

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

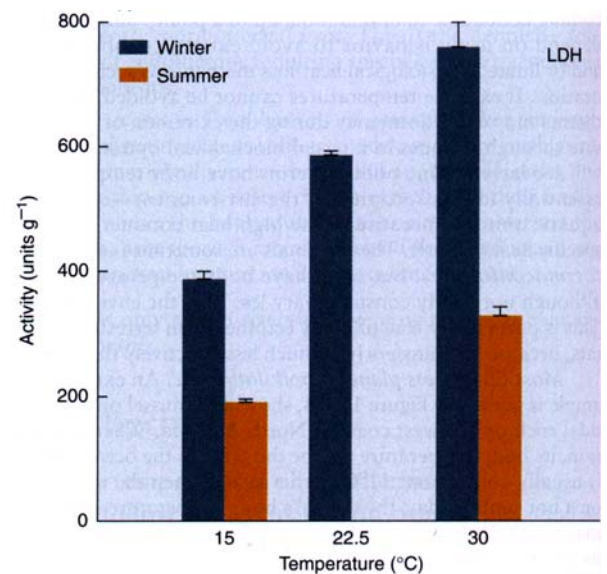
CO₂ protons heat K⁺ O₂ adenosine

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

Inulin Na⁺ urea H⁺ K⁺ glucose

6. Why is the aorta termed a “windkessel” vessel? What structural features of the aorta enable it to carry out this function? (2 marks)

7. 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 Q₁₀ effect.
 - Acclimatization acts essentially to equalize LDH activity for animals tested at the temperature to which they were acclimatized.
 - The Q₁₀ 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.

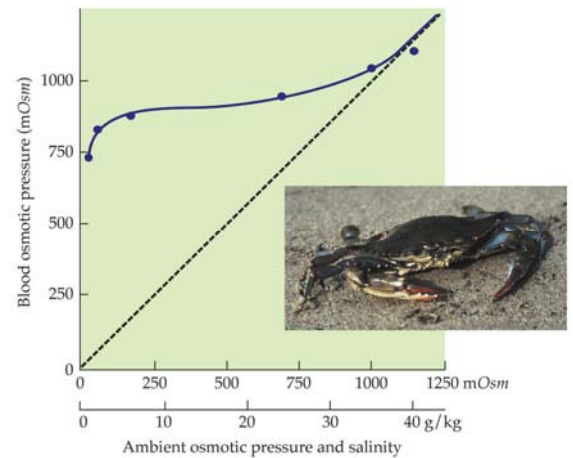


8. The secretion of _____ from the adrenal cortex is inhibited by atrial natriuretic peptide.

9. True OR false (select one): Ectothermic poikilotherms are incapable of thermoregulating.
Explain your answer.

10. True OR false (choose one): The solubility (α) of O_2 in blood is higher than that in plasma.
Explain your answer.

11. The figure at right illustrates the responses of a blue crab (*Callinectes sapidus*) to variations in salinity in an estuary. This animal is best described as a stenohaline OR euryhaline (select one), hyperosmotic OR iso-osmotic OR hypo-osmotic (select one) osmoregulator OR osmoconformer (select one).



12. For enzyme function, how does the strategy for acclimatization to seasonal changes in temperature differ from that for adaptation to differences in temperature owing to climate? (2 marks)

13. Which of the following statements about the transition from freshwater to seawater in a euryhaline teleost (such as a rainbow trout, eel or killifish) is **not** correct?
- AVT secretion increases.
 - AVT increases water reabsorption from the bladder.
 - AVT promotes water uptake from the environment via the pelvic patch.
 - AVT initiates water reabsorption at the distal tubule.
 - AVT reduces glomerular filtration rate.
14. The relatively high solubility (α) OR capacitance (β) (**select one**) of water for CO₂ reflects the chemical reaction of CO₂ with water to yield _____ and _____ . This reaction is catalyzed by the enzyme _____ .
15. True OR false (**choose one**): A thin, highly vascularized integument is an important component of the gas exchange system in most amphibians and some fish species that lack scales. It is the sole gas exchange surface in some small salamanders that lack both gills and lungs
16. Based on your knowledge of the osmorepiratory compromise, explain why urine production would be expected to increase during exercise in freshwater teleost fish. (2 marks)
17. _____ is a term that refers to the increased blood flow to a tissue resulting from elevated activity.
18. Distinguish between vasomotor tone and vagal tone. (2 marks)

Part B: Answer **FIVE** of the following six questions in the exam booklet. (6 marks each; 30 marks in total)

1. You are climbing Mount Everest (without supplemental O₂). As you ascend, ventilation increases. What triggers this increase in ventilation, and what effect does this increased ventilation have on blood O₂ content and acid-base status? Explain your answer.
2. Discuss the function(s) of the “diving reflex” in a Galapagos marine iguana.
3. The vertebrate nephron is a beautiful example of structure-function relationships, i.e. the structure of the nephron is uniquely adapted to carry out its function, or the function of the nephron is made possible by its structure. Describe these structure-function relationships for a mammalian nephron.
4. Erythropoietin (EPO) is a peptide hormone that acts on the bone marrow to stimulate red blood cell production. Synthetic EPO has become a popular drug among high-performance endurance athletes (e.g. cross-country skiers, distance cyclers). However, EPO abuse is associated with increased risk of cardiovascular problems including elevated blood pressure and cardiac failure. Explain the benefits and risks of EPO use to endurance athletes. Illustrate your answer with a labelled sketch of the O₂ equilibrium curves that would be expected in a “normal” athlete versus an athlete that has used EPO.
5. You down a 2-L container of water in a single gulp. Discuss the body’s response to this drink.
6. You are a student in BIO 3137 Experiments in Animal Physiology. Your instructor, who has an unusual fondness for bright footwear, asks you to determine the cardiac output of your lab partner. She allows arterial and venous blood samples to be collected, but specifies that under no circumstances may more invasive techniques be used. Being a resourceful student who successfully completed BIO 3302 Animal Physiology II, you rise to this challenge and proceed to collect the data below. Use these data to calculate the cardiac output (in L/min) of your 70 kg male lab partner.

PO₂ of expired* air (P_eO₂) = 80 Torr

Ventilation volume = 4300 mL/min

Capacitance of air for O₂ (β_aO₂) = 2.33 mL O₂/L/Torr

PO₂ of arterial blood (P_aO₂) = 140 Torr

PO₂ of venous blood (P_eO₂) = 60 Torr

Capacitance of blood for O₂ (β_bO₂) = 0.2 mL O₂/100 mL blood/Torr

*note that your partner, like you, is breathing air!

Part C: Answer **THREE** of the following four questions in the exam booklet. (10 marks each; 30 marks in total)

1. Discuss the acute and chronic mechanisms involved in returning blood pressure in a mammal to normal following an acute fall in blood pressure resulting from severe blood loss.
2. Discuss the structural and functional adaptations underlying the evolution of endothermy in vertebrates.
3. Flight requires that high rates of O₂ uptake and delivery to exercising muscles be achieved and sustained, and high altitude flight poses additional respiratory and thermoregulatory challenges. Discuss the physiological strategies used by birds in general and high-flying birds in particular to meet these challenges.
4. Contrast and compare the osmoregulatory strategies of a marine teleost fish such as a flounder and a marine elasmobranch fish such as a dogfish.

Bonus: 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, fill in the blanks below to come up with the names of some fishy communities in Canada:

1. _____ Falls, Ontario
2. Red _____ Lake, Manitoba
3. _____ (meaning “place of fish”), Nunavut
4. _____ Arm, British Columbia
5. _____, Ontario (this one is very close to home)