Biology 449 - Animal Physiology

Midterm 3

Fill in your scantron form as follows:

- Write and bubble in your name in the upper left (last name first).
- Sign your form on the upper right. By so doing you verify that you are abiding by Creighton’s policy on academic honesty.

Multiple choice: As always, choose the best answer for each multiple-choice question. Answer on your scantron form. Each question is worth 3 points.

1. In mammalian lungs, gas exchange with the blood takes place
   a. in the alveoli.
   b. in the alveoli and all bronchioles.
   c. in the alveoli, all bronchioles and some bronchi.
   d. in the alveoli, all bronchioles and all bronchi.
   e. throughout the respiratory tree.

2. Which of the following statements about ventilation at resting levels is true?
   a. Alveolar pressure is negative throughout the ventilatory cycle.
   b. Alveolar pressure is positive throughout the ventilatory cycle.
   c. Intrapleural pressure is negative throughout the ventilatory cycle.
   d. Intrapleural pressure is positive throughout the ventilatory cycle.
   e. The diaphragm does not contract during the ventilatory cycle.

3. An individual who lost the ability to activate his internal intercostal muscles would probably
   a. have trouble inhaling forcefully.
   b. be unable to inhale at all.
   c. have trouble exhaling forcefully.
   d. be unable to exhale at all.
   e. not have his ventilation affected in any way.

4. Consider a “standard” adult male breathing with a tidal volume of 1150 ml at a rate of 20
   breaths per minute. His alveolar ventilation rate would be about
   a. 3 liters/min.
   b. 20 liters/min.
   c. 23 liters/min.
   d. 26 liters/min.
   e. None of the above.
5. Bronchoconstriction (a reduction in bronchiole diameter) makes ventilation more difficult because it
   a. decreases compliance of the lungs.
   b. increases compliance of the lungs.
   c. decreases resistance to airflow in the lungs.
   d. increases resistance to airflow in the lungs.
   e. Bronchoconstriction does not affect ventilation.

6. The element that forms the center of the heme molecules in hemoglobin is
   a. cadmium.
   b. iron.
   c. nickel.
   d. zinc.
   e. plutonium.

7. Imagine that blood with a $P_{O_2}$ of 40 torr and an oxygen concentration of 150ml/liter is exposed to a volume of water with a $P_{O_2}$ of 160 torr and an oxygen concentration of 5ml/liter. Which of the following statements is true?
   a. Oxygen will diffuse from the water to the blood due to the difference in oxygen concentration.
   b. Oxygen will diffuse from the blood to the water due to the difference in oxygen concentration.
   c. Oxygen will diffuse from the water to the blood due to the difference in partial pressures.
   d. Oxygen will diffuse from the blood to the water due to the difference in partial pressures.
   e. Physiology is the easiest class I have ever taken.

8. When blood from the systemic circuit enters the lungs, which of the following should decrease?
   a. The concentration of dissolved CO$_2$.
   b. The concentration of carbamino compounds.
   c. The concentration of bicarbonate ions.
   d. Two of the above should decrease.
   e. All of the above should decrease.
9. In the proximal tubule of the nephron, urea is reabsorbed across the epithelium
   a. through primary active transport in a uniport carrier protein.
   b. through cotransport with sodium in a symport carrier protein.
   c. when it adheres to water molecules moving by osmosis.
   d. through passive diffusion when its concentration rises due to the loss of water from
      the nephron.
   e. through the generation of an electrical charge across the epithelial layer due to the
      movement of ions.

10. In the loop of Henle,
    a. water is reabsorbed in the descending limb, and sodium is reabsorbed in the
        ascending limb.
    b. sodium is reabsorbed in the descending limb, and water is reabsorbed in the
        ascending limb.
    c. water is reabsorbed in both the descending and ascending limbs.
    d. sodium is reabsorbed in both the descending and ascending limbs.
    e. The loop of Henle is a new roller coaster at Adventureland.

