Instructions: Please write your name and SSN on every sheet. Check to make sure that four
pages are present. Read the questions carefully. Limit your answer to
the minimum required and make sure that you answer the question asked!
Make sure that, where labeling is required, you label unambiguously. The
exam is worth 100 points total. The point values for each question are
listed.

Some useful relationships:

\[ H = C \left( T_b - T_a \right) + H_{evap} \]

\[ V_T = V_A + V_D, \quad R_Q = \frac{V_{CO2}}{V_{O2}}, \quad P_{ACO2} = \frac{(RT)(V_{CO2})}{V_A} \]

\[ P_{AO2} = P_{IO2} - \frac{(RT)(1 - (F_{IO2})(1-R_Q))}{(VO2)/V_A} \]

1. An animal is experiencing steady-state exchange of some material with its environment.

   a. (5pts) Write a word equation (no symbols) describing the exchange when the animal
      is producing the material.

   b. (5pts) Write a word equation (no symbols) describing the exchange when the animal
      is consuming the material.

   c. (10pts) Your metabolism is around 80 watts, what is your heat loss and why? What
      is the relationship between metabolism and heat loss?

2. You are given the following figure representing the metabolic response (ie. the heat
   production) of a homeothermic thermoregulator to changes in ambient temperature,
   (remember that heat production must equal dry heat loss plus wet heat loss
   \[ H = C(T_b - T_a - H_{evap}) \])
a. (5pts) Where are the thermoneutral zone and the zone of chemical thermoregulation. Label the upper and lower critical temperatures?

b. (5 pts) Place a line representing $H_{\text{Evap}}$ (the wet heat loss) on the figure.

c. (5 pts) Place a line representing the dry heat loss on the figure. The original line represents the change in heat production (metabolism) with temperature. (Think about this!!)

c. (5pts) How would you determine the body temperature of the animal from the figure? Place an axis and a line representing the change in $T_b$ with change in $T_a$.

d. (5pts) What relationship on the figure represents the resistance of the animal to heat loss? Can this resistance change? Explain using an example?
3. You are given the following figure

a. (5pts) Label the point representing the inspired gas, the expired gas and the alveolar gas.

b. (5pts) Why is there a difference between the inspired gas and the expired gas?

c. (5 pts) Why is there a difference between the expired gas and the alveolar gas?

c. (5pts) Indicate how the expired gas and alveolar gas points would change if you increased your rate of ventilation, if you decreased your rate of ventilation.

e. (5pts) The dead space in your lung increases, everything else remaining unchanged, what would you expect to happen to your alveolar point and your expired point (think about this one)?

f. (5pts) The solubility of the breathing fluid for oxygen decreases by about a factor of 20 (it becomes 20 times smaller). How would you expect this to change the position of the alveolar and expired gas points (Show and explain briefly)!
4. The relationship between the brain temperature (T_{poah}) and the heat production for two different animal species (A & B) are given in the following figure:

a. (5pts) Is this figure describing a response to cooling the brain or heating the brain?

b. (5pts) Is the gain or sensitivity of the response of heat production to brain temperature change greater in A or B? Explain!

c. (5pts) The response might also be described as having a threshold or point where the response comes on. How would you define the threshold? Is the threshold greater for A or B?

d. (5pts) If one of the species is much larger than the other which relationship do you think represents the large species and which one the small species? Why?

e. (5pts) Draw in a response relationship for an animal responding to brain heating by evaporative cooling.