Exam 1 – Zoology 250

Instructor: John Godwin, Fall 2005

Name (please print):_______ KEY ______

Sign your name in the space provided below if you would like your grade to be posted by the last five digits of your student ID number (sign here, do not put your ID#) :_____________

This exam has 7 pages, Please check that your copy is complete.

Terminology/Short answer - These questions require terms or brief answers. (15 questions + 2 bonus questions, 1 pt. each except where noted, 29 pts total plus two bonus)

Use the diagram below for questions 1 to 8

Key to numbers on the diagram:
1. mouth/pharynx
2. esophagus
3. stomach
4. small intestine
5. large intestine
6. rectum
7. colon
8. pancreas
9. liver

Where on the diagram above of the human digestive tract does digestion of the following nutrients begin? Indicate your answer by writing the number associated with the correct structure in the space next to the nutrient types or processes below:

1. Fats (lipids): 4 (small intestine)
2. Carbohydrates: 1 (mouth/pharynx)
3. Nucleic Acids: 4 (small intestine)
4. Proteins: 3 (stomach)
5. Which of the numbered structures primarily functions in water reabsorption? 5 (7 is okay too)
6. Which of the labeled structures produces most of the enzymes important in digestion?_____
   8 (pancreas)

7. If you wanted to find the bacterium *Helicobacter pylori*, where would you look?_____
   3 (stomach)

8. Which of the structures shown in the figure above will all the blood coming from the intestines pass through before returning to the heart? (either the number or name here for 1 pt) Why is it that all blood from the intestines passes through this structure (What function does this serve? hint: what is the key function of this structure?) (1 pt, 2 pts total for this question).
   9 (the Liver) for 1 pt. Why? The liver is a detoxification organ and this serves to remove any toxins that might enter the general circulation via the digestive system (i.e., via food that is taken in).

9. List and compare the three types of muscle found in a vertebrate in terms of microscopic appearance, nature of control, and location where you would find each in the body using the table below (1 pt for each box here, 9 pts total for the question).

<table>
<thead>
<tr>
<th>Muscle Type</th>
<th>Location in the body</th>
<th>Microscopic Appearance</th>
<th>Nature of Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>smooth</td>
<td>Surrounding spaces typically (intestines, blood vessels, etc.)</td>
<td>Involuntary</td>
<td>Not striated or unstriated</td>
</tr>
<tr>
<td>skeletal</td>
<td>Attached to the skeleton (arms, legs, etc. is okay too)</td>
<td>Voluntary</td>
<td>striated</td>
</tr>
<tr>
<td>cardiac</td>
<td>The heart</td>
<td>Involuntary</td>
<td>striated</td>
</tr>
</tbody>
</table>

10. Living cells within bone are found in spaces called *lacunae* and are connected to each other through cytoplasmic processes that extend through *canaliculi* (1/2 pt each, 1 pt total)

11. A cheetah springs from hiding and sprints towards a gazelle on the African plains. The cheetah is much faster than the gazelle initially, but does not catch it in the initial burst of speed and the gazelle pulls away as the cheetah quickly fatigues. Based on this, you would expect that the gazelle has more A)_______ fibers in its leg muscles while the cheetah has more B)_______ fibers in its leg muscles. (1 pt each, 2 pts total, fill in answers below here).
   A) slow twitch (1/2 pt for just ‘slow’)
   B) fast twitch (1/2 pt for just ‘fast’)


12. What is the term for the common circulatory system disorder that results in the blockage of blood vessels by ‘plaques’?
   ‘atherosclerosis’ or ‘arteriosclerosis’

13. What does erythropoietin do? **Stimulates the production of red blood cells** (1/2 pt for just ‘stimulates production of blood cells’)

13. Name one of the two circulatory adaptations mammalian fetuses show (1 pt) and briefly explain what function these adaptations serve before birth (*Why do we have them?* 1 pt for the explanation, 2 pts total for this question).
   - Two possibilities here: ‘foramen ovale’ and ‘ductus arteriosus’
   - Why do we have them?: to shunt blood from the pulmonary to systemic circulation before birth when the lungs are not active in gas exchange