11. In an individual who cannot make aldosterone, an increase in renin release should cause
    a. an increase in sodium reabsorption.
    b. an increase in vasoconstriction.
    c. Both a and b
    d. Neither a nor b
    e. Dance fever

12. Consider a solute that enters the nephron at Bowman’s capsule along with all the other
    solutes that are part of the primary urine. As the substance moves along the nephron to the
    collecting duct, about 50% of the original amount gets reabsorbed. Assuming the kidney is
    functioning in a relatively normal way and the person is normally hydrated, what can we
    safely say about this substance?
    a. It will have a higher concentration in the final urine than it did in the primary urine.
    b. It will have the same concentration in the final urine as it did in the primary urine.
    c. It will have a lower concentration in the final urine than it did in the primary urine.
    d. The substance is sodium chloride.
    e. The substance is alcohol.

13. Which of the following would not be expected in response to an increase in blood volume?
    a. A decrease in cardiac output
    b. An increase in vasodilation
    c. An increase in secretion of atrial natriuretic factor
    d. An increase in the rate at which urine enters the bladder
    e. An increase in salt reabsorption.
14. The conversion of proteins into short peptides and amino acids by proteases is an example of
   a. absorption.
   b. anabolism.
   c. digestion.
   d. motility.
   e. secretion.

15. Inadequate parietal cells in an individual might result in
   a. incomplete digestion of proteins by the stomach.
   b. reduced motility by the stomach.
   c. inactivation of the pyloric sphincter.
   d. an increased chance of infection of the GI tract by pathogens.
   e. an increased chance of developing a gastric ulcer.

16. Cholecystokinin promotes the release of
   a. bile.
   b. pancreatic digestive enzymes.
   c. saliva.
   d. Two of the above
   e. All of the above

17. Which of the following are released as zymogens (an inactive form of the enzyme) and activated only once they are in the lumen of the GI tract?
   a. amylases.
   b. disaccharidases.
   c. lipases.
   d. proteases.
   e. None of the above.

18. After digested fats are absorbed across the epithelial layer, they next end up in the
   a. hepatic portal vein.
   b. main systemic veins.
   c. pulmonary veins
   d. lymphatic system.
   e. love handles.

19. Most of the absorption of water from the GI tract (in terms of overall volume) occurs in the
   a. stomach.
   b. small intestine.
   c. large intestine.
   d. liver.
   e. pancreas.
20. Which of the following best describes the activity of the external anal sphincter?
   a. It reflexively contracts when the internal anal sphincter relaxes during a mass movement.
   b. It reflexively relaxes when the internal anal sphincter contracts during a mass movement.
   c. It reflexively contracts when the internal anal sphincter contracts during a mass movement.
   d. It reflexively relaxes when the internal anal sphincter relaxes during a mass movement.
   e. None of the above is true.

Short answer: Write a concise answer to each question (beginning next page). Your answers should fit in the spaces provided. Diagrams may be used but must include sufficient labeling or written explanation to fully answer the question asked. Each question is worth 8 points.
21. Based on the oxygen saturation curve shown below, answer the following questions.

![Oxygen Saturation Curve](image)

a. What is the approximate percent saturation of hemoglobin at $P_{O2} = 35$ torr?

b. At about what partial pressure of oxygen is the hemoglobin 90% saturated?

c. About how much oxygen (in units of percent saturation, as shown on the Y axis) is delivered to tissues if their $P_{O2}$ is 10 torr and the $P_{O2}$ at the lungs is only 40 torr?

d. How might a mild acidosis change the curve shown? Provide your answer by drawing the new curve on the graph.

e. Determine the answer to c again based on your new curve.
22. Explain the factors that control the release of anti-diuretic hormone, and what the effects of ADH are (down to the cellular level in the kidney). Use of a pathway diagram may be helpful, but be sure to provide sufficient labels and other text to make clear the identity and action of each component.

23. Briefly (2-3 sentences each) describe two mechanisms that help regulate glomerular filtration rate over normal ranges of mean arterial pressure.

Why is it useful for GFR to drop once MAP drops below the normal range?
24. Consider an individual who drinks a quantity of vinegar (essentially dilute acetic acid) on a dare. We will assume this acid is successfully absorbed rather than regurgitated.

a. What is the expected ventilatory response, and why?

b. What is the expected renal response?

25. There are two major hormonal pathways we covered in lecture that help control the release of acid in the stomach. Diagram or describe these two pathways, being sure to include the factors that control the release of each hormone.