shaped ulcers (i.e., having narrow neck and a wide base that undermines the adjacent mucosa). These organisms can also be carried in the portal circulation to the liver where they form characteristic "anchovy paste" abscesses. *G. lamblia* (choice D) is an intestinal flagellate that infests the upper small intestine. It is very common worldwide and is the most common intestinal protozoan parasite in the Western world. The majority of infected individuals remain asymptomatic but it can cause diarrhea that is usually mild but can be severe.

QUESTION 4

The parents bring a 5-month-old baby to the emergency room. It is their first child and they are insecure. The boy vomits frequently, seems to be constantly constipated, and has difficulties in defecation. A barium enema study reveals a region in the bowel that is collapsed and an enlarged colon above this area. Biopsy from the part of the bowel 1 in above the anus is sent to the laboratory and histological analysis reveals the absence of ganglia in this tissue. What is the most likely diagnosis?

- A. cholecystitis
- B. gastroesophageal reflux disease
- C. hirschsprung disease
- D. polymyositis
- E. temporary problem with no treatment required

Correct Answer: C

Section: Physiology Hirschsprung disease is a genetic disorder caused by the absence of enteric nerve cells in the wall of the sigmoid colon and/or rectum. The portion of the bowel wall without nerve ganglia (aganglionic) cannot relax in response to bowel content so that the stool builds up behind the obstruction. In some children the problems begin shortly after birth, other infants are not acutely ill, but develop chronic symptoms such as constipation or anemia. Cholecystitis (choice A), caused by inflammation of the gallbladder, gastroesophageal reflux disease GERD (choice B), and polymyositis (choice D), a disorder affecting esophageal skeletal muscle, do not affect the neuronal regulation of the large intestine. Hirschsprung disease is almost always treated by surgical removal of the affected bowel segment

and then joining the healthy bowel segments (choice E). A GI motility disorder might improve on its own due to the ability of the enteric nervous system in healthy GI tract portions to learn new motility patterns. However, it takes a very long time and the success is not certain.

QUESTION 5

Which of the following describes a possible adverse effect of long-term chronic treatment of schizophrenia with a phenothiazine such as fluphenazine?

- A. diarrhea, nausea, and vomiting
- B. reduced secretion of prolactin
- C. tardive dyskinesia
- D. Tourette syndrome
- E. weight loss

Correct Answer: C

QUESTION 6

As a hypothetical approach to treating the hyperglycemia associated with Type II diabetes, a drug firm proposes to develop an inhibitor of liver glycogen phosphorylase. What is the biochemical rationale for this approach to inducing hypoglycemia?

- A. Hepatic fatty acid oxidation will decrease leading to reduced energy production needed for gluconeogenesis.
- B. Hepatocytes will have a reduced capacity to store glucose following meals.
- C. Liver glucose output will be reduced early during fasting.
- D. The resultant increase in glycogen storage will inhibit glucose uptake by the liver, leading to increased usage in skeletal muscle.
- E. There will be an increase in hepatic gluconeogenesis.

Correct Answer: C

Section: Biochemistry During early fasting, as the level of glucose in the blood falls, the pancreas releases glucagon into the circulation to counter this drop. The major site of glucagon action is the liver. There it induces the activity of the glycogen phosphorylase leading to an increase in glucose release from glycogen stores. Thus, an inhibition of glycogen phosphorylase would limit the ability of the liver to provide glucose to the blood. Negatively affecting the activity of glycogen phosphorylase would not significantly affect the rate of hepatic fatty acid oxidation (choice A), skeletal muscle glucose usage (choice D), nor hepatic gluconeogenesis (choice E). The liver may have a reduced capacity for de novo storage of glucose following meals (choice B) due to a prior reduction in the release of glucose via the inhibition of glycogen phosphorylase; however, on fasting there would still be a reduction in glucose release.

QUESTION 7

A 20-year-old female tennis player has just won a tennis match on a warm summer day. Her blood pressure at this time is 135/70 with a heart rate of 140 beats per minute and a respiratory rate of 25 per minute. She is flushed and sweating profusely. Compared to the resting state, what can be said about the level of activity of sympathetic nerves to her heart and to her cutaneous vasculature?

