

**BIO 3302 ANIMAL PHYSIOLOGY II  
FINAL EXAMINATION**

**December 12<sup>th</sup>, 2015 (3 h)**                      **Name:** \_\_\_\_\_  
**Dr KM Gilmour**  
**Closed book exam**                      **Student number:** \_\_\_\_\_

**Cellular phones, unauthorized electronic devices or course notes (unless an open-book exam) are not allowed during this exam. Phones and devices must be turned off and put away in your bag. Do not keep them in your possession, such as in your pockets. If caught with such a device or document, the following may occur: you will be asked to leave the exam immediately and academic fraud allegations will be filed which may result in you obtaining a 0 (zero) for the exam.**

**By signing below, you acknowledge that you have ensured that you are complying with the above statement.**

**SIGNATURE:** \_\_\_\_\_

**Note:** This exam consists of four sections and one bonus question. The questions in Section A should be answered **in the space provided on the question sheet**. The questions in Sections B-D should be answered **in the exam booklet**.

**Part A:** Answer on the question sheet. (1 mark per answer unless otherwise indicated; 29 marks in total)

1. List **three** structural features of the renal corpuscle that permit it to function as the site of filtration in urine formation. (3 marks)

2. True OR false (select one): Vagal tone refers to the resting level of sympathetic output to the blood vessels.

3. The body temperature of a leopard frog swimming in a pond will be less than OR equal to OR greater than (**select one**) the temperature of the water primarily because of \_\_\_\_\_ heat exchange. Once the frog emerges from the water to sit on a lily pad, \_\_\_\_\_ heat exchange may permit body temperature to be less than OR equal to OR greater than (**select one**) air temperature.

4. An increase in which of the following would **not** tend to induce vasodilation in the systemic vasculature?

CO<sub>2</sub>      protons      heat      K<sup>+</sup>      O<sub>2</sub>      adenosine

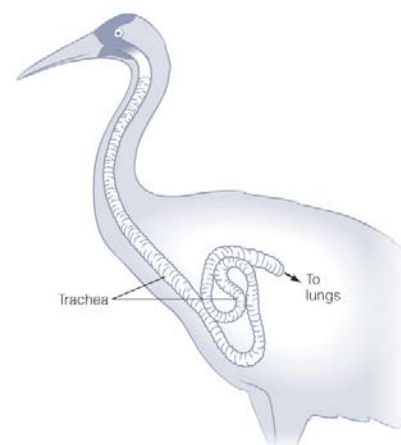
When these conditions occur as a result of elevated activity or exercise, the increased blood flow to the tissue is termed \_\_\_\_\_.

A tissue in which this phenomenon is particularly highly developed is \_\_\_\_\_.

5. Because some hummingbirds maintain their body temperature at 42°C during the day but a lower value at night, they are termed \_\_\_\_\_.

6. The sketch at right illustrates the long neck of a crane. In comparison to a similarly-sized bird with a shorter neck, we would predict that the crane would have...

- Lower alveolar PO<sub>2</sub> and therefore lower blood O<sub>2</sub> content
- Higher breathing frequency so as to achieve normal PO<sub>2</sub> in the lung
- Larger tidal volume to compensate for the greater anatomical dead space
- Lower arterial PCO<sub>2</sub> owing to a relative hyperventilation of the lung
- All of the above would be observed in the crane.



7. The pacemaker potential...

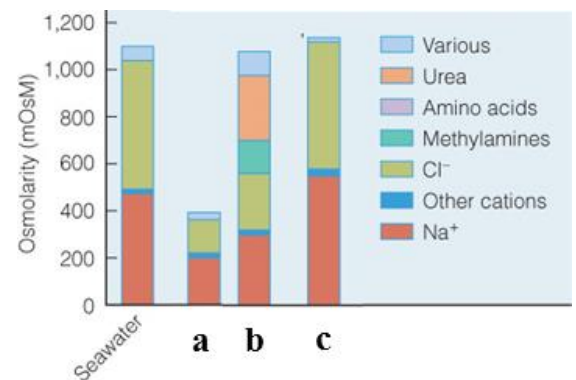
- Is the unstable resting membrane potential that occurs in cells of the conducting system in the vertebrate heart.
- Reflects the presence of a K<sup>+</sup> leak channel (sometimes called the K<sup>+</sup> “funny” channel) that results in spontaneous depolarization.
- Is decreased following sympathetic stimulation of the heart, resulting in a decrease in heart rate that is termed a negative chronotropic effect.
- Is decreased following parasympathetic stimulation of the heart, owing to increased K<sup>+</sup> efflux achieved by the action of acetylcholine on β<sub>1</sub>-adrenoreceptors.
- Accounts for the prolonged plateau phase of the contractile cells of the vertebrate heart

8. The figure at right presents the main inorganic and organic solutes in the extracellular fluids of three water-breathing vertebrates.

