93

George Pappas
CHM. 121.004
Inst. Mark Novak
Lab Report – Experiment 7
10/26/17

Experiment Objective

The objective of this experiment was to find the specific heat of an unknown material. After finding the specific heat, we could then use the Law of DuLong and Petit to find the molar mass of the unknown; thus revealing to us what metal it is.

Conclusion

Trial 1:

After confirming the heat of the unknown metal was about 97.8 °C, we quickly put the unknown into the calorimeter. The temperature did not change as much as predicted, in fact the water temperature only changed 1.06 °C. Because the unknown felt very dense, we predicted that it would have increased the temperature by a significant amount; this was not the case. After finding the specific heat for trial one, which we calculated as .104, we calculated the approximate atomic mass which we found to be 238.91 g/m.

Trial 2:

Trial two was the exact same procedure except more water was added to the calorimeter. In this trial, the temperature of our metal was 95.6 °C before putting in it the calorimeter. Because there was more water in the calorimeter in this trial, the temperature change was even less than in the first trial, only a .89 degrees C change in temperature occurred.

After calculating the specific heat to be .106, we calculated the approximate atomic mass which we found to be 234.21 g/m.

When comparing both data sheets, we can see that they are consistent with one another, meaning that our data is valid. When we completed the first trial, my lab partner and I thought we made a mistake because of the small temperature change; however, because both of the trials were consistent with one another, it is likely that our data is correct. The next problem we ran into was finding out what metal we had. Anything that was close to our calculated average atomic mass, 236.56 g/m, was ether radioactive or would be too harmful to touch with bare hands (which I saw the professor doing). We came to the conclusion that Lead, element 82, is the metal for unknown #5. We ended up saying this because of the similarities in the characteristics as well as the similarities in atomic mass. The reason that we didn't calculate the exact atomic mass was because the calorimeter naturally absorbs some heat from its contents. I also feel that it would have been a better calculation if we allowed the temperature of the metal to reach an exact temperature of 100 °C.

CHM121 E7
ADVANCE STUDY ASSIGNMENT Name: George Pappas

1) A metal sample weighing 44.625 grams and at a temperature of 100.00°C was placed in 35.278 grams of water contained in a calorimeter at 24.72°C. At equilibrium, the temperature of the water and metal was 34.93°C. What is the specific heat of the metal? What is the approximate atomic weight of the metal?

Specific Heat = .52 Atomic Weight = 47.98

$$SH = \frac{-(35.278)(4.184)(34.93-24.72)}{(44.625)(34.93-100)}$$

$= .518994001l$

$$\frac{24.9\ J/mole\ °C}{(\text{Specific heat } J/g\ °C)} = \text{atomic mass } g/mol$$

2) In the experiment we assume that the calorimeter is not only a good heat insulator, but also that it absorbs only a very small amount of heat from its contents. These are good approximations for our calorimeter, but some heat will actually be lost to the surroundings, and some will be absorbed by the thermometer. Would you expect that these effects would result in specific heat values that are larger or smaller than the true values? Why?

Larger or smaller? ~~Larger~~ -2

Why? Because some of the equillibrium heat has escaped, the result would be a smaller Specific Heat. After dividing that smaller result by 24.9 (to calculate Atomic weight) you will get a significantly larger number than the actual Atomic mass.

Name: George Pappas

DATA TABLE

		TRIAL 1	TRIAL 2	TRIAL 3
1.	Mass of metal and beaker	91.767g	91.767 g	
2.	Mass of empty beaker	29.560 g	29.560 g	
3.	Mass of metal (#1 - #2)	62.207g	62.207g	
4.	Mass of calorimeter bottom and water	118.013 g	138.343 g	
5.	Mass of empty, dry calorimeter bottom	6.705 g	6.705 g	
6.	Mass of water (#4 - #5)	111.308 g	131.638 g	
7.	Initial temperature of water in the calorimeter (T_{iw}) (2 minute reading)	20.60 °C	20.59 °C	
8.	Initial temperature of the metal (T_{im})	97.8 °C	95.6 °C	
9.	Equilibrium temperature of metal and water in calorimeter (T_{fw} and T_{fm}) (from graph)	21.66 °C	21.48 °C	
10.	ΔT_{metal} (equilibrium – initial)	-76.14 °C	-74.12 °C	
11.	ΔT_{water} (equilibrium – initial)	1.06 °C	.89 °C	
12.	Energy gain by water (#6 x 4.184 x #11)	493.655	490.188	
13.	Calculated specific heat of the metal (- #12)/(#3 x #10)	.104	.106	
14.	Calculated approximate atomic mass of metal	238.91	234.21	
15.	Calculated average atomic mass of metal	236.56 ← high -5		
16.	Metal name and actual atomic mass	~~Lead~~ 207.2		

