

1. Elizabeth and Kate

Elizabeth and Kate are coming out of physics class discussing the question of what would happen if you wrapped a frozen bottle of water in a winter coat: If you were in a warm room, would wrapping it up in the coat help keep the ice remain ice longer, or would it make the ice melt faster?

Elizabeth: I think it's going to stay cold, because the coat keeps outside heat from going into the bottle, so it can't warm up.

Kate: That doesn't make sense. If I'm cold and I put on a coat, the coat warms me up! So the coat should make the ice melt faster.

If you think Elizabeth is right, how would you respond to Kate? And if you think Kate is right how would you respond to Elizabeth? You will likely include some explanation of what you think is going on, but also include in your response why the reasoning that is used to predict the wrong thing doesn't work in this situation.

2. Hot and Cold Water - Simple!!

Kate has 2 gallons of cold water in a bucket. The temperature of the cold water is 10°C . But Kate wants the water to be at 40°C . So obviously Kate wanted to add some hot water to the bucket. Kate also knows that water from the hot-water-tap is at 70°C .

How much hot water would Kate add to the cold water in the bucket so that the mixture reaches the comfortable temperature of 40°C ?

But of course, being in a physics course Kate started to think about energy.

Kate (thinking to herself) : If temperature measures movement (kinetic energy) then since the cold water became warm, it must have gained energy.

Kate now wants to find how much kinetic energy did the cold water in the bucket gain. Can you calculate for Kate how much energy the cold water in the bucket gained?

Without doing any further calculations can Kate tell how much kinetic energy did the hot water lose? As usual, do explain your reasoning.

3. Copper and Water

I want you to remind yourself of the first copper experiment - when you added hot copper cylinder to an equal amount (weight) of cold water. You noted the final equilibrium temperature when the copper and cold water come to the same temperature. For uniformity, I am picking up one of the data-sets: 220 grams of hot copper at 54°C and 220 grams of cold water at 9°C . When the copper was dropped in the cold water, the final temperature was 13°C .

(a) Suppose instead of copper if you were to use hot water at 54°C . **Without using a formula/doing calculations, qualitatively** reason how much hot water would you have to use (less than, more than or equal to 220 grams)? I am not interested in an exact number here, only if you can use the data above in a logical manner to deduce if you need more/less/equal to 220 grams of hot water. Think about what would happen to the temperature of the mixture if you had 220 grams of hot water, or if you had more than that or if you had less than that.

(b) Now I want you do a calculation. Use any formula developed in class to find out how much hot water (at 54°C) you would need to add to the cold water (instead of copper) so that the resulting mixture is at 13°C .

Think: The amount of water you calculated in part (b) is equivalent to 220 grams of copper; or 220 grams of hot copper at 54°C produces the same effect as amount of hot water (54°C) in part(b).

4. Now we want to see if we can use what we learnt in question 3

Suppose I had 100 grams of water at 70°C and 200 grams of copper (the copper was sitting in a very cold water bucket for a long time- a thermometer stuck into the bucket read 5°C); what would be the final temperature if I take the cold copper cylinder and dunk it into the hot water?

I want you to try and use the things we learnt in Qs. 3 to solve this question. If you cannot think of any way to use that, then go ahead and try to find the final temperature any way you feel suitable. But please explain what you are doing. **Do not assume that I would know what you are doing.**