AP Physics 2 – Specific and Latent Heat

C3-WWT03: Mixing Liquids—Final Temperature

A student mixes 100 g of liquid A at a temperature of 80 °C with 100 g of liquid B at a temperature of 20 °C. After the mixture comes to thermal equilibrium, it has a temperature of 40 °C. The student contends:

"If I mix 100 g of liquid A at a temperature of 60 °C with 100 g of liquid B at a temperature of 30 °C, I will also end up with a 200 g mixture at a temperature of 40 °C."

What, if anything, is wrong with the student's contention? If something is wrong, identify it and explain how to correct it. If nothing is wrong, explain the physics behind the student's answer.

C3-WWT04: Boiling Water—Temperature

Two pans of water are being heated on two burners on a stove. In pan A the water is boiling vigorously, but in pan B the water is boiling at a much slower rate. A student contends that:

"The temperature of the water in the pan that is boiling vigorously is a little higher than the other pan because it has definitely reached the boiling point."

What, if anything, is wrong with this student's contention? If something is wrong, identify it and explain how to correct it. If nothing is wrong, explain why the statement is valid.

C3-CT08: Preparing Coffee—Time to Heat

A teacher prepares a cup of instant coffee by heating 200 g of water that was initially at 20 °C with an electric immersion heater placed directly in the cup. It takes 207 seconds to warm the water to 90 °C.

(a) Another teacher with an identical cup uses the same heater to warm up 150 g of water, initially at 20 °C. Is the time taken to heat this second cup of water to 90 °C (i) *greater than*, (ii) *less than*, or (iii) *equal to* 207 seconds? _____

Explain your reasoning.

(b) A third teacher with an identical cup uses the same heater to warm up 200 g of warmer water, initially at 30 °C. Is the time taken to heat this third cup of water to 90°C (i) *greater than*, (ii) *less than*, or (iii) *equal to* 207 seconds? _____

Explain your reasoning.

(c) A fourth teacher with an identical cup uses the same heater to warm up 200 g of colder water, initially at 10 °C. Is the time taken to heat this fourth cup of water to a very warm 80 °C (i) *greater than*, (ii) *less than*, or (iii) *equal to* 207 seconds that it took for the first teacher to heat the water? _____

Explain your reasoning.

C3-CT06: Combining Water, Steam, or Ice—Final Mass and Final Temperature

In three experiments described below, combinations of water (liquid), steam (gas), and ice (solid) are mixed together in an insulated container, and are allowed to reach thermal equilibrium.

First, 40 g of water at 100 °C and 60 g of water at 0 °C are mixed together.

(a) When the mixture reaches thermal equilibrium, will the mass of water be (i) *greater than*, (ii) *less than*, or (iii) *the same as* the sum (100 g) of the two initial masses of water? _____

Explain your reasoning.

(b) When the mixture reaches thermal equilibrium, will the final temperature of the system be (i) *greater than*, (ii) *less than*, or (iii) *equal to* 50 °C? _____

Explain your reasoning.

Next, 50 g of steam at 100 °C and 50 g of water at 80 °C are mixed together in a different insulated container.

(c) When the combination reaches thermal equilibrium, will the mass of water (liquid) be (i) *greater than*, (ii) *less than*, or (iii) *the same as* the sum (100 g) of the two initial masses? _____

Explain your reasoning.

(d) When the mixture reaches thermal equilibrium, will the temperature of the system be (i) *greater than*, (ii) *less than*, or (iii) *equal to* 90 °C? _____

Explain your reasoning.

Finally, 40 g of liquid water at 20 °C and 60 g of ice at 0 °C are mixed together in another insulated container.

(e) When the combination reaches thermal equilibrium, will the mass of water (liquid) be (i) *greater than*, (ii) *less than*, or (iii) *equal to* 100 g? _____

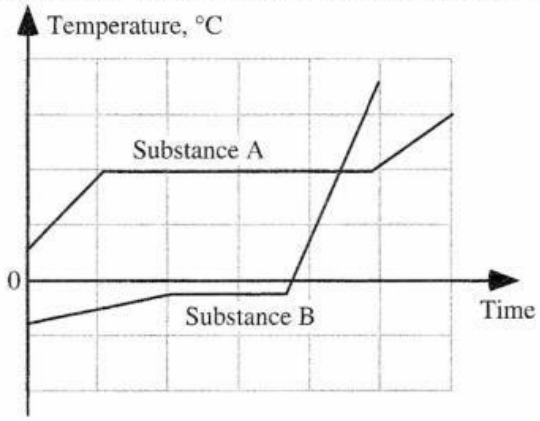
Explain your reasoning.

(f) When the mixture reaches thermal equilibrium, will the temperature of the system be (i) *greater than*, (ii) *less than*, or (iii) *equal to* 10 °C? _____

Explain your reasoning.

C3-CT18: Temperature-Time Graph—Properties of Samples

Samples of two pure substances are heated at a constant rate, and their temperature as a function of time is recorded. Both substances started as solids and melted. The mass of the two samples is the same.



Is the melting point of substance A (i) *greater than*, (ii) *less than*, or (iii) *equal to* the melting point of substance B? _____

Explain your reasoning.

Is the specific heat of substance A in its solid state (i) *greater than*, (ii) *less than*, or (iii) *equal to* the specific heat of substance B in its solid state? _____

Explain your reasoning.

Is the latent heat of fusion of substance A (i) *greater than*, (ii) *less than*, or (iii) *equal to* the latent heat of fusion of substance B? _____

Explain your reasoning.