BIOLOGY 423/523 Environmental Physiology of Animals **Name:**_____
Lecture Exam 1, 29 February 2000 – 100 pts. total

I. Define or discuss the terms or topics below. (5 pts. each, 20 pts. total)

1. Eccritic Temperature

2. Aerobic Capacity Model for the Evolution of Endothermy

3. Factorial Aerobic Scope

4. Compensation vs. Regulation Strategies

II. Fill-in the blank. Some answers may require a short phrase or description. (2 pts. each, 20 pts. total)

1._____ Equation for heat transfer between an animal and the environment.

2._____
3._____ } 2 factors that may affect RMR in animals

4._____ Basis for physiological adaptation within a population.

5._____ How much more oxygen is available to air-breathers than to water-breathers at 15°C?

6._____ Term for simultaneous function of opposing enzymes so that the net result is the splitting of ATP for heat.

7._____ Term for ambient temperature below which an endotherm must increase metabolic heat production to offset heat loss to the environment.

8._____ Cheapest method of locomotion in vertebrates.

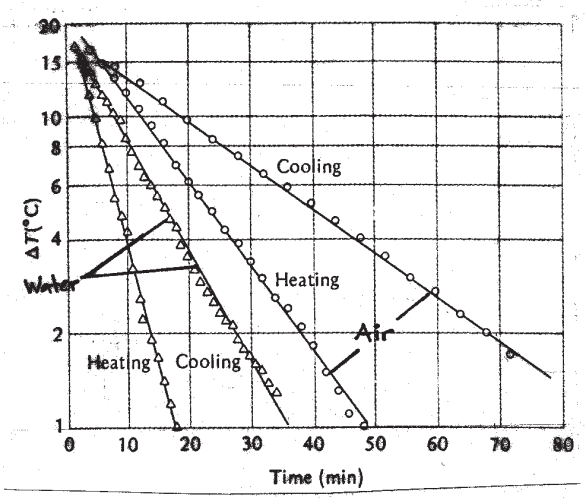
9._____ The presumed rate-limiting enzyme for glycolysis

10._____ Regulatory enzyme complex catalyzing entrance of carbohydrates into the Krebs cycle as acetyl-Co A.

III. Essays (40 pts. total)

1. Discuss the common laboratory and field methods used for the measurement of metabolic rate in animals. (10 pts.)

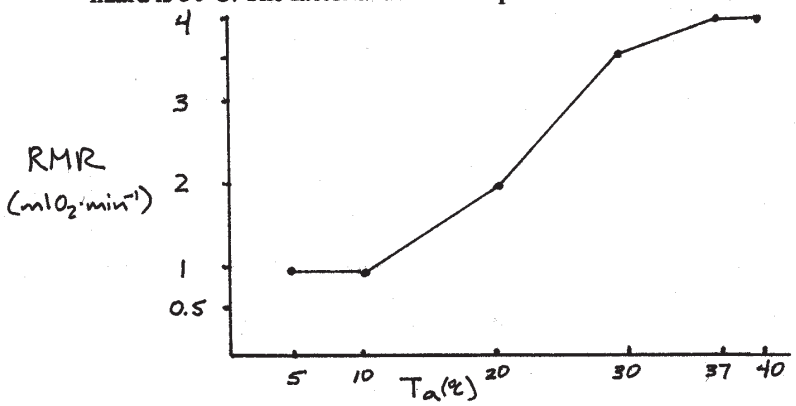
2. Answer one of the following two questions. (10 pts.)
   a) Discuss the mechanism by which brown fat functions to produce heat in mammals.
   b) The graph below depicts heating and cooling rates for a marine iguana placed in water or air that is 20°C different from its body temperature. Discuss the factors that account for the differential rates of heating and cooling and the differences between water and air.



3. While watching the coyote poop out while chasing the roadrunner, you are suddenly struck with the desire to take up marathon running. However, you don't want to go through all of that bothersome training. Fortunately, you are a gifted bioengineer with an intricate knowledge of the metabolic pathways for carbohydrate, lipid, and protein metabolism. Thus, instead of training, you decide to alter your enzyme activities to promote endurance activity. Which enzyme activities would you alter and why? (20 pts.)

IV. Graph Interpretation (20 pts. total).

1. The graph below depicts resting metabolic rate (RMR) vs. ambient temperature (T_a) in a 100 gram lizard in the lab without any capacity for behavioral thermoregulation. Assume that T_a equals T_b without behavioral thermoregulation and that the preferred body temperature of the lizard is 30°C. The factorial aerobic scope for the lizard is 10 below 20°C and 8 above 20°C.



a) What is the *absolute* scope for aerobic activity in the lizard at 37°C? (4 pts.)

b) Plot Q_{10} against T_a over the range of temperatures indicated on the graph. You don't need to plot exact values, just provide the relative trends. (4 pts.)

c) Plot maximum metabolic rate against T_a if the lizard is given access to a heat lamp and shade for behavioral thermoregulation. In this case, label the axes with *absolute values*. (4 pts.)

d) Plot RMR vs. T_a for a similar-sized mammal. Assume that mammalian metabolic rates are 10-times lizard values and that the mammal has access to the heat lamp and shade. Label axes with *absolute values*. (4 pts.)

e) Plot the relationship of RMR vs. T_a in the mammal if the metabolic chamber were equipped with a fan that blew a 20 mph wind through the chamber. (4 pts.)

b)

c)

e)