PHASE CHANGE: Simulation worksheet

Name: ____________________ Date: _________________ Class: ___________

Phase Change Worksheet Concept of Variation during Phase Change: How are internal energy and Temperature Related?

Vocabulary list:

**Manipulated:** Changed, or modified

**Chlorine:** It is a molecule or substance that is always paired up, it looks like this: 00

**Bromine:** It is a molecule or substance that is always paired up. It has more mass and it is bigger than chlorine.

**Iodine:** It is a molecule or substance that is always paired up. It has more mass and it is bigger than bromine.

Explain, USING COMPLETE SENTENCES, why Gabriella is ‘beasting’ or ‘tripping’? (Tell me why she is complaining).

______________________________________________________________________________
______________________________________________________________________________

Is heat matter or non-matter? __________________________

Heat is a process for _________________ energy.
What 3 variables will you be studying in this simulation? ___________________ ________________

What are the units of heat? (What is heat measured in?) ___________________ (write out the whole word).

What 3 elements are we using in this simulation? _______________ ________________

Phase Change simulation (25 minutes)

Which element is composed of molecules with the smallest mass? ________________

Which element is composed of molecules with the largest mass? ________________

Before you answer any further questions, please turn on the heat and watch the molecules and the graph. Think about the definitions of the different phases of matter (solid, liquid, gas).
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Chlorine (the “green” molecule)

1. What is the temperature before you turn on the flame? ___________ K and ___________ °C
2. What phase is the molecule in? ___________ (solid, liquid, or gas)
3. How many seconds does it take for the molecule to reach its boiling point? ___________ seconds
4. What is the temperature when the molecule reaches its boiling point? ___________ K and ___________ °C
5. How much heat was put into the container to make the liquid boil? ___________ Kj
6. What is happening to the molecules as the temperature on the graph stays the same?

[Graph not shown]

7. What happens to the pressure when all the molecules are in the gas phase?

[Graph not shown]

8. How much heat was put into the container once the phase change is over? ___________ Kj
9. Please copy the graph including scale and labels for both X and Y axis. Add a title!
Bromine (the “red” molecule)

1. What is the temperature before you turn on the flame? __________ K and __________ °C
2. What phase is the molecule in? _______________ (solid, liquid, or gas)
3. How many seconds does it take for the molecule to reach its boiling point? ________ seconds
4. What is the temperature when the molecule reaches its boiling point? __________ K and __________ °C
5. How much heat was put into the container to make the liquid boil? __________ Kj
6. What is happening to the molecules as the temperature on the graph stays the same?
   
7. What happens to the pressure when all the molecules are in the gas phase?

8. How much heat was put into the container once the phase change is over? __________ Kj
9. Please copy the graph including scale and labels for both X and Y axis. Add a title!
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Iodine (the “yellow” molecule)

1. What is the temperature before you turn on the flame? _______________ K and _______________ °C
2. What phase is the molecule in? _______________ (solid, liquid, or gas)
3. How many seconds does it take for the molecule to reach its boiling point? ___________ seconds
4. What is the temperature when the molecule reaches its boiling point? _______________ K and _______________ °C
5. How much heat was put into the container to make the liquid boil? _______________ Kj
6. What is happening to the molecules as the temperature on the graph stays the same?

7. What happens to the pressure when all the molecules are in the gas phase?

8. How much heat was put into the container once the phase change is over? _______________ Kj

9. Please copy the graph including scale and labels for both X and Y axis. Add a title!
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Bringing it all together: Screen 4 (15 minutes)

1. Explain why there wasn't enough water in the saucepan for Gabriella to make hot chocolate

2. How is the water Tac was heating like the liquids you used in the program?

   How is the water Tac was heating different from the liquids you used in the program?

SUMMARY

1. What phase change were you observing in the program?

2. In the simulation, bromine was shown as yellow molecules, chlorine as green molecules, and iodine as red molecules. Are the molecules really those colors? Explain.

3. Looking at your graphs, tell me what was the relationship between heat and temperature?

4. You should have observed that as you heated the molecules of chlorine, bromine and iodine they moved faster. We say that have more kinetic (movement) energy, which we could tell because the temperature (average kinetic energy of the molecules) increased. BUT as the phase change took place the temperature of the element did not change even though we continued to heat the element. What was happening?
Introduction: You know that matter can exist in one of three physical states—solid, liquid, or gas. For a pure substance, changes in state occur at a definite temperature, which is a physical property of that substance. Water, for example, changes from a solid to a liquid at 0°C.

