

39.3)

Do aluminiowego kalorymetru o masie 100g wlozono wode o masie 300g. Temperatura poczatkowa wody i kalorymetru wynosila 25°C. Po wrzuceniu pokruszonego lodu o temperaturze -10°C temperatura wody obnizyla sie do 8,4°C. Oblicz masę lodu.

Dane:

$$m_{Al} = 100g = 0,1kg$$

$$m_w = 300g = 0,3kg$$

$$t_w = t_k = 25^\circ C \Rightarrow T_w = T_k = 298K$$

?

$$t_L = (-10^\circ C) \Rightarrow T_L = 263K$$

$$t_{kw} = 8,4^\circ C \Rightarrow T_{kw} = 281,6K$$

⇓

$$c_{Al} = 900 \frac{J}{kg \cdot K}$$

$$c_w = 4190 \frac{J}{kg \cdot K}$$

$$c_L = 2100 \frac{J}{kg \cdot K}$$

$$c_{t2} = 3,34 \cdot 10^5 \frac{J}{kg}$$

szukane:

$$m_L = ?$$

$$Q_{Al} = m_{Al} c_{Al} \Delta T \quad (T_k - T_{kw})$$

$$Q_w = m_w c_w \Delta T \quad (T_w - T_{kw})$$

$$Q_{od} = Q_{Al} + Q_w$$

$$Q_{od} = m_{Al} c_{Al} (T_k - T_{kw}) + m_w c_w (T_w - T_{kw})$$

$$Q_{od} = m_L c_L (T_w - T_{kw}) + m_w c_w (T_w - T_{kw})$$

$$Q_{od} = (m_{Al} c_{Al} + m_w c_w) (T_w - T_{kw})$$

$$Q_{t2} = c_{t2} \cdot m_L \Rightarrow Q_2 = c_L \cdot m_L \cdot (T - T_L)$$

$$Q_2 = c_L \cdot m_L \cdot \Delta T_2 \Rightarrow Q_2 = c_L \cdot m_L \cdot (T - T_L)$$

$$Q_1 = c_w \cdot m_L \cdot \Delta T_3 \Rightarrow Q_3 = c_w \cdot m_L \cdot (T_{kw} - T)$$

$$Q_{PB} = Q_1 + Q_2 + Q_3$$

$$Q_{PB} = c_{t2} \cdot m_L + c_L \cdot m_L \cdot (T - T_L) + c_w \cdot m_L \cdot (T_{kw} - T)$$

$$Q_{PB} = m_L [c_{t2} + c_L (T - T_L) + c_w (T_{kw} - T)]$$

$$\Rightarrow Q_{PB} = Q_{od}$$

$$m_L [c_{t2} + c_L (T - T_L) + c_w (T_{kw} - T)] = (m_{Al} c_{Al} + m_w c_w) (T_w - T_{kw})$$

$$m_L = \frac{(m_{Al} c_{Al} + m_w c_w) (T_w - T_{kw})}{c_{t2} + c_L (T - T_L) + c_w (T_{kw} - T)}$$

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$$Q_{mL} = \frac{(0,1kg \cdot 900 \frac{J}{kg \cdot K} + 0,3kg \cdot 4190 \frac{J}{kg \cdot K}) \cdot (298K - 281,6K)}{3,34 \cdot 10^5 \frac{J}{kg} + 2100 \frac{J}{kg \cdot K} \cdot (273K - 263K) + 4190 \frac{J}{kg \cdot K} \cdot (281,6K - 273K)} = \frac{1347 \frac{J}{kg} \cdot 16,6K}{334000 \frac{J}{kg} + 21000 \frac{J}{kg} + 16034 \frac{J}{kg}} = \frac{22360,2 \frac{J}{kg}}{349034 \frac{J}{kg}} \approx 0,05689kg$$

$$m_L = 0,05689kg \approx 56,9g$$

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