Answer on Question #55464 - Chemistry - General chemistry

Question:

Liquid sodium is being considered as an engine coolant. How many grams of liquid sodium (minimum) are needed to absorb 2.30 MJ of energy (in the form of heat) if the temperature of the sodium is not to increase by more than 10.0 °C? Use Cm = 30.8 J/(K·mol) for Na(l) at 500 K.

Solution:

The amount of energy absorbed can be calculated using the heat capacity:

$$Q = mc(T_2 - T_1)$$

where m is the mass of sodium, c heat capacity, T_2 is the final temperature (510 K in our case) and T_1 is the initial temperature (500 K).

Then, the expression for the mass will be:

$$m = \frac{Q}{c(T_2 - T_1)}$$

In our case, the heat capacity is given per mole of sodium, so we should divide it by the molar mass of sodium:

$$c = \frac{c_M}{M} = \frac{c_M}{23}$$

Then:

$$m = \frac{Q}{c(T_2 - T_1)} = \frac{2.30 \times 10^6 \times 23}{30.8 \times (10)} = 1.72 \times 10^5 g,$$

So the mass of liquid sodium should be 1.72×10^5 g, or 172 kg.

Answer: 172 kg.