

1. Patients with prolonged starvation or untreated type 1 diabetes mellitus overproduce ketone bodies. Which of the following is a common factor that is responsible for ketosis in patients with these two conditions?

- A) Depletion of pentose phosphate pathway intermediates
- B) Increased availability of acetyl CoA
- C) Inhibition of fatty acid oxidation
- D) Inhibition of gluconeogenesis
- E) Inhibition of glycogenolysis



Next



Lab Values



Calculator



Review



Help



Pause

2. A 65-year-old man comes to the emergency department because of a 1-week history of blood in his sputum. A mass is found on a radiograph. Bronchoscopy is planned. In order to pass the bronchoscope through the oropharynx to the lungs without eliciting a gag reflex, the pharynx is anesthetized. The afferent limb of the reflex is most likely to be blocked by anesthesia to which of the following cranial nerves?

- A) Trigeminal
- B) Facial
- C) Glossopharyngeal
- D) Vagus
- E) Hypoglossal

3. A 62-year-old man with a 4-year history of chronic angina pectoris comes to the emergency department because of severe chest and left shoulder pain. Physical examination shows bradycardia. An ECG shows ST-segment elevation in leads II, III, and aVF. Occlusion of blood flow in which of the following arteries is the most likely cause of the findings in this patient?

- A) Anterior interventricular (left anterior descending)
- B) Circumflex
- C) Left coronary
- D) Right coronary

4. Cholestyramine prevents the reabsorption of bile acids from the lumen of the intestine. This decreases serum cholesterol concentrations by which of the following mechanisms?

- A) Activating lecithin-cholesterol acyltransferase (LCAT)
- B) Decreasing VLDL production
- C) Inhibiting hepatic cholesterol synthesis
- D) Stimulating HDL production
- E) Upregulating hepatic LDL receptors

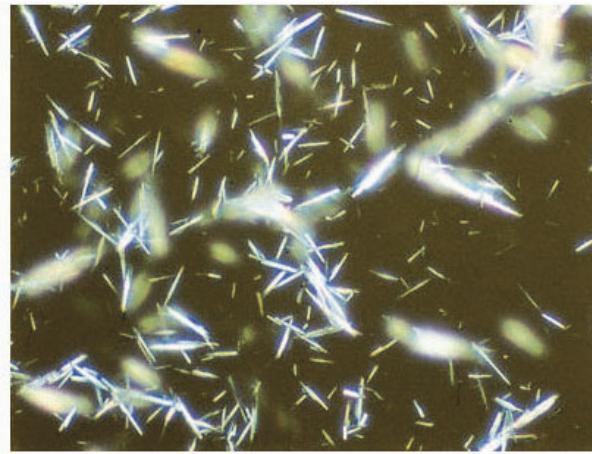
5. A 70-year-old woman comes to the physician for a follow-up examination. She had breast cancer 5 years ago and underwent partial mastectomy of the left breast at that time. She has received treatment with tamoxifen since then. Physical examination and mammography show no evidence of recurrence. Which of the following mechanisms most likely explains the beneficial effect of tamoxifen in treating this patient?

- A) Competitive inhibition of estradiol activation of cyclin D1 and E2 proteins
- B) Competitive inhibition of estradiol binding to its receptor
- C) Competitive inhibition of estradiol synthase in ovaries and adrenal cortex
- D) Downregulation of *bcl-2*
- E) Downregulation of estrogen receptors
- F) Increased estradiol catabolism by CYP3A
- G) Increased renal excretion of synthesized estradiol

6. A study is done to determine the efficacy of St. John's wort (*Hypericum perforatum*) for treatment of endogenous depression. One hundred patients with mild depression are randomly assigned to either a treatment group (900 mg of St. John's wort daily) or a placebo group. Scores on a Hamilton Depression Rating Scale are recorded for each subject before treatment and 4 weeks after the start of the study. Which of the following best describes this study design?

- A) Case-control
- B) Cohort
- C) Controlled trial
- D) Crossover
- E) Cross-sectional

Mark



7. A 60-year-old woman comes to the physician because of intermittent joint pain during the past 5 years. The pain is abrupt in onset and involves principally her hands, knees, and toes. She has a history of pyelonephritis; there is no history of trauma. Examination of the left knee shows tenderness, swelling, and warmth with dusky, erythematous overlying skin. A photograph of the left hand is shown, along with a photomicrograph of joint fluid aspirate. Which of the following is most likely in excess concentration in the joint fluid of this patient?

- A) Calcium apatite
- B) Calcium oxalate
- C) Calcium pyrophosphate
- D) Cholesterol
- E) Sodium chloride
- F) Sodium monourate

8. A 12-year-old boy is brought to the office by his mother for an annual well-child examination. He has asthma well controlled with inhaled budesonide. The mother says that the boy recently has voiced concern about his height and is bothered by the fact that he is considerably shorter than the other boys on his basketball team. The patient's father is 182 cm (6 ft) tall and his mother is 168 cm (5 ft 6 in) tall. The patient is 135 cm (4 ft 5 in; 3rd percentile) tall and weighs 32 kg (71 lb; 10th percentile); BMI is  $17 \text{ kg/m}^2$  (35th percentile). The patient's growth has remained steady at the 3rd percentile during the past 8 years. Vital signs are within normal limits. Sexual maturity rating is 1 for pubic hair and genital development. The remainder of the physical examination shows no abnormalities. Which of the following is the most likely diagnosis?

- A) Constitutional growth delay
- B) Familial short stature
- C) Growth hormone deficiency
- D) Hypopituitarism
- E) Hypothyroidism
- F) Steroid-induced growth failure

Mark



9. A previously healthy 16-year-old girl comes to the physician because of a progressive rash over her cheeks and the bridge of her nose during the past 5 weeks. She also has a 1-week history of stiffness of her fingers in the mornings that gradually resolves during the day. A photograph of the face is shown. Serum studies show an antinuclear antibody titer of 1:1280 and C3 concentration of 71 mg/dL (N=100–200). The pathogenesis of this patient's cutaneous and musculoskeletal symptoms is most similar to that of which of the following conditions?

- A) Acute rheumatic fever
- B) Drug-induced serum sickness
- C) Graft-versus-host disease
- D) Immune response to PPD skin testing
- E) Peanut allergy

- Mark
10. A 33-year-old woman comes to the physician because of fatigue for 2 months; she feels well otherwise. She has a 10-year history of systemic lupus erythematosus treated with prednisone. Physical examination shows no abnormalities. Laboratory studies show:

Hemoglobin	9.0 g/dL
Hematocrit	27%
Leukocyte count	8500/mm <sup>3</sup>
Reticulocyte count	0.2%
Platelet count	190,000/mm <sup>3</sup>
Serum	
Ferritin	250 ng/mL
Iron	10 µg/dL
Total iron-binding capacity	100 µg/dL (N=250–400)
Red cell morphology	normochromic, normocytic

Which of the following is the most likely cause of this patient's anemia?

- A) Accumulation of iron within mitochondria of erythroblasts
- B) Decreased serum concentrations of hepcidin
- C) Decreased serum concentrations of inflammatory cytokines
- D) Decreased uptake of iron by bone marrow macrophages
- E) Increased retention of iron within the reticuloendothelial system

11. A 47-year-old man comes to the emergency department because of the sudden onset of severe pain of his lower chest and upper abdomen, and dry heaves. He also has a 4-year history of intermittent heartburn. His pulse is 118/min, and blood pressure is 80/50 mm Hg. Physical examination shows epigastric tenderness. A nasogastric tube cannot be passed into the stomach. The diagnosis of gastric volvulus is made, and appropriate treatment is begun. This patient most likely also has which of the following underlying conditions?

- A) Cholecystitis
- B) Duodenal ulcer
- C) Gastric cancer
- D) Pancreatitis
- E) Paraesophageal hernia

- Mark
12. A 45-year-old man comes to the physician for a follow-up examination 2 weeks after beginning treatment with hydrochlorothiazide for hypertension. He says that he feels faint, light-headed, and dizzy when he gets out of bed and when he rises from a seated position too quickly. His pulse is 75/min, respirations are 12/min, and blood pressure is 130/85 mm Hg while supine. Physical examination shows no abnormalities. Which of the following sets of changes best characterizes changes in the cardiovascular system as this man goes from the supine to the standing position?

	Venous Return	Carotid Sinus Baroreceptor Activity	Cerebral Blood Flow
A)	↑	↑	↑
B)	↑	↑	↓
C)	↑	↓	↑
D)	↑	↓	↓
E)	↓	↑	↑
F)	↓	↑	↓
G)	↓	↓	↑
H)	↓	↓	↓

13. A 28-year-old woman undergoes PPD skin testing to determine previous infection with *Mycobacterium tuberculosis*. Results show a 25-mm, firm area of induration at 48 hours. Analysis of this patient's lesion is most likely to show a predominance of which of the following cell types?

- A) B lymphocytes
- B) Cytotoxic T lymphocytes
- C) Eosinophils
- D) Macrophages
- E) Mast cells
- F) Neutrophils

14. A 29-year-old woman comes to the physician because of a 4-month history of headaches that occur every few weeks. They consist of unilateral throbbing pain and are accompanied by nausea and photophobia. She has a history of similar episodes, which started with the onset of menarche, but she had been symptom-free for 7 years until now. She says the headaches seem worse now than ever. Physical examination shows no abnormalities. A diagnosis of migraine is made, and sumatriptan is prescribed. The patient then becomes anxious and tells the physician that she expects further evaluation of her symptoms. She says, "How can you know they are nothing dangerous after only examining me?" She refuses the prescription and begins to cry. After empathizing with the patient, which of the following statements by the physician is most appropriate at this time?

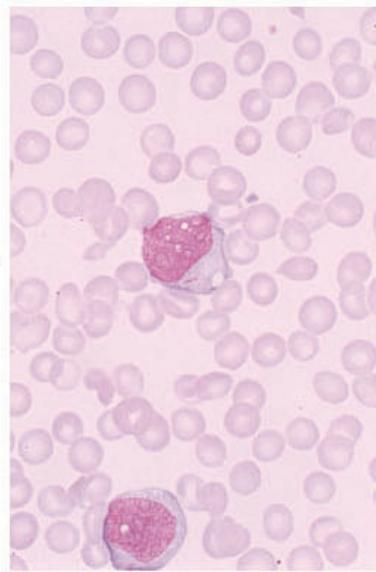
- A) "Have you been getting enough sleep lately or have you had any hormonal changes recently?"
- B) "I know that migraines are real and painful, but I have all of the information I need to make that diagnosis."
- C) "I'm concerned that you may be depressed. Would you like a referral to a therapist?"
- D) "It's all right. There is nothing to worry about since your illness has not changed in character over time."
- E) "Tell me what you think may be causing the headaches."

15. A 17-year-old boy has had fever, malaise, and a sore throat for 1 week. Laboratory studies show:

Hemoglobin	10 g/dL
Hematocrit	30%
Leukocyte count	70,000/mm <sup>3</sup>
Erythrocyte count	3.52 million/mm <sup>3</sup>
Mean corpuscular volume	85 $\mu\text{m}^3$
Platelet count	90,000/mm <sup>3</sup>

A representative leukocyte from a peripheral blood smear is shown. Which of the following is the most likely diagnosis?

- A) Acute lymphocytic leukemia
- B) Acute myelocytic leukemia
- C) Chronic lymphocytic leukemia
- D) Infectious mononucleosis
- E) Leukemoid reaction



16. A 50-year-old man with a temperature of 38.9°C (102°F) has produced 120 mL of rust-colored sputum over the past 2 days. Which of the following physical findings most clearly indicates a diagnosis of pneumonia in the right lower lobe?

- A) Hyperresonance on percussion over the right lower lung field
- B) Increased tactile fremitus over the right lower lung field
- C) Muffled whispered sounds over the right lower lung field
- D) A shift of the trachea to the right
- E) Vesicular breath sounds over the right lower lung field

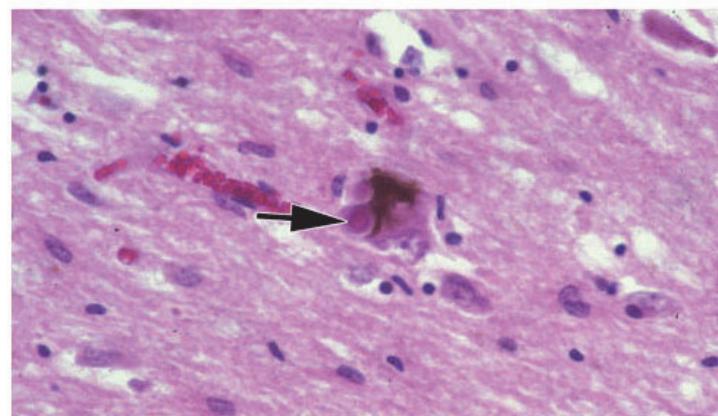
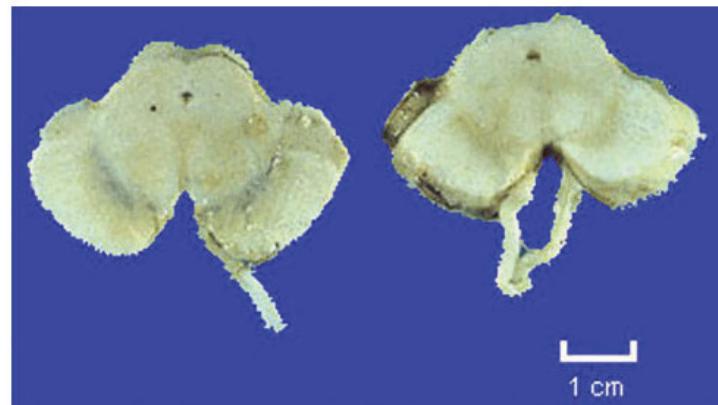
17. During an experimental study of oxygen consumption in the kidney, experimental animals are ventilated with 100% nitrogen. Cells from which of the following areas of the kidney are most likely to show the first signs of anoxic injury?

- A) Bowman capsule
- B) Distal convoluted tubule
- C) Efferent arteriole
- D) Glomerulus
- E) Proximal tubule

18. A 13-year-old girl grew 7.5 cm (3 in) over the summer. Which of the following most likely accounts for increased intestinal absorption of calcium during this period?

- A) Calcitonin-mediated hypercalcemia
- B) Calcium-binding proteins in goblet cells
- C) Cortisol-induced transcription of calcium transporters
- D) Cyclic AMP generated in the enterocytes in response to parathyroid hormone
- E) Hormones derived from 7-dehydrocholesterol

Mark



19. A 67-year-old man is brought to the physician by his wife because of a 1-year history of progressive difficulty writing and walking. The patient is stooped and talks slowly. Physical examination shows a bland facial expression. There is a fine resting tremor in both hands, but not in the lower extremities. The tremor is not apparent when the patient is moving. When asked to walk, the patient has some difficulty starting and stopping. There is cogwheel rigidity in all four extremities. Testing of postural reflexes shows moderate retropulsion and mild propulsion. Gross and microscopic appearances of brain tissue from a patient with a similar condition are shown. The midbrain on the left is a normal control. The inclusion indicated by the arrow is predominantly composed of which of the following substances?

- A) Alpha-synuclein
- B) Amyloid
- C) Ataxin
- D) Prion protein
- E) Tau

Mark

20. During a study of antibiotic treatment for pityriasis rosea, two randomized groups of patients with this condition are established (Groups A and B). Group A receives erythromycin and hydroxyzine, and Group B receives only hydroxyzine. The number of days that lesions are present in each group is then determined, and the average of days is calculated for each group. Which of the following statistics is most likely to establish the difference between the averages of these two groups?
- A) Chi-square test
  - B) Correlation
  - C) Mean
  - D) Regression
  - E) Student's *t*-test

21. A 6-year-old boy is brought to the physician because of a 2-year history of progressive leg stiffness and difficulty walking. Physical examination shows dystonia of the lower extremities. An MRI of the brain shows no abnormalities. A lumbar puncture is done. Cerebrospinal fluid analysis shows a markedly decreased homovanillic acid concentration. A deficiency of which of the following enzymes is the most likely cause of this patient's symptoms?

- A) CoQ reductase
- B) Cytochrome c reductase
- C) Glutamic acid decarboxylase
- D) Pyruvate decarboxylase
- E) Tryptophan hydroxylase
- F) Tyrosine hydroxylase

22. A 26-year-old man comes to the physician because of palpitations, heat intolerance, and a fine hand tremor for the past month. Examination shows an enlarged thyroid gland. Serum thyroxine ( $T_4$ ) concentration is 28  $\mu\text{g}/\text{dL}$ , and serum thyroid-stimulating hormone (TSH) concentration is less than 0.03  $\mu\text{U}/\text{mL}$ . The most likely cause of his condition is development of antibodies against which of the following?

- A)  $T_4$
- B)  $T_4$ -receptor protein
- C) Thyroid-releasing hormone (TRH)
- D) TRH receptor
- E) TSH
- F) TSH receptor

23. The table shows survival information for patients who had an operation for a particular form of cancer:

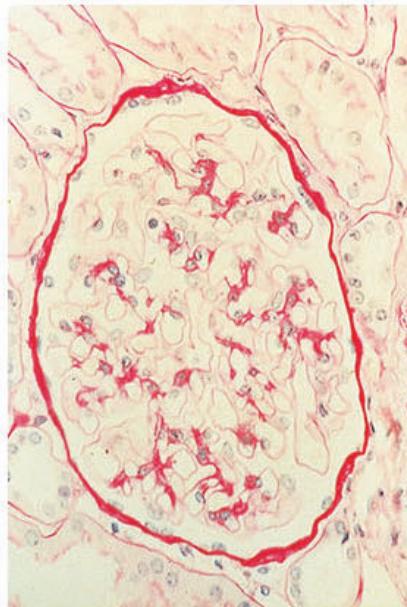
Interval	Patients at the Beginning of the Interval	Patients Who Died During the Interval	Patients Surviving This Interval (%)
0-1 year	1000	200	80
1-2 years	800	100	87.5
2-3 years	700	70	90
3-4 years	630	62	90.1

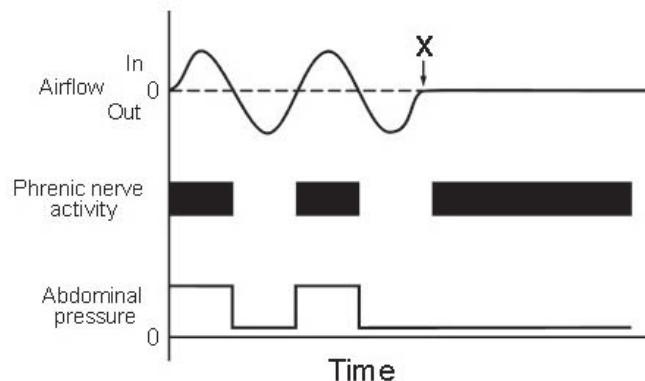
Based on this information, if a patient survives for 3 years, which of the following best represents the probability that he or she will survive for 4 years?