14. What structures prevent backflow into the atria during ventricular contraction? What structures prevent backflow into the ventricles in between ventricular contractions (1 pt each, 2 pts total for this question).
   - The **AV or atrioventricular valves** (same thing) prevent backflow from the ventricles to the atria
   - The **semilunar valves** prevent backflow into the ventricles from the pulmonary trunk and aorta in between ventricular contractions

15. How does the speed of conduction through the atrioventricular node (AV node) of the heart compare to that in the rest of the heart? (1 pt) **Why is this important functionally?** (1 pt, 2 pts total for this question)
   - Conduction is slow through the AV node. This is important because it delays the spreading of contraction in the heart and allows the atria to empty before ventricular contraction starts.

   **Bonus question:** What influence, demonstrated by experiment, determines the specific type a muscle fiber will become during development? (1 pt)
   - **Innervation** determines muscle fiber type during development (demonstrated in an experiment where the innervation was switched between two muscles and this altered the fiber type they developed)

   **Bonus question 2:** What protein has been found to suppress muscle growth?
   - **Myostatin** (must be spelled correctly)
**Multiple Choice Section** (27 questions, 1 pt each)

1. I am doing version __ of this exam: A) a,  B) b

2. Which of the diagrams above correctly shows the general relationship seen between body size and metabolic rate measured as oxygen consumption in endotherms and ectotherms?
   a) A,  b) B,  c) C,  d) D

3. Which of the figures above correctly shows the relationship seen between body size and specific metabolic rate in endotherms and ectotherms?
   a) A,  b) B,  c) C,  d) D

4. What part(s) of the digestive system have secretions with a pH of 2?
   a) small intestine,  b) **stomach**,  c) pancreas,  d) A and B only

5. To leave the digestive tract into the body, a substance must cross a cell membrane. During which stage of food processing does this take place?
   a) Ingestion,  b) digestion,  c) hydrolysis,  d) **absorption**,  e) elimination

6. Which of these animals has a gastrovascular cavity?
   a) Pigeon,  b) **hydra**,  c) elephant,  d) beetle,  e) leech
7. Which of the following statements about pepsin is true? Pepsin
   a) is manufactured by the pancreas.
   b) helps stabilize fat-water emulsions.
   c) splits maltose into monosaccharides.
   d) begins the hydrolysis of proteins in the stomach.
   e) is denatured and rendered inactive in solutions with low pH.

8. What is peristalsis?
   a) a process of fat emulsification in the small intestine
   b) voluntary control of the rectal sphincters regulating defecation
   c) the transport of nutrients to the liver through the hepatic portal vessel
   d) a common cause of loss of appetite, fatigue, and dehydration
   e) smooth muscle contractions that move food through the alimentary canal

9. All of the following are adaptations that increase surface area in the small intestine except:
   a) The intestine is quite long overall
   b) The walls of the intestine show folds
   c) The walls of the intestine are formed into finger-like villi
   d) The walls of the small intestine contain both circular and longitudinal muscles
   e) The epithelial cells in the small intestine have microvilli

10. How does the digestion and absorption of fat differ from that of carbohydrates?
    a) Processing of fat does not require any digestive enzymes, whereas the processing of carbohydrates does.
    b) Fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine.
    c) Carbohydrates need to be emulsified before they can be digested, whereas fats do not.
    d) Most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood.
    e) Only fat must be worked on by bacteria in the large intestine before it can be absorbed.

11. Which of the following statements about bile salts is true? Bile salts
    a) are enzymes.
    b) are manufactured by the pancreas.
   c) emulsify fats in the duodenum.
   d) increase the efficiency of pepsin action.
   e) are normally an ingredient of gastric juice in the stomach.

12. A human red blood cell in an artery of the left arm is on its way to deliver oxygen to a cell in the thumb. From where it is in the artery, how many capillary beds must this red blood cell pass through before it returns to the left ventricle of the heart?
    a) One,  b) two,  c) three,  d) four,  e) five

13. Which of the following are the only vertebrates in which blood flows directly from respiratory organs to body tissues without first returning to the heart?
    a) amphibians,  b) birds,  c) fishes,  d) mammals,  e) reptiles
14. Which is a correct statement concerning the type of circulatory system found in insects?
   a) The hemolymph bathes tissues directly.
   b) Blood is always contained in a system of tubes called tracheae.
   c) There is no heart, or pump.
   d) There is no blood, or circulating fluid.