Unknown #5 = Bismoth (209 g/mol)

Name: ____________________________

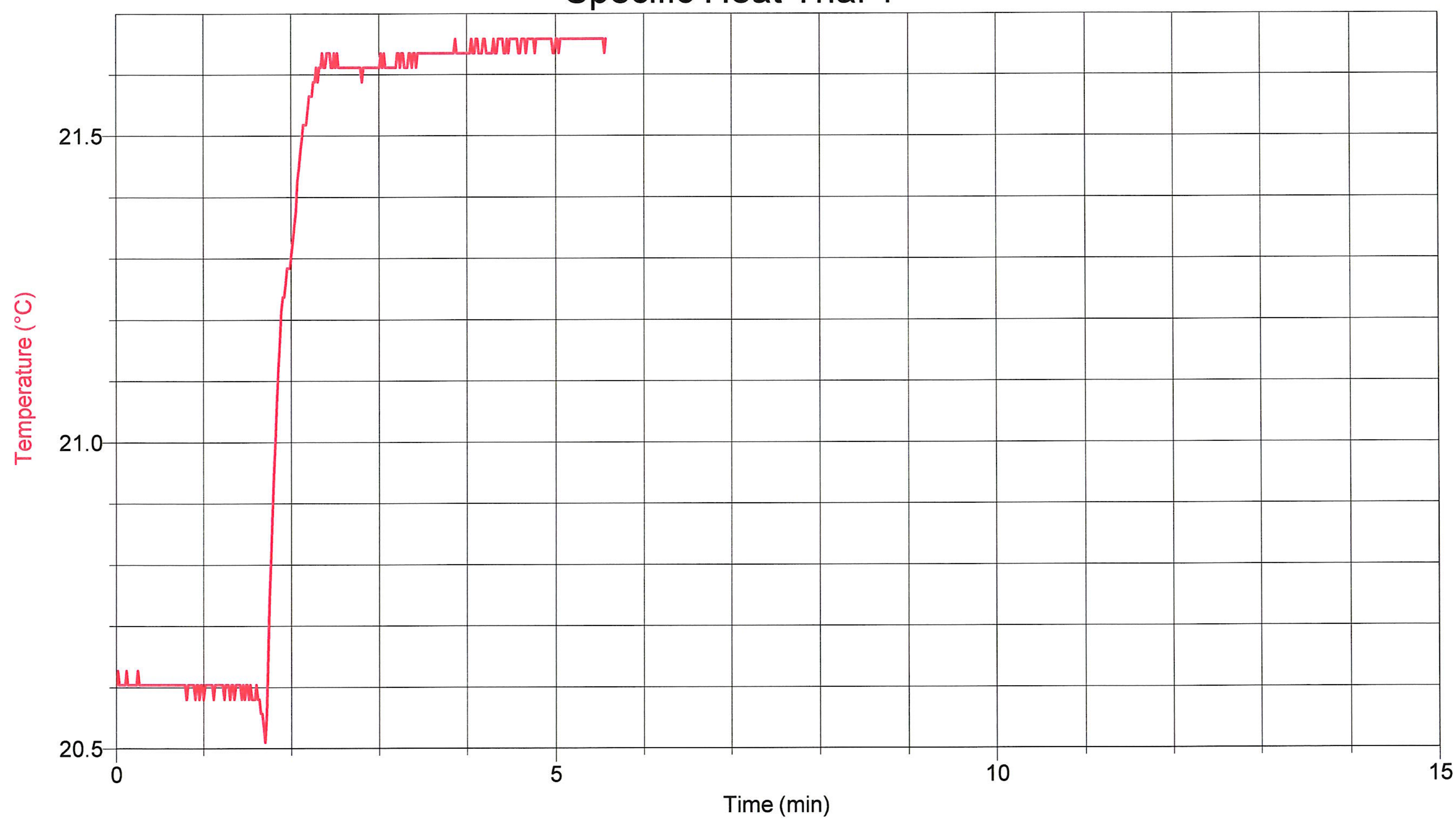
CALCULATIONS

$$\text{Specific Heat (J/g°C)} = \frac{-\,(\text{Mass of water})(4.184\ \text{J/g°C})(T_{fw} - T_{iw})}{(\text{Mass of metal})(T_{fm} - T_{im})}$$

