**BIO 3302 Animal Physiology II**
**Midterm #2**

**K. Gilmour**
**March 20th, 2008**
**80 min**

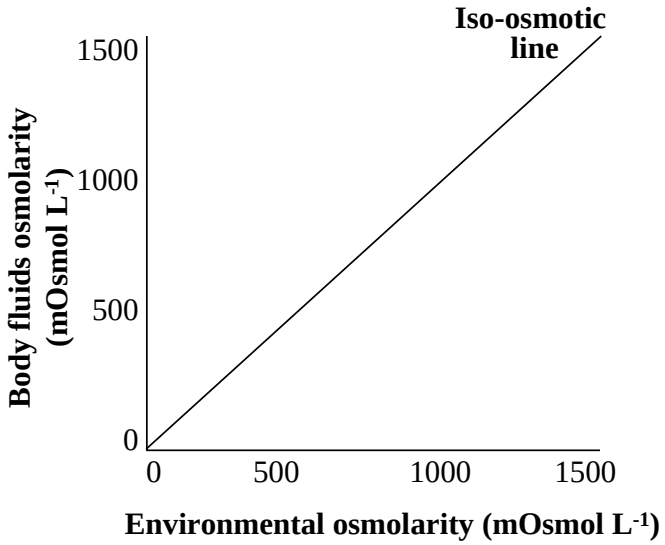
**NAME: _____**

**STUDENT #: _____**

**Part A:** Answer the following questions in the space provided on the question sheet. (1 mark per answer unless otherwise stated; 28 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 hagfish. (2 marks)

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



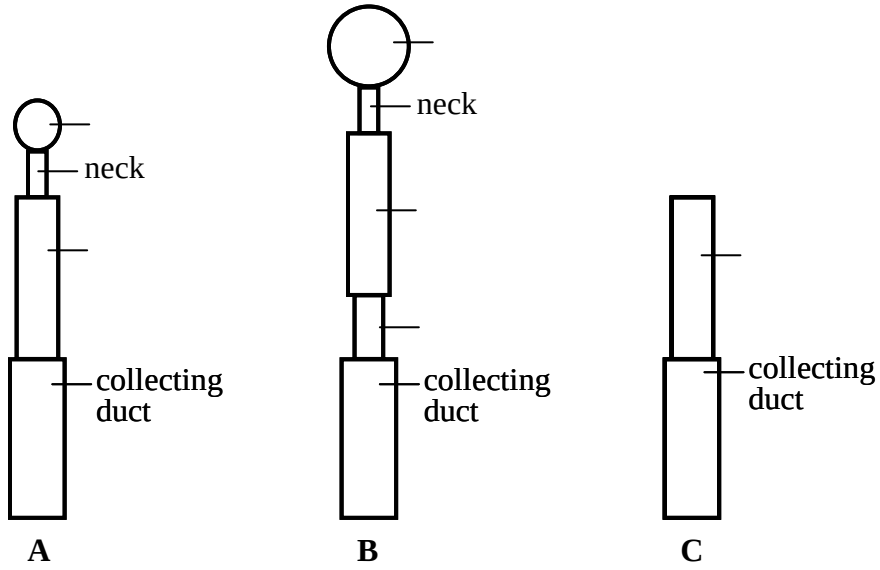

2. Urine formation relies on three processes. Name these three processes, and list the region of the mammalian nephron that plays the most significant role in each. (3 marks)

| Process | Nephron region |
|---|---|
| | |
| | |
| | |

3. The mangrove killifish is unusual because it…
   a. Retains urea as an osmolyte
   b. Switches from ammonia to urea production when it emerges from water
   c. Uses urea as the end-product of nitrogen metabolism even when it is immersed in water
   d. Retains ammonia as the end-product of nitrogen metabolism even when it emerges from water
   e. Excretes uric acid