- A) 0.80
- B)  $0.8 \times 0.875 \times 0.9 \times 0.901$
- C)  $(0.8 + 0.875 + 0.9 + 0.901)/4$
- D)  $(0.8 \times 0.875 + 0.9 + 0.901)/4$
- E) 0.901
- F)  $0.91 - (0.9 + 0.875 + 0.80)/3$

24. A 12-year-old boy comes to the physician's office with dependent and periorbital edema, hypoalbuminemia and proteinuria. A biopsy of the kidney is performed. A photomicrograph of a representative glomerulus is shown (periodic acid-Schiff-stained). Which of the following is the most likely diagnosis?

- A) Diabetic glomerulosclerosis
- B) Diffuse proliferative nephritis
- C) Focal glomerulonephritis
- D) Focal segmental glomerulosclerosis
- E) Membranous nephropathy
- F) Minimal change nephrotic syndrome
- G) Poststreptococcal glomerulonephritis





25. A study is conducted to determine the effects of drug X on respiratory function. The respiratory tracing of an experimental animal is shown. Drug X was administered at the arrow. Drug X is most likely which of the following?

- A) Lidocaine
- B) Morphine sulfate
- C) Pentobarbital
- D) Potassium chloride
- E) Tetrodotoxin
- F) Tubocurarine

26. A 95-year-old man who is a resident of a skilled nursing care facility is brought to the emergency department because of a 1-day history of temperatures to 39.4°C (102.9°F), headache, cough, and muscle aches. Several other residents have similar symptoms. Physical examination shows no other abnormalities. Treatment with a neuraminidase inhibitor is begun. This drug most likely will inhibit which of the following processes, therefore decreasing the duration of this patient's symptoms?

- A) Nucleocapsid-matrix protein interactions
- B) Release of virus from infected epithelial cells
- C) Replication of genomic RNA
- D) Synthesis of surface glycoproteins
- E) Transcription of mRNA

27. A 14-year-old girl is brought to the physician by her mother because of a 2-month history of hair loss on her head. The mother says that her daughter has been trying to imitate the hairstyles of several pop music stars by using various ties, rubber bands, and curlers, but she is not sure whether any chemical treatments have been used. The mother reports that the patient has been sad since her grandmother died unexpectedly 3 months ago. Vital signs are normal. Physical examination shows decreased hair density over several irregular patches temporally and frontally, but no denuded areas. The underlying skin is normal. The remaining hair shafts in these thinned areas are of varying lengths. There is no frontotemporal recession. A photograph of the affected area is shown. Which of the following is the most likely explanation for this patient's hair loss?

- A) Alopecia areata
- B) Androgenetic alopecia
- C) Telogen effluvium
- D) Tinea capitis
- E) Trichotillomania



28. A 3-month-old boy is brought to the physician because of frequent loose stools during the past month. His maternal cousin has similar symptoms. He is exclusively breast-fed. He is below the 3rd percentile for length and weight. Physical examination shows mild dehydration. Laboratory studies show acidic stools that are positive for reducing substances. Following the oral administration of glucose, there is no increase in his serum glucose concentration. Following the oral administration of fructose, his stools become normal. A deficiency in which of the following in intestinal mucosal cells is most likely in this patient?

- A) Glucose transporter-4 (GLUT-4)
- B) GLUT-5
- C) Lactase
- D) Sodium-glucose cotransporter-1 (SGLT-1)
- E) Sucrase-isomaltase

Mark

29. A 72-year-old woman with hypertension comes to the physician for a follow-up examination. She has had no fever, shortness of breath, weight loss, or symptoms of gastroesophageal reflux disease. She was admitted to the hospital because of tuberculosis at the age of 23 years. Current medications include aspirin, atenolol, hydrochlorothiazide, and lisinopril. Her pulse is 68/min, and blood pressure is 140/74 mm Hg. The lungs are clear. Cardiac examination shows a grade 2/6, systolic ejection murmur that is best heard along the left sternal border. A chest x-ray shows normal lung fields and a calcified aortic valve. Which of the following best explains these cardiac findings?

- A) Adverse effect of atenolol
- B) Coronary artery disease
- C) Idiopathic hypertrophic cardiomyopathy
- D) Past tuberculosis exposure
- E) Normal aging

30. An overweight 50-year-old man comes to the physician because of a 3-day history of intermittent severe abdominal and interscapular pain associated with nausea and vomiting. He has had an 18-kg (40-lb) weight loss during the past 6 months by caloric restriction and exercise. He has not used appetite suppressants. He is in mild distress. Abdominal examination shows tenderness of the right upper quadrant. Laboratory studies show:

Hemoglobin	13.8 g/dL
Leukocyte count	14,500/mm <sup>3</sup>
Serum	
Total bilirubin	4 mg/dL
Alkaline phosphatase	200 U/L
AST	70 U/L
ALT	68 U/L

Test of the stool for occult blood is negative. Which of the following is the most likely diagnosis?

- A) Acute pancreatitis
- B) Cholecystitis
- C) Esophageal reflux
- D) Fatty liver disease
- E) Peptic ulcer disease

31. A 50-year-old man who has had paraplegia for the past 5 years is admitted to the hospital for treatment of a urinary tract infection. Addressing which of the following factors is most likely to prevent the development of decubitus ulcers in this patient?

- A) Arterial blood flow
- B) Bacterial skin flora
- C) Nutritional status
- D) Pressure
- E) Venous stenosis

32. A 52-year-old woman with type 2 diabetes mellitus has chronic renal failure. She takes no medications other than glipizide. Creatinine clearance is 20% of normal. Which of the following sets of laboratory findings in serum is most likely in this patient?

**Ca<sup>2+</sup>    Phosphate    Parathyroid Hormone**

- |                          |   |   |   |
|--------------------------|---|---|---|
| <input type="radio"/> A) | ↑ | ↓ | ↓ |
| <input type="radio"/> B) | ↑ | ↓ | ↑ |
| <input type="radio"/> C) | ↓ | ↑ | ↑ |
| <input type="radio"/> D) | ↓ | ↓ | ↓ |
| <input type="radio"/> E) | ↑ | ↑ | ↑ |
| <input type="radio"/> F) | ↓ | ↓ | ↑ |

33. The cartilage surrounding the knee supports considerable pressure because of the presence of chondroitin sulfate, which creates a gel-like medium resilient to shock. Which of the following properties of chondroitin sulfate is responsible for this substance occupying a larger volume in solution than in the dehydrated solid?

- A) It adheres to positively charged molecules of collagen in the extracellular matrix
- B) It forms a covalent bond with the core protein of the proteoglycan complex
- C) It has many surface negative charges
- D) It is a high-molecular-weight polymer of *N*-acetylgalactosamine-sulfate monomers
- E) It is a highly branched *N*-linked oligosaccharide attached to cell-surface proteins

34. A 60-year-old woman is running her first marathon [42 km (26 mi)]. She does not drink enough liquids during the race and becomes dehydrated. Which of the following segments or channels will most likely be activated in this woman's kidney to help maintain hydration homeostasis?

- A) ADH (vasopressin) activity in the proximal tubular cells
- B) K<sup>+</sup>-H<sup>+</sup> exchange in the distal convoluted tubule
- C) Proximal tubule carbonic anhydrase activity
- D) Urea reabsorption in the medullary collecting ducts
- E) Water reabsorption in the ascending limb of the loop of Henle

35. A 58-year-old man is brought to the emergency department 2 hours after having a generalized tonic-clonic seizure. He has been treated numerous times in the past for seizures caused by alcohol withdrawal. On arrival, he is awake but confused and tremulous. His pulse is 110/min, and blood pressure is 160/90 mm Hg. Physical examination shows bilateral asterixis. Laboratory studies show:

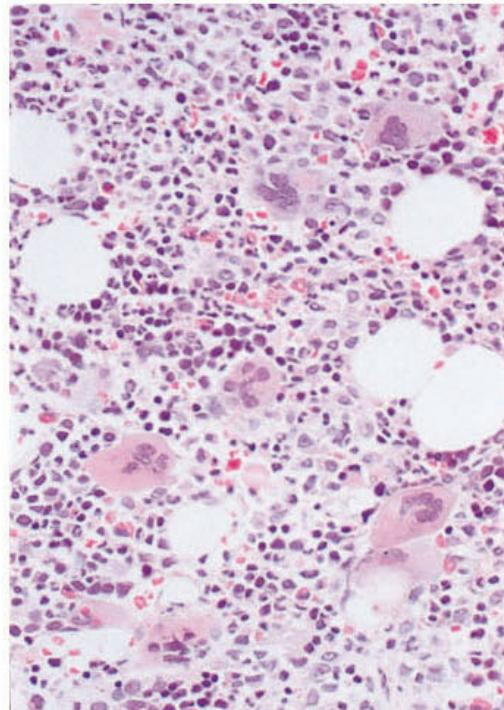
Hemoglobin	11 g/dL
Hematocrit	32%
Mean corpuscular volume	110 $\mu\text{m}^3$
Leukocyte count	3800/mm <sup>3</sup>
Reticulocyte count	1%
Platelet count	160,000/mm <sup>3</sup>

Which of the following is the most likely cause of this patient's anemia?

- A) Folic acid deficiency
- B) Iron deficiency
- C) Lead toxicity
- D)  $\beta$ -Thalassemia
- E) Vitamin B<sub>1</sub>(thiamine) deficiency

36. A 20-year-old woman comes to the physician because of easy bruising for 2 weeks. She had been in good health except for a viral respiratory illness 1 month ago. Laboratory studies show thrombocytopenia. A bone marrow smear is shown. Which of the following is the most likely cause of her thrombocytopenia?

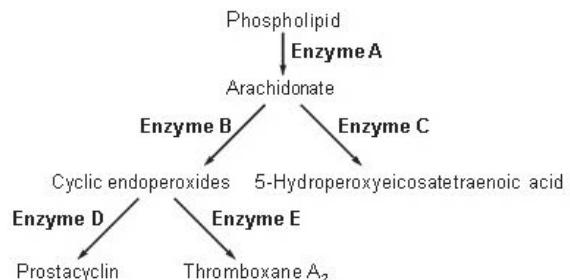
- A) Acute myeloblastic leukemia
- B) Aplastic anemia
- C) Metastatic adenocarcinoma
- D) Parvovirus infection
- E) Peripheral destruction of platelets



37. A 66-year-old woman comes to the physician because of a 3-week history of difficulty getting up from a seated position. Her temperature is 37°C (98.6°F), pulse is 70/min, and blood pressure is 145/95 mm Hg. Physical examination shows global weakness of the proximal muscles of the extremities. Sensation and reflexes are intact. Her fasting serum glucose concentration is 150 mg/dL. A chest x-ray shows a large mass in the hilum of the left lung. Examination of an endobronchial biopsy specimen shows small cell carcinoma of the lung. Increased secretion of which of the following hormones from the lung carcinoma is the most likely cause of the findings in this patient?

- A) ADH (vasopressin)
- B) Adrenocorticotropic hormone
- C) Calcitonin
- D) Parathyroid hormone
- E) Serotonin

38. A 15-year-old boy has nasal polyps and develops bronchospasms after taking a drug. The drug is most likely to inhibit which of the following enzymes in the biochemical scheme shown?



- A)
- B)
- C)
- D)
- E)

39. A 17-year-old boy is brought to the emergency department 15 minutes after he was found unarousable in the high school's bathroom. Approximately twenty 5-mg oxycodone tablets were found in his pocket. He has a history of using multiple illicit drugs. Which of the following sets of clinical findings is most likely in this patient?

	Pulse	Respirations	Pupil Examination	Glasgow Coma Score
<input type="radio"/> A)	Increased	normal	constricted	12
<input type="radio"/> B)	Increased	decreased	normal	15
<input type="radio"/> C)	Normal	increased	dilated	15
<input type="radio"/> D)	Normal	normal	dilated	7
<input type="radio"/> E)	Decreased	increased	normal	12
<input type="radio"/> F)	Decreased	decreased	constricted	7

Mark

40. A 30-year-old woman, gravida 1, para 0, at 32 weeks' gestation comes to the emergency department because of a 2-day history of fever, nausea, and headache. Physical examination shows a uterus consistent in size with a 30-week gestation. Serologic testing prior to pregnancy showed a positive IgG antibody titer to *Toxoplasma gondii*. Blood cultures grow a small gram-positive rod, which grows as pinpoint β-hemolytic colonies on sheep blood agar. The organism is catalase positive and exhibits tumbling motility. This infection could have been prevented by avoiding which of the following?

- A) Consumption of delicatessen meats
- B) Consumption of grapefruit juice
- C) Contact with cats
- D) Contact with dogs
- E) Contact with rabbits

Mark

41. A 49-year-old man is brought to the emergency department 30 minutes after fainting in the street. He regained consciousness 1 minute after fainting. He says that he has had watery diarrhea during the past 5 days, which has not improved with fasting. He has not changed his diet or travelled overseas recently. His blood pressure is 90/60 mm Hg. Physical examination shows a flushed face and dehydration. Serum studies show a potassium concentration of 2 mEq/L and glucose concentration of 150 mg/dL. He is admitted to the hospital, and intravenous fluid replacement is started. Over the next day, he passes a stool with a volume of 3.5 L. Treatment with which of the following hormones is most likely to control this patient's diarrhea?

- A) Aldosterone
- B) Cholecystokinin
- C) Gastric inhibitory polypeptide
- D) Gastrin
- E) Somatostatin

42. A 3-month-old boy is brought to the office by his mother because of a 1-week history of a lump on the right side of his groin. The mother says that when the patient cries, the bulge increases in size, and when he is quiet, it disappears. Physical examination shows a soft mass in the right groin region that decreases easily. Which of the following best describes the relationship of the hernia sac?

- A) Lateral to the inferior epigastric artery and inferior to the inguinal ligament
- B) Lateral to the inferior epigastric artery and superior to the inguinal ligament
- C) Medial to the inferior epigastric artery and inferior to the inguinal ligament
- D) Medial to the inferior epigastric artery and superior to the inguinal ligament

43. A 40-year-old man with type 2 diabetes mellitus comes to the physician for a follow-up examination. Treatment with glyburide and metformin has been ineffective in controlling his disease. The decision is made to try pioglitazone. This drug produces a beneficial effect through which of the following mechanisms of action?

- A) Blockade of ATP-sensitive potassium channels in the pancreatic  $\beta$  cells
- B) Increased insulin synthesis by promoting the effect of physiologic insulin secretagogues
- C) Increased insulin uptake by muscle and adipose tissue, thus making the insulin more effective
- D) Promotion of insulin action interfering with the synthesis of endogenous antagonists, primarily glucagons
- E) Stimulation of the peroxisome proliferator-activated receptor  $\gamma$

44. A 35-year-old African American man comes to the physician for a routine examination. He recently read a pamphlet at a health fair on the importance of screening for skin cancer. He enjoys sailing and usually goes out on his boat every weekend when the weather is nice. He does not use sunscreen, but he states that he does not "burn." Physical examination shows no abnormalities. This patient is at increased risk for melanoma at which of the following locations?

- A) Back
- B) Chest
- C) Forehead
- D) Palms
- E) Scalp

45. A 27-year-old man comes to the emergency department because of a 3-day history of numbness and a 2-day history of increasing weakness in his arms and legs. He had a "bad cold" 2 weeks ago. He tells the physician that his oral examinations for graduate school are in 1 month and that he broke up with his girlfriend 1 week ago. His temperature is 37.1°C (98.8°F). Neurologic examination shows symmetrical weakness that is greater in his legs than in his arms. Muscle stretch reflexes are absent in all four extremities, and vibration sense and proprioception are diminished in his lower extremities. Which of the following is most likely the greatest contributor to his current symptoms?

- A) Anterior horn cell degeneration
- B) Axonal polyneuropathy
- C) Conversion disorder
- D) Demyelinating polyneuropathy
- E) Muscle fiber degeneration
- F) Neuromuscular junction disorder

46. A 28-year-old woman, gravida 1, para 1, comes to the physician because of a 1-week history of pain with sexual intercourse. She had a spontaneous vaginal delivery 5 weeks ago and is currently breast-feeding. Pelvic examination shows vaginal dryness and atrophy. The most likely cause is a decreased concentration of which of the following hormones?

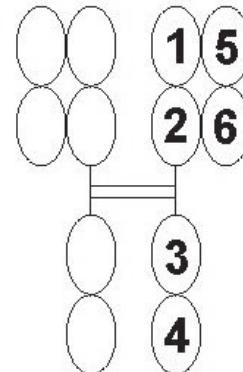
- A) Estrogen
- B) Follicle-stimulating hormone
- C) Luteinizing hormone
- D) Progesterone
- E) Prolactin

47. A 73-year-old man comes to the physician with his wife because of a 3-year history of daytime sleepiness. His wife says that he snores loudly. He is 183 cm (6 ft) tall and weighs 113 kg (250 lb); BMI is 34 kg/m<sup>2</sup>. His pulse is 84/min, respirations are 18/min, and blood pressure is 175/105 mm Hg. Physical examination shows congested conjunctivae and centripetal obesity. Serum studies show a glucose concentration of 250 mg/dL, creatinine concentration of 2 mg/dL, and uric acid concentration of 10.1 mg/dL. Polysomnography confirms the diagnosis, and treatment with nasal continuous positive airway pressure at night is started. This therapy will most likely cause a decrease in which of the following?

- A) Blood pressure
- B) Pulse rate
- C) Serum creatinine concentration
- D) Serum glucose concentration
- E) Serum uric acid concentration

48. Which of the following domains depicted in the schematic diagram of an immunoglobulin molecule shown would be altered by isotype switching?

- A) 1
- B) 1 and 2
- C) 1 and 5
- D) 1, 2, and 6
- E) 2, 3, and 4
- F) 5 and 6



49. A 16-year-old girl is brought to the emergency department 45 minutes after her mother found her in her room with an empty bottle of acetaminophen. She has a history of major depressive disorder. Physical examination shows no abnormalities. Which of the following events would contribute directly to hepatic toxicity in this patient?

- A) Activation of protein kinases
- B) Depletion of glycogen stores
- C) Increased conversion of triglycerides to fatty acids
- D) Liberation of lysosomal enzymes
- E) Peroxidation of lipids in cell membranes
- F) Swelling of the rough endoplasmic reticulum

50. In a recent study of patients with congestive heart failure, the investigators found that these patients showed a diminished capacity to restore low basal calcium concentration during diastole. Function of which of the following is most likely to be altered in these patients?

- A) Fast sodium channel
- B) Inward rectifier
- C) L-type calcium channel
- D)  $\text{Na}^+ - \text{Ca}^{2+}$  exchanger
- E) Ryanodine receptor

1. A newborn is evaluated for microcephaly, cataracts, and chorioretinitis. The mother developed an illness in the first trimester of pregnancy characterized by low-grade fever, a faint erythematous rash, occipital lymphadenopathy, and joint stiffness. The illness resolved within 1 week without complications. She did not receive any immunizations prior to the pregnancy. Which of the following viruses is the most likely cause of the newborn's illness?

- A) Cytomegalovirus
- B) Herpes simplex virus
- C) HIV
- D) HTLV-2
- E) Measles virus
- F) Reovirus
- G) Rubella virus
- H) Varicella-zoster virus



Next



Lab Values



Calculator



Review



Help



Pause

Mark

2. An 8-year-old boy is brought to the physician by his parents for a well-child examination. His sister died of leukemia 4 months ago. The parents state that he is sad at times, but he has had only minor performance difficulty at school since his sister died. During the interview, the patient talks about his sister's death and cries. He then says that he has a headache. Physical examination shows no abnormalities. Which of the following best describes this patient's condition?

