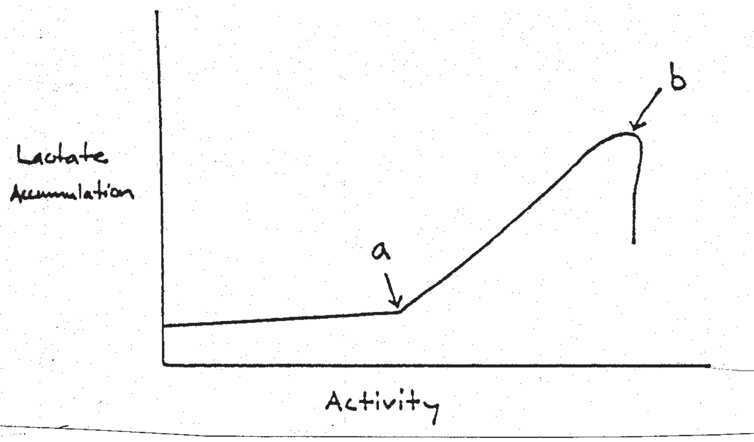
BIOLOGY 798 ENVIRONMENTAL PHYSIOLOGY - STUDY QUESTIONS

1. Physiological adaptations for an active lifestyle in aquatic environments virtually preclude fishes' ability to live in oxygen-poor water. Explain why this is so.

2. Fish are generally far less capable of utilizing a carbonate-bicarbonate blood buffering system than are air-breathers. Why is this so?

3. Plot the following relationships.
   a) Relative blood P_{50} in a sea-level dwelling carp and a sea-level dwelling human acutely exposed to increasing altitude from 100 - 15,000 feet.
   b) Relative RQ in a sea-level dwelling chimp and a sea-level dwelling llama (adapted for high altitude) acutely exposed to increasing altitude from 50-1500 meters.

4. The following plot depicts lactate accumulation against activity in a deer. What is happening at point "a"?, point "b"? What would the plot look like for a salamander?

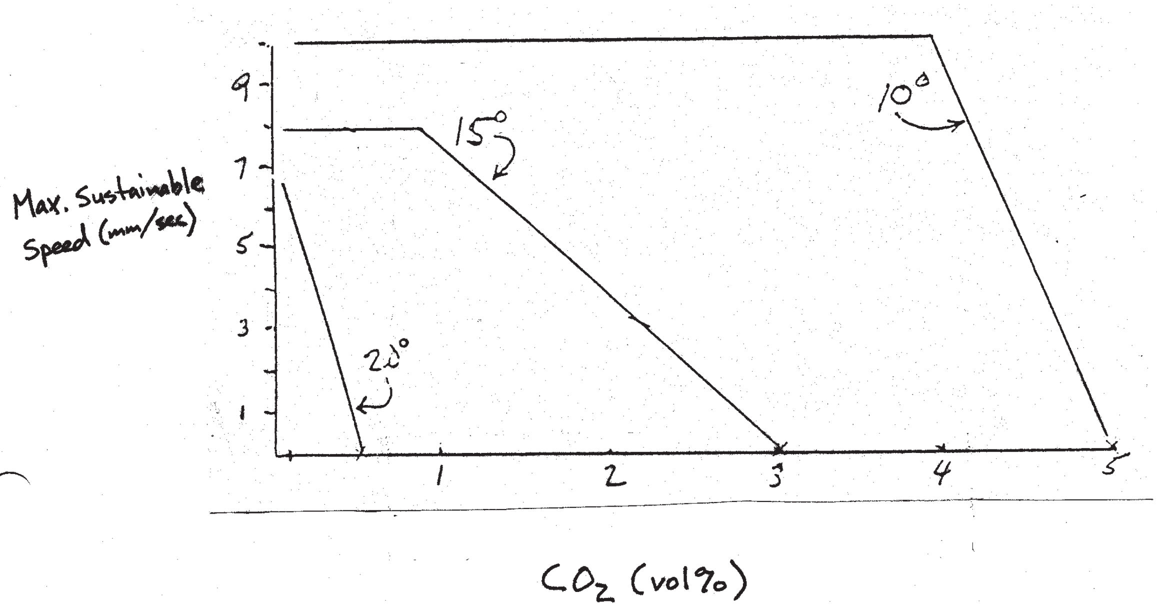


5. A heart disease results in a dramatically reduced ability to pump blood. What effect would this have on total metabolic capacity (aerobic + anaerobic) in a dog and a lizard over a range of temperatures from 10°C-25°C. Assume $T_a=T_b$ for ectotherms. Q_{10} for aerobic capacity = 2.5; Q_{10} for anerobic metabolism = 1.0 (from 20-30°C) and 3.0 (from 5-20°C).

