Exam 1 - Zoology 250 version B

Instructor: John Godwin, Fall 2004

Name (please print):___________________

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 (signature here, do not put your ID#):_______

This exam has 6 pages, Please check that your copy is complete.

Terminology/Short answer - These questions require terms or brief answers. (18 questions + 2 bonus questions, 1 pt. each except where noted, 34 pts total plus two bonus)

1. Give a specific example of a zymogen. Several are possible: Pepsinogen, Trypsinogen, Chymotrypsinogen, Procarboxypeptidase (1/2 credit for active form of each instead)

2. What are the four major components/stages of digestion? (1/2 pt each, 2 pts total) Ingestion, Digestion, Absorption, Elimination

3. What is the ‘Q10’ rule? Enzyme rates (or overall metabolic rates) tend to increase 2-3 fold for each 10OC increase in temperature.

4. List 4 structural features that increase the surface area of the small intestine. (1/2 pt each, 2 pts total) - Large overall length, folds in walls, villi, microvilli

5. List two mechanisms that protect the stomach from digesting itself. (1 pt each, 2 total) Three are possible: Pepsin secreted in zymogen form (pepsinogen), mucus secretion, rapid replacement of epithelial lining

6. On the axes to the left here, draw lines to show the general relationship between body size and specific metabolic rate. Draw a dashed line for endotherms (e.g., a mouse or elephant) and a solid line for ectotherms (e.g., a lizard or fish). Assume both axes are log scales as they were shown in class. (2 pts)

7. In an experiment we discussed in class, rabbits experimentally infected with Shigella flexneri and then treated with an anti-diarrheal medication recovered more slowly than control rabbits that were also experimentally infected, but did not receive anti-diarrheal medication. What do these findings suggest about the function
of diarrhea? (2 pts): - They suggest that diarrhea is an active defense against the pathogen rather than simply a symptom.

8. What does ‘heterodont dentition’ (as seen in mammals) mean?
- This means individuals have different kinds of teeth (e.g., canines vs. molars)

9. A connective tissue connection between a muscle and bone is termed a **tendon** while the connective tissue connection between two bones is termed a **ligament**. (1 pt each, 2 pts total)

10. The skull is part of the **Axial** division of the skeleton.

11. Living cells in bones occupy spaces termed **Lacunae** connected to each other by **canaliculi**. (1 pt each, 2 pts total)

12. Briefly explain what the term ‘summation’ refers to in the function of muscle fibers. (2 pts)
Summation refers to the increasing tension generated by a muscle fiber when it receives action potentials in quick succession (1 pt for noting increasing tension, 1 pt for noting repeated stimulation)

13. A crab’s cuticle is referred to as its **EXO** skeleton. Molting of this cuticle occurs under the influence of the hormone **Ecdysone**. (1 pt each, 2 pts total)

14. Why it is important that the stimulus to contract spreads from the bottom of the ventricle up rather than from the top towards the bottom?
- the openings (valves) for the ventricles are located on top, important to drive blood towards these

15. Compare the characteristics of open and closed circulatory systems using the table below and the choices given in parentheses. (1/2 pt each, 4 pts total)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Closed System</th>
<th>Open System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure (high/low)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Relative volume (large/small)</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Capillaries present? (yes/no)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Would be found in a clam? (yes/no)</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
16. List two changes that endurance training produces in muscle. (1 pt each, 2 pts total)
Three are possible: Increased vascularization, increased numbers of mitochondria, increased levels of myoglobin

17. Referring specifically to the themes of ‘Distance, Area and Gradients’, briefly describe how the circulatory system is well adapted for exchange by diffusion. (1 pt each, 3 pt total)
Distance: capillary walls are very thin, minimizing the diffusion distance
Area: There are an enormous number of capillaries, producing a large overall surface area
Gradients: Constant movement of blood by the heart maintains diffusion gradients

18. Briefly explain why tension peaks at approximately 100-120% of muscle resting length in the figure to the right here. (2 pts)
- Cross bridge formation is maximized at these lengths (1 pt) due to optimal overlap of the thick and thin filaments and therefore access of myosin molecules to the thin filament (1 pt)

19. Bonus: Hummingbirds beat their wings very quickly. What cellular component would you expect to be especially well represented in their flight muscles compared to, say, human pectoral muscles? (1 pt)
- Sarcoplasmic Reticulum

20. Bonus: What change in the intestine occurs as tadpoles become frogs and why? (1 pt)
- The intestine shortens (1/2 pt) because the animal is shifting from a plant to ‘meat’ diet (1/2 pt)

Multiple Choice (1 pt each, 23 points total)

1. I am writing version ___ of this exam.
   a) A
   b) B

2. An organism whose nutrition is derived by consuming other organisms is termed a:
   a) Autotroph, b) Heterotroph

3. Lacteals play critical roles in the absorption of ________.
   a) Carbohydrates, b) Proteins, c) Lipids, d) Nucleic Acids
4. The circular and longitudinal muscle in the walls of the small intestine aid in maximizing absorption of nutrients by:
   a) Increasing intestinal surface area
   **b) Helping to maintain diffusion gradients**
   c) Decreasing distances across which diffusion has to take place
d) Shortening the intestine to reduce food residence time

