Answer on the question #55963 - Chemistry - General chemistry

Question:

You add 100.0g of water at 55.0C to 100.0g of ice at 0.00C. Some of the ice melts and cools the water to 0.00C. When thermal equilibrium is established at 0.00C, what mass of ice has melted? Delta H of fusion for water is 333 J/g.

Solution:

According to the law of conservation of energy, the heat, released by water is equal to the heat of fusion of water:

$$Q_w = -Q_{ice}$$

$$Q_w = m_w c(T_2 - T_1)$$

where c is the heat capacity of liquid water, 4185.5 J/(kg*K), T_2 is the equilibrium temperature, 273.15 K, and T_1 is the initial temperature, 328.15 K.

The ice melts, absorbing the energy Q_{ice}:

$$Q_{ice} = m_{ice} \cdot l$$

where m_{ice} is the mass of the ice melted, and l is the enthalpy of fusion.

Then, with simple mathematics, one can get:

$$m_w c(T_2 - T_1) = -m_{ice} \cdot l$$

$$m_{ice} = -\frac{m_w c(T_2 - T_1)}{l} = -\frac{100\ (g) * 4.1855(J/g \cdot K)(273.15\ (K) - 328.15\ (K))}{333\ (J/g)} = 69.1\ g$$

Answer: 69.1 g