Specific Heat Problems

1) **How much heat must be absorbed by 375 grams of water to raise its temperature by 25° C?**

2) **What mass of water can be heated from 25.0° C to 50.0° C by the addition of 2825 J?**

3) **What is the final temperature when 625 grams of water at 75.0° C loses 7.96×10^4 J?**

4) **A copper cylinder has a mass of 76.8 g and a specific heat of 0.092 cal/g·C. It is heated to 86.5° C and then put in 68.7 g of turpentine whose temperature is 19.5° C. The final temperature of the mixture is 31.9° C. What is the specific heat of the turpentine?**

5) **A 65.0 g piece of iron at 525° C is put into 635 grams of water at 15.0° C. What is the final temperature of the water and the iron?**

Solutions

1) $m_w = 375\ g$

$c_w = 4.18\ J/g \cdot K$

$\Delta T = 25°\ C = 25\ K$

$q_g = m_w c_w \Delta T_w$

$q_g = 375\ g \times 4.18\ J/g \cdot \cancel{K} \times 25\ \cancel{K} = 3.9 \times 10^4\ J$

2) $m_w = ?$

$c_w = 4.18\ J/g \cdot K$

$\Delta T = 50.0°\ C - 25.0°\ C = 25.0\ K$

$q_g = m_w c_w \Delta T_w$

$m = q_g / c\Delta T$

$m = 2825\ J/(4.18\ \cancel{J}/g \cdot \cancel{K} \times 25.0\ \cancel{K}) = 27.0\ g\ H_2O$

3) $m_w = 625\ g$

$c_w = 4.18\ J/g{\cdot}K$

$T_i = 75.0°\ C$

$q_l = 7.96 \times 10^4\ J$

$q_l = m_w c_w \Delta T_w$

$\Delta T_w = q_l/(m \times c)$

$\Delta T_w = 7.96 \times 10^4\ \cancel{J}/(625\ \cancel{g} \times 4.18\ \cancel{J}/g{\cdot}K) = 30.5\ K = 30.5°\ C$

$\Delta T = T_i - T_f$

$T_f = T_i - \Delta T = 75.0°\ C - 30.5°\ C =$ **44° C**

4) $m_c = 76.8\ g$ $\qquad$ $m_t = 68.7\ g$

$c_c = 0.092\ cal/g{\cdot}C$ $\qquad$ $c_t = ?$

$\Delta T = T_i - T_f$ $\qquad$ $\Delta T = T_f - T_i$

$\Delta T = 86.5°\ C - 31.9°\ C = 54.6°\ C$ $\qquad$ $\Delta T = 31.9°\ C - 19.5°\ C = 12.4°\ C$

$\Delta q = 0$

$q_l = q_g$

$m_c c_c \Delta T_c = m_t c_t \Delta T_t$

$c_t = m_c c_c \Delta T_c / m_t \Delta T_t$

$c_t = 76.8\ g \times 0.092\ cal/g{\cdot}C \times 54.6\cancel{°\ C}/(68.7\ g \times 12.4\cancel{°\ C}) =$ **0.45 cal/g·C**

5) $m_{iron} = 65.0\ g$ $m_w = 635\ g$

$c_{iron} = 0.451\ J/g \cdot K$ $c_w = 4.18\ J/g \cdot K$

$T_i = 525°\ C$ $T_i = 15°\ C$

$\Delta q = 0$

$q_l = q_g$

$m_i c_i \Delta T_i = m_w c_w \Delta T_w$

$65.0\ g \times 0.451\ \cancel{J/g \cdot K} \times (525°\ C - T_f) = 635\ g \times 4.18\ \cancel{J/g \cdot K} \times (T_f - 15°\ C)$

$T_f = 20.6°\ C$