Answer on Question #48485, Physics, Molecular Physics | Thermodynamics

Work done in converting one gram of ice at -10 degree C into steam at 100 degree C is

Solution:

The ice will warm up to 0 degrees Celsius, then melting and then warming to the final temperature 100 degrees Celsius, and steaming of water at 100 degrees Celsius.

Specific heat capacity, ice: c_{ice} = 2.108 kJ/kg-K

Specific heat capacity, water: c_{water} = 4.187 kJ/kg-K

The heat of fusion (or specific enthalpy of fusion) of ice is L = 334 kJ/kg.

The latent heat of vaporization for water H_v = 2260 kJ /kg

m = $1*10^{-3}$kg.

The energy to heat up the ice is the sum of the following

$$Q = c_{ice}m\Delta t_1 + Lm + c_{water}m\Delta t_2 + H_v m$$

$$\Delta t_1 = 0 - (-10) = 10$$

$$\Delta t_2 = 100 - 0 = 100$$

Thus,

$$Q = 1 \cdot 10^{-3}(2.108 \cdot 10 + 334 + 4.187 \cdot 100 + 2260) \cdot 10^3 = 3033.78 \approx 3033.8 \text{ J}$$

Answer: 3033.8 J