- A. both are increased
- B. both are decreased
- C. neither is different from at rest
- D. sympathetic activity to the heart is decreased while that to the cutaneous vasculature is increased
- E. sympathetic activity to the heart is increased while that to the cutaneous vasculature is decreased

Correct Answer: E

Section: Physiology During exercise in the heat, blood flow must increase to the actively contracting muscles, as well as the cutaneous vessels to shunt heat from the interior of the body to the skin at the surface of the body. Activation of sweat glands allows cooling via evaporation from the surface of the skin. To increase blood flow to the muscles and the skin, it is necessary to increase sympathetic tone to the heart to increase cardiac output. Most sweat glands are activated by sympathetic cholinergic nerves that are activated during sweating. However, the cutaneous vasculature involved in bringing warm blood to the surface of the skin for cooling is constricted by a strong sympathetic tone at rest. During exercise, when body cooling is necessary, sympathetic tone to these cutaneous capillary loops is reduced, causing vasodilation and increased cutaneous blood flow, thus choice E is appropriate.

QUESTION 8

A 4-month-old boy presents with painful progressive joint deformity (particularly the ankles, knees, elbows, and wrists), hoarse crying, and granulomatous lesions of the epiglottis and larynx leading to feeding and breathing difficulty. Biopsy of the liver indicates an accumulation of ceramides. The observed symptoms and the results of the liver biopsy are indicative of which disease?

- A. Farber lipogranulomatosis
- B. fucosidosis
- C. Gaucher disease
- D. metachromic leukodystrophy
- E. Sandhoff-Jatzkewitz disease

Correct Answer: A

Section: Biochemistry Farber lipogranulomatosis is characterized by painful and progressively deformed joints and progressive hoarseness due to involvement of the larynx. Subcutaneous nodules form near the joints and over pressure points. Granulomatous lesions form in these tissues and there is an accumulation of lipid-laden macrophages. Significant accumulation of ceramide and gangliosides is observed, particularly in the liver. If these compounds accumulate in nervous tissue there may be moderate nervous dysfunction. The illness often leads to death within the first few years of life, although milder forms of the disease have been identified. Fucosidosis (choice B) is characterized by the accumulation and excretion of glycoproteins, glycolipids, and oligosaccharides- containing fucoside moieties. Symptoms of fucosidosis include psychomotor retardation, dystosis multiplex (a term referring to multiple skeletal

abnormalities), growth retardation, and coarse facial features. Gaucher disease (choice C) is characterized by an accumulation of glucosylceramide (glucocerebroside). Several forms of the disease have been identified and vary in severity. Typical symptoms include hepatosplenomegaly, bone lesions, and CNS involvement. Occasionally, the lungs and other organs may be involved. Metachromatic leukodystrophy (choice D) is a disorder of myelin metabolism. It is characterized by the accumulation of galactosyl sulfatide (cerebroside sulfate). Symptoms may appear at any age and include mental regression, urinary incontinence, blindness, loss of speech, peripheral neuropathy, and seizures. Sandhoff- Jatzkewitz disease (choice E) is a disorder related to Tay-Sachs disease. It is characterized by a defect in the degradation of GM2 gangliosides with symptoms of severe mental retardation, blindness, and early mortality.

QUESTION 9

Which of the following drugs has opioid antagonist actions and also reduces nicotine and alcohol craving in persons dependent on those drugs?

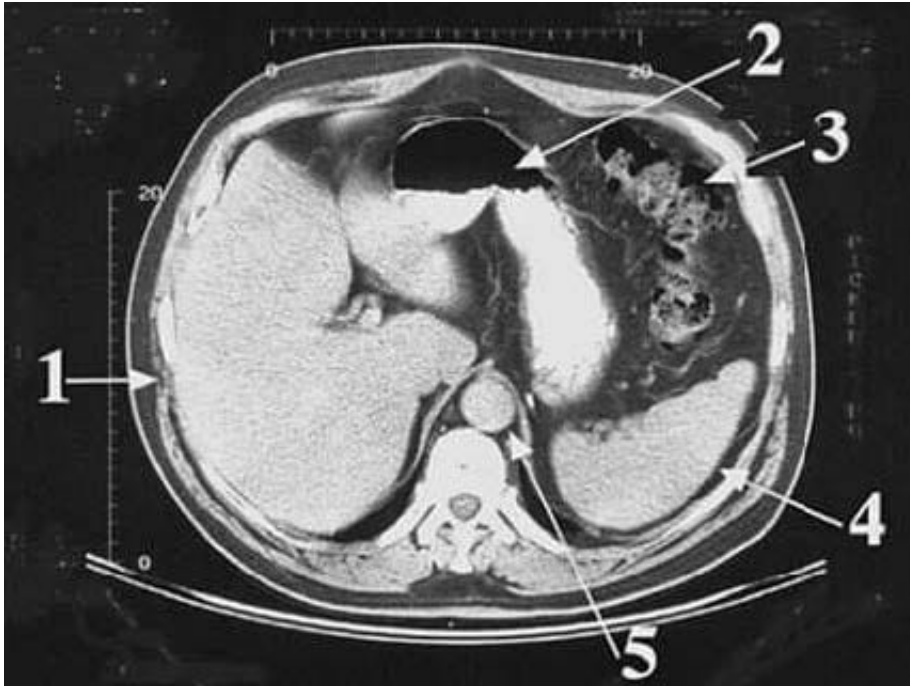
- A. bupropion
- B. flumazenil
- C. nalbuphine
- D. naloxone
- E. naltrexone

