Answer on the question #42621, Chemistry, Physical Chemistry

Question:

What was the initial temperature when a 61 gram water system has been raised to 43 degrees Celsius with the addition of 1.05 kJ of energy?
Show work please!
An unknown metal with a mass of 45 grams is heated to 96 degrees Celsius and dropped into 100 grams of water 18 degrees Celsius. If the final temperature of the mixture is 21.5 degrees Celsius, what is the specific heat capacity of the metal?
Show work please!

Solution:

1. According to the specific heat capacity definition:

$$Q = mc\Delta T$$
$$Q = mc(T_2 - T_1)$$
$$T_1 = T_2 - \frac{Q}{mc}$$

Water specific heat capacity is 4.1813 J g^{-1} K^{-1}. Then,

$$T_1 = 43 - \frac{1050}{61 * 4.1813} = 43 - 4.12 = 38.88\ ℃, or\ 312.03\ K$$

2. Energy addition to the water is equal to the energy that produced when metal was cooled:

$$Q_M = -Q_w$$

According to the specific heat capacity definition:

$$Q = mc\Delta T$$

$$Q_M = m_M c_M (T_2 - T_{M1})$$

$$c_M = \frac{Q_M}{m_M(T_2 - T_{M1})}$$

$$Q_w = m_w c_w (T_2 - T_{w1}) = 100 * 4.1813 * (21.5 - 18) = 1.46\ kJ$$
$$c_M = \frac{-Q_w}{m_M(T_2 - T_{M1})} = \frac{1.46}{45(96 - 21.5)} = 0.4355\ \frac{J}{g * K}$$