6. Diagram, over a range of pO_2 from 0 to 150 torr, the relative amounts of oxygen available to water and air-breathers at 15°C. Oxygen absorbancy coefficient at 15°C = 3.5. What effect would an increase in elevation of 10,000 ft. (Atmospheric pressure = 500 torr) have on oxygen availability in each case.

7. Graph the effect of changing ambient temperature on P_{50} over a range of T_a's from 5°C to 30°C for a frog and a cat. What effect would an increase in pH have on this graph?, an increase in pCO_2?, and increase in pO_2?

8. The graph below depicts the influence of environmental CO_2 concentration and ambient temperature on the maximum sustainable speed of a 10 g ectothermic tetrapod at sea level. Ambient oxygen concentration is 21% at all CO_2 concentrations and ambient temperatures.



Illustrate the following by using carefully labeled graphs. For a-c label axes with absolute values on both axes.

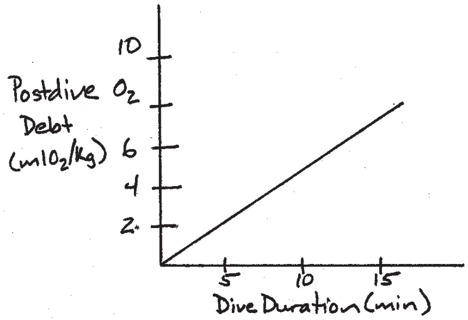
a) The influence of temperature on pCO_2 that induces critical pO_2 (pO_2 at which RMR can no longer be maintained).

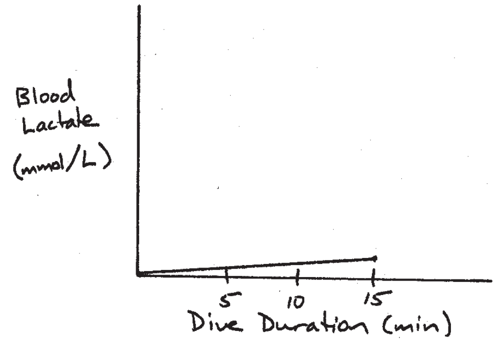
b) The influence of CO_2, over the range given, on maximal sustainable speed at 10°C, 15°C and 20°C if the animal were breathing water. Assume uptake of equivalent amounts of oxygen require no more energy expenditure in water than on land.

c) The influence of CO_2 on total heat production during the initial 30 sec of burst activity on land at 15°C.

d) The relative influence of CO_2 on blood P_{50} at the different temperatures.

9. A crocodile, during voluntary diving, gave the following results.



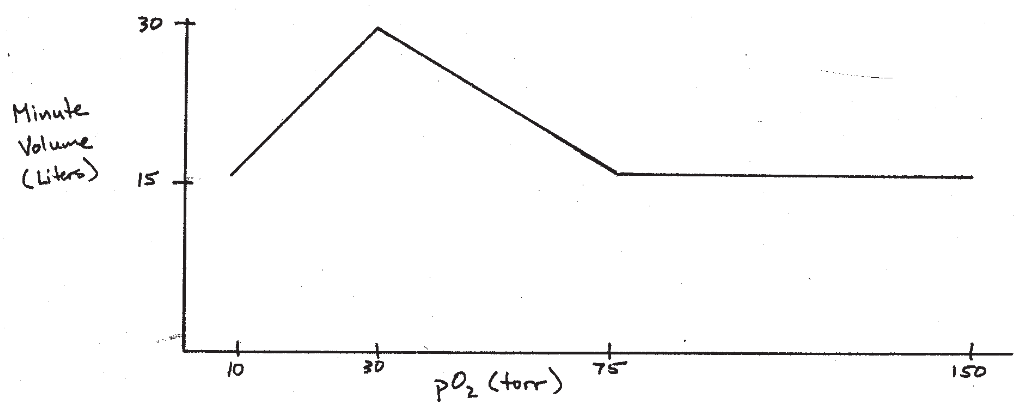


Given these results, plot the effect of dive duration, over the range of times given, on arterial pO_2. Assume no peripheral vasoconstriction.

a) What effect would very high CO_2 concentrations in the water have on this plot? What about a decrease in temperature (Q_{10} = 2.5 for aerobic metabolism, Q_{10} = 1.0 for anaerobic metabolism.