Correct Answer: E

Section: Pharmacology Naltrexone is a very long-acting opioid antagonist that has also been shown to reduce craving and dependence in smokers and alcoholics. The mechanisms for the latter effects are not fully understood. Bupropion (choice A) is an antidepressant that has some efficacy in tobacco dependence. It is not an opioid antagonist. Flumazenil (choice B) is a benzodiazepine antagonist that is useful in BDZ overdose. It has no opioid antagonist effect. Nalbuphine (choice C) is an opioid partial agonist that has analgesic effects but can also antagonize the actions of strong agonists like morphine. Naloxone (choice D) is a shortacting opioid antagonist but has not been shown to have efficacy in tobacco or alcohol dependence.

QUESTION 10

Arrow 4 in following figure, is pointing to which of the following structures?



- A. abdominal aorta
- B. colon
- C. liver
- D. spleen
- E. stomach

Correct Answer: D

Section: Anatomy The spleen (arrow 4) lies to the left of the abdominal cavity. It is in contact with the left side of the stomach (arrow 2) and lodges against the left paravertebral gutter. The abdominal aorta (choice A, arrow 5) is seen as the circular structure immediately anterior to the vertebra. The colon (choice B, arrow 3) is the convoluted structure to the left anterior aspect of the abdominal cavity. The large liver (choice C, arrow 1) occupies most of the right side of the abdominal cavity. The stomach (choice E, arrow 2) is located between the colon and the liver, and in this case, contains liquid contrast material.

QUESTION 11

A patient with newly diagnosed schizophrenia is given chlorpromazine. It is a drug that has amongst other effects moderate anticholinergic activity. As a consequence, which of the following is an expected side effect of this medication?

- A. bradycardia
- B. decreased GI sphincter tone
- C. dry mouth
- D. emptying of urinary bladder

E. increased GI motility

Correct Answer: C

Section: Physiology Chlorpromazine is an antipsychotic drug with anticholinergic action (i.e., it inhibits the effects of parasympathetic stimulation). Parasympathetic stimulation causes copious secretion by nasal, lacrimal, and parotid glands. Consequently, parasympathetic blockade is leading to a dry mouth. Parasympathetic fibers slow the heart rate and anticholinergic drugs cause tachycardia rather than bradycardia (choice A). Functions of the parasympathetic nervous system include decreasing GI sphincter tone, increasing GI motility, and increasing emptying of the rectum and urinary bladder. Parasympathetic blockade would thus cause increased GI sphincter tone (choice B), urinary retention (choice D), and decreased GI motility (choice E) leading to constipation.

QUESTION 12

A 25-year-old female presents to her doctor's office with a rash over the malar eminences of her face, sparing the nasolabial folds; a skin rash due to exposure to sunlight; and painless nasopharyngeal ulcers. Suspecting an autoimmune disorder, her physician obtains an antinuclear antibody test of her blood and finds high titers of anti-double-stranded DNA antibodies. Which one of the following diseases is most likely responsible for this immunological reaction?

