Answer on Question #42234, Physics, Molecular Physics — Thermodynamics — for completion

Question:A 0.50 kg lump of ice at -18 ?C is dropped into a well-insulated beaker with 1.0 kg of water at 42?C in it. Calculate what the beaker contains once thermal equilibrium has been reached? (The specific heat capacities for ice and water are 2220 J kg-1 K-1 and 4190 J kg-1 K-1 respectively. The latent heat of fusion for water is 333 x 103 J kg-1)

Solution

There will be less ice, and more water, both at 0° C. It easy to check. Indeed, when cooling to 0° water will give amount of heat of

$$Q_1 = c_w m_w t_w = 4190 \cdot 1 \cdot 42 = 175980J$$

Heat required for ice to get to 0° C is

$$Q_2 = c_i m_i t_i = 2220 \cdot 0.5 \cdot 18 = 19980J$$

Hence, for melting ice it will be left

$$Q_2 - Q_1 = 175980 - 19980 = 156000J$$

And with this amount of heat you can melt

$$\frac{156000}{333000} \approx 0.47\,kg$$

this much ice. So, it will be left 0.03 kg of ice and 1.47 kg of water at 0° C