- A) Abnormal grief reaction
- B) Conversion disorder
- C) Major depressive disorder
- D) Somatoform disorder
- E) Normal emotional response

3. In a series of 1000 patients with colonic polyposis, three developed colonic malignancies over a 2-year follow-up period. In 1000 control patients without colonic polyposis, one developed a colonic malignancy over the 2-year follow-up period. Which of the following factors most limits the ability to conclude that polyposis is associated with an increased risk for subsequent malignancies?

- A) The follow-up period is too short
- B) The investigators are not blinded
- C) The subjects are not blinded
- D) There is no control group

4. During a clinical study, nine patients are given a new antihypertensive drug. One week later, their serum creatinine concentrations are measured, and the results are shown:

Patient	Serum Creatinine (mg/dL)
1	0.9
2	0.9
3	0.9
4	1.0
5	1.1
6	1.2
7	1.2
8	1.3
9	1.4

If one of the 0.9 values were now mistakenly entered as 1.2, which of the following would the most likely effect be on the mean, median, and mode?

- |    | Mean      | Median    | Mode      |
|----|-----------|-----------|-----------|
| A) | ↑         | ↑         | ↑         |
| B) | ↑         | ↑         | no change |
| C) | ↑         | no change | no change |
| D) | No change | ↑         | ↑         |
| E) | No change | ↑         | no change |
| F) | No change | no change | no change |

5. A 28-year-old woman comes to the physician because of heavy menstrual bleeding since menarche at the age of 13 years. She also has a lifelong history of easy bleeding with minor cuts. She says several family members of both genders have prolonged bleeding with minor surgical procedures. Physical examination shows no abnormalities. Laboratory studies show a deficiency of von Willebrand factor. Which of the following mechanisms is the most likely cause of this patient's bleeding disorder?

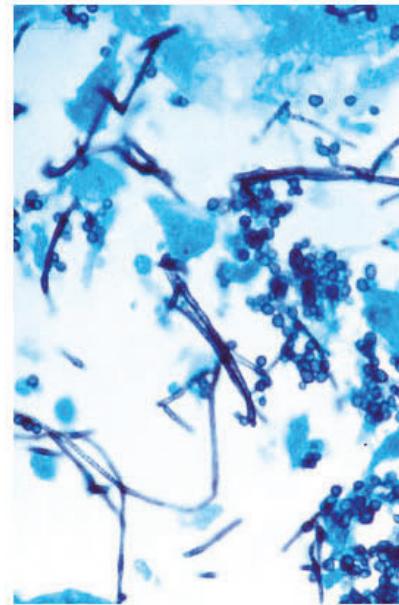
- A) Decreased platelet adhesion
- B) Decreased platelet glycoprotein IIb/IIIa
- C) Decreased secretion of platelet granular contents
- D) Increased antiplatelet antibodies
- E) Increased number of giant platelets
- F) Increased platelet sequestration in the spleen

6. A 54-year-old woman comes to the physician because of a 5-day history of severe mid-back pain. Physical examination shows point tenderness over the T6 vertebra. Serum studies show a calcium concentration of 13.4 mg/dL; urinalysis shows Bence Jones proteins. Which of the following is the most likely cause of this patient's hypercalcemia?

- A) Excessive parathyroid hormone production
- B) Excessive parathyroid hormone-related protein production
- C) Increased fractional calcium gastrointestinal absorption
- D) Local interleukin-1 (IL-1) and tumor necrosis factor effects
- E) Unregulated 1,25-dihydroxycholecalciferol production

7. A 20-year-old woman comes to the physician because of a 10-day history of a vaginal discharge and vaginal itching and soreness. Current medications include a multivitamin and an antibiotic for acne. Pelvic examination shows vulvar erythema and edema and a thick, white vaginal discharge. Her vaginal fluid pH is 4.2. A photomicrograph of the vaginal discharge is shown. The most appropriate pharmacotherapy for this patient is an oral agent with which of the following mechanisms of action?

- A) Inhibition of the cytochrome P450-dependent demethylation reaction
- B) Inhibition of DNA and RNA synthesis
- C) Pore formation in the fungal cell membrane
- D) Prevention of cross-linking of  $\beta$ -glucans in the cell wall
- E) Prevention of tetrahydrofolic acid synthesis





8. A 78-year-old man comes to the physician because of a 1-week history of blisters over several areas of his body. A photograph of the lesions is shown. Direct immunofluorescence of the affected areas shows linear deposition of IgG and C3b at the dermal-epidermal junction. Which of the following best describes the function of the target structure to which IgG is binding in this patient?
- A) Attaches keratinocytes to the extracellular matrix
  - B) Provides tensile strength to the skin
  - C) Secretes the chitinous cuticle
  - D) Serves as a chemokine receptor on keratinocytes
  - E) Serves as a ligand for cutaneous lymphocyte antigen

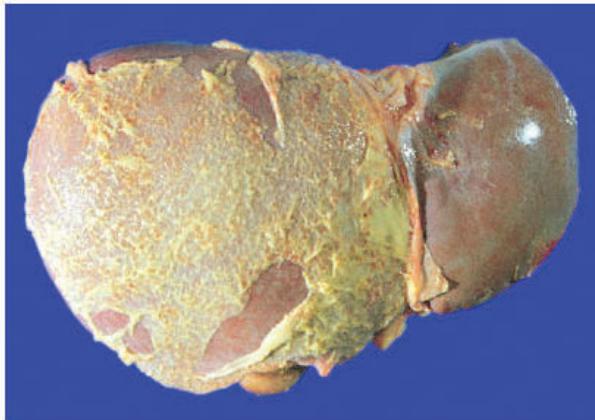
9. A 26-year-old woman is diagnosed with a metastatic anaplastic tumor. Immunohistochemical studies of a biopsy specimen show large quantities of desmin in the tumor cells. Based on these findings, these cells most likely originated in which of the following tissues?

- A) Bone
- B) Epithelial
- C) Fibrous
- D) Muscle
- E) Nerve

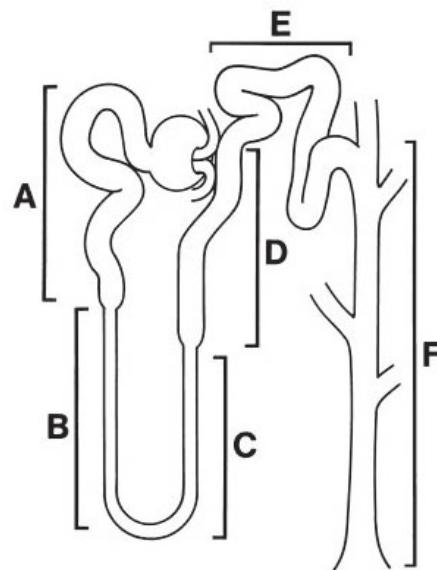
Mark<https://t.me/USMLENBME>

10. An 82-year-old woman comes to the physician because of constant severe lower abdominal pain and fever for 24 hours. Laparoscopic examination shows severe diverticulosis and perforated diverticulitis. In spite of appropriate therapy, she dies 2 days later. Her liver at autopsy is shown. Which of the following is the primary component of the material shown on the hepatic surface?

- A) Collagen, type I
- B) Collagen, type III
- C) Fibrin
- D) Fibronectin
- E) Proteoglycans



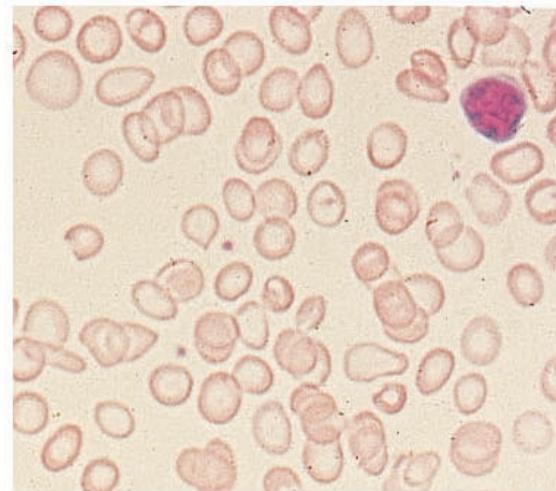
- Mark
11. A 32-year-old man sustains a head injury in a motorcycle accident and is admitted to the intensive care unit. Six days later he becomes confused and is very thirsty. His serum sodium concentration is 158 mEq/L, and his urine output is 6.1 L/day. These findings most likely indicate that he has a disorder that is affecting which of the following labeled parts of the nephron shown?



- A)
- B)
- C)
- D)
- E)
- F)

12. A previously healthy 72-year-old man is brought to the physician because of weakness and fatigue. His hemoglobin concentration is 9.2 g/dL, leukocyte count is 5400/mm<sup>3</sup>, and platelet count is 350,000/mm<sup>3</sup>. A peripheral blood smear is shown. Which of the following is the most likely cause of these findings?

- A) Aplastic anemia
- B) Chronic myelogenous leukemia
- C) Gastrointestinal blood loss
- D) β-Thalassemia major
- E) Vitamin B<sub>12</sub> (cobalamin) deficiency



13. A 50-year-old man with septic shock develops diffuse cortical necrosis in the kidneys. He dies 2 weeks later. At autopsy, gross examination of the cortex of the kidneys shows changes indicative of acute ischemic infarction. Histologic examination of the kidney medulla shows no abnormalities. Based on these findings, which of the following structures is most likely to show pathologic changes?

- A) Collecting ducts
- B) Interlobular arteries
- C) Loops of Henle
- D) Papillary ducts
- E) Proximal convoluted tubules

14. A 52-year-old woman has a 10-year history of recurrent urinary tract infections. Urinalysis shows:

pH	7.6
Specific gravity	1.019
Blood	1+
Glucose	none
Protein	none
Ketones	none

Microscopic analysis of urine sediment shows numerous erythrocytes, leukocytes, and crystals. Her symptoms do not respond to therapy, and she undergoes a left nephrectomy. A photograph of the resected specimen is shown. Which of the following is the most likely causal agent?

- A) *Escherichia coli*
- B) *Mycobacterium tuberculosis*
- C) *Proteus vulgaris*
- D) *Pseudomonas aeruginosa*
- E) *Streptococcus pyogenes* (group A)



15. A 13-year-old boy is brought to the physician because of a 4-week history of mild left thigh and knee pain that was exacerbated when he jumped off the school bus steps onto the sidewalk this morning. The pain increases with activity. He has no history of serious illness or trauma and takes no medications. He is at the 50th percentile for height, 90th percentile for weight, and 97th percentile for BMI. His temperature is 37°C (98.6°F), pulse is 80/min, respirations are 16/min, and blood pressure is 115/65 mm Hg. Genital development is Tanner stage 3. Physical examination of the left lower extremity shows no muscle tenderness. Muscle tone and strength are normal in both lower extremities. Range of motion of the left knee is full and elicits no pain. Internal rotation of the left hip is limited by pain. Which of the following is the most likely diagnosis?

- A) Ankylosing spondylitis
- B) Osgood-Schlatter disease
- C) Septic arthritis
- D) Slipped capital femoral epiphysis

16. A 3-month-old girl is brought to the physician by her father because of developmental delay and delayed growth. She is below the 3rd percentile for length and weight. Physical examination shows coarse facial features, generalized hypotonia, bilateral hip dislocation, and inguinal hernias. Laboratory studies show an increased serum activity of lysosomal enzymes. Urine studies show no mucopolysaccharides. This patient most likely has a defect in which of the following biochemical pathways?

- A) Addition of mannose phosphate to lysosomal enzymes
- B) Degradation of dermatan sulfate
- C) Glycosaminoglycan degradation
- D) Lysosomal acid lipase
- E) Lysosomal trafficking of exogenous cholesterol

17. During an investigational study, antibodies are induced that bind to and inactivate inhibin in female experimental animals. On examination of these animals, which of the following is the direct result of the inactivation of inhibin?

- A) Decreased serum follicle-stimulating hormone concentration
- B) Decreased serum gonadotropin-releasing hormone concentration
- C) Increased serum follicle-stimulating hormone concentration
- D) Increased serum gonadotropin-releasing hormone concentration
- E) Theca cell atrophy
- F) Theca cell hypertrophy

18. A 32-year-old man comes to the physician for a health maintenance examination. His maternal uncles and grandfather had hypertension, renal calculi, enlargement of both kidneys, and decreased renal function. His maternal grandfather died of a ruptured intracranial berry aneurysm. Physical examination shows no abnormalities. Ultrasonography shows five to seven cysts in both kidneys. This patient most likely has a mutation in the gene that encodes which of the following proteins?

- A) Fibrocystin
- B) Nephrocystin
- C) Polycystin
- D) Sodium chloride cotransporter
- E) Sodium–potassium-2 chloride transporter
- F) Voltage-gated chloride channel
- G) Wilms tumor 1 (WT1)

19. An 18-year-old man develops a painless 1x1-cm ulcer on his penis, followed 4 weeks later by an erythematous maculopapular rash involving the palms and soles. The drug of choice for treatment of this disease inhibits which of the following microbial processes?

- A) Cell wall synthesis
- B) DNA replication
- C) Glycosylation
- D) Pore formation
- E) Translation

20. A 22-year-old woman is found to be HIV positive after sexual contact with a partner with HIV infection. Combination therapy with lamivudine (3TC), ritonavir/lopinavir, and zidovudine (AZT) is initiated. Three months later, genomic typing shows that her HIV strain has become resistant to ritonavir/lopinavir. The cause of this resistance is most likely the acquisition of a mutation in a gene that is critical for which of the following viral processes?

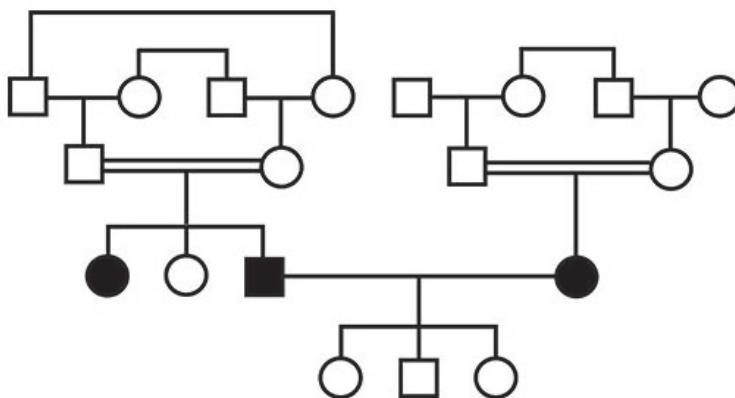
- A) Adsorption and penetration
- B) Early protein synthesis
- C) Genome integration
- D) Late protein synthesis
- E) Nucleic acid synthesis
- F) Packaging and assembly
- G) Protein processing
- H) Release
- I) Uncoating

21. A 3-year-old girl is found to have a grade 4/6, loud, harsh, high-pitched holosystolic murmur that radiates over the precordium and a palpable thrill at the left sternal border. Which of the following defects is most likely in this patient?

- A) Aortic regurgitation
- B) Aortic stenosis
- C) Atrial septal defect
- D) Coarctation of the aorta
- E) Mitral regurgitation
- F) Mitral stenosis
- G) Patent ductus arteriosus
- H) Pulmonic stenosis
- I) Tricuspid regurgitation
- J) Ventricular septal defect

22. During a clinical study, an investigator examines the effects of monoamine oxidase inhibitors to treat certain types of major depressive and phobic anxiety disorders. The concentration of which of the following compounds is most likely to be increased as a result of this treatment?

- A)  $\gamma$ -Aminobutyric acid (GABA)
- B) Dihydroxyphenylalanine
- C) Epinephrine
- D) Tryptophan
- E) Tyrosine



- Affected female
- Affected male
- Unaffected female
- Unaffected male

23. A 28-year-old woman and her 40-year-old husband both have albinism; none of their three children is affected. A pedigree is shown. Which of the following genetic mechanisms best explains the absence of albinism in their children?

- A) Genetic heterogeneity
- B) Germinal mosaicism
- C) Pleiotropy
- D) Variable expressivity

Mark

24. A 68-year-old woman with hypertension comes to the physician because of concerns about recent home blood pressure measurements. She says that her systolic blood pressures have ranged from 140 mm Hg to 160 mm Hg during the past 10 days. She has generalized anxiety disorder and major depressive disorder. Medications include amlodipine, citalopram, and hydrochlorothiazide. She appears anxious. Her blood pressure is 145/94 mm Hg. Physical examination shows no other abnormalities. While discussing treatment options, the patient says, "You are not taking good care of me; you must not like me very much." Which of the following is the most appropriate initial response by the physician?
- A) "Blood pressure often goes up as you get older, so needing additional medication is common."
  - B) "A common reason for poorly controlled blood pressure is not taking medications properly. Can you tell me how you take your medicines?"
  - C) "I am taking the best possible care of you; we just need to make some medication adjustments."
  - D) "I want to help you as much as I can. Why don't we talk about what is going on in your life."
  - E) "Your anxiety seems worse today. Let's talk about some treatment options."

- Mark
25. A 76-year-old man with a 5-year history of progressive dementia, Alzheimer type, is brought to the emergency department by his son, who found him weak and unable to get out of bed. The patient has had increasing problems caring for himself while living alone and has lost 11 kg (25 lb) over the past year. He takes no medications. He is 173 cm (5 ft 8 in) tall and weighs 42 kg (92 lb); BMI is 14 kg/m<sup>2</sup>. He is alert and talkative. Vital signs are normal. Physical examination shows sparse brittle hair and a red smooth tongue. There is general atrophy of interosseous and temporalis muscles, loss of subcutaneous fat, and edema of the lower extremities. He is oriented to person but not to place or time. Laboratory studies show:

Total lymphocyte count	↓
Serum	
Albumin	↓
Pre-albumin	↓
Transferrin	↓
Cortisol	↑

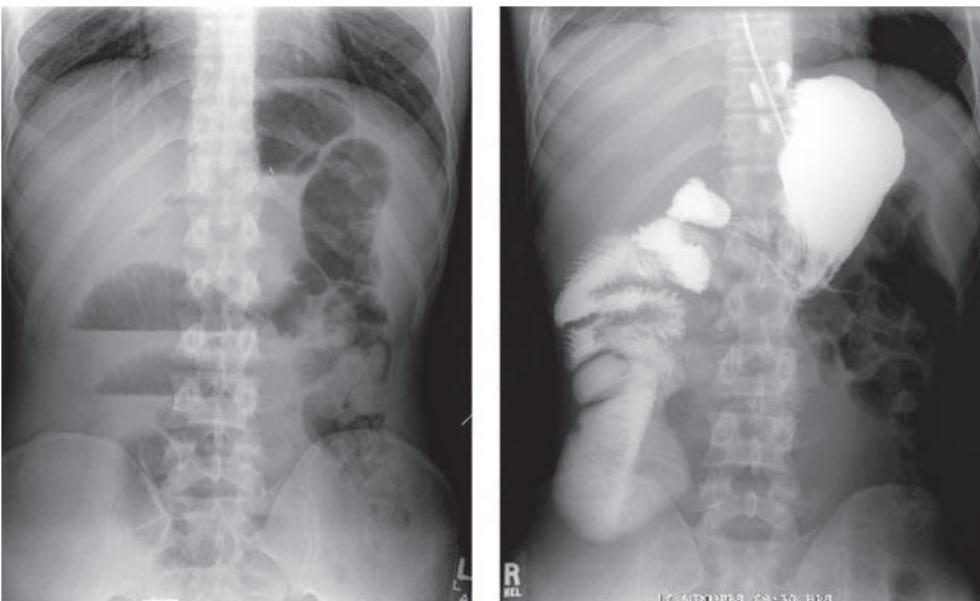
Liver function tests show no abnormalities. An x-ray of the chest shows a healed granuloma in the right upper lobe of the lung. Which of the following is the most likely explanation for this patient's condition?

