Phys 115: Inquiry Into Physics	**13th Assignment, due Monday, Dec. 10th**
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Question 1:

On Wednesday, in class we talked a lot about the energy calculation when mixing hot and cold water. We were using the definition of a calorie to determine that when we mixed hot and cold water, how much total energy (in calories) the hot water lost and how much total energy (in calories) the cold water gained.

a. What was your expectation about the "total energies" lost and gained (for unequal amounts of waters and for equal amounts of waters) before we did the calculations? Explain your reasoning (You can have different expectations and reasoning for equal and unequal amounts – just be explicit about what you are talking)

b. Show the calculations for the set of data we considered on Wednesday with unequal amounts of hot and cold water and also for equal amounts of hot and cold water. Show me all the steps of your calculation (We did this in groups in class but I want you to do this on your own now). How do the calculations stand with respect to your expectations?

c. If the calculations did not match your original expectation, what do we do now? The possible options I can think of are: reason that the idea behind expectations was simply wrong – this would then require us to generate a new explanation for the observed results; or, reconcile the results with expectations – maybe explore hidden assumptions or think about the experimental situation in ways that would help us understand that mismatch between expectation and observation.

Question 2:

A. In class we have come up with a couple of formulae for the final temperature (when water at one temperature is mixed with same or different amount of water at a different temperature). Let us pick one of them: If we mix M_{hot} grams of hot water at a temperature of T_{hot} °C with M_{cold} grams of cold water at T_{cold} °C then the final temperature in °C is

$$T_{final} = \frac{(M_{hot} \times T_{hot}) + (M_{cold} \times T_{cold})}{(M_{hot} + M_{cold})}$$

Now often we get this complicated mathematical expression that provides us with an answer but we do not know why it works. In this question, I want you to try and make sense of this formula. **Can you understand what the formula means to say – i.e., why does it work?** The formula seems to make reasonable predictions (i.e., close enough to the observed final temperatures). And that is good. But that is not the reasoning I am looking for. **I want you to understand the mathematical steps in the formula from a physical perspective.**

B. Now, think about the total energy lost by hot water and total energy gained by cold water. Can you write down expressions for the total energy lost by the hot water and total energy gained by the cold water? What does the formula for T_{final} tell you about these? Feel free to speculate in this portion.

Question 3:

Write down all the additional footholds that you would like to add to the list that we started on Wednesday. Feel free to use the ideas from group work on Wednesday, but don't just copy without thinking from your notebook to the HW. Some pointers:

1. Specify the foothold in words that would be unambiguous and would make sense to others (so for example, always think if you are talking about the individual energy of a molecule or the total energy in the entire sample). Make sure that you understand each idea that you are writing down and can explain that idea.

2. Add supporting evidence for the footholds, where applicable. Is the foothold supported by the experiments done in class or the other ideas that we have discussed.

Think of it like a revision for your finals!

Next, go back to the 4-5 footholds that we wrote down in class. Examine them and make sure that you understand what those footholds are saying. If you are not comfortable with any of the footholds stated on Wednesday, or would like to modify them, make a note of that. What about that idea makes you uncomfortable or what modification would you suggest.