Which bar (a to c) represents an osmoconformer that ionoregulates? \_\_\_\_\_

The animal represented by which bar (a to c) would experience water loss to the surrounding environment?  
\_\_\_\_\_

Which bar (a to c) represents an animal that has spent its entire evolutionary history in seawater? \_\_\_\_\_

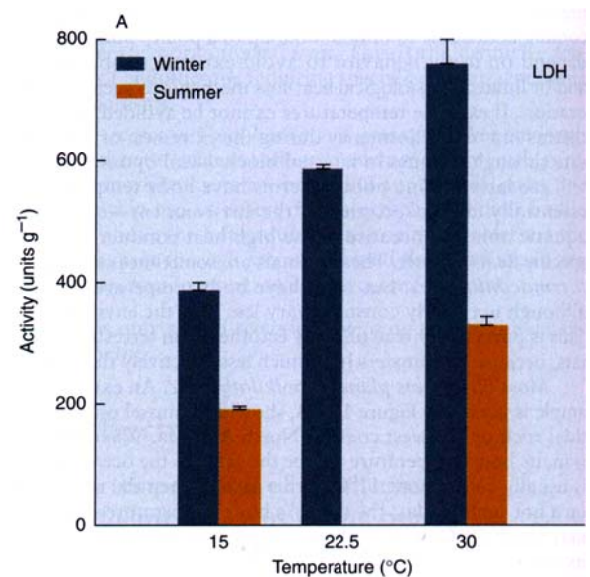


9. During a dive, blood pressure might be expected to increase OR stay constant OR decrease (**select one**) in a Weddell seal. Explain your reasoning: (3 marks)

10. What is the functional significance of the smooth muscle that is present in the walls of the largest veins? What function do these vessels serve in the circulatory system? (2 marks)

11. The secretion of \_\_\_\_\_ from the adrenal cortex is inhibited by atrial natriuretic peptide
12. Both lobster and cod are (or at least used to be) found off the coast of Newfoundland, where winter water temperatures hover around  $-2^{\circ}\text{C}$ . Which of these two species would be more likely to exhibit antifreeze compounds, and why? (2 marks)

13. The figure at right illustrates lactate dehydrogenase (LDH) activity in the leg muscles of alligators. Based on this figure...
- Animals acclimated to the same temperature experience essentially equal LDH activities.
  - LDH activity does not exhibit a  $Q_{10}$  effect.
  - Acclimatization acts essentially to equalize LDH activity for animals tested at the temperature to which they were acclimatized.
  - The  $Q_{10}$  for LDH activity appears to be higher in alligators sampled in the summer than in alligators sampled in the winter.
  - None of the above is true.



14. Fluid and \_\_\_\_\_ that are lost from the capillaries are returned to the circulatory system by means of the \_\_\_\_\_ system.

**Part B:** Answer **ONE** of the following two questions in the exam booklet. (6 marks)

- Owing to the presence of a kidney stone that is lodged in the nephron, glomerular filtration has fallen to zero. Assuming that blood in the glomerulus exerts a pressure of 55 mmHg and that the colloid osmotic pressure difference between blood and the initial filtrate is 25 mmHg, what hydrostatic pressure must be exerted by the fluid in Bowman's capsule? To re-establish filtration, the afferent arteriole dilates. Assuming that blood flow through the renal arteriole does not change as a result of this adjustment and that blood always enters the renal arteriole with a pressure of 91 mmHg, by what factor must the resistance of the afferent arteriole change to re-establish the normal net filtration pressure of 18 mmHg? By what factor must the afferent arteriole dilate to achieve this change in resistance?
- Myrtle is a mangrove rivulus, an amphibious fish species that lives in mangrove swamps and can emerge from the water to spend days or weeks in air. Your task is to figure out whether Myrtle currently is in the water or living on land by using the data below to calculate the ventilation:perfusion ratio. Having determined whether Myrtle is on land or in water, comment on the potential impact of this habitat on Myrtle's acid-base status and choice of nitrogen end-product.

$$CaO_2 = 2.5 \text{ mmol L}^{-1}$$

$$CvO_2 = 2.2 \text{ mmol L}^{-1}$$

$$CiO_2 = 0.70 \text{ mmol L}^{-1}$$

$$CeO_2 = 0.41 \text{ mmol L}^{-1}$$

**Part C:** Answer **THREE** of the following four questions in the exam booklet. (8 marks each; 24 marks in total)

- Most freshwater teleost fish are unable to survive in water with high concentrations of bicarbonate ions because ionic regulation, acid-base balance and nitrogenous waste excretion all are impaired. Use a labelled sketch of the fish gill to explain why.
- Discuss the functional significance of the linkage between  $O_2$  uptake and  $CO_2$  excretion with respect to blood gas transport. Illustrate your answer with labelled sketches of the  $O_2$  and  $CO_2$  equilibrium curves.
- You are climbing Mount Everest (without supplemental  $O_2$ ). As you ascend, ventilation increases. What triggers this increase in ventilation? Discuss the physiological consequences of high altitude for gas transfer, blood flow and acid-base balance in a human.
- Why are mammals and birds endothermic homeotherms whereas fish, amphibians and reptiles are not? Discuss the adaptations and physiological strategies that permit mammals and birds to maintain body temperature through metabolic heat production.

**Part D:** Answer **TWO** of the following three questions in the exam booklet. (12 marks each; 24 marks in total)

1. Certain tuna species (e.g. bluefin tuna, yellowfin tuna) display a suite of integrated cardiovascular, respiratory and thermoregulatory adaptations for its high performance lifestyle. Discuss these adaptations, explaining the physiological significance and structural basis of each adaptation.
2. Discuss the acute and chronic mechanisms involved in returning blood pressure in a human to normal following an acute fall in blood pressure resulting from severe haemorrhage.
3. Discuss the physiological problems faced by small mammals that inhabit hot, arid environments, and the strategies used to overcome these problems

**Bonus:** Hopefully you saw this one coming... Hockey, that quintessential Canadian sport, is also fairly fishy. For a bonus mark that, in the spirit of socialism will be applied to the entire class if even one student answers the question correctly, can you complete the names of the following fishy NHL players? And come up with the fishy team, too?

Fishy team: \_\_\_\_\_

Mike \_\_\_\_\_ - Nashville Predators #12

Cody \_\_\_\_\_ - Nashville Predators #16

Jon \_\_\_\_\_ - Calgary Flames #82

Matthew \_\_\_\_\_ - NY Islanders #54