Virtual Laboratory

Topic 07 – Heat

		07
Section #	Date	Topic #

Name ______________________________

Show your work. (Show how you arrived at your answer.)

1. Determine the heat energy needed to raise 175 grams of **water** from a temperature of $22^{O}C$ to the boiling point.

2. Determine the heat energy needed to raise a 105 grams of **aluminum** from a temperature of $15^{O}C$ to $38^{O}C$.

3. Calculate the specific heat of an unknown substance, and identify that substance using the chart provided in your textbook. The mass of the substance is 500 g. It undergoes a $100^{o}C$ change in temperature when 11.000 calories of heat are added.

4. Calculate the specific heat of an unknown substance. The mass of the substance is 310 g. Its temperature changes from $20^{o}C$ to $80^{o}C$, when 2976 calories of heat are added.

5. Calculate the thermal expansion of a 425 m **glass** rod when its temperature changes from $5^{O}C$ to $50^{O}C$.

6. Calculate the thermal expansion of a 100 m **brass** rod when its temperature changes from $5^{O}C$ to $90^{O}C$.

7. Calculate the amount of heat transfer for a 6.00 cm thick **wood** wall when its temperature changes from 25 ^{O}C to 50 ^{O}C in 60 seconds. The area of the wall is 5000 cm^2.

8. Calculate the amount of heat transfer for a 6.00 cm thick **copper** wall when its temperature changes from 50 ^{O}C to 25 ^{O}C in 60 seconds. The length of the wall is 90 cm and its width is 40 cm.

• 07 •
H E A T

	Section #	Kit #	Topic #
Name			**07**
			07
			07

PART A - Conservation of Energy

Lab Prep: State the Law of Conservation of Energy: ____

Lab Prep: Identify the research question, (Make sure to identify the mass of the water that is gaining the heat and the mass of the water that is losing the heat**.)** ____

Lab Prep: Write your hypothesis (don't forget to include the prediction about what will gain heat and what will lose heat**).** ____

	Trial 1 150-g. hot + 150-g. cold	Trial 2 200-g. hot + 100-g. cold	Trial 3 75-g. hot +225-g. cold
$M_{\text{cold water Cup}}$ (grams)			
$M_{\text{cold water + Cup}}$ (grams)			
$M_{\text{cold water}}$ (grams)			
$M_{\text{hot water Cup}}$ (grams)			
$M_{\text{hot water + Cup}}$ (grams)			
$M_{\text{hot water}}$ (grams)			
$T_{\text{hot water}}$ (^{o}C) (before mixing)			
$T_{\text{cold water}}$ (^{o}C) (before mixing)			
T_{Final} (^{o}C) (after mixing)			
$\Delta T_{\text{hot water}}$ (^{o}C) = $T_{\text{hot}} - T_{\text{final}}$			
$\Delta T_{\text{cold water}}$ (^{o}C) = $T_{\text{final}} - T_{\text{cold}}$			
Heat gain: (calories) $\Delta H_{\text{cold}} = M_{\text{cold water}} \times \Delta T_{\text{cold}} \times c$			
Heat loss: (calories) $\Delta H_{\text{hot}} = M_{\text{hot water}} \times \Delta T_{\text{hot}} \times c$			
Theoretical Value The theoretical value is the average of the heat gain and heat loss.			
Error			
Percent Error			
Does Heat Loss equal Heat Gain within experimental uncertainty?			

Do your results support your hypothesis? Explain your answer. ____

____

PART B - Specific Heat Capacity

	Trial 1 Aluminum	Trial 2 Lead	Trial 3 Copper
M_{cup} (grams)			
$M_{water+Cup}$ (grams)			
M_{water} (grams)			
M_{sample} (grams)			
$T_{hot\ water}$ (^{O}C) (this is also the temperature of the sample)			
$T_{cold\ water}$ (^{O}C)			
T_{final} (^{O}C) (temperature of water with sample in it)			
ΔT_{water} (^{O}C) = $T_{final} - T_{cold\ water}$			
ΔT_{sample} (^{O}C) = $T_{hot\ water} - T_{final}$			
Specific heat capacity (cal/g ^{O}C) (keep 3 decimal places) $C_{sample} = (M_{water} \times \Delta T_{water} \times c_{water}) / (M_{sample} \times \Delta T_{sample})$			
Theoretical Specific heat (from table provided in chapter)			
Error			
Percent Error			

Suppose you have three equal mass samples placed in equal amounts of water at the same temperature. Then suppose you light similar candles and place a candle under each of the masses (lead, copper and aluminum), letting the candles burn for **equal times**. Would one of the materials **change temperature more** than the other? (This is not asking about the fastest temperature change.)

If so, which one and why? (Use Table 1 in your textbook for assistance.)

____

Part C – Graphical analysis

A research question is: How does the specific heat capacity change for the chemical elements as the atomic number increases?

What does *atomic number* mean? ____

Your hypothesis is: ____

Create your hypothesis before going to the website.

Go the following website http://periodictable.com/Properties/A/SpecificHeat.html **and review the graph of Specific Heat vs. Atomic Number.** Notice that if you place your cursor on the graph a purple line will appear. You can obtain information for each atomic number by placing the purple line on the atomic number of interest. Look above the graph, to the left, for the information.

From the graph identify the following:

1. The dependent variable (include the units): __________________________________
2. The independent variable: __________________________________
3. What is the value of each tick mark on the horizontal scale: __________________________________
4. What is the value of each tick mark on the vertical scale: ______________________________________

Observe patterns in the behavior of specific heats for the chemical elements:

5. Describe what you observe for the atomic numbers 0 – 10. ____________________________________
6. Describe what you observe for atomic numbers 10-20. _______________________________________
7. Describe what you observe for atomic numbers 20-60. _______________________________________
8. Describe what you observe for atomic numbers 60-92. _______________________________________
9. What is the value of specific heat for atomic number 35 _______?
10. Name this chemical element. ________________
11. What is the chemical symbol? ___________
12. What is the value of specific heat for the atomic number 53 _______?
13. Name this chemical element. ________________
14. What is the chemical symbol? ___________
15. Develop a *general* statement concerning the specific heat values for the chemical elements. Does it agree with your hypothesis?