

Answer on Question #62510, Chemistry / General Chemistry

The metabolism of glucose, $C_6H_{12}O_6$, yields carbon dioxide, $CO_2(g)$, and water, $H_2O(l)$, as products. Energy released in this metabolic process is converted to useful work, w , with about 66.0 % efficiency. Use the data below to answer questions about the metabolism of glucose.

Calculate the mass of glucose metabolized by a 46.2 kg person in climbing a mountain with an elevation gain of 1810 m. Assume that the work performed in the climb is four times that required to simply lift 46.2 kg by 1810 m.

Solution:

$$W = mgh,$$

Where m = mass of person in kg, $g = 9.80 \text{ m/s}^2$, and h = height in meters.

$$W = 46.2 \text{ kg} \times (9.80 \text{ m/s}^2) \times (1810 \text{ m}) = 0.82 \cdot 10^6 \text{ kg} \cdot \text{m}^2/\text{s}^2 = 0.82 \cdot 10^6 \text{ J}.$$

$$\text{Actual work} = 4W = 3.28 \times 10^6 \text{ J} = 3.28 \times 10^3 \text{ kJ}$$

$$\text{Molar mass } (C_6H_{12}O_6) = 180.16 \text{ g/mol}$$

$$\text{Standard enthalpy of combustion of glucose} = -2805 \text{ kJ/mol}$$

$$\text{Moles glucose} = (3.28 \cdot 10^3 \text{ kJ}) / (2805 \text{ kJ/mol}) = 1.169 \text{ mol}$$

$$\text{Mass glucose} = 1.169 \text{ mol}(180.16 \text{ g}) / (1 \text{ mol}) = 210.6 \text{ g}.$$

Answer: 210.6 g