

## Physiology Sample Items

1. A hormone is known to activate phospholipase C with subsequent release of calcium from internal stores. The release of calcium most likely occurs as a result of an increase in the concentration of which of the following intracellular second messengers?

  - (A) Calcium
  - (B) cAMP
  - (C) cGMP
  - (D) Diacylglycerol
  - (E) Inositol 1,4,5-trisphosphate
2. A 28-year-old man with a history of intravenous drug use comes to the physician because of a 6-week history of fever, nonproductive cough, chills, and progressive shortness of breath. His temperature is 39°C (102.2°F), pulse is 110/min, respirations are 32/min and regular, and blood pressure is 120/80 mm Hg. Physical examination shows a white, patchy, loosely adherent exudate on the buccal mucosa bilaterally. A chest x-ray shows bilateral interstitial infiltrates. After receiving treatment for pneumonia, he agrees to participate in a clinical study of the effects of interleukin-2 (IL-2). After administration of IL-2, which of the following hematologic changes is most likely in this patient?

  - (A) Decreased CD4+ T lymphocytes
  - (B) Decreased erythrocytes
  - (C) Decreased platelet count
  - (D) Increased CD4+ T lymphocytes
  - (E) Increased erythrocytes
  - (F) Increased platelet count
3. A 5-year-old girl falls through the ice while skating on an outdoor pond. She is removed from the water within 1 minute, but dry clothing is not available, and she is still cold and wet 20 minutes later. Which of the following mechanisms helps maintain the patient's core temperature during the period following her rescue?

  - (A) Cutaneous vasodilation
  - (B) Diving response
  - (C) Increased thermoregulatory set point
  - (D) Release of endogenous pyrogen
  - (E) Shivering
4. A 39-year-old woman comes to the physician for a follow-up examination because she recently was diagnosed with hypertension. Her blood pressure is 156/100 mm Hg. Physical examination shows no other abnormalities. Serum studies show normal findings. A 24-hour urine collection shows three times the normal excretion of epinephrine and metanephrine. The excessive epinephrine production in this patient is most likely caused by which of the following cell types?

  - (A) Chromaffin
  - (B) Juxtaglomerular
  - (C) Zona fasciculata
  - (D) Zona glomerulosa
  - (E) Zona reticularis
5. The blood flow through an organ is measured while the perfusion pressure is varied experimentally. An abrupt, sustained increase in perfusion pressure increases flow initially, but over the course of 1 minute, the flow returns nearly to the baseline level despite continued elevation of the perfusion pressure. The organ under study is exhibiting which of the following?

  - (A) Active hyperemia
  - (B) Autoregulation
  - (C) Ischemia
  - (D) Reactive hyperemia

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6. After an overnight fast, a 52-year-old man undergoes infusion of acid through a catheter into the upper duodenum. This most likely will increase pancreatic secretion mainly through the action of which of the following substances?
- (A) Cholecystokinin
  - (B) Gastrin
  - (C) Glucagon
  - (D) Secretin
  - (E) Vasoactive intestinal polypeptide
7. A 20-year-old woman is brought to the emergency department 20 minutes after being stung by a wasp. She says that she feels a lump in her throat and chest tightness. She has a history of allergy to wasp venom. Her pulse is 120/min, and blood pressure is 80/40 mm Hg. Physical examination shows eruptions that coalesce into giant urticaria. There is audible wheezing. Which of the following best describes the cause of this patient's reaction?
- (A) Activation of macrophages by soluble immune complexes
  - (B) Binding of antigen to preexisting cell-fixed IgE antibodies
  - (C) Formation of IgG antibodies against extracellular matrix antigen
  - (D) Formation of IgM antibodies against cell surface receptor antigens
  - (E) Induction of a cytotoxic reaction by CD8+ T lymphocytes
8. A demonstration is performed during a lecture on muscle physiology in which a student is asked to fully extend his right arm with the palm up. Two large textbooks are placed on his palm, one at a time. Which of the following facilitates the maximum amount of tension that allows the student to keep his arm extended in place under the increasing weight of the books?
- (A) Amount of  $\text{Ca}^{2+}$  released from the sarcoplasmic reticulum
  - (B) Amount of muscle phosphocreatine
  - (C) Amplitude of the action potential
  - (D) Number of motor units recruited
  - (E) Rate of cross-bridge recycling
9. During an experiment on the cough reflex in humans, a volunteer inhales air containing different amounts of particles that will impact and adhere to mucus primarily in the trachea. Blockade of which of the following receptors would most likely prevent this volunteer's reflex to initiate a cough?
- (A) Chemoreceptors
  - (B) Irritant receptors
  - (C) J receptors
  - (D) Proprioceptors
  - (E) Stretch receptors
10. A 35-year-old man has an adenoma of the parathyroid gland, with increased serum concentrations of parathyroid hormone (PTH) and calcium. In this patient, PTH induces which of the following processes to cause hypercalcemia?
- (A) Production of 25-hydroxycholecalciferol
  - (B) Shift of  $\text{Ca}^{2+}$  from the intracellular to the extracellular fluid compartment
  - (C) Stimulation of osteoclast activity
  - (D) Suppression of renal production of 1,25-dihydroxycholecalciferol

