

Answer on Question #41180 – Physics – Molecular Physics | Thermodynamics

In an energy recycling process X gram of steam at 100°C becomes water at 100°C which converts Y gram of ice at 0°C into water at 100°C . The ratio of X and Y will be

Solution:

$$\lambda = 334 \frac{\text{kJ}}{\text{g}} - \text{heat of fusion for the water};$$

$$q = 2260 \frac{\text{kJ}}{\text{g}} - \text{heat of evaporation for the water};$$

$$c = 4180 \frac{\text{J}}{\text{g} \cdot ^{\circ}\text{C}} - \text{heat capacity of water};$$

$\Delta T = 100^{\circ}\text{C}$ – change in temperature;

$$Q_{\text{lost}} = Q_{\text{gain}} \quad (1)$$

The amount of heat lost by steam:

$$Q_{\text{lost}} = q \cdot X \quad (2)$$

The amount of heat gained by ice:

$$Q_{\text{gain}} = Y \cdot \lambda + cY\Delta T \quad (3)$$

(3)and(2)in(1)

$$q \cdot X = Y \cdot \lambda + cY\Delta T$$

$$q \cdot X = Y(\lambda + c\Delta T)$$

$$\frac{Y}{X} = \frac{\lambda + c\Delta T}{q} = \frac{2260 \frac{\text{kJ}}{\text{g}}}{334 \frac{\text{kJ}}{\text{g}} + 4180 \frac{\text{J}}{\text{g} \cdot ^{\circ}\text{C}} \cdot 100^{\circ}\text{C}} = 3$$

$$Y = 3X$$

Answer: The ratio of X and Y will be: $Y = 3X$.