4. Add the missing labels to the diagram below of fish nephrons. (3 marks)

   Which nephron or nephrons would be found in a freshwater fish? _____

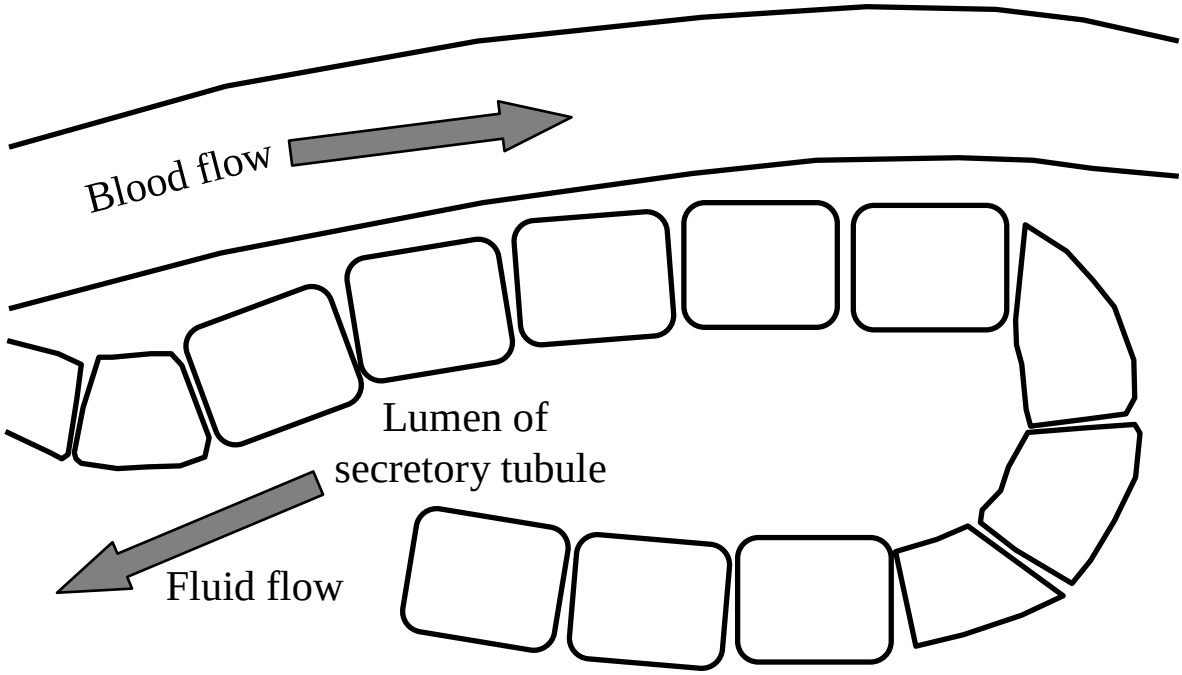



   Explain the **functional** significance of the **structural** difference between nephron A and nephron C. (2 marks)

5. Which one of the following responses is not involved in the autoregulation of glomerular filtration rate?
   a. Stretch-induced contraction of the smooth muscle of the afferent arteriole
   b. Release of vasodilatory substances by the juxtaglomerular cells in response to low filtrate flow through the distal tubule
   c. Vasoconstriction of the afferent arteriole induced by the sympathetic nervous system
   d. Maintenance of a constant glomerular blood pressure in the face of minor perturbations of systemic blood pressure
   e. All of the above are involved in the autoregulation of glomerular filtration rate

6. List **two** structural adaptations for life in a desert that are displayed by the kangaroo rat, and explain (**BRIEFLY**) the functional significance of each. (4 marks)

7. The diagram below is a schematic of part of the salt-secreting gland of a marine bird. Add to this schematic, using the cells that are present in the sketch:
   a. The essential elements of the mechanism of salt secretion for an individual cell (4 marks)
   b. Two structural characteristics that are associated with cells of this type (2 marks)
   c. List another example of a cell that would show the **same** mechanism of salt secretion and the same structural characteristics: _____