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11. A female newborn delivered at 32 weeks' gestation develops severe respiratory distress within hours of birth. Despite resuscitative efforts, the patient dies. Examination of the lungs at autopsy shows lung alveoli with radii of less than 50  $\mu\text{m}$  (N=100). Which of the following is most likely decreased in the lungs of this newborn?
- (A) Airway resistance
  - (B) Compliance
  - (C) Elastic recoil
  - (D) Surface tension
  - (E) Vascular resistance
12. A 55-year-old woman who is obese has a greater risk for endometrial carcinoma than a 55-year-old woman with the same health history and status who is not obese. Which of the following best explains this increased risk?
- (A) Accelerated catabolism of antioxidants
  - (B) Association of obesity with smoking
  - (C) Carcinogenic effects of dietary fats
  - (D) Greater average number of pregnancies
  - (E) Impairment of immune surveillance by T lymphocytes
  - (F) Increased production of estrogen by adipose tissue
  - (G) Later age of menopause
  - (H) More frequent episodes of vaginitis
13. A 4-hour-old female newborn delivered at 30 weeks' gestation has respiratory distress. Her temperature is 36.5°C (97.7°F), pulse is 160/min, respirations are 85/min, and blood pressure is 68/40 mm Hg. Arterial blood gas analysis on room air shows:
- |                  |          |
|------------------|----------|
| pH               | 7.18     |
| PCO <sub>2</sub> | 78 mm Hg |
| PO <sub>2</sub>  | 55 mm Hg |
- Endotracheal intubation and mechanical ventilation are required. The primary cause of this patient's condition is a dysfunction of which of the following cell types?
- (A) Alveolar macrophages
  - (B) Pneumocytes
  - (C) Pulmonary chondrocytes
  - (D) Pulmonary vascular endothelial cells
  - (E) Smooth muscle cells
14. A 22-year-old man is brought to the emergency department because of a 6-hour history of severe, sharp, upper back pain. He has had progressive fatigue during the past 3 weeks. He is 183 cm (6 ft) tall and weighs 79 kg (175 lb); BMI is 24 kg/m<sup>2</sup>. His temperature is 36.9°C (98.5°F), pulse is 90/min, and blood pressure is 160/55 mm Hg. Physical examination shows long, thin upper and lower extremities. Fingertip to fingertip with arms outstretched is 189 cm (74 in) wide. A high-pitched midsystolic click is heard predominantly over the apex. Which of the following best describes the primary genetic cause of this patient's condition?
- (A) Expression of genomic duplication within the fibrin gene
  - (B) Mutation in keratin-14 gene
  - (C) Nonsense mutation in fibrillin-1 gene
  - (D) Overexpression of collagen X gene
  - (E) Overexpression of fibronectin gene

