Exam 3

100 points

1. In a saturated hemoglobin molecule, (3 points)
   a. one oxygen molecules bind to each hemoglobin tetramer.
   b. one oxygen molecule binds to each heme group.
   c. one oxygen molecule binds to each globin group.
   d. one oxygen molecule binds to each heme group and each globin group.

2. Use the oxygen saturation curve below to answer the following questions. (6 points)

   ![Oxygen Saturation Curve]

   a. Under standard atmospheric conditions (normal levels of oxygen in the lungs), what is the expected delivery of $O_2$ to tissues with a $Po_2$ of 30 torr? (Give your answer in the units on the Y-axis, %HbO$_2$.)

   b. How low would $Po_2$ have to be in the tissues for 80% of the $O_2$ to get offloaded?

   c. Consider a situation at high altitude where the $Po_2$ in the alveoli is only 60 torr. If the $Po_2$ in the tissues is 20 torr, what is the amount of $O_2$ delivered? (Again, in %HbO$_2$)

   d. Draw a curve of your own that shows the general pattern if pH rises.
3. Two fluids are separated by a membrane that is permeable to $O_2$. In fluid $A$, the concentration of $O_2$ is 100 ml $O_2$/liter of fluid; in $B$, it is 200 ml $O_2$/liter. This means (3 points)
   a. $O_2$ will diffuse from $A$ to $B$.
   b. $O_2$ will diffuse from $B$ to $A$.
   c. There will be no net movement of $O_2$.
   d. It is impossible to say for certain with the information given.

4. Name the three major forms in which $CO_2$ is transported from tissues to the lungs, and indicate the approximate percentage of $CO_2$ transported in each form. (6 points)

5. Given what you know about the formation of urine at the renal corpuscle, how would a drop in blood pressure at the afferent arteriole affect the rate of glomerular filtration (the rate of initial urine formation), and (briefly) why? (3 points)

6. Explain how urea ends up leaving the urine and reentering the ECF space in the proximal tubule. (In other words, what factors or events drive this process?) (5 points)

7. The active reabsorption of solutes in the loop of Henle takes place in the (3 points)
   a. thick ascending limb.
   b. thin ascending limb.
   c. descending limb.
8. At what region(s) in the nephron is urine concentration normally the lowest, and where is it the highest? (4 points)

9. In response to increasing blood osmolarity (among other factors), the ________________ gland releases increasing levels of ________________. This hormone reaches the region of the nephron known as the ________________ where it causes insertion of ________________ into the epithelial cell membranes. This results in increased reabsorption of water. (4 points)

10. Describe (with the aid of a diagram, if you like) the events that trigger increased release of renin, and the responses that result from this increase. (10 points)

11. The main reason central venous pressure is important in cardiovascular function is that it (3 points)
   a. influences heart rate through the stretching of the atria.
   b. influences stroke volume through the stretching of the ventricles.
   c. influences arteriolar vasoconstriction through its effects on active hyperemia.
12. James Bond’s lesser-known brother Covalent is captured by his nemesis, Silvertoe, who promptly injects him with a quantity of acid in an effort to make him talk. Assuming Bond survives at all, and ignoring any localized tissue damage, what physiological responses can we expect to see in him as his body attempts to bring the pH of his ECF back to normal? Be sure to indicate why each process occurs. (7 points)

13. In anaphylactic shock, an allergic reaction causes widespread vasodilation. What are the consequences of this for MAP, and what is the expected cardiovascular (not renal) response? Why are those with this condition often given a short of epinephrine? (7 points)

14. True / False The major digestive enzyme secreted in the saliva is a protease. (2 points)

15. True / False Most of the fluid that enters the GI tract comes from the food and drink we take in. (2 points)
16. Provide the three major exocrine secretions of the stomach, a one-sentence description of the function of each, and name the type of cell that secretes each. (5 points)

17. Diagram or describe the effects of secretin, and the factors that promote its release. (5 points)

18. Which of the following statements about the digestion and absorption of fats is true? (3 points)
   a. Bile salts cleave fatty acids off triglycerides.
   b. Once absorbed, fats pass from the GI tract straight to the liver.
   c. Fats have to be converted to fatty acids to be absorbed into the epithelium.
   d. The pancreas is not involved in the digestion of fats.

19. The process of defecation begins with what’s known as a __________________________, when wavelike contractions, called __________________________, of the intestinal muscle transport the fecal matter from the colon to the __________________________. This triggers relaxation of the __________________________ sphincter and reflexive tightening of the __________________________ sphincter. (3 points)

20. True / False Anabolic metabolism occurs mainly during the absorptive phase. (2 points)

21. True / False Humans can metabolically convert glucose to fatty acids and vice versa. (2 points)
22. Indicate (using a table if desired) the changes in metabolism of liver, fat, and general tissue cells (as discussed in lecture) during the absorptive versus postabsorptive stages. (8 points)

23. In Type I diabetes, beta cells (releasing insulin) are lost but alpha cells (releasing glucagon) are normally not. Consider a condition in which the opposite occurs – beta cells are present but not alpha cells. What would be some of the potential consequences of this condition, based on the material discussed in lecture? (4 points)