In a solid, the particles are arranged in an orderly, repeating, three-dimensional pattern. As the solid is heated, the energy of the particles increases. Eventually, at some temperature, which is called the melting point, the molecules overcome the forces of attraction holding the particles together, and the substance changes to a liquid. At another temperature, called the boiling point, molecules in the liquid state overcome the forces of attraction between them and the substance changes from a liquid to a gas.

When a liquid is cooled, the reverse process occurs. The temperature of the gas decreases until the condensation point is reached and the gas becomes a liquid. Only after the gas has completely changed to a liquid will the temperature decrease again. The temperature of the liquid decreases further until the freezing point is reached. Only after the liquid is completely changed to a solid will the temperature begin to decrease further.

Purpose: Changes of state (phase changes) occur in the change between solid and liquid and liquid and gas. In the phase change simulation you observe a change between liquid and gas. In this activity, you will observe what happens as lauric acid (C12H24O2) melts. You will measure the temperature at timed intervals as the lauric acid is heated to determine its melting point experimentally (What other strategies could you use to find out a temperature for the melting point of lauric acid? Why are both useful?)

Pre-Lab:

1. What phase is the lauric acid in at the beginning of the lab? ________________

2. What will be the next phase the acid changes to when you add heat? ________________

3. Based on the simulations we did yesterday, predict the shape of its heating curve:
4. What are the independent and dependent variables?

Independent: ________________  Dependent: ________________

5. What do you always need to wear while chemicals are on the lab tables? Why?

Materials:

- goggles
- lauric acid test tube
- 2 beakers, 400 mL
- thermometers
- hot plate
- tap water
- ice for ice bath

Procedure:

1. Put on goggles.
2. Fill one 400 mL beaker _ full of tap water and heat it on the hot plate. Turn the hot plate all the way to 10. Once you see tiny bubbles, turn it down to 6. CAUTION: Do not touch the hot plate or beaker.
3. At the same time make an ice bath using a 400 mL beaker and ice from the front desk.
4. Get a large test tube of lauric acid and hold it with a test tube holder. Place it in the hot water bath. (You need to melt the lauric acid so you can insert the thermometer into the acid)
5. As the solid begins to melt, place a thermometer into the test tube, once you are able to insert the thermometer (see diagram on previous page), use the test tube holder to place the test tube in an ice water bath. Stop once the temperature reaches about 30(C.
6. Carefully place the test tube containing the lauric acid back into the hot water bath (it should NOT be boiling).
7. Immediately begin to take temperature readings every 30 seconds. Record your temperatures and time in the data table provided.
8. Begin stirring gently as soon as you are able to move the thermometer easily. Continue to
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measure and record the temperature until the lauric acid is at approximately 55°C.
9. Turn off the hot plate. Remove the thermometer from the lauric acid and return test tube to your teacher.
10. Clean up your work station and wash your hands.

Observations:

Approximate melting point of lauric acid _____________

Describe the changes you witnessed?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Could you see the actual molecules? Why or why not?

_________________________________________________________________________
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Data Table:

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Temperature (°C)</th>
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<tbody>
<tr>
<td>0</td>
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<td>(right when you put the test tube in hot water)</td>
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<td>0.5</td>
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<td>(30 seconds)</td>
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</tbody>
</table>

Why do you need to record so many points?

______________________________________________________________________________
______________________________________________________________________________
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Draw a graph representing the table on the previous page. You MUST label all axes, put in the scale, and write a title.

Title: ________________________________

Think About it:

1. Did you prediction match your actual data? ____________ Why do you think it was the same or different?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
2. What was difficult about the procedure (measuring the temperature, keeping the time, etc...)?
_____________________________________________________________________________
_____________________________________________________________________________

3. How can you explain the fact that at its melting point the temperature of the lauric acid did not change even though you were still adding heat? What is happening to the heat energy you are putting into the lauric acid:
   When it is a solid?
__________________________________________________________________________
__________________________________________________________________________
When it is changing from solid to liquid? [What is happening to the forces of attraction between the lauric acid molecules?]
__________________________________________________________________________
__________________________________________________________________________
When it is a liquid?
__________________________________________________________________________
__________________________________________________________________________

4. What were the similarities and differences between what we did in the simulation yesterday and the lab we did today?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

5. How did the simulation help you understand what is happening to the lauric acid as it melts? Give specific details
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

6. The simulation you did yesterday is a model that explains the relationship between heat and temperature during a phase change. Why do you think scientists need to test things theoretically and also do actual experiments?
7. Draw particle diagrams of what you think the molecules will look like as a solid and as a liquid:

Solid  

During Melting  

Liquid