- A) Cushing disease
- B) Hepatic encephalopathy
- C) Nephrotic syndrome
- D) Protein-calorie malnutrition
- E) Tuberculosis

26. Which of the following hormones decreases synthesis of prostaglandins and leukotrienes?

- A) Aldosterone
- B) Cortisol
- C) Dehydroepiandrosterone
- D) Desoxycorticosterone
- E) Pregnenolone

Mark



27. A 24-year-old man comes to the emergency department because of a 2-hour history of severe abdominal pain. His pulse is 110/min. Abdominal examination shows distention. An x-ray of the abdomen while the patient is sitting upright and an image from upper gastrointestinal series are shown. Based on the findings shown, this patient most likely has which of the following developmental anomalies?

- A) Gastroschisis
- B) Intestinal aganglionosis
- C) Malrotation
- D) Persistent vitelline duct
- E) Situs inversus viscerum

28. A 7-year-old boy is brought to the physician by his parents because of a 1-month history of progressive double vision and a 2-week history of imbalance. Physical examination shows weakness of abduction of the right eye, mild weakness of the left extremities, increased muscle stretch reflexes of the left extremities, and gait ataxia. Which of the following is the most likely diagnosis?

- A) Arnold-Chiari malformation
- B) Brain stem glioma
- C) Guillain-Barré syndrome
- D) Multiple sclerosis
- E) Myasthenia gravis

29. A male newborn is found to have an increased serum phenylalanine concentration on routine screening. The increased serum phenylalanine concentration is best explained by a defect in which of the following processes?

- A) Metabolism of tetrahydrobiopterin
- B) Metabolism of tetrahydrofolate
- C) Transport of branched-chain amino acids across the enterocytes
- D) Transport of phenylalanine across the enterocytes
- E) Transport of tyrosine across the enterocytes

30. The table summarizes the result of a study of the relationship between smoking and death from lung cancer.

Annual Death Rate (Per 1000 Persons)		
	Nonsmokers	Heavy Smokers
Lung cancer	0.07	2.27

Which of the following best describes the attributable (excess) risk per 1000 persons from heavy smoking in those with lung cancer?

- A)  $2.27 - 0.07$
- B)  $2.27 \div 0.07$
- C)  $0.07 \div 2.27$
- D)  $(2.27 - 0.07) \div 2.27$
- E) Cannot be determined from the data provided

Mark

31. A 73-year-old woman is admitted to the hospital 2 days after she fell while walking down her front steps. She has severe back pain. She has a 7-year history of polymyalgia rheumatica and a 20-year history of hypertension. Current medications include lisinopril, prednisone, vitamin D, and a multivitamin. She appears frail. Physical examination shows thoracic kyphosis and multiple ecchymoses over the dorsa of the hands. There is a tender point on percussion of the mid spine. A spinal x-ray shows multiple vertebral compression fractures. If a bone biopsy specimen were obtained from this patient, it would most likely show which of the following findings?

- A) Defective mineralization
- B) Increased collagen staining
- C) Increased mineralization
- D) Thickening at the cortex
- E) Thinned trabeculae

32. A full-term male newborn has severe hypotonia. His 20-year-old mother shows little facial expression. When she shakes the physician's hand, she has difficulty releasing her grip. Which of the following genetic phenomena is the most likely cause of these findings?

- A) Expanded trinucleotide repeats
- B) Gonadal mosaicism
- C) Mitochondrial inheritance
- D) Submicroscopic deletion
- E) Uniparental disomy

33. A 69-year-old man is admitted to the hospital after having a myocardial infarction. He cannot take aspirin because of a history of bronchospasm. At discharge, a substitute drug that inhibits platelet function is prescribed. This drug most likely has which of the following mechanisms of action?

- A) Activates adenosine deaminase
- B) Blocks the ADP receptors
- C) Blocks serotonin release
- D) Inhibits gamma-carboxylation of coagulation factors
- E) Inhibits prostaglandin synthesis

Mark

34. A 28-year-old woman comes to the physician for a health maintenance examination. During the interview, she tearfully tells the physician that she and her new husband are having problems. She says she wants to go out with friends, but he does not enjoy being with people, preferring individual activities such as hiking. She says he seems indifferent to sexual intimacy and neither shows much emotion nor understands her feelings at all. Which of the following personality styles best explains the husband's behavior?

- A) Avoidant
- B) Narcissistic
- C) Paranoid
- D) Schizoid
- E) Schizotypal

Mark

35. A 55-year-old woman comes to the physician because of a 2-day history of fever and the recent onset of cough productive of blood-tinged sputum. She also has had progressive shortness of breath during physical activity. She has smoked 2 packs of cigarettes daily for 41 years. Her temperature is 38.6°C (101.5°F), pulse is 95/min, respirations are 22/min, and blood pressure is 135/84 mm Hg. Breath sounds are decreased, and crackles are heard in the right middle lung field. A chest x-ray shows consolidation of the right middle lobe and a possible mass in the right hilar region. A CT scan of the lungs shows a 4-cm mass involving and obstructing the proximal right middle lobe bronchus. Which of the following is the most likely type of lung neoplasm?

- A) Adenocarcinoma
- B) Bronchioalveolar carcinoma
- C) Large cell carcinoma
- D) Lymphoma
- E) Squamous cell carcinoma

Mark

36. An investigator conducts a study of cranial nerve regeneration among two groups of experimental animals. During the study, the facial nerves are severed in one group (Group X) and the optic nerves are severed in the second group (Group Y). Three months later, it is found that the severed facial nerves among animals in Group X have regenerated, but the severed optic nerves among animals in Group Y have not regenerated. Which of the following best explains the absence of nerve regeneration among the animals in Group Y?

- A) Axons of the optic nerve are myelinated by oligodendrocytes
- B) The blood vessels that supply the retina cannot grow to supply the optic nerve
- C) Regenerating optic nerve fibers cannot cross the optic chiasm
- D) Retinal ganglion neurons are formed by neural crest cells
- E) Retinal photoreceptors are nonpermissive for optic nerve regeneration

37. A 70-year-old woman comes to the physician because of a 3-month history of frequent constipation and fatigue. She has had a 4.5-kg (10-lb) weight loss during this period. Her vital signs are within normal limits. Abdominal examination shows mild tenderness. Rectal examination shows a 10-cm firm mass. Laboratory studies show:

Hemoglobin	7.5 g/dL
Hematocrit	21%
Mean corpuscular volume	70 $\mu\text{m}^3$
Leukocyte count	25,000/mm <sup>3</sup>
Platelet count	500,000/mm <sup>3</sup>

This patient is at greatest risk for complications involving which of the following organs?

- A) Kidney
- B) Liver
- C) Lung
- D) Skin
- E) Uterus

38. An investigator is studying the efficacy of distinct vaccine formulations directed against the capsular polysaccharides of *Neisseria meningitidis*. The carbohydrates are chemically conjugated to various compounds and injected into laboratory mice. Titers of anticapsular IgG antibodies are then measured. Which of the following compounds is most likely to induce increased titers of these antibodies when conjugated to the polysaccharides?

- A) Dinitrophenol
- B) Flagellin
- C) Lactose
- D) Lipopolysaccharide
- E) Palmitic acid
- F) Polyinosinic acid-polycytidylic acid

39. A 79-year-old woman is brought to the emergency department because of pain in her left hip that began after she fell in her home. Physical examination shows a shortened and externally rotated left lower extremity. An x-ray shows an intertrochanteric fracture of the femur. Which of the following muscles best contributes to the lateral rotation of the thigh?

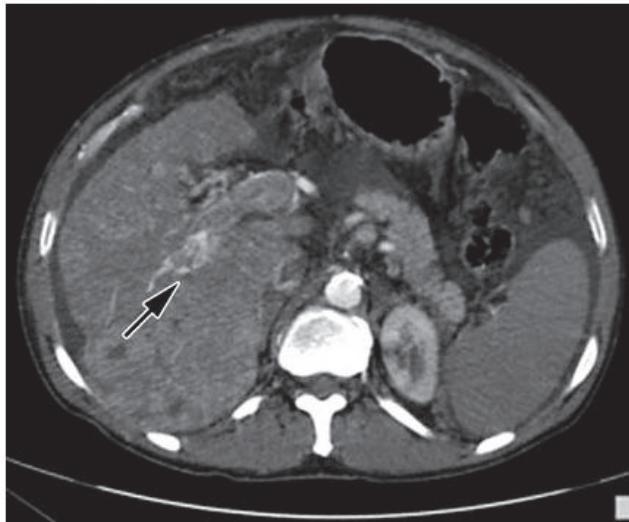
- A) Gluteus minimus
- B) Gracilis
- C) Pectineus
- D) Piriformis
- E) Rectus femoris

40. A 12-year-old boy with severe deafness is brought to the physician because of a 3-month history of episodes of loss of consciousness. Physical examination shows no abnormalities except for severe bilateral sensorineural hearing loss. An ECG shows a long QT interval. This patient most likely has a mutation in the gene that encodes which of the following proteins?

- A) α-Adrenergic receptor
- B) β-Adrenergic receptor
- C) Gap junction channel
- D) Muscarinic cholinergic receptor
- E) Neurotransmitter-gated calcium channel
- F) Voltage-gated potassium channel

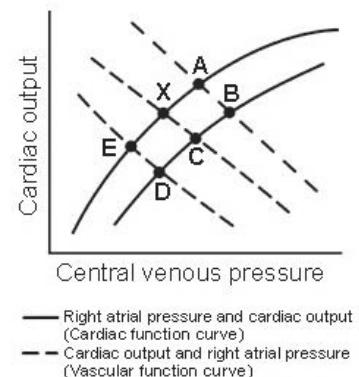
- Mark
41. A 55-year-old man is admitted to the hospital because of a 2-day history of vomiting and severe abdominal pain in the right upper quadrant. He drinks six 12-ounce beers daily. Abdominal examination shows spider angiomata. The liver is hard and nodular on palpation. A CT scan of the abdomen is shown; the arrow indicates a mass. Hypertension of which of the following veins is most likely in this patient?

- A) Hepatic
- B) Inferior phrenic
- C) Renal
- D) Short gastric
- E) Suprarenal



Mark

42. An 18-year-old man is brought to the emergency department 30 minutes after a motorcycle collision. He has lost a significant amount of blood. His pulse is 120/min, and blood pressure is 90/70 mm Hg. Physical examination shows a severe laceration of the left calf. Rapid infusion of 0.9% saline is started to restore his vascular volume deficit. The solid curves in the graph show the relationship between right atrial pressure and cardiac output (cardiac function curve). The dashed lines show the relationship between cardiac output and right atrial pressure (vascular function curve). Point X is the preinfusion equilibrium point. Which of the following is the most likely new cardiac and vascular equilibrium point following the infusion?



- A)
- B)
- C)
- D)
- E)

43. A 28-year-old man comes to the physician because of a 2-day history of an abscess at the site of a splinter on his right index finger. The leukocytes in this abscess initially localized to the site of inflammation because of an endothelial adhesion molecule that binds ligands on the surface of the leukocyte. Which of the following molecules is the most likely cause of the adhesion to the endothelial surface at the site of inflammation?

- A) Cadherins
- B) Extracellular matrix proteins
- C) G protein
- D) Proteoglycans
- E) Selectins

44. A 25-year-old man is lost in the desert for 1 week with an ample supply of water but no food. Which of the following changes in enzyme activities and regulatory molecule concentrations in liver is most likely in this patient?

	Fructose 2, 6-bisphosphate	Glucose 6-phosphatase	Phosphoenol/pyruvate Carboxykinase	Pyruvate Kinase
A)	↑	↑	↑	↓
B)	↑	↑	↓	↓
C)	↑	↓	↓	↑
D)	↓	↑	↑	↓
E)	↓	↑	↓	↓
F)	↓	↓	↑	↑
G)	↓	↓	↓	↑
H)	↓	↓	↓	↓

Mark

45. A 28-year-old African American man comes to the physician because of a 3-month history of mild fatigue and weakness; he has had a 4.5-kg (10-lb) weight loss during this period. He also has a 6-month history of dry cough associated with chest pain and shortness of breath. The patient is married with two children, ages 2 and 3 years. He says that no one else at home has similar symptoms. He is a carpenter. He has several pets, including a dog, two cats, and a bird. He spent a week in Mexico approximately 1 year ago. He has smoked one-half pack of cigarettes daily for 10 years. He is 178 cm (5 ft 10 in) tall and weighs 70 kg (154 lb); BMI is 22 kg/m<sup>2</sup>. Mild wheezes are heard. Physical examination shows no other abnormalities. A chest x-ray shows bilateral hilar adenopathy and right paratracheal node enlargement. Biopsy specimens obtained via fiberoptic bronchoscopy show noncaseating granulomas. Test results of the biopsy specimen for acid-fast bacilli and fungi are negative. Which of the following is the strongest predisposing risk factor for this patient's condition?
- A) Employment
  - B) Ethnicity
  - C) Gender
  - D) Living with pets
  - E) Recent travel to Mexico
  - F) Smoking history

46. A 10-year-old boy is brought to the emergency department 30 minutes after sustaining injuries in a skateboard accident. His vital signs are within normal limits. Physical examination shows tenderness to palpation over the right wrist. An x-ray shows a fracture of the right radius and ulna. He is treated with cast immobilization extending over the right elbow. He is no longer able to move his forearm muscles. Which of the following is most likely to occur in the immobilized muscles after 3 weeks in the cast?

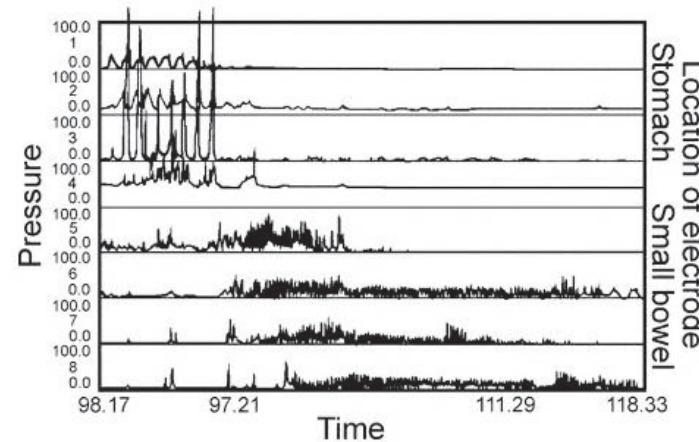
- A) Decreased capillarity
- B) Decreased intracellular  $Po_2$
- C) Decreased myoglobin oxygen saturation
- D) Increased metabolic rate
- E) Increased production of vascular endothelial growth factor
- F) Increased tissue adenosine concentration
- G) Increased total blood flow

47. A previously healthy 12-year-old girl is brought to the physician because of a 1-week history of brief generalized tonic-clonic seizures. Her family recently emigrated from Mexico. Physical examination shows no abnormalities. A CT scan of the head shows multiple calcified nodules and some cysts. The most likely cause of her seizures is infection with which of the following causal organisms?

- A) *Cryptococcus neoformans*
- B) Herpes simplex virus
- C) HIV
- D) *Listeria monocytogenes*
- E) *Mycobacterium tuberculosis*
- F) *Streptococcus pneumoniae*
- G) *Taenia solium*
- H) *Toxoplasma gondii*

48. A 24-year-old man comes to the physician because of nasal congestion, a watery nasal discharge, and sneezing. He says that these symptoms happen each spring, when grass and tree pollens are abundant. Which of the following types of drugs is most likely to be effective in relieving these symptoms in the short term?

- A) α-Adrenergic agonist
- B) α-Adrenergic antagonist
- C) β-Adrenergic agonist
- D) β-Adrenergic antagonist
- E) Nicotinic cholinergic agonist
- F) Nicotinic cholinergic antagonist



49. A healthy 22-year-old man participates in a study that analyzes the effects of various therapies on gastrointestinal motility. A manometric tracing of this man is shown. This manometric pattern is most likely due to binding of which of the following neurotransmitters with its respective receptor in the stomach?

- A) Acetylcholine
- B) Motilin
- C) Norepinephrine
- D) Serotonin
- E) Vasoactive intestinal polypeptide

50. A healthy 30-year-old woman is traveling on a commercial airliner where the cabin's barometric pressure is measured at 565 mm Hg. The inspiratory partial pressure of alveolar oxygen in this woman is most likely which of the following (in mm Hg)?

- A) 27
- B) 60
- C) 109
- D) 515
- E) 713

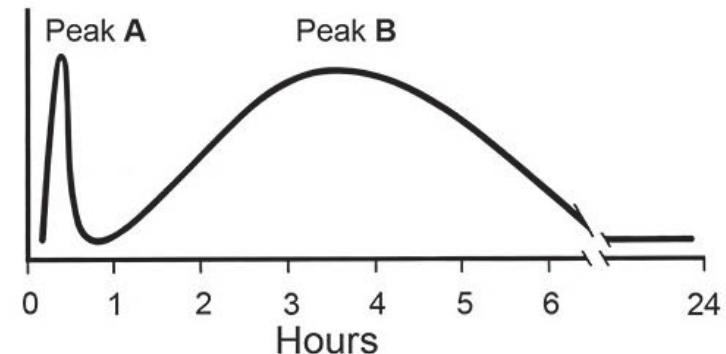
1. A 20-year-old man is brought to the physician by his mother because of bizarre behavior for 6 months. Although he had always been a good student, he failed all his classes at college last term. He no longer showers or shaves, and his appearance has become disheveled and unkempt. He appears distracted at the beginning of the interview and then begins talking nonstop to unseen people in the corner of the examining room. His mother looks upset and says, "It seems as if he's hearing voices all the time now. He's really scaring our family." Which of the following initial responses by the physician is most appropriate?

- A) "He must be schizophrenic. Does schizophrenia run in your husband's family or yours?"
- B) "He needs to take a shower. Have you tried sitting down with him and talking to him about taking better care of himself?"
- C) "How frightening for you to see your son like this. Do you have any idea about what might be causing his behavior?"
- D) "I am concerned he might be on drugs. Do you know anything about the friends he is hanging out with now?"
- E) "Was he under any unusual stress at home or at school or did he have any problems with a girlfriend when all of this started?"

2. A 79-year-old woman comes to the physician because of swollen, painful joints in her hands and knees for 6 months. Her hematocrit is 39%. Serum protein electrophoresis shows a monoclonal IgG spike of 1.8 g; serum IgA and IgM concentrations are within the reference range. Her urine does not contain Bence Jones protein. A bone marrow biopsy specimen shows no abnormalities. Which of the following is the most likely explanation for the increased serum IgG concentration in this patient?

