Department of Chemistry
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Name:_____

Thermodynamics Unit – Specific Heat and Heating Curves

1. What is the difference between a Calorie and a Joule? (Which is bigger, by how much?)

   1 Cal = 4.184 J

   A calorie is bigger than a Joule by more than 4 times.

2. Heat is exchanged from _warmer_ substances to _colder_ substances. (Choices for each blank: warmer or colder)

3. Examine the specific heat values given below (units J/g°C). If the same amount of heat is added to identical masses of each of these substances, which substances reaches the highest temperature change? (Hint: No calculations needed.)

Copper	0.384
Lead	0.159
Water	4.18
Glass	0.502

Because lead needs the least amount of energy to increase 1 gram of itself by 1°C

4. Determine the specific heat of iron if 6.1 J of energy are needed to warm 1.50g of iron from 20.0°C to 29.0°C.

   Work:

   Energy per gram:

   $$\Delta E_{pergram} = \frac{6.1J}{1.5g} = 4.07\frac{J}{g}$$

   Specific Heat:

   $$C_{Fe} = \frac{4.07\frac{J}{g}}{(29^{\circ}C - 20^{\circ}C)} = 0.452\frac{J}{g^{\circ}C}$$

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5. Calculate the amount of heat (in kJ) required to raise the temperature of 140 grams of water from 30˚C to 70˚C.

   Work:

   $q = mC\Delta T$

   $q = (140g)(4.184\frac{J}{g^{\circ}C})(70^{\circ}C - 30^{\circ}C)$

   $q = 23430.4\ J = 23.43\ kJ$

6. Calculate the amount of heat (in kJ) required to raise the temperature of 140 grams of water from -30˚C to 110˚C. Do you expect it to require more or less heat than in the problem above?

   We expect there to be a greater heat requirement because even though the mass is the same, the ΔT is greater (40˚C vs. 140˚C).

   We have to calculate the heat for warming ice, melting ice, warming water, vaporizing water and warming steam. A total of 5 steps!

   $q_1 = mC_{ice}\Delta T = (140g)(2.09\frac{J}{g^{\circ}C})(0^{\circ}C - {}^{-}\ 30^{\circ}C) = 8778J$

   $q_2 = m\Delta H_{fus} = (140g)(334\frac{J}{g}) = 46760J$

   $q_3 = mC_{water}\Delta T = (140g)(4.184\frac{J}{g^{\circ}C})(100^{\circ}C - 0^{\circ}C) = 58576J$

   $q_4 = m\Delta H_{vap} = (140g)(2260\frac{J}{g}) = 316400J$

   $q_5 = mC_{steam}\Delta T = (140g)(2.00\frac{J}{g^{\circ}C})(110^{\circ}C - 100^{\circ}C) = 2800J$

   $q_{tot} = q_1 + q_2 + q_3 + q_4 + q_5 = 433314J = 433.314kJ$

C_{ice} = 2.09 J/g˚C C_{water} = 4.18 J/g˚C C_{steam} = 2.00 J/g˚C
$\Delta H_{fus} H_2O$ = 334 J/g ΔH_{vap} H_2O = 2260 J/g

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