Biology 390 **The Scaling of Metabolism -- Problems**

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The equation that describes the relationship between rates of oxygen consumption and body size in mammals is:

$\dot{V}_{O_2} = 0.676\ M^{0.75}$ (Eq 1)

where: $\dot{V}_{O_2}$ is **liters O_2 / hour** and **M** is body mass in **kilograms**.

1. Derive an equation (from eq. 1) for mammals that expresses the relationship between the **mass-specific** $\dot{V}_{O_2}$ (*i.e.*, liters O_2 hr^{-1} kg^{-1}) and body mass.

2. Derive an equation from eq. 1 where the dimensions for $\dot{V}_{O_2}$ are ml O_2 per hour and **M** is in **grams**. (This is "tricky" so please check your answer by numerical substitution. – you should check the appendix to the scaling notes and Schmidt Nielson before trying this one).

3. Given: the scaling relationship between body mass and $\dot{V}_{O_2}$ in mammals:

$\dot{V}_{O_2} = 0.676\ M^{0.75}$

where: $\dot{V}_{O_2}$ is **liters O_2 / hour** and **M** is body mass in **kilograms**.

An investigator wanted to measure the effect of a particular habitat on the energetics of a certain group of mammals. He selected two species belonging to the same genus for his comparisons. Species A weighed 10 grams and lived in the habitat in question. Species B weighed 669 grams and lived in a more "typical" habitat. Their measured rates of metabolism were:

Species	Standard Rate of Metabolism $(\frac{\text{liters } O_2}{\text{hr}})$
A (10 g)	0.0107
B (669 g)	0.250

a. Which species has the higher total rate of metabolism? How many times higher? (*no tricks here, its an easy calculation that is useful for comparison below*)

b. Which species has the higher mass-specific rate of metabolism? How many times higher? (*again, no tricks here)*

c. The investigator wants to determine whether living in the particular habit affects rates of metabolism. So , he desires to partition out the effect of body size in his comparisons.

(i) Is it biologically valid to accomplish this by comparing the rates of metabolism divided by weight, *i.e*., comparing mass-specific rates?

(ii) In what specific circumstances can you use mass-specific rates in comparisons?

(iii) What is the apparent effect of living in this habitat on the rates of metabolism? (Is living in the habitat correlated with an increase or decrease in rates of oxygen consumption?) How much of an increase or decrease? Express your answer in percent.