- A. Goodpasture syndrome
- B. multiple sclerosis
- C. myasthenia gravis
- D. rheumatoid arthritis
- E. systemic lupus erythematosus

Correct Answer: E

Section: Microbiology/Immunology SLE is characterized by development of auto-antibodies against double-stranded DNA, and other components of the nucleus. These auto-antibodies are involved in the production of immune complexes that lead to activation of complement, tissue damage, including vasculitis, glomerulonephritis, or arthritis. Rheumatoid arthritis (choice D) is due to production of auto-antibodies (of the IgM type) against IgG. In multiple sclerosis (choice B), auto-activated T cells and macrophages cause demyelization of the white matter of the brain. Goodpasture syndrome (choice A) is caused by the development of auto-antibodies to the collagen component of the basement membrane of the lungs and kidneys. In myasthenia gravis (choice C), auto-antibodies are generated against the acetylcholine receptors of the neuromuscular junction.

QUESTION 13

A foul-smelling specimen was obtained from a 26-year-old female with a pelvic abscess. Culture grew both aerobic and anaerobic gramnegative bacteria. Which of the following represent the cultured organisms?

- A. *A. israelii* and *E. coli*
- B. *B. fragilis* and *L. monocytogenes*
- C. *B. fragilis* and *N. gonorrhoeae*
- D. *C. difficile* and *B. fragilis*

E. E. coli and Peptostreptococcus spp.

Correct Answer: C

Section: Microbiology/Immunology Medically important infections due to anaerobic bacteria are common. The infections are often polymicrobial, being mixed with other anaerobes, facultative anaerobes, and aerobes. Anaerobes are found in all parts of the body including skin, intestinal tract, oral cavity, and urogenital mucosa. Infection usually occurs when anaerobes contaminate usually sterile body sites or are heavily inoculated with anaerobes. Most of the B. fragilis bacteria contain small amounts of catalase and SOD, allowing them to survive oxygen toxicity. Their usual clinical manifestation is an abscess. Anaerobes produce an extremely foul odor from abscess pus or growth on media. In this scenario, choice C could be the proper answer. A. israelii (choice A) is anaerobic but not usually involved in intra-abdominal/pelvic abscess formations. L. monocytogenes (choice B) enters the GI tract by ingestion of contaminated food (cheese or vegetables). L. monocytogenes is usually found in intrauterine infections, bacteremias, and CNS infections. C. difficile (choice D) is usually present in small numbers and increases when broad-spectrum antibiotics have been used with the patient. C. difficile produces toxins that act on the intestinal lining, producing severe diarrhea. Peptostreptococci (choice E) are anaerobic streptococci, usually found in the intestine. These and E. coli would not likely be routinely found as etiologic causes of pelvic abscesses.

QUESTION 14

Resistance to Type I diabetes has been shown to be associated with a specific polymorphic allele. Which of the following loci represents this allele?

- A. a VNTR in the 5' region of the insulin gene
- B. glutamic acid decarboxylase (GAD)
- C. HLA-B27
- D. HLA-DQ
- E. HLA-DR3

Correct Answer: D

Section: Biochemistry Class I and class II genes of the major histocompatibility locus (MHC), which comprise the HLA genes, are highly polymorphic and express hundreds of different alleles in humans. Many of these polymorphic loci are associated, either positively or negatively, with autoimmune-related disorders. Inheritance of the class II HLA-DQ allele has been highly correlated to resistance to development of Type I diabetes. Conversely, the DR3 allele (choice E) is positively correlated with development of Type I diabetes. Autoantibodies to GAD (choice B) are found in over 80% of patients with Type I diabetes. Different VNTR structure present in the promoter region of the insulin gene (choice A) has been shown to indicate susceptibility to Type I diabetes. The HLA-B27 allele (choice C) is correlated with ankylosing spondylitis.

QUESTION 15

The sinoatrial (SA) node initiates the heartbeat by giving off an impulse about 80 times per minute. It is located at the junction of the superior vena cava and right atrium. In about 60% of the cases, the SA node derives its vascular supply from which of the following?

- A. anterior interventricular artery
- B. left circumflex artery

C. posterior interventricular artery

D. right coronary artery E. right marginal branch

Correct Answer: D

Section: Anatomy In 60% of patients, the right coronary artery supplies the SA node. In a third of the population, the SA node is supplied by the left coronary artery and in some patients it receives branches from both the right and the left. The anterior interventricular (choice A) and left circumflex (choice B) arteries are distal branches of the left coronary artery, too distant to supply the SA node. The right coronary artery normally gives out its SA nodal branch in its proximal portion and then distally gives rise to the right marginal (choice E) and posterior interventricular (choice C) arteries. These are also too distant to supply the SA node.

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