Worksheet 7.8: Thermal Energy, Heat and Specific Heat Capacity

1. How much heat is needed to rise the temperature of 462 g of water from 24.0 °C to 80.0 °C?

$\Delta E_H = mc\Delta T$

$= (0.462\,kg)(4180\,J/kg{\cdot}°C)(80.0-24.0)$

$= 108\,000\,J$

2. How much heat is required to raise the temperature of 462 g of copper from 24.0 °C to 80.0 °C?

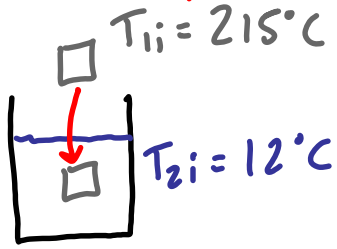
$\Delta E_H = mc\Delta T$

$= (0.462\,kg)(390\,J/kg{\cdot}°C)(80.0-24.0)$

$= 10\,100\,J$

* 3. A 0.240 kg chunk of carbon is heated to 215 °C and quickly placed into 0.275 kg of water that has a temperature of 12 °C. What will the final temperature of the water be?

* I won't put this on the test...



Since they will reach thermal equilibrium

$T_{1f} = T_{2f}$

Energy is conserved so: $-\Delta E_{H_1} = \Delta E_{H_2}$ (↑ decreases, ↑ increases)

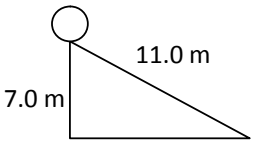
$-m_1c_1\Delta T_1 = m_2c_2\Delta T_2$

$-m_1c_1(T_f - T_{1i}) = m_2c_2(T_f - T_{2i})$

$-m_1c_1T_f + m_1c_1T_{1i} = m_2c_2T_f - m_2c_2T_{2i}$

$T_f(m_2c_2 + m_1c_1) = m_1c_1T_{1i} + m_2c_2T_{2i}$

4. A 3.0 kg ball rolls down from the top of a ramp as shown. If the ball is moving at 10.0 m/sat the bottom, how much energy was lost due to friction (thermal energy)?



$E_{pi} + \cancel{E_{Ki}} = \cancel{E_{pf}} + E_{Kf} + E_H$

$E_{pi} = E_{Kf} + E_H$

$E_H = E_{pi} - E_{Kf} = mgh_i - \frac{1}{2}mv_f^2$

$= \boxed{56\,J}$

5. A 1.00 g raindrop traveling at 40.0 m/s strikes the surface of 100 g of water in a glass. How much will the water's temperature change if we assume that:

i) all of the raindrop's kinetic energy is transformed into thermal energy, and

ii) the raindrop and the glass of water's temperatures are initially the same

$E_K = \frac{1}{2}mv^2 = \frac{1}{2}(0.001)(40.0)^2$

$= 0.80\,J$

$\Delta E_H = mc\Delta T$

$\Delta T = \frac{\Delta E_H}{mc} = \frac{0.80}{(0.100)(4180)} = 0.0019°C$

Algebra is FUN!

$$T_f = \frac{m_1 c_1 T_{1i} + m_2 c_2 T_{2i}}{m_2 c_2 + m_1 c_1}$$

$$= \boxed{39^\circ C}$$