

According to Kooyman et al (*Science* 217:726) avian energy utilization (E = kilocalories/day) is 2.8 times the standard metabolic rate (SMR = kilocalories/day), which in turn depends on body mass (M = kg).

$$E = 2.8 * SMR = 2.8 * b M^{0.723}$$

The parameter b has a numerical value of 78.3

1. Calculate the expected energy utilization of a 5 kg penguin. 701.9 kcal day⁻¹ [2]
Be sure to show your calculations by writing values underneath each symbol in the equation.
2. Write a data equation for 5 kilogram penguin with a measured energy utilization of 750 kilocalories/day.

$$\underline{750} = \underline{701.9} + \underline{48.1} \quad [6]$$

3. The parameter b = 78.3 has units of E M^{-0.723}
Write its units kcal day⁻¹ kg^{-0.723} [1]
4. The parameter b has what dimensions ? E T⁻¹ M^{-0.723} [1]
(Use the symbol E for the dimension that includes kcal and kJ)
5. Convert a 10 cubic km volume of seawater to cubic miles of seawater
Be sure to show your calculations.
1 mile = 1.609344 km 2.4 mile³ [2]

$$\left(10 \text{ km}^3\right) \left(\frac{1 \text{ mile}}{1.609344 \text{ km}}\right)^3 = 2.4 \text{ mile}^3$$