5. You would find both a small and large intestine in a teleost fish.
   a) This statement is true,  b) **This statement is false.**

6. The structure that prevents entry of food into the trachea is termed the:
   a) **Epiglottis**,  b) Glottis,  c) Pharynx,  d) Eustachian tube,  e) None of the above

7. Enzymes responsible for **protein** digestion in the duodenum originate primarily in the:
   a) **Pancreas**,  b) Liver,  c) Spleen,  d) Thymus,  d) Appendix

8. Cellulose digestion in an animal like a cow takes place primarily in the ______
   a) Mouth,  b) Pancreas,  c) Colon,  d) **Rumen**

9. Shortly after death, a body will exhibit a strong contraction of muscles giving it a stiffness referred to as **rigor mortis**. Given what you know about muscle function and our discussion of this in class, what accounts for this phenomenon.
   a) A lack of Ca$^{2+}$ ions in the muscle
   **b) A lack of ATP in the muscle**
   c) A lack of ADP in the muscle
d) A lack of troponin in the muscle
e) A lack of sarcoplasmic reticulum in the muscle

10. Which of the following is **not** a function of bone cells in vertebrates?
    a) Protection,  b) Mineral storage,  c) Fat storage,  d) Blood formation
e) **All of the above are functions of bone cells**

11. Vertebrate bone consists mainly of a mineralized matrix composed of:
    a) Calcium carbonate,  b) Hydroxy azide,  c) **Hydroxyapatite**,  d) Calcium hydroxide
e) Hyaline cartilage

12. This question and the next are based on the figure to the right here. Based on what you know about the characteristics of fast and slow twitch muscle fibers, which of the two athletes shown is probably the marathoner?
   a) Athlete A
   **b) Athlete B**

![Bar graph showing % of total leg muscle fibers that are fast twitch for Athletes A and B]
13. Still referring to the diagram to the right of the question above, which athlete would you expect to show greater vascularization in the leg muscles (i.e., higher density of capillaries?)
   a) Athlete A
   b) Athlete B

14. In muscle contraction, Ca^{2+} ions bind to _______, allowing _______ molecules to form cross bridges.
   a) Troponin, myosin
   b) Tropomyosin, myosin
   c) Actin, myosin
   d) Troponin, actin
   e) Tropomyosin, acetylcholine

15. Strength training increases the number of muscle fibers in a muscle, but not myofibrils within those muscle fibers.
   a) This statement is true.
   b) This statement is false.

16. Which of the following has been shown to determine whether a muscle fiber develops as a fast or slow twitch fiber?
   a) Intensive strength training
   b) Intensive endurance training
   c) Experimentally increasing blood flow to the fiber
   d) Experimentally switching the neuron innervating the fiber
   e) Experimentally altering myostatin levels in the muscle

17. What protein helps give arteries their ability to damp out pressure oscillations during the cardiac cycle and allows the arterial system to act as a ‘pressure reservoir’?
   a) Elastin
   b) Collagen
   c) Carboxypeptidase
   d) Troponin
   e) Myostatin

18. The structure in fetal mammals that allows blood to shunt from the right atrium to the left atrium is termed the:
   a) Foramen ovale
   b) Foramen magnum
   c) Ductus arteriosus
   d) Patent ductus arteriosus
   e) Coronary artery
19. Choose the sequence below the path a red blood cell could take in a human on leaving the left ventricle before it would return to the left ventricle.
   a) Lungs, Right Ventricle, Right Atrium, Aorta, Small intestine, Left Atrium,
   b) Lungs, Right Ventricle, Right Atrium, Aorta, Small intestine, Left Atrium,
   c) Aorta, Lungs, Small intestine, Right Ventricle, Right Atrium, Left Atrium
   d) Aorta, Small intestine, Right Ventricle, Right Atrium, Lungs, Left Atrium
   e) Aorta, Small intestine, Right Atrium, Right Ventricle, Lungs, Left Atrium

20. The active enzyme that catalyzes the formation of fibrin in clots is:
   a) Fibrinogen
   b) Prothrombin
   c) Thrombin
   d) Carboxypeptidase
   e) Acetylcholinesterase

21. The heartbeat originates:
   a) In the sinoatrial node
   b) In the atioventricular node
   c) Spontaneously due to electrical connections between cardiac muscle cells.
   d) In the Bundle of His
   e) In the purkinje fibers

22. The AV node conducts action potentials (signal to contract as it passes through the heart) ________ the Bundle of His.
   a) More quickly than
   b) More slowly than
   c) At the same rate as

23. The layer of an artery that contains smooth muscle is termed the:
   a) Tunica intima
   b) Tunica media
   c) Tunica adventitia
   d) Endothelium

24. If you were to increase osmolality of the blood (i.e., increase the concentration of osmotically active substances in it), what do you predict would be the net effect on loss of fluid from capillaries?
   a) Fluid loss from capillaries would increase
   b) Fluid loss from capillaries would decrease
   c) No net change would be observed