## Answer on the Question #63205, Chemistry / General chemistry

Using information in Appendices B and C in the textbook, calculate the minimum number of grams of propane C3H8(g), that must be combusted to provide the energy necessary to convert 4.05 kg of ice at -17.0 C to liquid water at 74.0 C.

## Solution:

The propane combustion occurs by the following reaction:

$$C_3H_8 + 5O_2 = 3CO_2 + 4H_2O$$

The combustion can provide the energy or heat:

$$Q(C_3H_8) = q(C_3H_8) \cdot m(C_3H_8)$$

where $q(C_3H_8) = 47.54\ MJ/kg$ and correspond to specific heat of combustion of propane gas.

We need to convert the ice to liquid water and in this case, the energy of combustion will be the same as sum of energies of melting of ice water from -17 C to 0 C ($Q_m$) and heating of water from 0 C to 74 C ($Q_h$):

$$Q(C_3H_8) = \ Q_m + Q_h$$

The melting and heat energies equal to:

$$Q_m = \lambda \cdot m \cdot \Delta T = 0.33 \frac{MJ}{kg \cdot ℃} \cdot 4.05\ kg \cdot (0\ + 17\ ) = 22.7\ MJ$$

$$Q_h = C \cdot m \cdot \Delta T = 4.2 \frac{kJ}{kg \cdot ℃} \cdot 4.05\ kg\ \cdot (74 - 0) = 1.26\ MJ$$

where $\lambda$ is specific heat of melting of ice water and *C* is specific heat of capacity of liquid water.

$$Q(C_3H_8) = 22.7\ MJ + 1.26\ MJ = 23.96\ MJ$$

$$m(C_3H_8) = \frac{Q(C_3H_8)}{q(C_3H_8)} = \frac{23.96MJ}{47.54\ MJ/kg} = 0.504\ kg = 504\ g$$

**Answer:** to convert 4.05 kg ice to liquid water in specified conditions we need to combust 508 g of propane gas.