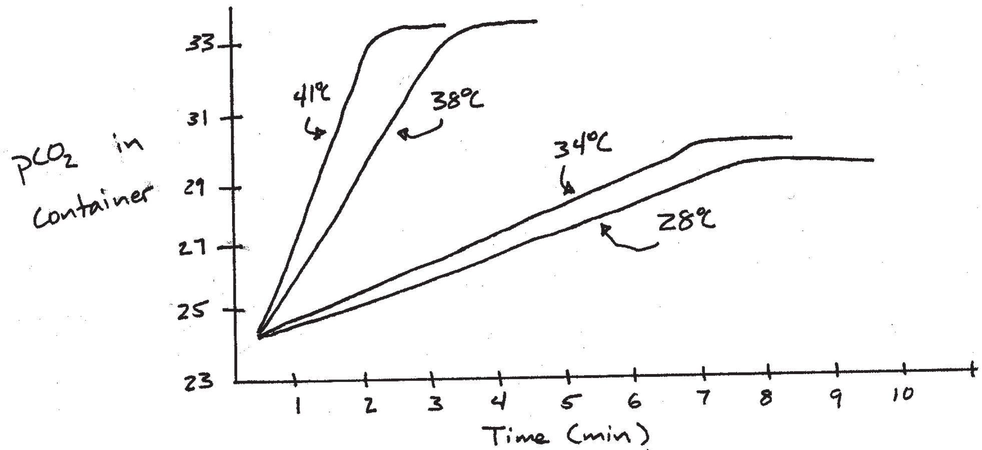
b) Why is it important to assume that no peripheral vasoconstriction is occurring for these conclusions?

10. Consider the following relationship between minute volume and environmental pO_2 for a resting vertebrate breathing air at sea level:



Plot the following relationships based on the information given above:
a) The influence of decreasing environmental pO_2 on relative breathing rate at 6000m.
b) The influence of pO_2 on relative (1) aerobic and (2) anaerobic scope at sea level.
c) Assume the animal was sealed in an airtight container. Plot pO_2 in the jar against time. Assume initial po_2=150 torr.
d) The probable relationship of blood P_{50} to pO_2 over the range of oxygen pressures given above.

11 An ectothermic vertebrate was sealed in an air-tight container and the following date were recorded at varying experimental temperatures:

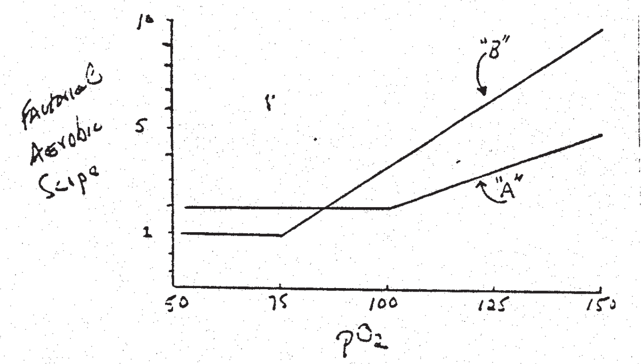


Experimental vessel volume = 100 ml, animal volume = 15 ml, initial barometric pressure = 760 torr, vessel is filled with air, animal density = 1, RQ = 1.

a) graphically depict the relationship of temperature on critical pCO_2 (pCO_2 at which RMR can no longer be maintained) between 28°C and 41°C. Label axes with absolute values.
b) graphically depict the influence of pCO_2 on critical pO_2 between 28°C and 41°C. Label axes with absolute values.
c) Estimate toatl heat production during maximal activity at 34°C. Express your answer in terms of mass-specific heat production per hour. Caloric equivalents of Fat = 4.7 cal/mlO_2, Protein = 4.5 cal/mlO_2, Carbohydrate = 5.0 cal/mlO_2.
d) Discuss factors potentially responsible for the shift in critical pCO_2 over the range of temperatures tested.

Soc. Sec. No.______________________________

12. The following data were collected from reptile species "A" and "B":



Mean wgt. in both species=20g; resting MR=0.1cc O2/gxhr. Both were observed to have R.Q.=0.7 at all times. Based on the above, graphically depict the following relationships:

a.(8) Resting metabolic rates (in absolute cc02/gxhr.) for A and B over the range of P02 shown;

b.(8) Relative blood P50 at rest over the range of P02 shown;

c.(4) Relative blood-oxygen dissociation curves for A and B for P02=5-150mm Hg.;

d.(16) Absolute capacity for <u>maximal</u> sustainable total heat production with increasing altitude from 10m-6,000m altitude.

a.

b.

d.

c.