Answer on the question #55463 - Chemistry - General chemistry

Question:

If you have 370.0 mL of water at 25.00 °C and add 120.0 mL of water at 95.00 °C, what is the final temperature of the mixture? Use 1.00 g/mL as the density of water.

Solution:

Upon the mixing, the cold water is warming up and the hot water is cooling down. The exchange of the heat is summarized in a set of equations:

$$Q_{cold} = m_{cold}c(T_2 - T_{1-cold})$$

$$Q_{hot} = m_{hot}c(T_2 - T_{1-hot})$$

where the amount of heat cold water gets and hot water gives are Q_{cold} and Q_{hot}, respectively, m_{cold} and $m_{hot}$are the masses of water added, c is water heat capacity and T_1 and T_2 are the initial and final temperature, respectively.

If we consider the law of conservation of energy, we find out that the Q_{cold} is equal to Q_{hot}:

$$Q_{cold} = -Q_{hot}$$

$$m_{cold}c(T_2 - T_{1-cold}) = -m_{hot}c(T_2 - T_{1-hot})$$

Then, let's derive the final temperature T_2, taking into account assumption about 1g/mL density of the water:

$$T_2 = \frac{m_{cold} \times T_{1-cold} + m_{hot} \times T_{1-hot}}{m_{cold} + m_{hot}} = \frac{370 \times 1 \times 298.15 + 120 \times 1 \times 368.15}{370 \times 1 + 120 \times 1} = 315.3\ K$$

Answer: 315.3 K, or 42 ^oC