- A) Chronic hepatic disease
- B) Chronic inflammation
- C) Monoclonal gammopathy of uncertain significance
- D) Multiple myeloma
- E) Waldenström macroglobulinemia

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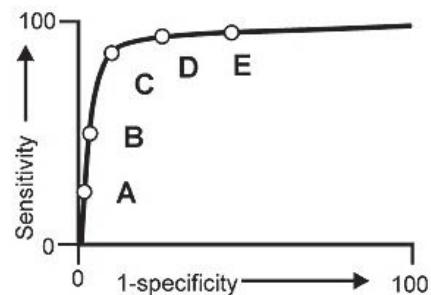
3. In an experimental model of mild thermal injury to skin (a single application of 54°C for 20 seconds), the following pattern of extravasation of intravenously administered dye is observed. Administration of an antihistamine prior to thermal injury would have significantly blunted the extent of dye extravasation observed at which of the following labeled sites?

- A) Peak A only
- B) Peak B only
- C) Both Peak A and B
- D) Neither Peak A nor B

4. A 35-year-old woman is brought to the emergency department because of a 3-hour history of sharp cramping pain in the right flank. Urinalysis shows blood. A noncontrast CT scan is obtained, and a renal calculus is found to be lodged in the ureter just above the sacroiliac joint. At this point, the ureter narrows as it passes over which of the following structures?

- A) External iliac vessels
- B) Infundibulopelvic ligament
- C) Internal pudendal vessels
- D) Left colic vessels
- E) Ovary

5. An inexpensive screening test for a disease is available through analysis of venous blood. The receiver operating characteristic (ROC) curve for five different cut points is shown. The disease is irreversible and fatal if not discovered and treated early. Which of the following is the most appropriate cut point between normal and abnormal venous blood analysis results for this screening test?



- A)
- B)
- C)
- D)
- E)

6. A 20-year-old man with intellectual disability is brought to the physician for a routine examination. Physical examination shows a long face, prominent ears, and large testes. His younger brother and a maternal uncle have similar features. Analysis of the patient's DNA shows 800 CGG repeated sequences ( $N < 60$ ) in the 5' untranslated region of the *FMR1* gene. This region of expanded CGG trinucleotide repeats is heavily methylated. Which of the following is the most likely effect of these expanded nucleotide repeats on transcription of *FMR1* mRNA?

- A) Alteration of mRNA splicing
- B) Decreased transcription
- C) Enhancement of mRNA degradation
- D) Incorporation of CGG repeats into mRNA
- E) Increased binding of RNA polymerase

7. A 68-year-old man comes to the physician because of difficulty swallowing solids for 2 months. He has a history of dilated cardiomyopathy. X-rays of the esophagus with barium contrast show indentation and posterior displacement of the esophagus. Enlargement of which of the following structures is the most likely cause of the dysphagia?

- A) Left atrium
- B) Left ventricle
- C) Right atrium
- D) Right ventricle
- E) Superior vena cava

8. A 21-year-old man comes to the physician because of intermittent episodes of light brown urine during the past year associated with upper respiratory tract infections. His blood pressure is 145/85 mm Hg. Physical examination shows no other abnormalities. Urinalysis shows microscopic blood, 3+ protein, and several RBC casts. Immunohistochemical staining of a renal biopsy specimen is most likely to show granular deposits in the glomerular mesangium predominantly consisting of which of the following immunoglobulins?

- A) IgA
- B) IgD
- C) IgE
- D) IgM

9. For aerobic catabolism of compounds with equivalent numbers of carbon atoms, the greatest amount of energy in the form of ATP is obtained from compounds with the largest number of which of the following?

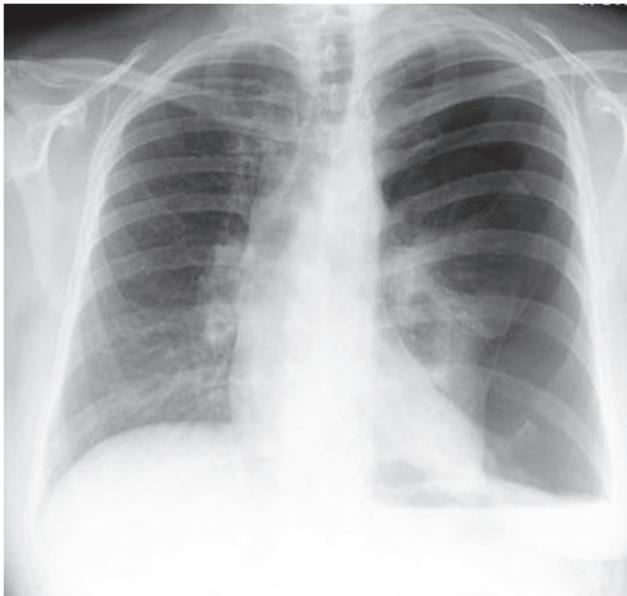
- A) Aldehyde groups
- B) Amino groups
- C) Hydrogen atoms
- D) Keto groups
- E) Oxygen atoms

10. A 25-year-old man comes to the emergency department 5 hours after developing shortness of breath and chest pain during exercise; he has had no cough or bloody mucus. He has asthma and major depressive disorder. Current medications include fluticasone inhaler and albuterol. His temperature is 37.1°C (98.8°F), pulse is 110/min, respirations are 30/min, and blood pressure is 90/60 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 93%. Cardiac examination shows a normal S<sub>1</sub> and S<sub>2</sub> with no murmurs and no increase in jugular venous pressure. Laboratory studies show:

Hemoglobin	13 g/dL
Hematocrit	39%
Arterial blood gas analysis on room air:	
pH	7.46
Pco <sub>2</sub>	26 mm Hg
Po <sub>2</sub>	60 mm Hg

A chest x-ray is shown. Which of the following pulmonary findings are most likely in this patient?

- A) Crackles on the left lung base and apex
- B) Crackles on the right lung base
- C) Decreased breath sounds on the left
- D) Increased wheezes on the left
- E) Rhonchi on the right



11. A 42-year-old woman with type 2 diabetes mellitus comes to the physician because of a 1-day history of increasingly severe right knee pain. She now has difficulty walking because of the pain. She recalls no trauma to the knee and has never had similar symptoms. She is 152 cm (5 ft) tall and weighs 100 kg (220 lb); BMI is  $43 \text{ kg/m}^2$ . Her temperature is  $39.3^\circ\text{C}$  ( $102.7^\circ\text{F}$ ), pulse is 110/min, respirations are 12/min, and blood pressure is 160/90 mm Hg. Physical examination shows a 10-cm area of erythema surrounding the right knee, which is warm to the touch and exquisitely tender with movement. There is a moderate effusion. Arthrocentesis yields cloudy yellow synovial fluid. Analysis of the synovial fluid shows a leukocyte count of  $90,000/\text{mm}^3$  (95% neutrophils) and no crystals. A Gram stain of the fluid shows numerous segmented neutrophils but no organisms. Which of the following is the most likely cause of the findings in this patient?

- A) Deep venous thrombosis of the right common femoral vein
- B) Gout
- C) Infectious arthritis
- D) Pseudogout
- E) Ruptured Baker cyst

12. A 6-year-old girl of Mediterranean ancestry has severe anemia. Analysis shows normal production of  $\alpha$ -globin gene mRNA. Production of  $\beta$ -globin gene mRNA is decreased 75% because of a splice-site mutation within both of the patient's  $\beta$ -globin genes. Which of the following is the most likely explanation for the anemia?

- A) Decreased production of  $\alpha$ -4 tetramers compared with normal individuals
- B) Decreased production of  $\beta$ -4 tetramers compared with normal individuals
- C) Imbalance in the synthesis of the  $\alpha$ - and  $\beta$ -globin gene products
- D) Imbalance in the synthesis of the four  $\alpha$ -globin genes

13. A 50-year-old man with schizophrenia is admitted to the hospital because of chest pain. He develops acute fever, lethargy, and muscular rigidity 5 days later. He has been receiving haloperidol treatment since admission. His temperature is 41°C (105.8°F), pulse is 120/min, and blood pressure is 140/80 mm Hg. He is disoriented and agitated and has diffusely increased muscle tone. Serum creatine kinase activity is 1500 U/L. Which of the following is the most likely diagnosis?

- A) Catatonia
- B) Dystonia
- C) Malignant hyperthermia
- D) Neuroleptic malignant syndrome
- E) Tardive dyskinesia

14. A 1-month-old boy with X-linked severe combined immunodeficiency is enrolled in a gene therapy trial. Bone marrow stem cells are extracted from the patient and are treated ex vivo with a retrovirus expressing the wild-type gene. Although the patient initially responds well, 30 months after treatment he develops a form of T-lymphocyte leukemia. Molecular studies show that the T lymphocytes are monoclonal. Which of the following viral processes is the most likely cause of the leukemia in this patient?

- A) Deactivation of the p53 tumor suppressor gene
- B) Generation of the Philadelphia (Ph<sup>1</sup>) chromosome
- C) Integration adjacent to an oncogene
- D) Phosphorylation of pRB
- E) Reverse transcription of *PTEN*

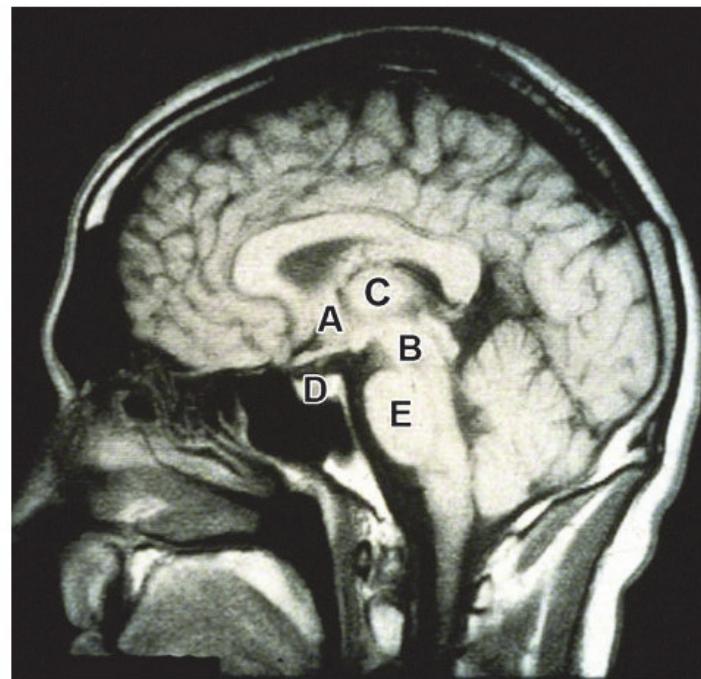
15. A 72-year-old man with severe congestive heart failure is brought to the emergency department because of a 5-day history of malaise and vomiting. He takes no medications. His pulse is 104/min, respirations are 35/min, and blood pressure is 90/64 mm Hg. Physical examination shows dusky-colored skin, peripheral cyanosis, and 10-cm jugular venous distention. Crackles are heard over the lung bases bilaterally. Cardiac examination shows an S<sub>3</sub>. There is 2+ pitting edema to the knees bilaterally. Laboratory studies show:

Serum	
Na <sup>+</sup>	127 mEq/L
K <sup>+</sup>	5.2 mEq/L
Cl <sup>-</sup>	79 mEq/L
HCO <sub>3</sub> <sup>-</sup>	17 mEq/L
Urea nitrogen	100 mg/dL
Glucose	171 mg/dL
Creatinine	8.4 mg/dL
Urine	
Glucose	1+
Ketones	absent
Arterial blood gas analysis on 28% oxygen	
pH	7.35
Pco <sub>2</sub>	32 mm Hg
Po <sub>2</sub>	154 mm Hg
HCO <sub>3</sub> <sup>-</sup>	17 mEq/L

Which of the following is the most likely cause of the anion gap in this patient?

- A) Alcoholic ketoacidosis
- B) Diabetic ketoacidosis
- C) Hyperperfusion
- D) Hypoalbuminemia
- E) Metabolic alkalosis
- F) Milk-alkali syndrome
- G) Renal failure
- H) Respiratory alkalosis

16. A 24-year-old nulligravid woman comes to the office because of a 6-month history of chronic headache and vision difficulties. She also recently had several episodes of milky discharge from her breasts. Menses occur at irregular 50- to 90-day intervals; her last menstrual period was 6 months ago. She takes an oral contraceptive continuously and does not have withdrawal bleeding. Pulse is 80/min, respirations are 14/min, and blood pressure is 110/78 mm Hg. Ophthalmologic examination shows bitemporal hemianopia. Physical examination shows galactorrhea. Urine pregnancy test result is negative. MRI of the brain shows a 2-cm mass. Which of the following labeled structures in the normal MRI of the brain is the most likely location of the mass in this patient?

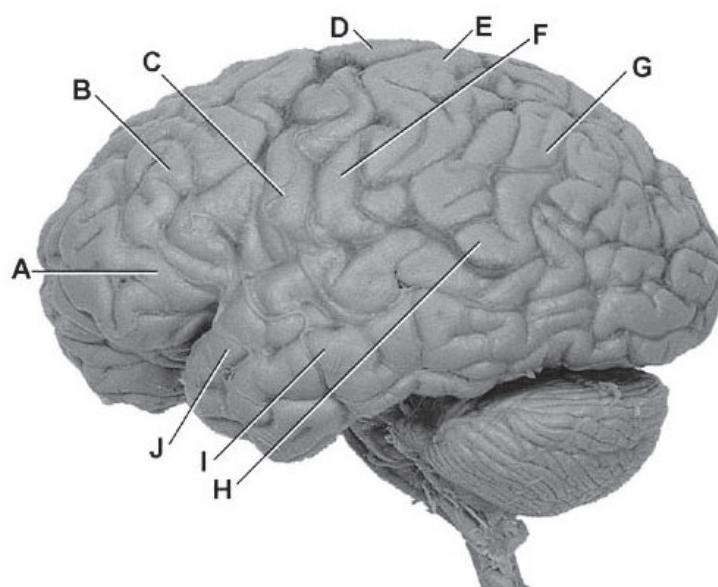


- A)
- B)
- C)
- D)
- E)

17. Diisopropyl fluorophosphate, a potent inhibitor of acetylcholinesterase, reacts with which of the following specific amino acids at the active site of the enzyme?

- A) Cysteine
- B) Glutamic acid
- C) Histidine
- D) Serine
- E) Tyrosine

18. Following a stroke, a 68-year-old man has a language problem. His speech is fluent but contains many grammatical errors, word substitutions, and neologisms. He is unable to repeat words after the examiner and is apparently unable to comprehend other verbal requests. Which of the following labeled sites on the photograph of the left hemisphere is most likely to be damaged?



- A)
- B)
- C)
- D)
- E)
- F)
- G)
- H)
- I)
- J)

19. A male newborn develops vomiting and convulsions 4 hours after delivery. There is slight bulging of the fontanelles. Which of the following organisms is most likely responsible for these findings?

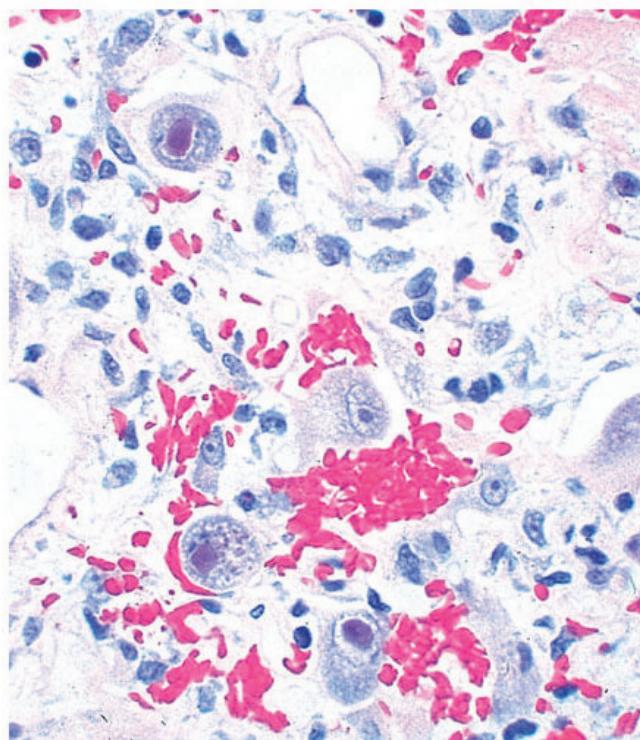
- A) *Escherichia coli*
- B) *Haemophilus influenzae*
- C) *Neisseria meningitidis*
- D) *Staphylococcus aureus*
- E) *Streptococcus pneumoniae*

- Mark
20. A 23-year-old woman comes to the physician because of a 2-week history of increasingly severe itching and yellow-tinged skin. Three months ago, she started taking a combination oral contraceptive. She does not smoke. She consumes two to three alcoholic beverages only on the weekends. Physical examination shows mild jaundice and scleral icterus. The liver span is 11 cm with no tenderness. Serum studies show:

Bilirubin, total	7.3 mg/dL
Direct	5.8 mg/dL
Alkaline phosphatase	440 U/L
AST	80 U/L
ALT	70 U/L
γ-Glutamyltransferase (GGT)	234 U/L (N=0-30)

Serologic studies for acute viral hepatitis are negative. Which of the following is the most likely cause of these findings?

- A) Autoimmune hemolytic anemia
- B) Dilated canalicular with bile plugs
- C) Hepatic vein thrombosis
- D) Hepatocellular necrosis
- E) Portal vein thrombosis

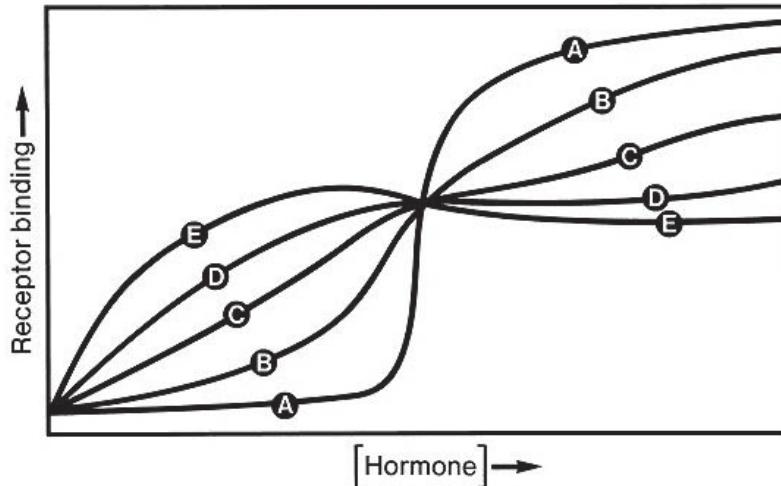


21. A 17-year-old boy is brought to the emergency department because of a 2-day history of fever and shortness of breath. He underwent bone marrow transplantation for acute myelogenous leukemia 2 months ago. His temperature is 39°C (102.2°F), and respirations are 32/min. Diffuse crackles are heard over the lung fields on auscultation. A chest x-ray shows interstitial pneumonia. A photomicrograph of a biopsy specimen of the lung tissue is shown. Decreased function of which of the following most likely predisposed this patient to infection?