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15. A 25-year-old woman comes to the physician because of a 2-day history of muscle cramps and profuse, watery stools. She returned from a trip to Pakistan 3 days ago. Her temperature is 37°C (98.6°F), pulse is 120/min, and blood pressure is 80/50 mm Hg. Stool culture shows numerous curved, gram-negative bacteria; there are no erythrocytes or leukocytes. Oral rehydration is initiated. The blood pressure increases, and the pulse decreases. The oral hydration formula most likely promotes sodium absorption via the gut by allowing cotransport with which of the following?
- (A) Albumin
  - (B) Fatty acid
  - (C) Glucose
  - (D) Magnesium
  - (E) Potassium
16. A 26-year-old woman is brought to the emergency department because of a 4-day history of flu-like symptoms accompanied by vomiting following each attempt to eat or drink. Her temperature is 38.5°C (101.3°F), pulse is 93/min, respirations are 24/min, and blood pressure is 105/70 mm Hg. Physical examination shows no other abnormalities. Which of the following additional findings is most likely in this patient?
- (A) Decreased serum ADH (vasopressin) concentration
  - (B) Increased serum aldosterone concentration
  - (C) Increased serum atrial natriuretic peptide
  - (D) Increased urine sodium and chloride concentrations
  - (E) Increased urine volume
17. A 77-year-old man comes to the physician because of swelling of his legs and feet for 6 months. He has a 40-year history of alcoholism and a 5-year history of hepatic disease. Physical examination shows ascites and a 2+ edema of the lower extremities. A decrease in which of the following most likely promotes edema formation in this patient?
- (A) Capillary hydrostatic pressure
  - (B) Filtration coefficient
  - (C) Interstitial colloid osmotic pressure
  - (D) Interstitial fluid hydrostatic pressure
  - (E) Plasma colloid oncotic pressure
18. During a study of gastric parietal cells, an investigator attempts to elicit maximum hydrochloric acid secretion from the stomach of an experimental animal. Which of the following combinations of substances is most likely to lead to this desired effect?
- |     | <b>Acetylcholine</b> | <b>Gastrin</b> | <b>Histamine</b> | <b>Secretin</b> |
|-----|----------------------|----------------|------------------|-----------------|
| (A) | Increased            | increased      | increased        | increased       |
| (B) | Increased            | increased      | increased        | decreased       |
| (C) | Increased            | decreased      | decreased        | increased       |
| (D) | Decreased            | increased      | increased        | increased       |
| (E) | Decreased            | decreased      | increased        | increased       |
| (F) | Decreased            | decreased      | decreased        | decreased       |
| (G) | Decreased            | decreased      | decreased        | decreased       |

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19. A 30-year-old woman comes to the physician for a routine health maintenance examination. She takes no medications. Physical examination shows no abnormalities. Serum studies show a calcium concentration of 12 mg/dL. An increase in which of the following substances is the most likely cause of the serum finding in this patient?
- (A) Bone morphogenic protein
  - (B) Calcitonin
  - (C) Integrins
  - (D) Parathyroid hormone
  - (E) Vitamin A
20. A 28-year-old woman comes to the physician because of a 3-month history of shortness of breath with exertion. She takes an oral contraceptive. There are no occupational exposures to birds or grain dusts. Her respirations are 20/min. The lungs are clear to auscultation. Cardiac examination shows a regular rate and rhythm; S<sub>2</sub> is slightly louder than S<sub>1</sub>. Cardiac catheterization shows a pulmonary artery pressure of 78/31 mm Hg (N=15–30/3–12) with a normal left ventricular end-diastolic pressure. Which of the following is most likely changed in this patient?
- (A) Decreased alveolar ventilation
  - (B) Decreased left ventricular afterload
  - (C) Increased muscle tone
  - (D) Increased pulmonary compliance
  - (E) Increased pulmonary vascular resistance

**Physiology Sample Items**

**Answer Form for Physiology Sample Questions**

**(Questions 1–20)**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
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20. \_\_\_\_\_

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### Answer Key for Physiology Sample Questions

#### (Questions 1–20)

- |     |   |     |   |
|-----|---|-----|---|
| 1.  | E | 11. | B |
| 2.  | D | 12. | F |
| 3.  | E | 13. | B |
| 4.  | A | 14. | C |
| 5.  | B | 15. | C |
| 6.  | D | 16. | B |
| 7.  | B | 17. | E |
| 8.  | D | 18. | B |
| 9.  | B | 19. | D |
| 10. | C | 20. | E |