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Specific Heat
Quiz: Solutions

1. Determine the amount of energy required for a 5 pound iron skillet to increase 75 ^{o}C.

   $\Delta Q = mc\Delta T$
   $\Delta Q = (5\text{ lb})(\text{kg}/2.205\text{ lbs})(1000\text{ g/kg})(0.448\text{ J}/(\text{g}\cdot{}^{o}\text{C}))(75\ {}^{o}\text{C})$
   $\Delta Q = 76200\text{ J}$

2. An unknown metal having a mass of 13 g increases 25 ^{o}C when 292 J of energy is added. Identify the metal.

   $\Delta Q = mc\Delta T$
   $292\text{ J} = (13\text{ g})(c)(25\ {}^{o}\text{C})$
   $c = 0.898\text{ J}/(\text{g}\cdot{}^{o}\text{C})$
   The metal is aluminum.

3. Gold, silver and iron samples, each with a mass of 50 g, have an initial temperature of 20 ^{o}C. Determine the temperature of each metal when 1.2 kJ of energy is applied to each sample.

   Gold: $\Delta Q = mc\Delta T$
   $(1.2\text{ kJ})(1000\text{ J/kJ}) = (50\text{ g})(0.129\text{ J}/(\text{g}\cdot{}^{o}\text{C}))(T - 20\ {}^{o}\text{C})$
   $T = 206\ {}^{o}\text{C}$

   Silver: $\Delta Q = mc\Delta T$
   $(1.2\text{ kJ})(1000\text{ J/kJ}) = (50\text{ g})(0.234\text{ J}/(\text{g}\cdot{}^{o}\text{C}))(T - 20\ {}^{o}\text{C})$
   $T = 123\ {}^{o}\text{C}$

   Iron: $\Delta Q = mc\Delta T$
   $(1.2\text{ kJ})(1000\text{ J/kJ}) = (50\text{ g})(0.448\text{ J}/(\text{g}\cdot{}^{o}\text{C}))(T - 20\ {}^{o}\text{C})$
   $T = 73.6\ {}^{o}\text{C}$

4. **A 42.1 g sample of silver has a final temperature of 83.9 °C when 300 J of energy is applied. Determine the initial temperature of the silver.**

$\Delta Q = mc\Delta T$
$\Delta Q = (m)(c)(T - T_o)$
$300\ J = (42.1\ g)(0.234\ J/(g\cdot{}^oC))(83.9\ {}^oC - T_o)$
$T_o = 53.4\ {}^oC$

5. **A metal sample requires 5 kJ of energy for a temperature increase of 10 °C. Determine the amount of energy required to raise the metal sample 30 °C.**

Solution 1: $(5\ kJ)(3) = 15\ kJ$

Solution 2:

$\Delta Q = mc\Delta T$
$5\ kJ = (mc)\ 10\ {}^oC$
$mc = 5\ kJ / 10\ {}^oC$

$\Delta Q = mc\Delta T$
$\Delta Q = (5\ kJ / 10\ {}^oC)(30\ {}^oC)$
$\Delta Q = 15\ kJ$

6. **Determine the energy required to raise the temperature of 800 mL of water from 24.2 °C to 28.1 °C. The density of water over this temperature range is approximately 0.997 g/mL.**

$D = m / V$
$0.997\ g/mL = m / 800\ mL$
$m = 797.6\ g$

$\Delta Q = mc\Delta T$
$\Delta Q = 797.6\ g\ (4.184\ J/(g\cdot{}^oC))(28.1\ {}^oC - 24.2\ {}^oC)$
$\Delta Q = 13000\ J$

7. **Determine the mass of zinc at 293 K that requires 5.2×10^3 J of energy to raise the temperature to 312 K.**

$\Delta T = (T - T_o)$
$\Delta T = 312\ K - 293\ K$
$\Delta T = 19\ K$
$\Delta T = 19\ ^oC$

$T_K = T_C + 273.15$
$312 = T_C + 273.15$
$T_C = 38.85\ ^oC$

$T_K = T_C + 273.15$
$293 = T_C + 273.15$
$T_C = 19.85\ ^oC$

$\Delta T = (T - T_o)$
$\Delta T = 38.85\ ^oC - 19.85\ ^oC$
$\Delta T = 19\ ^oC$

$\Delta Q = mc\Delta T$
$5.2 \times 10^3\ J = m\ (0.388\ J/(g \cdot ^oC))(19\ ^oC)$
$m = 705\ g$