

Name\_\_\_\_\_

Date\_\_\_\_\_

**Physics 216: Homework for Lab 9:**  
**Energy Transfer and Temperature Change**  
(Due at the beginning of Lab 10)

1. Suppose you transfer a certain amount of heat energy to a known amount of a liquid in a perfectly insulated cup and the temperature changes. Then, you decide to alter the experiment in several different ways. For each of the alterations listed below, state whether the total change in temperature will be larger, smaller, or the same as that measured in the original experiment (before the alteration). Briefly explain each answer.

- a. Heat for a longer time but transfer the same total heat energy.
  
  
  
- b. Start with more liquid in the cup.
  
  
  
- c. Increase the starting temperature of the liquid.
  
  
  
- d. Use an equal mass of liquid that has a larger specific heat.
  
  
  
- e. Use the same volume of a denser liquid that has the same specific heat.

2. a) Alfred Einstein took the following data to determine the specific heat of water, using the same equipment and procedure as we used in lab, except that 2-s pulses were used.

Mass of water (kg)	Number of heat pulses	Total time of heat pulses (s)	Total energy transferred by heater (J)	Change in temperature ( $^{\circ}\text{C}$ )	Specific heat ( $\text{J/kg}\cdot^{\circ}\text{C}$ )
0.075	4			4.4	
0.075	8			8.4	
0.150	7			4.1	

From these data, find the specific heat of water and its uncertainty (standard deviation of the mean (show your calculations). Compare Alfred's measurement of specific heat to yours, and comment on whether the two measurements agree within uncertainties.

b) What (practical) changes to the experimental procedure would you suggest in order to improve the measurements of specific heat that we made in this lab?

3. The air temperature outside is  $5^{\circ}\text{C}$ . Two identical outdoor swimming pools are heated by electric heaters. Swimming pool A is maintained at  $20^{\circ}\text{C}$ , while pool B is maintained at  $35^{\circ}\text{C}$ . Compare the rate at which heat energy must be transferred to pool A to keep it at  $20^{\circ}\text{C}$  with the rate at which heat energy must be transferred to pool B to keep it at  $35^{\circ}\text{C}$ . Be quantitative (give an approximate numerical ratio for the power ratings of the two heaters) and explain your answer in terms of your observations in this laboratory. Assume that the rate of heat loss of the pools follows a similar relationship as the one you found for the water in the Styrofoam cup in Activity 3.