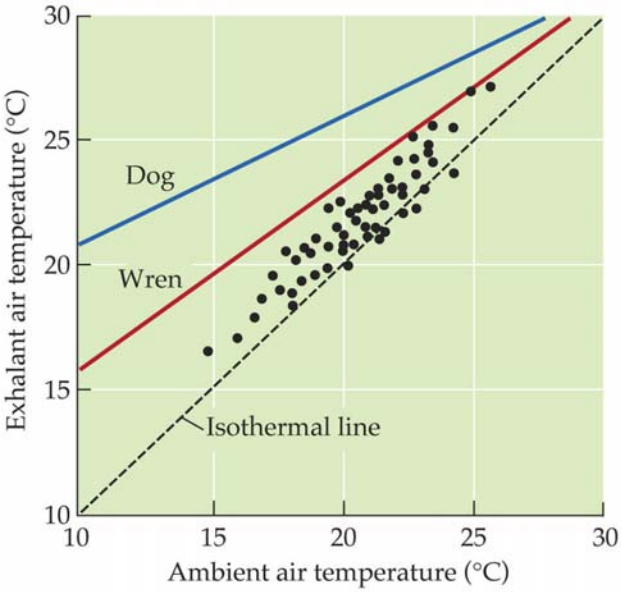


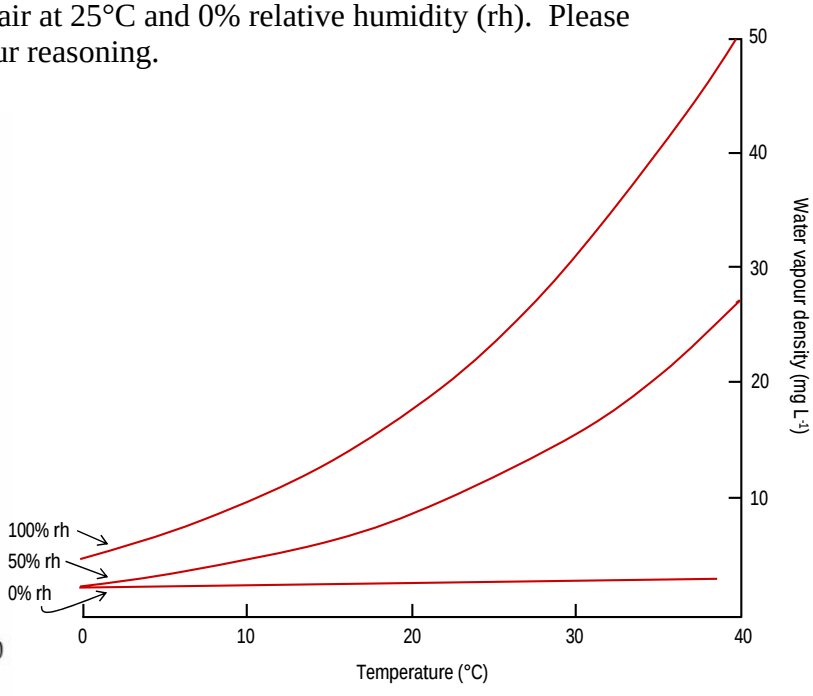
8. Inulin is freely filtered at the renal corpuscle and is neither secreted nor reabsorbed. If the concentration of inulin in the plasma is 1% of that in the urine and the glomerular filtration rate is 125 mL $min^{-1}$, then calculate the volume of urine produced per day. (3 marks)

**Part B:** Answer the following questions in the exam booklet. (4 marks; ~6 min each)

1. Sinéad the salmon over-indulged during the St. Patrick's day festivities and as a result, suffered a prolonged period of severe vomiting. What acid-base disturbance did Sinéad experience as a result? Through what compensatory mechanisms would Sinéad correct this acid-base disturbance? Please justify your answers.

2. Use the two figures below to estimate the percentage of water that will be recovered by a dog of body temperature 38°C that inhales air at 25°C and 0% relative humidity (rh). Please show your calculations and explain your reasoning.



**Part C:** Answer **ONE** of the following two questions in the exam booklet. (10 marks; ~12 min)

1. Contrast and compare the ionoregulatory and osmoregulatory strategies of a marine teleost fish such as a flounder and a marine elasmobranch fish such as a dogfish.

2. A person hiking through a desert runs out of water while still several hours from the nearest tall, cool drink. Describe what will happen to plasma osmolarity and volume (and why), and then explain the physiological mechanisms that attempt to counter this situation, with specific reference to the hormonal control mechanisms involved.

**Bonus:** For a bonus mark that, in the spirit of socialism will be applied to the entire class if even one person answers correctly, from what story is the following excerpt taken, and who wrote the story?

> "From the rippulous pond
> came the comfortable sound
> of the Humming-Fish humming
> while splashing around."

Ttle: _____

Author: _____