15. Blood is carried directly to the lungs from which of the structures on the diagram to the right here?
   a) 2
   b) 3
   c) 4
   d) 5
   e) 6

16. The meshwork that forms the fabric of a blood clot consists mostly of which protein?
   a) fibrinogen, b) fibrin, c) thrombin, d) prothrombin, e) collagen

17. Why is the velocity of blood flow the lowest in capillaries?
   a) The capillary walls are not thin enough to allow oxygen to exchange with the cells.
   b) Capillaries are far from the heart, and blood flow slows as distance from the heart increases.
   c) The diastolic blood pressure is too low to deliver blood to the capillaries at a high flow rate.
   d) The systemic capillaries are supplied by the left ventricle, which has a lower cardiac output than the right ventricle.
   e) The total cross-sectional area of the capillaries is larger than the total cross-sectional area of the arterioles.

18. If, during protein starvation, the osmotic pressure on the venous side of capillary beds drops below the hydrostatic pressure, then
   a) hemoglobin will not release oxygen.
   b) fluids will tend to accumulate in tissues.
   c) the pH of the interstitial fluids will increase.
   d) most carbon dioxide will be bound to hemoglobin and carried away from tissues.
   e) plasma proteins will escape through the endothelium of the capillaries.

19. What would be the long-term effect if the lymphatic vessels associated with a capillary bed were to become blocked?
   a) More fluid would enter the venous capillaries.
   b) Blood pressure in the capillary bed would increase.
   c) Fluid would accumulate in interstitial areas.
   d) Fewer proteins would leak into the interstitial fluid from the blood.
   e) Nothing would happen.
20. The relative proportion of muscle fiber types in your muscles is determined primarily by the type of activity or training you do as an adult.
   a) This statement is true,  b) This statement is false

21. Which of the following responses would be important changes seen with endurance training?
   a) Increased numbers of mitochondria within muscle fibers
   b) Increased vascularization of the muscles
   c) Greatly increased numbers of myofibrils within muscle fibers
   d) Increased myoglobin concentrations within muscle fibers
   e) A, B, and D are true

22. When an organism dies, its muscles remain in a contracted state termed "rigor mortis" for a brief period of time. Which of the following most directly contributes to this phenomenon?
   a) There is no ATP to move myosin heads back to the ‘high energy’ position
   b) There is no ATP to break bonds between the thick and thin filaments.
   c) There is no calcium to bind to troponin.
   d) There is no oxygen supplied to muscle.
   e) There is no glycogen remaining in the muscles.

23. Which of the following does not form part of the thin filaments of a muscle cell?
   a) Actin,  b) troponin,  c) tropomyosin,  d) myosin,  e) calcium-binding site

24. What is the role of calcium in muscle contractions?
   a) break the cross-bridges as a cofactor in the hydrolysis of ATP
   b) bind to the troponin complex, which exposes the myosin-binding sites
   c) transmit the action potential across the neuromuscular junction
   d) spread the action potential through the T tubules
   e) reestablish the polarization of the plasma membrane following an action potential

25. Which of the following is a true statement about cardiac muscle cells?
   a) They lack an orderly arrangement of actin and myosin filaments.
   b) They have less extensive sarcoplasmic reticulum and thus contract more slowly than smooth muscle cells.
   c) They are connected by intercalated discs
   d) They have a resting potential more positive than an action potential threshold.
   e) They contract only when stimulated by neurons.

26. Botulinum toxin is increasingly used cosmetically to reduce wrinkles. Application of ‘Botox’ blocks acetylcholine release, blocking muscle contraction before which of these steps:
   a) Generation of action potentials in the muscle fiber
   b) Release of Ca$^{2+}$ from the sarcoplasmic reticulum
   c) Detachment of myosin heads during cross bridge cycling
   d) Generation of action potentials in the motor neuron serving that muscle fiber

27. What molecule is the ‘phosphate donor’ for ATP production in working muscles?
   a) Ca$^{2+}$,  b) creatine,  c) glycogen,  d) NADPH,  e) oxygen