- A) Dendritic cells
- B) Eosinophils
- C) Mast cells
- D) Neutrophils
- E) T lymphocytes

Mark

22. Which of the following curves shows the highest cooperativity between a hormone and its receptor?



- A)
- B)
- C)
- D)
- E)

23. A 17-year-old girl with type 1 diabetes mellitus comes to the physician for a follow-up examination. She has had multiple admissions to the hospital during the past 5 months for diabetic ketoacidosis. She appears well. Physical examination shows no abnormalities. Laboratory studies show a hemoglobin A<sub>1c</sub> of 11.5%. She tells the physician that she does not take her insulin regularly because she either forgets to or is too busy. Which of the following is the most appropriate initial step by the physician?

- A) Acknowledge the patient's reasons for missing insulin injections
- B) Discuss the patient's noncompliance with her parents
- C) Educate the patient about the long-term complications of untreated diabetes
- D) Tell the patient's parents to ensure that their daughter is compliant
- E) Refer the patient to a psychologist

24. A 63-year-old man from southern China has had a bloody nasal discharge for the past 5 months. Physical examination shows an enlarged, fixed lymph node in the upper posterior cervical triangle of the left neck. Examination of tissue obtained on needle biopsy of the lymph node shows neoplastic cells that are positive for keratin and Epstein-Barr nuclear antigen. Which of the following is the most likely diagnosis?

- A) Burkitt lymphoma
- B) Kaposi sarcoma
- C) Nasopharyngeal carcinoma
- D) Sinonasal carcinoma
- E) Squamous cell carcinoma

25. A 55-year-old man comes to the physician because of pain and stiffness of his right hand and wrist for 3 months. The pain is exacerbated by hand movement and is relieved by rest. He was a professional boxer for 15 years. Physical examination shows moderate swelling over the dorsum of the right wrist. Examination of fluid aspirated from the wrist shows:

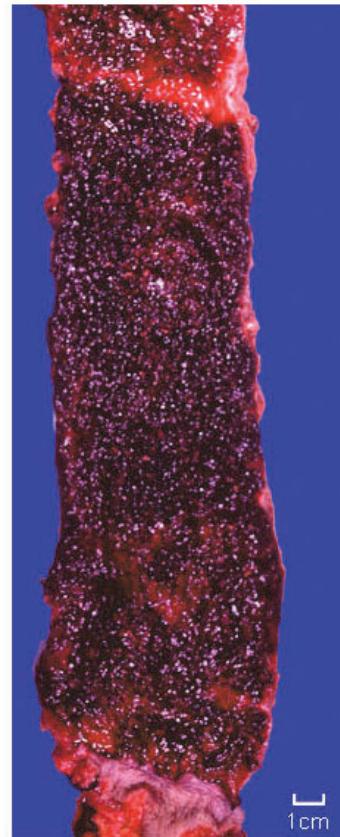
Appearance	Clear, yellowish
Leukocyte count	250/mm <sup>3</sup> (N≤200)
Neutrophils	5% (N≤25%)
Glucose	101 mg/dL (N=80–100)

Which of the following is the most likely cause of this patient's condition?

- A) Acute gouty arthritis
- B) Osteoarthritis
- C) Rheumatoid arthritis
- D) Septic arthritis
- E) Normal age-related changes in joints

26. A 34-year-old woman has a 3-year history of recurring episodes of tenesmus, mucoid bloody diarrhea, and cramping abdominal pain. A section of bowel removed following a severe episode is shown. Which of the following is the most likely diagnosis?

- A) Crohn disease
- B) Diverticulitis
- C) Pseudomembranous enterocolitis
- D) Superior mesenteric artery occlusion
- E) Ulcerative colitis



Mark

27. A 22-year-old woman is admitted to the hospital because of a 10-day history of polydipsia and polyuria. She says that the urge to urinate often awakens her at night. She has been taking lithium carbonate for 2 years for bipolar disorder; her dosage was increased 6 months ago because of recurrent severe manic episodes. Her vital signs are within normal limits. Physical examination shows no abnormalities. Over the next 24 hours, urine excretion totals 6.5 L. Laboratory studies at this time show a serum sodium concentration of 148 mEq/L, serum osmolality of 315 mOsmol/kg, and urine osmolality of 75 mOsmol/kg. After administration of desmopressin, urine output and osmolality do not change. Which of the following findings in the nephron best describes the tubular osmolality, compared with serum, in this patient?

	Proximal Tubule	Juxtaglomerular Apparatus	Medullary Collecting Duct
<input type="radio"/> A)	Hypertonic	hypertonic	hypertonic
<input type="radio"/> B)	Hypertonic	hypertonic	hypotonic
<input type="radio"/> C)	Hypertonic	hypotonic	hypotonic
<input type="radio"/> D)	Isotonic	isotonic	isotonic
<input type="radio"/> E)	Isotonic	hypotonic	hypertonic
<input type="radio"/> F)	Isotonic	hypotonic	hypotonic
<input type="radio"/> G)	Hypotonic	hypertonic	hypertonic
<input type="radio"/> H)	Hypotonic	hypotonic	hypertonic
<input type="radio"/> I)	Hypotonic	hypotonic	hypotonic

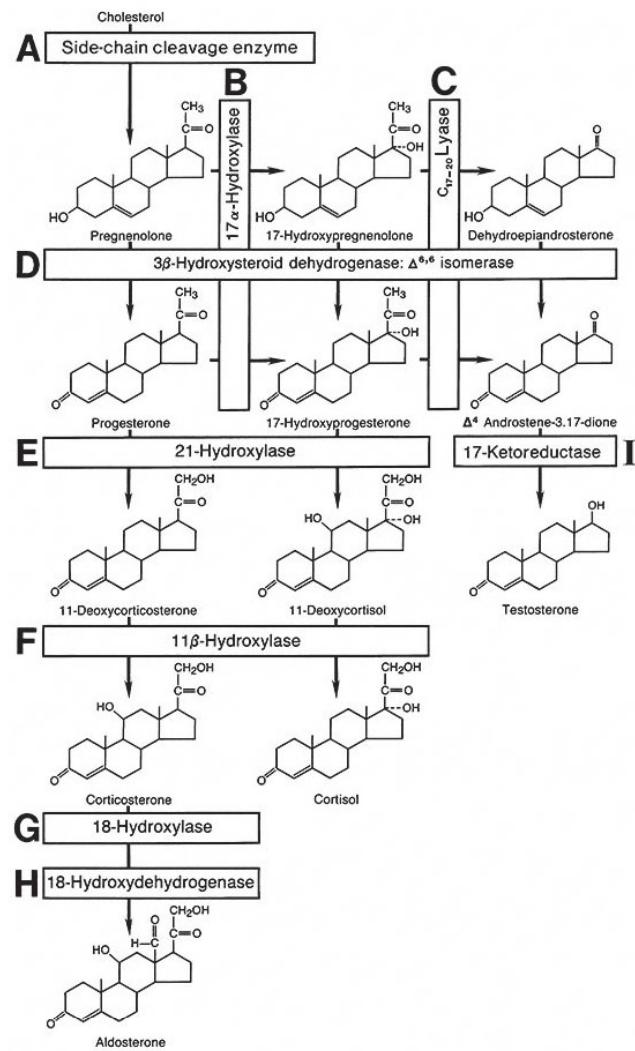
28. A 58-year-old woman with type 2 diabetes mellitus is brought to the emergency department because of an 18-hour history of fever, confusion, and pain of her left leg. Her temperature is 39.6°C (103.3°F), pulse is 124/min, respirations are 22/min, and blood pressure is 94/60 mm Hg. Physical examination shows a diffuse, erythematous rash and conjunctival injection. Erythema and edema extend from the dorsum of the left foot to the knee. She is oriented to person but not to place or time. Neurologic examination shows no other abnormalities. Serum studies show:

Urea nitrogen	36 mg/dL
Creatinine	2.8 mg/dL
Total bilirubin	2.2 mg/dL
AST	470 U/L
ALT	385 U/L

One day later, blood cultures grow gram-positive cocci in chains. These bacteria most likely produced a toxin that caused this patient's condition via which of the following mechanisms?

- A) Binding to the T-lymphocyte receptor and class II MHC molecules
- B) Blockade of protein synthesis by depurination of ribosomal RNA
- C) Catalyzing of the formation of cAMP from ATP
- D) Cleavage of kinases that activate mitogen-activated protein kinase to induce macrophage apoptosis
- E) Disruption of cytoskeleton architecture by glycosylating Rho1

29. A newborn born with ambiguous external genitalia becomes severely dehydrated shortly after birth. Serum sodium and chloride concentrations are decreased, and serum potassium concentration is increased. The newborn's karyotype is 46,XX. The most likely cause of these findings is a genetic defect in which of the following labeled enzymes?



- A)
- B)
- C)
- D)
- E)
- F)
- G)
- H)
- I)

30. A 25-year-old man comes to the physician because of a 2-month history of recurrent episodes of chest pain and shortness of breath. He has a 2-year history of nodules on his hands and feet. Physical examination shows numerous 1- to 2-cm yellow nodules that are palpable on both Achilles tendons and on the extensor tendons of the hands. Ophthalmologic examination shows corneal arcus. Serum studies show:

Creatine kinase	35 U/L
Cholesterol, total	350 mg/dL
HDL-cholesterol	50 mg/dL
LDL-cholesterol	300 mg/dL
Triglycerides	100 mg/dL
Troponin I	0.1 ng/mL (N<0.4)

An ECG shows no abnormalities. This patient most likely has an impairment in function involving which of the following structures?

- A) Caveolae
- B) Clathrin-coated pit
- C) COPII-coated pit
- D) Phagosome
- E) Snap receptors (SNAREs)

31. Patients who have recurrent infections involving *Neisseria* species are most likely to have a genetic deficiency in which of the following serum factors?

- A) C1 esterase inhibitor
- B) Factors B and H
- C) Immunoglobulins
- D) Late component of complement
- E)  $\beta_2$ -Microglobulin

32. A 17-year-old boy comes to the physician because of a 3-month history of worsening acne. Treatment over the past year with tetracycline had been effective. His symptoms began when he started taking the medication in the morning with a glass of milk. Which of the following best explains the ineffectiveness of tetracycline in this patient?

- A) Milk calcium chelates with tetracycline
- B) Milk carbonate inactivates tetracycline
- C) Milk lipids bind tetracycline
- D) Milk peptides induce drug-metabolizing enzymes
- E) Milk proteins bind tetracycline

33. A 50-year-old woman has azotemia. Renal ultrasonography shows bilateral hydroureters and hydronephrosis. The most likely cause of these findings is primary carcinoma of which of the following?

- A) Colon
- B) Kidney
- C) Ovary
- D) Ureter
- E) Uterine cervix

34. A 45-year-old woman is brought to the emergency department because of the sudden onset of severe abdominal pain. Examination shows an irregularly irregular pulse, a grade 3/6, apical diastolic murmur, and an opening snap. An x-ray of the abdomen shows distention of the small intestine, the ascending colon, and a portion of the transverse colon. Which of the following is the most likely underlying cause of these findings?

- A) Atherosclerosis
- B) Embolization
- C) Hemorrhage
- D) Plaque rupture
- E) Thrombosis

35. A 67-year-old man comes to the physician because of a 2-month history of pain in his feet. The discomfort is more severe in bed at night and is relieved by taking a hot bath. He has type 2 diabetes mellitus treated with glipizide. His pulse is 60/min, respirations are 12/min, and blood pressure is 130/88 mm Hg. Strength is normal and symmetric in the distal and proximal upper and lower extremities. The Achilles deep tendon reflexes are decreased, and quadriceps deep tendon reflexes are normal. Sensation to pinprick and vibration is decreased from just above the ankles distally. This patient is most likely to describe his pain as which of the following?

- A) Aching
- B) Burning
- C) Colicky
- D) Cramping
- E) Sharp
- F) Squeezing

36. A 35-year-old woman comes to the physician for advice on smoking cessation. She has smoked 2 packs of cigarettes daily for 15 years. She has tried to quit smoking numerous times in the past without success. The physician plans to prescribe a medication that decreases the craving for cigarettes and also blocks the central nervous system stimulation caused by smoking. This drug most likely has which of the following nicotinic effects?

- A) Agonist
- B) Antagonist
- C) Inverse agonist
- D) Partial agonist

37. A 35-year-old man comes to the physician because of a 2-week history of daily left-sided headaches that last 30 to 60 minutes. The headaches usually occur at night and often awaken him. They are accompanied by redness and tearing of the left eye and nasal congestion on the left. Alcohol seems to trigger their occurrence. Vital signs are normal. Neurologic examination shows no abnormalities. Which of the following is the most likely diagnosis?

- A) Alcohol-induced vasodilation
- B) Allergic rhinitis
- C) Central nervous system neoplasia
- D) Cluster headache
- E) Temporal arteritis

38. A 4-year-old girl with chronic otitis media is brought to the physician by her mother because of a 5-day history of recurrence of symptoms. The mother says that her daughter had a mild cough that began 8 days ago and progressed to a sore throat and ear pain during the next 3 days. The patient appears irritable and is pulling at her right ear. Otoscopic examination shows fluid behind the tympanic membrane. Which of the following best describes the anatomic pathway of the spread of infection from this patient's throat?

- A) Laryngopharynx → auditory tube → inner ear
- B) Larynx → oropharynx → sinuses → inner and middle ear
- C) Lungs → paranasal sinuses → inner ear
- D) Nasopharynx → auditory tube → middle ear
- E) Nose → sinuses → outer ear

Mark

39. An investigator is conducting a randomized, double-blind, placebo-controlled clinical trial of a new medication for the treatment of mild insomnia in adults. A total of 2000 participants are enrolled in the study and randomized to one of two groups: 1000 participants receive the new medication (Group 1), and 1000 participants receive a placebo that appears identical to the medication (Group 2). Participants in both groups are instructed to take one pill 30 minutes before bedtime each day and to keep a sleep diary. After 1 month, each participant is interviewed, and the daily sleep diaries are reviewed. At follow-up, it is determined that 200 participants in Group 1 and 50 participants in Group 2 did not take the pill as directed. In accordance with intention-to-treat analysis, how should the data pertaining to all individuals who did not adhere to the instructions be treated?

- A) Analyze all nonadherent participants according to the group of the study to which each was randomized
- B) Exclude all nonadherent participants from analysis
- C) Exclude only nonadherent participants in Group 1 from analysis
- D) Exclude only nonadherent participants in Group 2 from analysis
- E) Perform separate analyses of the 250 nonadherent participants and the 1750 adherent participants

40. A 64-year-old man undergoes surgical repair of an abdominal aortic aneurysm. During the repair, the left testicular artery is ligated. Anastomotic supply from which of the following arteries will maintain adequate arterial supply to the left testis in this patient?

- A) Artery of the ductus deferens
- B) Inferior vesical artery
- C) Obturator artery
- D) Posterior scrotal artery
- E) Superficial circumflex iliac artery

41. A 42-year-old man is brought to the emergency department 1 hour after police found him wandering the street. He has a 5-year history of gout. There is no odor of alcohol, but he is drowsy and ataxic. Physical examination shows severe jaundice, prominent periumbilical veins, and several cutaneous spider angiomas. Abdominal examination shows splenomegaly and ascites. There is a flapping, up-and-down motion of the hands when his arms are outstretched horizontally. His hemoglobin concentration is 10.8 g/dL. Test of the stool for occult blood is positive. The arm motions and drowsiness are best explained by which of the following?

- A) Alcohol intoxication
- B) Anemia
- C) Hyperammonemia
- D) Hyperbilirubinemia
- E) Hyperuricemia

42. A 61-year-old man is prescribed fluoxetine for major depressive disorder. This drug has its initial effects on neurons arising in which of the following structures?

- A) Amygdala
- B) Insular cortex
- C) Locus caeruleus
- D) Raphe nuclei
- E) Substantia nigra

43. A 29-year-old woman with major depressive disorder develops constipation and urinary retention 1 week after beginning antidepressant therapy. The most likely cause of these adverse effects is blockade of which of the following neurotransmitters by the antidepressant?

- A) Acetylcholine
- B) Dopamine
- C) Histamine
- D) Norepinephrine
- E) Serotonin

44. An experiment is performed in which an isolated segment of skeletal muscle undergoes isotonic contraction. Which of the following would determine the maximum rate of shortening?

- A) Amount of muscle phosphocreatine
- B) Amplitude of the action potentials
- C) Frequency of the action potentials
- D) Rate of cross-bridge recycling
- E) Rate of  $\text{Na}^+ \text{--} \text{K}^+$ -ATPase activity

45. A 2-year-old boy is brought to the physician by his mother because of a 3-week history of increased irritability. He is at the 10th percentile for height, 5th percentile for weight, and 80th percentile for head circumference. Physical examination shows evidence of hydrocephalus. A CT scan of the head shows a cyst-like dilation of the fourth ventricle, hypoplastic cerebellar hemispheres, and an enlarged posterior fossa with high tentorium cerebelli. Which of the following subdivisions of the neural tube was most likely affected in this patient during prenatal development?

- A) Diencephalon
- B) Mesencephalon
- C) Metencephalon
- D) Prosencephalon
- E) Spinal cord
- F) Telencephalon

46. A 1-year-old girl is brought to the physician by her mother because of a 1-day history of blisters on her skin. The mother says that she has had several previous similar episodes earlier in the summer. Physical examination shows areas of dense freckling over sun-exposed areas, with hypo- and hyperpigmented macules. The skin appears dry and atrophic. This patient's disorder is most likely caused by a defect in which of the following DNA repair mechanisms?

- A) Base excision repair
- B) Mismatch repair
- C) Nonhomologous end joining
- D) Nucleotide excision repair
- E) Recombination repair

47. A 72-year-old woman is admitted to the hospital because of an acute myocardial infarction. She undergoes cardiac catheterization. Angiography shows a left dominant circulation, and a 90% narrowing of the artery supplying the diaphragmatic surface and atrioventricular node of the heart. A balloon angioplasty is scheduled during which a stent will be inserted in the narrowed vessel. The catheter and the balloon must be passed through which of the following vessels (stated in order) to reach the narrowed vessel?

- A) Left coronary, circumflex, anterior interventricular (left anterior descending)
- B) Left coronary, circumflex, posterior interventricular (posterior descending)
- C) Left coronary, posterior interventricular (posterior descending), circumflex
- D) Right coronary, circumflex, anterior interventricular (left anterior descending)
- E) Right coronary, circumflex, posterior interventricular (posterior descending)
- F) Right coronary, posterior interventricular (posterior descending), circumflex

48. An 8-year-old boy is admitted to the hospital because of severe flank pain and blood in his urine. He has had intellectual developmental disorder since early infancy. Examination shows choreoathetosis and self-mutilation of the lips and fingers. His serum uric acid concentration is increased. Urinalysis shows numerous uric acid crystals and erythrocytes. The most likely cause of the hyperuricemia is deficient activity of which of the following enzymes?

- A) δ-Aminolevulinate synthase
- B) Glycine-oxaloacetic transaminase
- C) Glycine synthase
- D) Hypoxanthine-guanine phosphoribosyl transferase
- E) Serine transhydroxymethylase
- F) Xanthine oxidase

49. A 35-year-old woman comes to the physician because of a 2-day history of painful blisters on her upper and lower lips. She has a 10-year history of similar symptoms interspersed with periods of remission. A photograph of the lesions is shown. Which of the following neuronal processes was most likely involved in the initial establishment of the viral infection in this patient?

