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9.0.H Question Bank Feb 19 Heating Cooling Phase Change

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Question Bank

Intermolecular attraction, composition, structure

What caused the molecules of a solid to align geometrically in patterns such as rows?

How does energy enable the bonds to be broken (in order to go from solid to liquid to gas)?

Does heat actually break molecular bonds?

Does structure actually affect melting/boiling points? Can't a substance form multiple structures? Does this lead to different melting points/

How does the strength of the bonds relate to the phase of the matter?

Does the energy that is causing the temp in a substance to increase (like in the expts) transfer to "bond-breaking"… is that why the graphs "flatten" at state changes?

Is the melting point simply the amount of energy needed to "rip apart" bonds?

In the solid state are the molecules actually attached or are they just so close together that they appear attached? If they are attached, what are the bonds made of?

What specifically about the structure of molecules makes them heat and cool at different rates. Why did ethylene glycol take much longer to cool than it did to heat? I know it is antifreeze, so it makes sense that is would be hard to cool down, but what about it makes it behave this way?

Since different substances change states quicker than others, depending on chemical makeup, what elements have been proven to either move quickly or slowly? Do we know what chemical elements have certain predispositions?

How do the formulas relate to poster #3?

What is it about the structure of a molecule that causes different substances to have different transition points?

What determines the strength of the bonds between the molecules of different substances?

Does bond strength directly relate to the time that it takes to freeze or boil a substance? Are any substances so unstable that extremely subtle temperature changes can cause them to freeze or boil?

Why does water expand when frozen unlike most other substances?

In the solid phase, molecules are bonded together and in the liquid and gas phase the molecules begin to drift apart. Why are the molecules so attracted to each other in the solid phase and what causes them to detach themselves from each other in subsequent phases?

Christopher F. Bauer, Principal Investigator.
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Rate of heating/cooling and does direction matter?

We noted that with different substances it took longer to either heat up or cool down. Does it typically take longer to do one or another or is this a part of the human error of the experiment?

What is the standard Newtonian Empirical model of heating/cooling

Is there a correlation between the time it takes a substance to change from a solid to a liquid and then a liquid to a gas? Should one take longer?

Why does it take longer to go from warm to cool, than it does cool to warm in many circumstances?

In our experiment we noticed that it took longer to cool than to warm. Is this only because of human error or do substances take longer to cool than to warm generally?

What properties of a substance determine the speed at which it heats up and changes phases?

In general do substances heat or cool faster?

Why does it take longer for some items to freeze or boil?

Why does it take longer to reach higher temperature or low temperatures? For example the temperature in the simulation can be adjusted quickly in the "mid-range temperatures", but it takes a while to decrease temperature under 15 K.

Do molecules like to be in a more stable and organized state? If so, would this be a reason for a substance to cool more rapidly than heat?

What is the reason behind why some substances took longer to cool down than they did to heat up? Was this caused by errors in the experiment, or does this represent some phenomenon? Do all substances behave this way when being heated/cooled?

What's in between the molecules?

What is in that "empty space" between molecules

What is between atoms/molecules? I have discussed this with multiple groups and we have never agreed on an answer.

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Meaning of the flat parts of heating/cooling curves

Does the specific heat of a substance also pertain to the length of the plateau that we saw on the graphs?

Why does the temperature stop increasing or decreasing during a phase change? What causes the slop to flatten out?

Why exactly is there a dip in the upward curve of the graph where the melting/freezing and boiling/condensation point is?

What is the curve phenomenon we observe on the graphs? (How is this explained and related?) ???

Does threshold point relate to this topic? (reaching/attaining a specific amount of heat/energy to be able to progress to next phase)?

If heat was/could be added at a constant rate, how can temperature not rise at a constant rate?

During the times when the curve "levels off" is the energy being added to the system being used solely for phase change, since temperature isn't increasing?

Fundamental nature of heat or energy

What is the difference between how heat and temperature relate to the state of matter? Is there a difference between heat and temperature's effects?

In the PhET, where is the "increased kinetic energy" coming from? Is heat being placed upon the system, or the result of collisions?

What is the molecular difference between a gas that is hotter than another? Are molecules even more spread apart?

Why does heat make molecules speed up?

How does heat transfer to energy in molecules?

When the cold sample was placed in the room temperature water to raise its temperature, why did the water temperature decrease so minimally if cold was being added to it? Where did the energy go?

How is thermal energy converted to kinetic energy when heat is added to the system?

I have an idea of what is in between the molecules when their structure is being broken down -- heat. But seeing as we are still unsure of what exactly heat is, what is breaking them apart? Energy? Is there ANY "empty" space? Is empty space possible?

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Nature of Phases

Is decreasing/increasing heat (changing the temperature) the only way to cause a phase change?

What allows certain substances to never change into certain phases? (like liquid nitrogen won't every be a solid)

What causes things to burn instead of melt? Is it possible to melt any solid (like meat or bread, e.g.) under the right circumstances?

How is it possible for a solid to go straight from a solid to a gas, skipping the liquid phase?

What happens to molecules in the plasma phase?

What is the difference between vaporization and condensation if condensation if the third transition state during the heating process? ???

What are the properties of a substance as a plasma, the fourth state of matter?

All molecules have a structure. Once they go through a phase change, can they ever come back to that exact structure?

Does the molecular structure of a liquid look different depending on if there was a phase change from solid to liquid to gas or gas to liquid? Or will the liquid phase always be the same? Is this true for all phases?

Does gravity play any part in a substance's ability to undergo a phase change? If so, how?

Why do substances even change phase? Is there reasoning behind why it is necessary? How did someone first find out that solids went to liquid and liquid to gas?

What is the phase called when a substance is between phases? Is there a name for when an ice cube is still half frozen yet in a puddle of water?

As a substance begins to melt or boil, what determines which molecules will turn to liquid first or turn to gas first?

When a substance is in the process of changing phases are the temperatures of the molecules in one phase the same as those who have yet to change phase?

What happened is you superheat a gas?

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Validity of Experiments and Simulations

What is the accurate (with errors) graph of heating/cooling of a substance in order to change states supposed to look like? How did our graphs compare?

How do you measure the time it takes a substance to change phases?

Do scientists consider the melting and boiling point of a substance to be when it first shows signs of transition or when it is fully changed?

Will a substance have a consistent decreasing or increasing graphed line depending on the intensity of heat or cold that is applied to a substance? Would there be no curve to the graphs line if the heat and cold were very extreme, like dry ice?

What happened with the water in the cooling and warming experiment? [Data showed plateau when warming but just a straight line when cooling]

How do we decide what temperature environment is best for heating and what is best for cooling?

If you developed a method of heating/cooling which kept a constant difference (say 20 C) between the sample and its surroundings would there still be the plateau during the phase changes that we see on the graphs?

Is there a temperature that would cause instantaneous freezing or will it always take time for a substance to freeze/melt?

What is the significance of where heating and cooling curves intersect? Should these be points at which a phase change occurs?

On the heating/cooling graphs, do the intersection points have any significance?

Why does the simulation allow us to see something at absolute zero if this is not possible in real life?

AND

What was the significance of experiment C (oil, water, salt water). How does it fit in with the others?

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