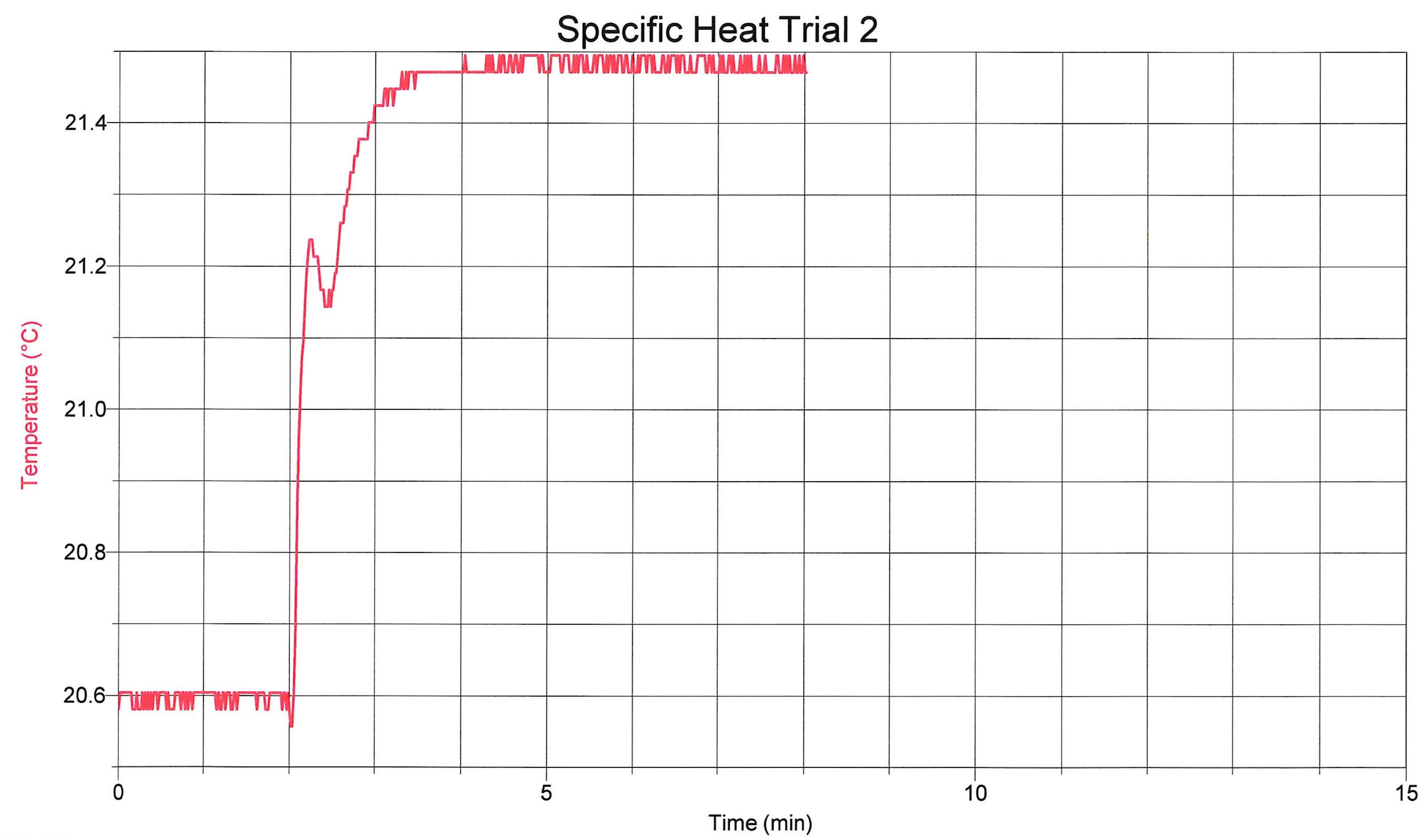
$$= \frac{-\,(\#6)(4.184)(\#9 - \#7)}{(\#3)(\#9 - \#8)}$$

$$\text{Approximate atomic weight (g/mole)} = \frac{(24.9\ \text{J/mole°C})}{(\text{Specific Heat J/g°C})}$$

Specific Heat Trial 1



Savanna Paffumi and George Pappas (1) 10/20/2017 12:02:48



Savanna Paffumi and George Pappas (1) 10/20/2017 12:34:39