Answer on the question #46324, Physics, Molecular Physics | Thermodynamics

Question:

If 1 kg of water at 20 c and 1 kg of ice at -20 c are mixed. what will the final temperature?

Answer:

The processes that take place in the system are:

1. Warming of the ice
2. Cooling of the water
3. Melting of the ice (probably, we need to calculate to elucidate it)

According to the heat capacity definition:

$$Q = \int_1^2 C dT$$

Where 1 and 2 are initial and finish conditions of the system and C is heat capacity for the substance.

Let's write the equations for heating ice and cooling water:

$$Q = C_{ice} * m_{ice}(0 - T_{1ice}) = 2.11 * 1000 * (0 + 20) = 4.22 * 10^4\ J$$

$$-Q = C_{water} * m_{water}(T_{2water} - T_{1water}),$$

Then, T_{2water} is:

$$T_{2water} = T_{1water} - \frac{Q}{C_{water} * m_{water}} = 20 - \frac{4.22 * 10^4}{4.1813 * 10^3} = 20 - 10.09 = 9.91\ ℃$$

As T_{2water} is >0 ℃, the part of the ice melts.

$$-Q = C_{water} * m_{water}(0 - 9.91) = -41.42 * 10^3\ J$$

$$Q = \Delta H_{fus} * m_{ice}$$

$$m_{ice.melt} = \frac{Q}{\Delta H_{fus}} = \frac{41.42 * 1000}{333.55} = 124.2\ g$$

Then, the part (57 g) of ice melts. The water and the ice are in equilibrium at 0℃.