BIO 3302 Animal Physiology II
Midterm #1

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80 min

NAME: _____

STUDENT #: _____

Part A: Answer the following questions in the space provided on the question sheet. (1 mark per answer unless otherwise stated; 20 marks in total)

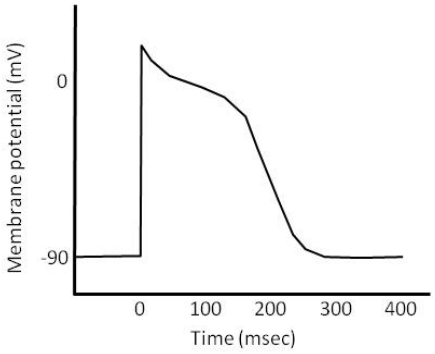
1. Distinguish between vasomotor tone and vagal tone. (2 marks)

2. Which one of the following statements about the regulation of blood pressure in vertebrates is **not** correct?
   a. Baroreceptors are stretch-sensitive receptors found in the carotid sinus and the aorta that function in the acute regulation of blood pressure.
   b. Blood pressure regulation is essential both for the maintenance of blood flow to critical tissues (the brain, heart and gas-exchange organ) and for the maintenance of fluid balance.
   c. Owing to the high capacitance of the veins, it is possible to remove blood from the venous system (e.g. when donating blood) without affecting blood pressure.
   d. An appropriate response to a sudden fall in blood pressure is to increase sympathetic activity to the vasculature, as this will increase both total peripheral resistance and, indirectly, cardiac output.
   e. Individuals suffering from hypertension are often treated with ß$_2$ blockers and blood thinners to limit increases in heart rate and to decrease blood viscosity (and hence total peripheral resistance), respectively.

   Briefly explain why the statement that you have chosen above is not correct:

3. The viscosity of a milkshake is 32 times the viscosity of diet coke. The resistance to sucking a milkshake through a straw that is 10 cm long and 0.4 cm in diameter is (**select one**) <u>greater than OR the same as OR lower than</u> the resistance to sucking diet coke through a 20 cm long, 0.2 cm diameter straw.

4. The figure at right presents the membrane potential for a cardiac muscle fibre. Would this fibre be located in the ventricle or the conducting system of the heart? Explain your answer. (3 marks)



5. The enzyme that catalyzes the reversible hydration and dehydration reactions of CO_2 is _____.

6. Sketch a CO_2 equilibrium curve (i.e. the relationship between concentration and partial pressure for CO_2 in blood), labelling the axes appropriately. On the same set of axes, add a line representing the physically dissolved CO_2 that is present in blood. What accounts for the difference between the two lines? (4 marks)

7. The _____ of the fish heart becomes the sinoatrial node of the mammalian heart.

8. During digestion, the metabolic rate of a python increases ~44-fold, similar to the fold increase in the metabolic rate of a race horse running at top speed. The heart of a python differs from that of other snakes. Predict in what way the python heart is different. Explain your reasoning. (3 marks)

9. The O_2 equilibrium curve…
   a. Is hyperbolic in shape when the respiratory pigment is made up of subunits that can interact resulting in cooperativity of O_2 binding.
   b. Exhibits a steep region that allows for near saturation of haemoglobin by oxygen even at (moderately) reduced environmental PO_2 levels.
   c. Shifts to the left as red blood cell organic phosphate levels rise.
   d. Is a straight line for the Antarctic icefish.
   e. Includes a plateau region in which large changes in blood O_2 content can occur with relatively little change in PO_2.

   Explain your answer:

10. Based on the guest lecture given by Natalie Sopinka, name one effect of maternal stress on the offspring of female sockeye salmon.

Part B: Answer the following questions in the exam booklet. (20 marks in total)

1. A goose in flight consumes 585 mL O_2 min^{-1}. Arterial blood exhibits a PO_2 of 110 Torr, while the PO_2 of the venous blood is 64 Torr; the capacitance of blood for O_2 is 1.2 mL O_2 L^{-1} $Torr^{-1}$. If heart rate is 190 bpm, what volume of blood is ejected by the heart with each beat (i.e. what is stroke volume)? Please show your calculations. (4 marks)

2. What are the Bohr and Haldane effects? Explain how these two effects link blood O_2 transport and blood CO_2 transport together. (4 marks)

3. Structure and function are often intimately linked in physiological systems, *i.e.* structures are often uniquely adapted to carry out particular functions, or the function of a particular system is made possible by its structure. Discuss such structure-function relationships with respect to the capillaries, making specific reference to the Fick equation and explaining its relevance. (6 marks)

4. During exercise, the oxygen demand of skeletal muscle increases dramatically. Explain how this increased oxygen demand is met through cardiovascular adjustments **and** adjustments of blood oxygen transport. (6 marks)

Bonus: For a bonus mark that, in the spirit of socialism will be applied to the entire class if even one person answers correctly, which one of the following Hallowe'en-themed fish is not a real fish?

a. Batfish
b. Devil fish
c. Hallowe'en barb
d. Dracula fish
e. Witch fish
f. Broom filefish
g. Costume clownfish
h. Black ghost knifefish
i. Pumpkinseed
j. Goblin shark