Answer on Question#64786, Physics / Molecular Physics | Thermodynamics

Question

How much Ice at $0°C$ must be mixed with $50.0g$ of water at $75.0°C$ to give a final water temperature of $20°C$?

Solution

Denote mass of ice as M, mass of water as m, energy required to melt $1g$ of ice at $0°C$ as Q, energy required to heat up $1g$ of water by $1°C$ $(or\ 1K)$ as q, initial temperature of water as t_1, initial temperature of ice as $t_0 \equiv 0$ and final temperature as t_2.

Then,

$$MQ + Mq(t_2 - t_0) = mq(t_1 - t_2)$$

$$M = \frac{mq(t_1 - t_2)}{Q + q(t_2 - t_0)} = \frac{mq(t_1 - t_2)}{Q + qt_2}$$

$$Q = 335\frac{kJ}{kg}, \qquad q = 4.2\frac{kJ}{kg \cdot K}$$

$$M = \frac{50 \cdot 4.2 \cdot (75 - 20)}{335 + 4.2 \cdot 20} = \frac{11550}{419} \approx 27.57\ g$$