- A) Action potential
- B) Bulk axoplasmic flow
- C) Protein synthesis
- D) Retrograde axon transport
- E) Synaptic transmission



50. A hospital laboratory is comparing two methods for measuring serum sodium concentrations. Using method I, the coefficient of variation for the analysis of a series of known samples is 3.5%. Using method II, the coefficient of variation is 2.5% using the same samples. Which of the following best describes the precision of these methods?

- A) Both are equally precise
- B) Method I is more precise than method II
- C) Method II is more precise than method I
- D) Precision cannot be determined from information given

1. Cytogenetic analysis of 20 metaphases from the peripheral lymphocytes of a 15-year-old girl with gonadal dysgenesis (Turner syndrome) shows the karyotype 45,X in 11 metaphases and 46,XX in 9 metaphases. Which of the following is the most likely explanation for this result?

- A) Genetic recombination
- B) Loss of heterozygosity
- C) Postfertilization nondisjunction
- D) Translocation
- E) X-inactivation



Next



Lab Values



Calculator



Review



Help



Pause

2. A healthy 20-year-old man comes to the physician with his wife for genetic counseling prior to conception. His sister died of cystinosis, an autosomal recessive disorder affecting cystine transport across lysosomal membranes. The incidence of this disorder in the general population is approximately 1/40,000. The wife's history is noncontributory. The wife's risk for being a carrier of this disorder is closest to which of the following?

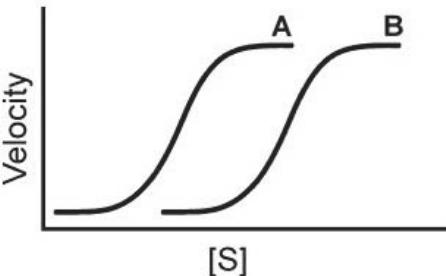
- A) 1/2
- B) 2/3
- C) 1/50
- D) 1/100
- E) 1/200

3. A 45-year-old man develops multiple punctate, erythematous, nonblanching, 1-mm lesions on the upper and lower extremities and the belt line. A defect in which of the following is the most likely cause of the patient's symptoms?

- A) Metabolism of protein catabolic byproducts
- B) Oxidative metabolism of endogenous toxins
- C) Production of platelets
- D) Synthesis of coagulation factors
- E) Synthesis of protein C

4. The kinetics of a regulatory enzyme are shown in the figure as curve A. The kinetics in the presence of an allosteric modifier are represented by curve B. Which of the following best describes the effect of the modifier on the activity of this enzyme?

- A) Completely inhibits enzyme activity
- B) Decreases  $K_m$
- C) Decreases  $V_{max}$
- D) Increases  $K_m$
- E) Increases  $V_{max}$
- F) Has no effect on enzyme activity

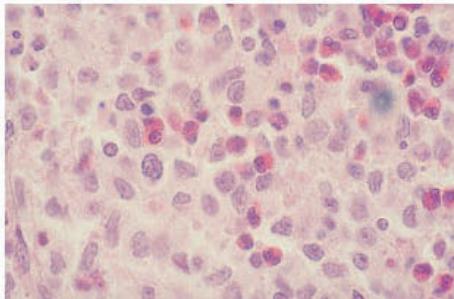


5. A 20-year-old woman comes to the emergency department because of pain in the right lower quadrant of the abdomen and vaginal bleeding for 2 days. Her last menstrual period was 8 weeks ago. Which of the following historic findings further increases the likelihood of an ectopic pregnancy in this patient?

- A) Cigarette smoking
- B) Habitual abortion
- C) HIV seropositivity
- D) Previous gonorrhea infection
- E) Previous vaginal delivery

6. An otherwise healthy 15-year-old boy is brought to the physician 2 days after the onset of a headache. His vital signs are within normal limits. Physical examination shows mild tenderness over the right occipital area. An x-ray of the skull shows a 2-cm lytic lesion in the right occipital bone. A photomicrograph of a biopsy specimen of the lesion stained with hematoxylin and eosin is shown. Which of the following is the most likely diagnosis?

- A) Langerhans cell histiocytosis
- B) Meningioma
- C) Metastatic carcinoma
- D) Osteosarcoma
- E) Solitary bone cyst



7. Patients with a history of deep venous thrombosis are recruited as part of a research study on chronic venous insufficiency. The patients are evaluated at the beginning of the study and reevaluated 2 years later. At the second visit, they are asked if they wore compression stockings since the study began. The prevalence of venous insufficiency in those who wore the stockings is compared to those who did not. Which of the following best describes this type of study?

- A) Case-control study
- B) Case series study
- C) Clinical trial
- D) Cohort study

8. A 25-year-old man is admitted to the hospital after he sustained second-degree burns over 70% of his body while fighting a fire. Administration of fluid and antibiotics is started. Two days later, he develops dyspnea, tachypnea, and hypoxemia. Diffuse crackles are heard on auscultation of the chest. A chest x-ray shows fluffy alveolar infiltrates. Despite appropriate intervention, he dies. Autopsy shows diffusely firm and hyperemic lungs. Microscopic examination of the lung tissue shows widening of the alveolar septa and eosinophilic hyaline membranes lining the alveolar spaces. Which of the following pathologic mechanisms is the most likely cause of the pulmonary disorder in this patient?

- A) Bacterial invasion of the distal pulmonary parenchyma
- B) Diffuse pulmonary atelectasis
- C) Injury to the alveolar epithelium and endothelium
- D) Proteolytic destruction of the alveolar walls
- E) Type I (immediate) hypersensitivity reaction

9. A 65-year-old woman with type 1 diabetes mellitus suddenly develops continuous involuntary ballistic movements of her right arm and leg. She is alert, and neurologic examination shows no other abnormalities. The most likely cause of this patient's movement disorder is infarction involving which of the following areas of the brain on the contralateral side?

- A) Caudate nucleus
- B) Globus pallidus
- C) Putamen
- D) Substantia nigra
- E) Subthalamus

10. A healthy 8-year-old boy is brought to the physician by his parents because of a long history of disruptive behavior at school and poor academic performance. During class, he talks out of turn, wanders around the room, and pesters classmates. He is easily distracted and cannot keep his attention on a topic very long. His homework is sloppy and usually incomplete; he often explains that he leaves segments of assignments undone because he "just didn't notice them." He has had similar problems since kindergarten. He has normal developmental milestones. He is bright and cheerful and has a caring family. A drug with which of the following actions is most likely to be useful for this patient?

- A) Stimulation of the release of excitatory amino acid neurotransmitters
- B) Blockade of postsynaptic excitatory amino acid neurotransmitter receptors
- C) Stimulation of the release of biogenic amine neurotransmitters
- D) Blockade of postsynaptic biogenic amine neurotransmitter receptors
- E) Stimulation of the release of inhibitory amino acid neurotransmitters
- F) Blockade of postsynaptic inhibitory amino acid neurotransmitter receptors

11. A 40-year-old man with alcoholism is admitted to the hospital because of a 2-day history of confusion. Serum studies show a sodium concentration of 99 mEq/L. He is treated with 0.9% saline. Four days later, he develops slurred speech. Physical examination shows mild-to-moderate muscle weakness of all extremities and dysarthria. Sensation is intact. Babinski sign is present bilaterally. These findings are most likely caused by a lesion in which of the following locations?

- A) Bilateral cerebral hemispheres
- B) Brain stem
- C) Medial diencephalon
- D) Muscle
- E) Neuromuscular junction
- F) Peripheral nerve

12. A 30-year-old woman comes to the physician for evaluation of recurrent postprandial retrosternal burning occurring three times weekly during the past 6 months. The symptoms occur only during the day and are noticeably more severe after large meals, especially if she eats fried foods. Initially, the symptoms responded well to over-the-counter antacids, but in the past 2 months, the antacids have failed to control her symptoms. She had similar symptoms 5 years ago during pregnancy that also responded well to antacids and then resolved after the delivery of her child. She has had no difficulty swallowing, weight loss, or gastrointestinal bleeding. She is sleeping well. She takes no other medications and does not smoke cigarettes or drink alcohol. Physical examination shows no abnormalities. Which of the following is the most likely cause of her condition?

- A) Gastrin-induced inhibition of antral contractility
- B) Gastrin-induced inhibition of lower esophageal sphincter tone
- C) Somatostatin-induced stimulation of gastric acid secretion
- D) Vagal inhibition of esophageal contractility
- E) Vagal stimulation of lower esophageal sphincter relaxation

Mark

13. A 17-year-old boy has septic shock that is unresponsive to intravenous ADH (vasopressin) therapy. This treatment is discontinued, and high-dose dopamine therapy is initiated. Stimulation of which of the following receptors is most likely to be of benefit to this patient?

- A)  $\alpha_1$ -Adrenoreceptors
- B)  $\alpha_2$ -Adrenoreceptors
- C)  $\beta_1$ -Adrenoreceptors
- D)  $\beta_2$ -Adrenoreceptors
- E)  $D_2$ -Receptors

14. A 5-year-old boy is stung on his foot by a bee. Within 30 minutes the local area is edematous. The extravascular accumulation of fluid is most directly related to which of the following?

- A) Demargination of leukocytes
- B) Fibrin thrombi
- C) Gap formation between endothelial cells
- D) Vasoconstriction
- E) Vasodilation

Mark

15. A 43-year-old woman comes to the physician for a routine health maintenance examination. The physician is 30 minutes late for the appointment because of an emergency, and when he enters the examining room, the patient checks her watch. Which of the following initial statements by the physician is most appropriate?

- A) "I apologize for being behind schedule, but this won't take long."
- B) "I apologize for being late. Why don't we reschedule for another time?"
- C) "I apologize for running behind. They made my schedule really tight today."
- D) "I'm sorry I got delayed. I hope I haven't made you late somewhere else."
- E) "I'm sorry I got tied up. The emergency room always seems to call me for their most difficult cases."

16. A 67-year-old woman is brought to the emergency department 30 minutes after she fainted while grocery shopping. On arrival, she is conscious. Her blood pressure is 115/85 mm Hg. Physical examination shows carotid pulses with small amplitude and a delayed upstroke. A grade 4/6, crescendo systolic murmur that is heard throughout the precordium is loudest at the upper right sternal border and radiates to the carotid arteries. There is a loud S<sub>4</sub>. A chest x-ray shows no cardiomegaly. This patient most likely has which of the following cardiac valve abnormalities?

- A) Aortic regurgitation
- B) Aortic stenosis
- C) Mitral regurgitation
- D) Mitral stenosis
- E) Pulmonic regurgitation
- F) Pulmonic stenosis
- G) Tricuspid regurgitation
- H) Tricuspid stenosis

Mark

17. A previously healthy 73-year-old man with benign prostatic hyperplasia comes to the physician because of a 2-day history of pain with urination and a 12-hour history of fever and chills. His temperature is 38.3°C (101°F). Physical examination shows moderate tenderness of the left flank. Urinalysis shows 50 to 100 WBC/hpf. Culture of urine grows 100,000 colonies/mL of a gram-positive organism. Which of the following is the most likely causal organism?

- A) *Enterococcus faecalis*
- B) *Escherichia coli*
- C) *Shigella dysenteriae*
- D) *Staphylococcus aureus*
- E) *Streptococcus pyogenes* (group A)

18. A 53-year-old woman is diagnosed with gastric carcinoma and receives a chemotherapeutic regimen including doxorubicin. Six months later, she develops cardiomyopathy. Dose-limiting toxicity of doxorubicin, resulting in cardiomyopathy, is produced by which of the following mechanisms?

- A) Downregulation of epidermal growth factor receptors
- B) Formation of abnormal myoglobin
- C) Generation of free radicals
- D) Impairment of actin synthesis
- E) Reduction of formation of nitric oxide in cardiac cells

19. A full-term newborn has respiratory distress. Imaging studies show herniation of abdominal contents into the left pleural cavity. Maldevelopment of which of the following structures is most likely to have caused the defect of the diaphragm?

- A) Esophageal mesoderm
- B) Left diaphragmatic crus
- C) Left pleuropericardial fold
- D) Left pleuroperitoneal membrane
- E) Septum transversum

20. An 18-month-old girl is brought to the physician for a follow-up examination because of macrosomia. She was 53 cm (21 in) in length and weighed 4200 g (9 lb 4 oz) at birth. She is now at the 95th percentile for length and weight. Physical examination shows a nevus flammeus on the forehead, a large tongue, and an abdominal mass. Abdominal ultrasonography shows a tumor in the left kidney. A biopsy specimen of the resected mass shows nephroblastoma (Wilms tumor). Genetic testing of the patient shows abnormal methylation at *KCNQ1OT1* (*DMR2*) of maternal 11p15. Which of the following genetic mechanisms is the most likely cause of these findings?

- A) Anticipation
- B) Heteroplasmy
- C) Imprinting
- D) Non-paternity
- E) Pleiotropy

21. A randomized, double-blind, clinical trial of a new medication for acute stroke was just completed. The results are summarized as follows:

Treatment Group	Relative Risk		Relative Risk	
	Disability	(95% Confidence Interval)	Mortality	(95% Confidence Interval)
Placebo (n=90)	40%		17%	
Active drug (n=89)	30%	0.67 (0.44–0.89)	13%	0.77 (0.43–1.11)

Compared with the placebo group, which of the following sets best summarizes the relative risks in the active drug group?

- |                          | Relative Risks of Disability | Relative Risks of Mortality |
|--------------------------|------------------------------|-----------------------------|
| <input type="radio"/> A) | Significantly higher         | significantly higher        |
| <input type="radio"/> B) | Significantly higher         | no significant difference   |
| <input type="radio"/> C) | Significantly higher         | significantly lower         |
| <input type="radio"/> D) | No significant difference    | significantly higher        |
| <input type="radio"/> E) | No significant difference    | no significant difference   |
| <input type="radio"/> F) | No significant difference    | significantly lower         |
| <input type="radio"/> G) | Significantly lower          | significantly higher        |
| <input type="radio"/> H) | Significantly lower          | no significant difference   |
| <input type="radio"/> I) | Significantly lower          | significantly lower         |

22. A 65-year-old man with hypertension volunteers to participate in a clinical trial of a newly developed loop diuretic. As part of the study, his acid-base/volume status is monitored. After 3 days of treatment, which of the following sets of findings is most likely in this patient?

	<b>Acid-base</b>	<b>Volume Contraction</b>
<input type="radio"/>	A) Metabolic acidosis	yes
<input type="radio"/>	B) Metabolic acidosis	no
<input type="radio"/>	C) Metabolic alkalosis	yes
<input type="radio"/>	D) Metabolic alkalosis	no

23. A 45-year-old man with type 1 diabetes mellitus comes to the physician because of a 6-week history of swelling of his face, legs, and left testicle. He says that his blood pressure has been higher than normal ( $\geq 170/100$  mm Hg) during the past 2 months. At his last visit 1 year ago, his serum creatinine concentration was 2.1 mg/dL. He is 180 cm (5 ft 11 in) tall and weighs 100 kg (220 lb); BMI is 31 kg/m<sup>2</sup>. His blood pressure is 172/93 mm Hg. Physical examination shows marked edema around the eyes and of the lower extremities to the level of the thighs. The left side of the scrotum is 1½ times the size of the right side and enlarges further when the patient bears down. Palpation shows a lumpy mass just superior to the normal-sized left testis. Which of the following is the most likely cause of these scrotal findings?

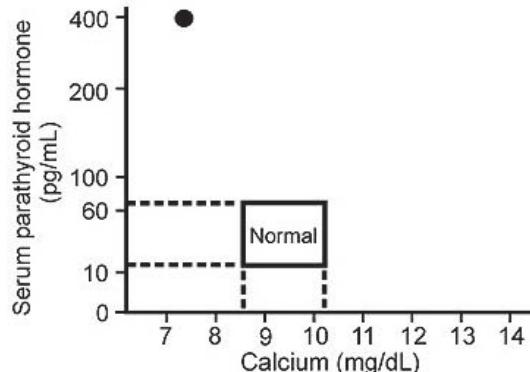
- A) Epididymal cyst
- B) Epididymitis
- C) Hydrocele
- D) Testicular cancer
- E) Testicular torsion
- F) Varicocele

24. A 2-month-old male infant has jaundice and pale stools caused by congenital biliary atresia. Deficiency of which of the following is most likely in this patient?

- A) Folic acid
- B) Vitamin B<sub>6</sub> (pyridoxine)
- C) Vitamin B<sub>12</sub> (cobalamin)
- D) Vitamin C
- E) Vitamin E

- Mark
25. A 72-year-old woman comes to the physician because of diffuse muscle pain and weakness for 6 months. The muscle pain is exacerbated by activity. Physical examination shows proximal muscle weakness and tenderness over the surface of both shins. The dot on the nomogram shown indicates the relationship between her serum calcium and parathyroid hormone concentrations. Which of the following conditions is the most likely cause of this patient's symptoms?

- A) Hypoparathyroidism
- B) Metastatic breast cancer
- C) Osteomalacia
- D) Osteoporosis
- E) Primary hyperparathyroidism



26. A 57-year-old man undergoes coronary artery bypass grafting. The stress of the operation results in increased secretion of cortisol from the adrenal gland postoperatively. Which of the following cells is the most likely origin of the stimulus of this cortisol secretion?

- A) Acidophil of the anterior pituitary gland
- B) Alpha cell of the islet of Langerhans
- C) Basophil of the anterior pituitary gland
- D) Beta cell of the islet of Langerhans
- E) Delta cell of the islet of Langerhans
- F) Pituicytes of the posterior pituitary gland

Mark

27. A mildly obese 42-year-old woman comes to the physician 2 days after the sudden onset of chest pain and intermittent cough while she was doing laundry. Medications include oral contraceptives. She has smoked 1½ packs of cigarettes daily for 24 years. She appears somewhat anxious. An x-ray of the chest shows normal findings, and an ECG shows sinus tachycardia. Ventilation-perfusion lung scans show a defect in the anterior inferior segment of the right upper lobe. Collateral arterial flow is provided to this area by which of the following arteries?

- A) Brachiocephalic
- B) Internal thoracic
- C) Left pulmonary
- D) Right bronchial
- E) Right coronary

28. A 24-year-old woman, gravida 1, para 1, comes to the physician because of nervousness and tremor since delivering a healthy female newborn 6 weeks ago. She also has had a 5-kg (11-lb) weight loss during this period. She has a history of panic disorder and carpal tunnel syndrome. Her temperature is 37°C (98.6°F), pulse is 100/min, and blood pressure is 140/80 mm Hg. Physical examination shows a firm thyroid gland that is twice the normal size. Serum studies show a free thyroxine ( $FT_4$ ) concentration of 2.4 ng/dL (N=0.8–2.4), thyroid-stimulating hormone concentration of less than 0.03  $\mu$ U/mL, and 24-hour thyroid radioactive iodine uptake of 1% (N=8–25%). Which of the following is the most likely explanation for this patient's symptoms?

- A) Anaplastic thyroid carcinoma
- B) Hypothyroidism
- C) Release of stored thyroid hormone from a thyroid gland infiltrated by lymphocytes
- D) Release of thyroid hormone from a lymphomatous thyroid gland
- E) Release of thyroid hormone from a thyroid gland stimulated by antibodies



29. A 32-year-old woman comes to the physician because of a 1-week history of a progressive, itchy rash. The rash initially appeared as an oval patch on her abdomen and has since spread over her abdomen and back. She has not had fever, chills, or sweating. She has no history of major medical illness. She has been sexually active with two male partners during the past year, and she uses an oral contraceptive. Her vital signs are within normal limits. Physical examination shows the findings in the photograph. Which of the following is the most likely diagnosis?

