HW 9 Due Wednesday April 12th **Phys 115: Heat and Tempearture**

1. Adding energy

Imagine that you have four open cups in your freezer. The four cups have respectively a block of metal, a block of Styrofoam, a block of ice and liquid alcohol. The blocks and the alcohol all weigh exactly the same (i.e. we have same amount of metal, Styrofoam, ice and alcohol). They have been in your freezer for a very long time.

Now you take all three of them out of the freezer and leave them out on the table. They will eventually come to the room temperature (temperature of the air in the room), say about 22 degrees Celsius. Based on our discussions in class, you know that in order to raise the temperature of something you need to add energy to it. So you say, "Well, some energy from the air has moved into each block/alcohol, warming it up, until the block is the same temperature as the air (room temperature)." The air has lost a little heat, but there is so much air that the loss of a little heat doesn't lower its temperature noticeably.

In this scenario do the four things each get the exact same amount of energy from the air? Or do they get different amounts? Explain your reasoning in detail. Please explain any term/concept that you use/introduce.

Just as an example, I can imagine someone saying "it's because of the properties". Saying that would not be sufficient for this question. IF you do refer to some property please articulate what it is and explain how that particular property leads to your answer.

2. Mixing water and alcohol

You had 100 grams of water at 60°C and some isopropanol (alcohol) at 10°C. When you mixed the two substances the temperature of the mixture came to 40°C.
Now in class, we defined 1 Kelsey as the amount of energy gained or lost by 1 gram of water when its temperature changes by 1 °C. In this case, the water cooled down – so it must have lost kinetic energy. How much energy (in Kelsey units) did the water lose?

In class we talked about how energy is like candy and candy can be exchanged but it does not just disappear. In this case, use this idea to determine how much energy has the alcohol gained?

Now use this to determine the amount of alcohol that was mixed?

3. Melting Ice; Mixing Ice and water

In class when we discussed about ice, I think most of us were comfortable with the idea that it takes energy to melt ice.
Now say it took 100 grams of water at 80°C to melt 100 grams of ice (0°C). In this particular case, the mixture was at 0°C and the ice was just completely melted.

(a) you want to melt 200 grams of ice (0°C). How much hot water at 50°C would you need so that all the ice is melted and the mixture is just at 0°C?
(b) say you mix 100 grams of ice (0°C) with 200 grams of hot water at 60°C. What would be the temperature of the mixture after the ice has all melted and the water from melted ice and the hot water have all come to an equilibrium temperature?

(c) Now obviously, the hot water cooled down in melting the ice etc. etc. In part (b) without doing any further calculation, tell us if you think that the total energy that the hot water lost is equal to, less than or greater than the amount of energy needed to melt the 100 grams of ice? Explain your answer in details. If the energies were not equal, explain the mismatch (remember energy is like candy – so it does not just disappear; if there is a mismatch in "candy" it must be explained somehow).