BIO 3302 Animal Physiology II
Midterm #2

K. Gilmour **NAME: _____**
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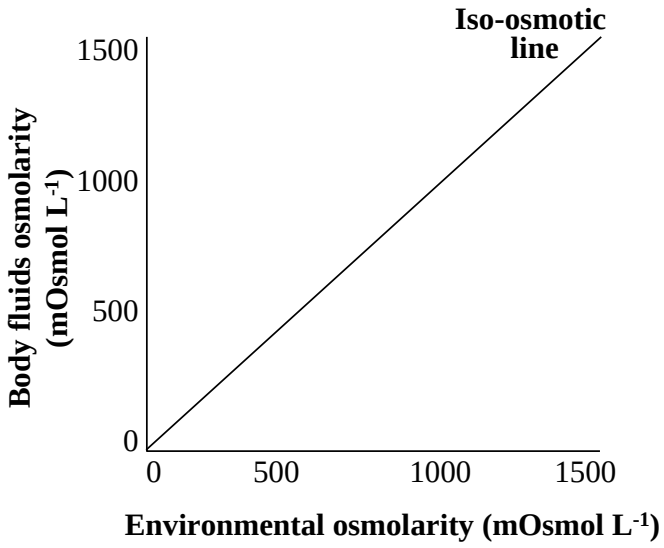
80 min **STUDENT #: _____**

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. On the axes at right, sketch the relationship between body fluid osmolarity and the osmolarity of the external environment for a crayfish. (2 marks)

   This animal is best described as…
   a. A hyperionic, hyperosmotic regulator
   b. An osmoconformer
   c. A hypoionic, hypo-osmotic regulator
   d. An isoionic, iso-osmotic regulator
   e. None of the above describes this animal



2. <u>True OR false</u> (**select one**): A decrease in glomerular blood pressure from 55 mm Hg to 47 mm Hg represents autoregulation of glomerular filtration rate.

3. Use your knowledge of nitrogen excretion to explain the unusual aspects of nitrogen excretion in the gulf toadfish (*Opsanus beta*) that fascinate Dr. Walsh. (2 marks)

4. The temporal counter-current system of air-breathing vertebrates…
   a. Is most effective in animals with (relatively) short, straight nasal passages.
   b. Allows air with a relative humidity of less than 100% to be exhaled.
   c. Refers to the recovery of water and heat from exhaled air as a result of the warming effects on the nasal passages of water and heat addition to the air as it is inhaled.
   d. Relies on cooling of the exhaled air for water recovery, as water vapour density at a constant relative humidity falls as temperature falls.
   e. All of the above are true of the temporal counter-current system.

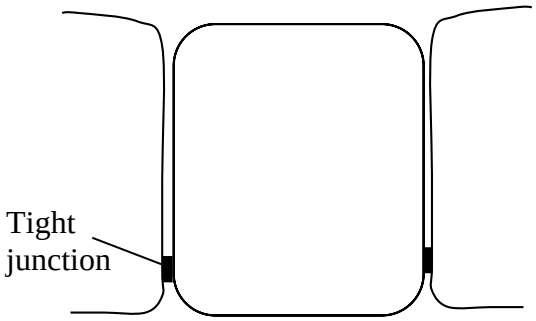
5. Metabolic acid-base compensation in marine elasmobranch fish utilizes the same organ and cellular mechanisms as metabolic acid-base compensation in freshwater or marine teleost fish.

   a. Name the organ: _____

   b. Draw a labelled sketch of the two cell types through which acid-base equivalents (i.e. H^+ and HCO_3^-) are excreted. (4 marks)

   c. Explain why compensation for a metabolic acidosis is a challenge to ionic homeostasis in marine elasmobranchs. (2 marks)

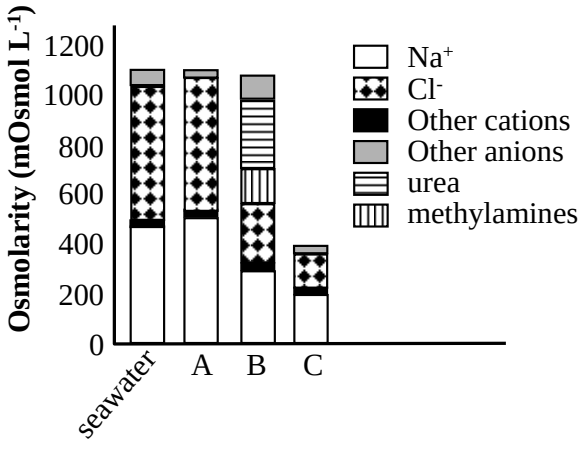
6. Dehydration in a frog results in an increase in the hormone _____. This hormone has three main effects. **List two of these three effects**. In all three cases, the hormone's effect depends on water channels called _____. Use the sketch below to indicate the cellular location of these water channels in the presence of the hormone.



7. An increase in which of the following will decrease urinary Na^+ loss?
   a. Circulating angiotensinogen levels
   b. Circulating aldosterone levels
   c. Circulating ADH levels
   d. Circulating atrial natriuretic peptide (ANP) levels
   e. Increases in all of the above cause urinary Na^+ loss to decrease

8. Which of A, B or C represents a marine elasmobranch? _____

   True OR false (**select one**): A marine elasmobranch is a uricotelic hypoionic osmoconformer. Explain your answer. (2 marks)



9. Which of the following solutes would exhibit the lowest renal clearance ratio (RCR)?

Inulin Na^+ urea H^+ glucose K^+

Part B: Answer the following questions in the exam booklet. (16 marks in total)

1. Based on your knowledge of the osmorespiratory compromise, predict how (and explain why) urine production would change during exercise in a freshwater teleost fish. (2 marks)

2. Structure and function are often intimately linked in physiological systems, *i.e.* structures may be 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 **renal corpuscle** of the vertebrate kidney. (6 marks)

3. Serena the sockeye salmon spent her first year of life in a small freshwater stream. She is now ready to graduate to life in the open ocean but must first go through the process of smoltification, that is, the physiological transformation that accompanies the transition from freshwater to marine life. Use your knowledge of the ionoregulatory and osmoregulatory challenges faced by teleost fish in different environments and the strategies through which they overcome these challenges to describe this physiological transformation. (8 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, indicate which one or ones of the following fishy researchers is/are fictitious…

Fictitious? (Y or N)	Name	Information
	Dr. Frank Fish	A researcher at West Chester University (PA, USA) who studies, among other things, the biomechanics of manta ray swimming.
	Dr. Christian Salmon	Dr. Salmon is with the Muséum National d'Histoire Naturelle in France and focuses on hormone evolution in fish.
	Dr. Ralph Sturgeon	This NRC researcher develops methods to detect trace levels of metals in tissues from, among other things, fish.
	Dr. Peter Herring	From the University of Southampton, Dr. Herring investigates bioluminescence in fish and cephalopods.
	Dr. Thomas Pike	Dr. Pike is a postdoctoral researcher whose research interests in behavioural ecology encompass parental care in sticklebacks.