BIO 3302 Animal Physiology II
Midterm #1

KM Gilmour **NAME: _____**
February 14th, 2011
80 min **STUDENT #: _____**

Part A: Answer the following questions in the space provided on the question sheet. (1 mark per answer unless otherwise stated; 25 marks in total)

1. In honour of St. Valentine's Day… Whose heart am I?
   (a) I have four chambers connected in series, the final chamber being the bulbus arteriosus. I am the heart of _____.
   (b) My single ventricle is undivided. I am the heart of _____.
   (c) My two halves are completely divided, allowing different input pressures to the systemic and respiratory circulations. I am the heart of _____.

2. Use the data below to calculate the contribution of physically dissolved CO_2 to the total blood CO_2 content. (3 marks)
   $\alpha_{plasma}CO_2$ (at 15°C) = 0.065 mmol L^{-1} $torr^{-1}$
   $ß_{blood}CO_2$ (at 15°C) = 1.55 mmol L^{-1} $torr^{-1}$
   PCO_2 = 4 torr

3. If the hydrostatic pressure of the interstitial fluid is 2 mmHg, blood entering a capillary must exert a hydrostatic pressure of _____ to avoid net fluid loss across the capillary wall when the osmotic pressure of the blood exceeds that of the interstitial fluid by 21 mmHg.

4. The _____ cells of the fish gill function as O_2 chemoreceptors.

5. Complete the following table: (0.5 marks per answer)

Gas exchange organ	Functional unit of gas exchange organ	PaO_2	Flow of ventilated medium at gas exchange unit
		$< PiO_2$	Unidirectional and continuous
			Tidal
Avian lung			

6. What is “ram ventilation”? Why is it used? (2 marks)

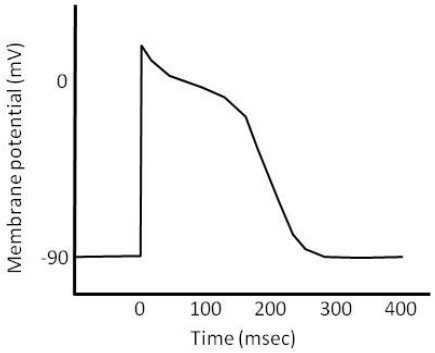
7. If the radius of a blood vessel increases by 50%, the pressure difference across the vessel must increase OR decrease (**select one**) by a factor of _____ to avoid a change in blood flow.

8. True OR false (**select one**): The air sacs of the avian respiratory system comprise ~80% of the volume of the system and contribute at least 50% of total O_2 and CO_2 exchange between air and blood.

9. Label the peaks in the ECG trace below (1.5 marks). Use an arrow to indicate the peak that reflects atrial depolarization (0.5 marks).

10. Increased OR decreased **(select one)** activation of the sympathetic OR parasympathetic **(select one)** nervous system results in vasodilation owing to the existence of a basal activity known as _____.

11. 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. (2 marks)



12. Sufferers of Raynaud's syndrome exhibit _____

when blood flow is re-established following a period of ischemia due to cold exposure.

Part B: Answer the following questions in the exam booklet. (22 marks in total)

1. The Weddell seal is a pinniped diver that relies on blood/muscle rather than lung O_2 stores during a dive. Sketch the O_2 equilibrium curve of a Weddell seal relative to that of a human, labelling the axes appropriately. Explain your sketch. (5 marks)

2. With reference to the Fick equation, what are the key characteristics of a good gas exchange organ? In what ways does the vertebrate integument fail to meet these criteria? (6 marks)

3. During both diving and exercise, blood pressure remains constant despite dramatic adjustments of heart rate and the degree of peripheral vasoconstriction. Contrast and compare diving and exercise with respect to the cardiovascular adjustments that occur, explaining in each case how blood pressure is maintained. (8 marks)

4. Which of the two creatures for which data are presented in the table below is a vertebrate? Explain your reasoning. (3 marks)

Circulatory characteristic	**Creature A**	**Creature B**
Rate of O_2 delivery to tissues (mL O_2 kg^{-1} min^{-1})	0.65	0.60
Blood flow (mL blood kg^{-1} min^{-1})	25	85
Pressure drop across the circulatory system (mmHg)	22	16
Systemic resistance (mmHg min kg mL^{-1})	0.9	0.2
Heart rate (min^{-1})	63	65
Blood-O_2 carrying capacity (vol%)	4	1.6

Bonus: For a bonus mark that, in the spirit of socialism will be applied to the entire class if even one person is successful, approximately how many hits are obtained when one googles "fish" and "Valentine's day"? _____