Answer on Question #37027, Thermodynamics

In a calorimeter of water equivalent 20 g, water of mass 1.1 kg at 288 k temperature .if steam at temperature 373 k is passed through it and temperature of water increase by 6.5 degree c then the mass of steam condensed is

Solution

Let *x* be the mass of steam condensed. The heat obtained calorimeter with water is equal the heat from condensing *x* kg of steam and the heat from cooling *x* kg of water to the final temperature of calorimeter with water.

$$x \cdot L + x \cdot c \cdot (T_3 - T_2) = (m + m_c) \cdot c \cdot (T_2 - T_1),$$

where $L = 540 \frac{cal}{g}$ – latent heat of steam, $c = 1 \frac{cal}{g \cdot \text{degree}}$ – specific heat of water, $T_1 = 288$ k – initial temperature of calorimeter with water, $T_2 = 288 \text{ k} + 6.5\text{K} = 294.5\text{K}$ – final temperature of calorimeter with water, $m = 1.1$ kg - mass of water, m_c - mass of calorimeter, $T_3 = 373$ k - temperature of steam.

The mass of steam condensed

$$x = \frac{(m + m_c) \cdot c \cdot (T_2 - T_1)}{L + c \cdot (T_3 - T_2)}.$$

$$x = \frac{(1.1 \cdot 10^3 g + 20 \text{ g}) \cdot 1 \frac{cal}{g \cdot \text{degree}} \cdot 6.5 \text{ degree}}{540 \frac{cal}{g} + 1 \frac{cal}{g \cdot \text{degree}} \cdot (373 \text{ k} - 294.5\text{K})} = 12g = 0.12\ kg.$$

Answer: $0.12\ kg$.