Chem 1402 Heat Capacity
Worksheet Key

Problem Sets:

1. Fill in the blanks for the following table of specific heat capacities. Use this table for the rest of this exercise

Substance	c (cal/g ^oC)	c (j/g ^oC)
Water	1.000	4.184
Ice	0.492	2.06
Lead	0.0306	0.127
Iron	0.444	1.86
Tungsten	0.134	0.561
Gold	0.0308	0.129

2. 35.0 kJ raises the temperature of an gold object from 22^oC to its melting point of 1064.18^oC. What is the mass of the gold object?

$$q = mc\Delta T = mc(T_F - T_I)$$

$$m = \frac{q}{c(T_F - T_I)} = \frac{35kJ\left(^{1000J}/_{kJ}\right)}{^{0.129J}/_{g\bullet^oC}(1064.18-22)^oC} = 260.g$$

3. What is the specific heat capacity in cal/g^oC of a substance if it takes 5.09 kJ to raise a 30.1 g mass sample of the material from 25.0 to 400.0^oC?

$$q = mc\Delta T = mc(T_F - T_I)$$

$$c = \frac{q}{m(T_F - T_I)} = \frac{5.09kJ\left(^{1000J}/_{kJ}\right)^{1cal}/_{4.184J}}{30.1g(400.0-25.0)^oC} = 0.108g$$

4. How much energy (in Joules) is absorbed when 100.0g of two different substances are raised from a temperature of 10.0^oC to 100.0^oC if the substances are:

a. Gold

$$q = mc\Delta T = 100.0(^{0.129J}/_{g\bullet^oC})(100.0^oC - 10.0^oC)$$

$$q = 1.16kJ$$

b. Water

$$q = mc\Delta T = 100.0(^{4.184J}/_{g\bullet^oC})(100.0^oC - 10.0^oC)$$

$$q = 37.7kJ$$

c. How much more heat did it take to raise the water to 100.0^oC than the gold? 36.5 kJ

d. What is the ratio of the heat required for the water to the gold?

$$\frac{q_{H_2O}}{q_{Au}} = \frac{37.7kJ}{1.16kJ} = 32.5$$

So it takes 32.5 times more energy to heat the water than the gold

e. What is the ratio of the heat capacities of water to gold?

$$\frac{c_{H_2O}}{c_{Au}} = \frac{4.184 J/g\cdot^oC}{0.129 J/g\cdot^oC} = 32.4$$

So water has 32.4 time the heat capactity of gold

***Note,** in comparing the answers of (d) and (e) you need to recognize that they are identical in all certain digits and the deviation is in the uncertain digit. So they are essentially the same.*

5. Find the final temperature when 7.25kJ of heat is added to a 132.0 g object if at 10.0°C if:

a. The object is made of iron

$$q = mc\Delta T = mc(T_F - T_I)$$

$$T_F = \frac{q}{mc} + T_I = \frac{7,250J}{132.0g(1.86 J/g\cdot^oC)} + 10.0^oC = 39.6^oC$$

b. The object is made of water

$$q = mc\Delta T = mc(T_F - T_I)$$

$$T_F = \frac{q}{mc} + T_I = \frac{7,250J}{132.0g(4.184 J/g\cdot^oC)} + 10.0^oC = 23.1^oC$$

***Note**, when we added the same amount of heat to equal masses of different substances the one with the lower heat capacity was raised to the higher temperature.*