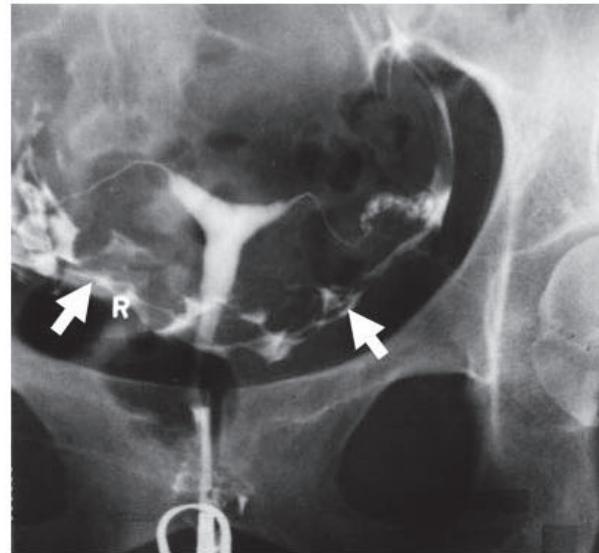
- A) Erythema infectiosum (fifth disease)
- B) Molluscum contagiosum
- C) Pityriasis rosea
- D) Roseola (exanthema subitum)
- E) Scabies
- F) Secondary syphilis

30. A 39-year-old woman, gravida 5, para 5, with type 2 diabetes mellitus and a history of gallstones comes to the physician because of a 4-day history of nausea, vomiting, and midabdominal pain radiating to her back. She is 165 cm (5 ft 5 in) tall and weighs 82 kg (180 lb); BMI is  $30 \text{ kg/m}^2$ . Physical examination shows bluish discoloration of both flanks and epigastric tenderness. Which of the following is the most likely diagnosis?

- A) Acute cholangitis
- B) Acute pancreatitis
- C) Ruptured abdominal aortic aneurysm
- D) Ruptured ectopic pregnancy
- E) Ruptured splenic artery aneurysm

31. A 35-year-old woman who is being examined because of infertility receives an injection of contrast material into her cervix to visualize the reproductive tract before undergoing radiographic tests. On the hysterosalpingogram shown, the contrast material (as indicated by the arrows) is also seen in the peritoneal cavity. Which of the following best explains this finding?

- A) Rupture of the fallopian tube
- B) Rupture of the uterine body
- C) Spillage of contrast, which is an artifact
- D) Spillage of contrast, which is normal



32. Fatty acids are infused into the proximal small intestine of an experimental animal. Which of the following is the most likely change in peptide secretion in this animal?

- A) Increased amylase
- B) Increased cholecystokinin
- C) Increased pancreatic polypeptide
- D) Increased secretin
- E) Suppressed amylase
- F) Suppressed cholecystokinin
- G) Suppressed motilin
- H) Suppressed pancreatic polypeptide
- I) Suppressed secretin

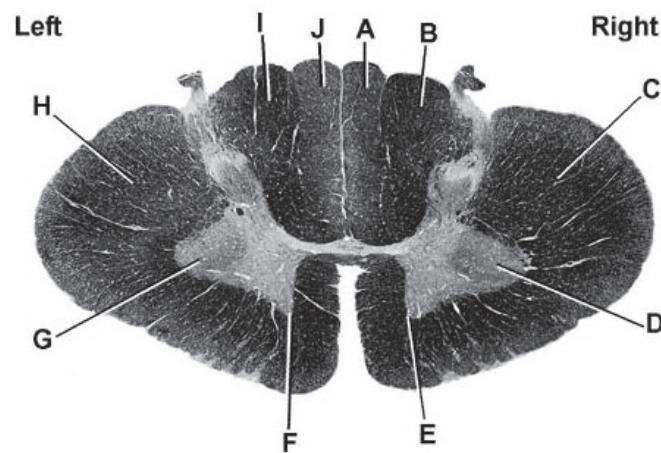
33. An investigator is studying the effects of several different drugs on human brain activity. During the study, positron emission tomography is used to measure real-time brain activity in human participants after administration of various drugs with abuse potential. Results show a common pattern of neurologic effects for drugs such as cocaine, amphetamines, opioids, sedative-hypnotics, alcohol, and nicotine. Activation of which of the following neurotransmitter pathways best explains the rewarding or positive reinforcing effects of using these drugs?

- A) A dopaminergic from the nucleus accumbens to the prefrontal cortex
- B) An endocannabinoid from the anterior thalamic nuclei to the somatosensory cortex
- C) An endorphin (opioid) from the substantia gelatinosa to the ventral tegmental area
- D) A GABAergic from the amygdala to the limbic cortex
- E) A noradrenergic from the locus caeruleus to the frontal cortex

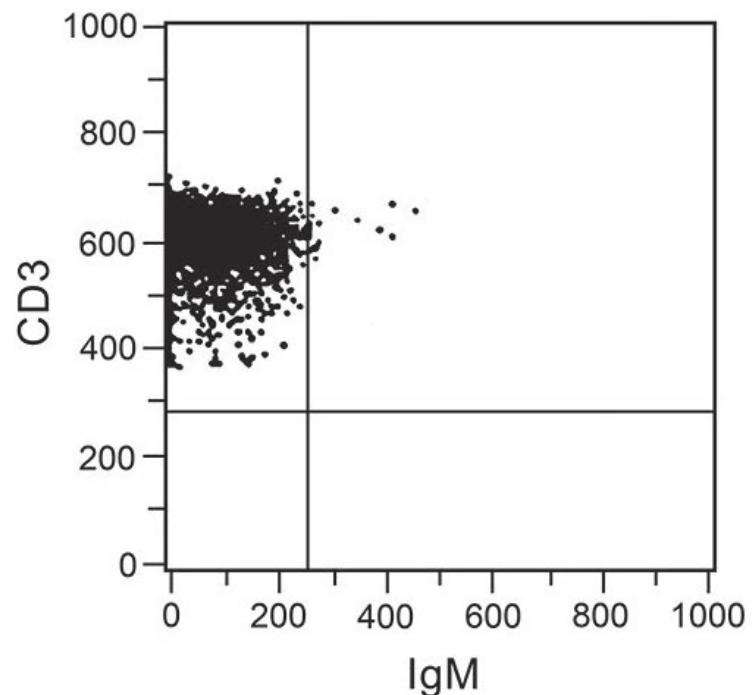
34. A 44-year-old man with a 1-year history of angina pectoris comes to the emergency department because of increasingly severe chest pain during the past 2 days. He has had five previous similar episodes, which required treatment with increasing doses of nitroglycerin to resolve. His temperature is 37°C (98.6°F), pulse is 105/min, respirations are 16/min, and blood pressure is 150/90 mm Hg. Cardiac examination shows an S<sub>4</sub>. An ECG shows ST-segment depression in the precordial leads. In addition to aspirin, heparin, and nitroglycerin, he is given a dose of a monoclonal antibody against the platelet IIb/IIIa receptor. This antibody will most likely prevent binding of which of the following substances to platelets?

- A) Adenosine
- B) ADP
- C) Fibrinogen
- D) Serotonin
- E) Thrombin
- F) Thromboxane A<sub>2</sub>

- Mark
35. A 23-year-old man has had progressive weakness and atrophy of the intrinsic muscles of the left hand during the past 3 months. The most likely cause is damage to which of the following labeled sites in the cross section of the spinal cord shown?



- A)
- B)
- C)
- D)
- E)
- F)
- G)
- H)
- I)
- J)



36. A 2-year-old boy has had recurrent sinopulmonary infections since 8 months of age. Flow cytometric analysis of his peripheral blood lymphoid cells with anti-CD3 and anti-IgM (with blockade of Fc receptor-mediated binding of IgG) is shown. Which of the following is the most likely diagnosis?

- A) Adenosine deaminase deficiency
- B) Hyper-IgM syndrome
- C) IgA deficiency
- D) Myeloperoxidase deficiency
- E) X-linked agammaglobulinemia

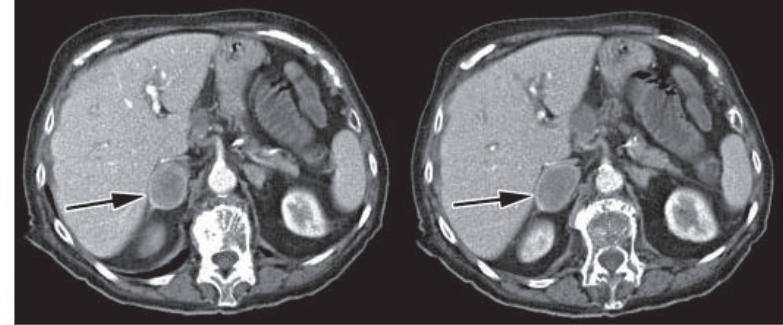
37. A 16-year-old girl comes to the physician because of worsening acne over her forehead for the past month. She began a vegetarian diet 6 months ago; she also has been craving and eating large amounts of chocolate. She currently works outdoors as a flag person for a local road construction company and is required to wear a helmet. Her brother received a chinchilla for a pet 2 months ago. Physical examination shows erythematous papules and pustules on the forehead. Which of the following is the most likely cause of the exacerbation of this patient's condition?

- A) Allergic reaction to materials used in road construction
- B) Allergy to the family pet
- C) Chocolate consumption
- D) Excessive sun exposure
- E) Vegetarian diet
- F) Wearing a helmet

38. An 18-year-old woman comes to the physician because of irregular menstrual periods since menarche at the age of 13 years. Menses occur at 60- to 120-day intervals. She takes no medications. She does not smoke cigarettes, drink alcohol, or use illicit drugs. She is sexually active with one partner, and they use condoms consistently. She is 157 cm (5 ft 2 in) tall and weighs 75 kg (165 lb); BMI is 30 kg/m<sup>2</sup>. Physical examination shows facial hirsutism. Pelvic examination shows no cervical motion tenderness or masses. Which of the following is the most likely diagnosis?

- A) Adrenal insufficiency
- B) Congenital adrenal hyperplasia
- C) Hyperaldosteronism
- D) Hypothyroidism
- E) Polycystic ovarian syndrome

Mark



39. A 32-year-old woman comes to the physician because of a 1-year history of palpitations and intermittent headaches. She has a 10-year history of poorly controlled hypertension treated with hydrochlorothiazide and metoprolol. Her blood pressure is 180/105 mm Hg. Physical examination shows no other abnormalities. CT scans of the abdomen are shown; the arrows indicate an abnormality. An abnormality of which of the following structures is the most likely cause of these findings?

- A) Adrenal gland
- B) Caudate lobe of the liver
- C) Gallbladder
- D) Inferior vena cava
- E) Portal vein
- F) Right kidney

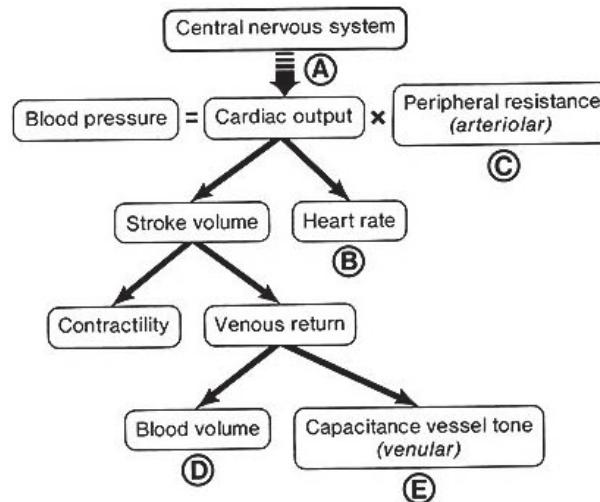
- Mark
40. A 41-year-old woman comes to the physician for a follow-up examination 6 weeks after the diagnosis of hypertension was made. Her blood pressure today is 162/104 mm Hg. A right abdominal bruit is heard. Physical examination shows no other abnormalities. Serum studies show:

Na <sup>+</sup>	135 mEq/L
K <sup>+</sup>	3.2 mEq/L
Cl <sup>-</sup>	105 mEq/L
HCO <sub>3</sub> <sup>-</sup>	28 mEq/L
Urea nitrogen	9 mg/dL
Creatinine	0.9 mg/dL

On renal arteriography, sampling shows a left renal vein renin activity of 5 µU/mL (N=5–97) and right renal vein renin activity of 176 µU/mL (N=5–97). The systemic hypertension in this patient is directly mediated by a vasoconstrictor that emerges from which of the following?

- A) Adrenal medullary chromaffin cells
- B) Glomerular afferent arteriole
- C) Glomerular efferent arteriole
- D) Pulmonary vasculature
- E) Renal juxtaglomerular cells

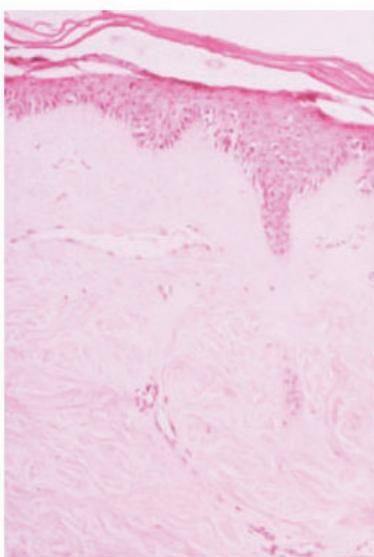
41. The diagram shows the major factors that determine blood pressure. Which of the following labeled factors is most responsible for the antihypertensive effect of a dihydropyridine calcium-channel blocking agent?



- A)
- B)
- C)
- D)
- E)

42. In order to investigate possible treatment options for acute respiratory distress syndrome (ARDS), experimental animals are anesthetized and subjected to smoke inhalation (cotton smoke) according to a well-established experimental protocol. The experimental animals are then given compounds designed to upregulate specific mediators involved in the inflammatory cascade. Upregulation of which of the following mediators would most likely prevent or ameliorate the lung injury induced in this experimental model of ARDS?

- A) Interleukin-1 (IL-1)
- B) IL-10
- C) Nuclear factor-kappa B
- D) Toll-like receptors
- E) Tumor necrosis factor



Hematoxylin and eosin



Trichrome

43. A 58-year-old woman comes to the physician because of a 6-month history of shortness of breath and chronic nonproductive cough. She has a 2-year history of difficulty swallowing, joint stiffness, and diffuse tightening of the skin of the face, neck, shoulders, arms, and fingers. She has had significant sensitivity to cold weather for 20 years, and she says that her hands turn white when they are exposed to the cold. Current medications include a histamine ( $H_2$ ) blocking agent for a long-standing history of esophageal reflux. Biopsy specimens of the skin from 1 year ago are shown in the photomicrographs. Examination of the hands shows cutaneous ulceration, clawlike flexion deformity, and decreased joint mobility. An autoimmune disorder is suspected. Which of the following pulmonary disorders is most likely in this patient?

- A) Adenocarcinoma
- B) Bronchiectasis
- C) Emphysema
- D) Granulomatous inflammation
- E) Interstitial fibrosis
- F) Pneumonia
- G) Pulmonary embolism
- H) Squamous cell carcinoma

44. An 80-year-old woman undergoes a brain biopsy of a cerebral mass. Immunofluorescence studies of a biopsy specimen show that the tumor cells contain intermediate filaments of the cytokeratin type. This patient's cancer cells most likely arose from which of the following cell types?

- A) Astrocytes
- B) Epithelial cells
- C) Mesenchymal cells
- D) Muscle cells
- E) Neurons

Mark

45. A 65-year-old woman with rheumatoid arthritis comes to the physician for a follow-up examination. In addition to methotrexate therapy, a course of rituximab is initiated. Approximately 45 minutes after the first infusion of rituximab, the patient's temperature is 38.5°C (101.3° F), and she develops diffuse muscle pain. She does not have any difficulty breathing or swallowing, and there are no signs of urticaria or angioedema. Which of the following is the most likely cause of this patient's symptoms?

- A) Basophil degranulation
- B) B-lymphocyte release of cytokines
- C) Natural killer cell activation
- D) Neutrophil activation
- E) Platelet aggregation

46. An investigator is conducting a study of natural killer cells and their role in destroying malignant tumors in experimental animals. This study is most likely to show that natural killer cells are particularly effective in destroying malignant tumors with which of the following characteristics?

- A) Decreased expression of class I MHC molecules
- B) Expression of adherent forms of cellular proteins
- C) Expression of altered cell-surface glycolipids
- D) Expression of viral antigens
- E) Increased expression of oncofetal antigens

47. A 44-year-old woman with a history of breast cancer comes to the physician for an initial examination. She says, "I'm concerned about my future. Can you give me any advice?" She recently moved to the city because her husband changed jobs. She underwent a mastectomy for inflammatory breast cancer, and she completed a course of chemotherapy 2 months ago. Physical examination shows an absent left breast and a well-healed scar on the left side of the chest. There are no palpable lymph nodes. Which of the following initial responses by the physician is most appropriate?

- A) "I recommend that you attend a breast cancer support group to learn from other women who have gone through a similar experience."
- B) "I understand you've been treated by other physicians. Tell me what you know about your disease."
- C) "I would like you to review these pamphlets by the American Cancer Society, and we can discuss them at your next appointment."
- D) "The survival statistics for persons with the type of cancer you have are not favorable."
- E) "Unfortunately, you are not out of the woods yet. You may have a recurrence of cancer in the next several months."

48. A 6-day-old female newborn is brought to the physician by her parents because of a 3-day history of difficulty feeding, vomiting, and progressive lethargy. Her parents have noticed that her urine has a burnt-sugar odor. Physical examination shows lethargy and hypotonia. Deficiency of which of the following is the most likely cause of these findings in this patient?

- A) Acid maltase
- B) Branched-chain  $\alpha$ -keto acid dehydrogenase
- C) Carnitine palmitoyltransferase
- D) Debranching enzyme
- E) Glucuronyl transferase

49. A 19-year-old woman comes to the physician because of a 2-day history of pain in her left index finger. She injured it during a softball game when catching a ball. Physical examination shows erythema of the left index finger. The patient is unable to flex the distal phalanx when the proximal interphalangeal joint and metacarpophalangeal joints are restrained. Laboratory studies and x-rays of the left hand show no abnormalities. Which of the following structures is most likely injured in this patient?

- A) Extensor digitorum indicis
- B) Extensor digitorum tendon
- C) Flexor digitorum profundus tendon
- D) Flexor digitorum superficialis tendon
- E) Median nerve
- F) Ulnar nerve

50. A previously healthy 55-year-old man comes to the physician 2 months after he noticed a lump in his neck. His vital signs are within normal limits. Physical examination shows a 2.5-cm, firm, cervical lymph node on the lower right. A photomicrograph of a biopsy specimen of the node stained with hematoxylin and eosin is shown. Flow cytometry of lymphoid cells from the node yields the following phenotype:

CD3	3%
CD19	70%
CD10	70%
Kappa	70%
Lambda	0%

Which of the following is the most likely diagnosis?

- A) Diffuse large B-cell lymphoma
- B) Follicular lymphoma
- C) Nodal marginal zone lymphoma
- D) Precursor B-cell lymphoblastic lymphoma
- E) Small lymphocytic lymphoma

