**Watch this video BEFORE you do the lab activity!**

[**https://www.youtube.com/watch?v=hrUZnXHERao**](https://www.youtube.com/watch?v=hrUZnXHERao)

**Alternate Lab – A Heating and Cooling Curve for Lauric Acid**

**Part 1: Heating Curve**

Using the data below, make a heating curve on graph paper (or use Excel or Google Charts). There is graph paper you can print on the Documents page of the web site. Time will be the independent variable, so will be on the x axis. Temperature will be the dependent variable and will be the y axis. Be sure to label your axes. You will label points A-E on the graph. Also, complete the paragraph below using the word bank. **Your graph should be neat, well-labeled, with appropriate scales for the axes. Utilize the entire piece of graph paper (make your graph big).**

**Data for Heating Curve**

**Graph Interpretation:**

At the start of the observations, Point A, the substance exists as a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The temperature at this point is \_\_\_\_\_\_\_\_\_\_\_\_. As heat is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the temperature of the substance rises at a constant rate for \_\_\_\_\_\_\_\_\_\_\_ minutes. At point B the temperature is \_\_\_\_\_\_\_\_\_\_\_. The solid begins to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The temperature remains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at 50°C, until the change from \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is complete. It has taken \_\_\_\_\_\_\_\_\_\_\_\_ minutes to add enough \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to melt the solid completely. From point C to point D, the substance is in the \_\_\_\_\_\_\_\_\_\_\_\_\_ state. Its temperature rises at a constant rate to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The temperature remains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ while the \_\_\_\_\_\_\_\_\_\_\_\_\_ changes to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This change required \_\_\_\_\_\_\_\_\_\_ minutes. The heat required to vaporize the liquid is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the heat required to melt the solid. At point E, the substance exists as a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Its temperature rises \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as heat is added.

**Word Bank:** (words can be used more than once)

constantly melt 4

gas 50 100

liquid 2 10

solid 3 heat

added more constant

|  |  |  |
| --- | --- | --- |
| Time (minutes) | Temp (°C) | Points to be labeled |
| 0 | 10 | A |
| 0.5 | 20 |  |
| 1.0 | 30 |  |
| 1.5 | 40 |  |
| 2.0 | 50 | B |
| 2.5 | 50 |  |
| 3.0 | 50 |  |
| 3.5 | 50 |  |
| 4.0 | 50 |  |
| 4.5 | 50 |  |
| 5.0 | 50 | C |
| 5.5 | 58 |  |
| 6.0 | 62 |  |
| 6.5 | 68 |  |
| 7.0 | 75 |  |
| 7.5 | 80 |  |
| 8.0 | 86 |  |
| 8.5 | 93 |  |
| 9.0 | 98 |  |
| 9.5 | 106 |  |
| 10.0 | 110 | D |
| 10.5 | 110 |  |
| 11.0 | 110 |  |
| 11.5 | 110 |  |
| 12.0 | 110 |  |
| 12.5 | 110 |  |
| 13.0 | 110 |  |
| 13.5 | 110 |  |
| 14.0 | 110 | E |
| 14.5 | 126 |  |
| 15.0 | 140 |  |
| 15.5 | 154 |  |
| 16.0 | 170 |  |

**Part 2: Cooling Curve**

Using the data below, create a cooling curve for the substance. **The cooling curve should be on the same graph as the heating curve**. Color code your graph as described below. Then answer the questions. Write your answers on a separate piece of paper.

NOTE: If you do not have colored pencils or pens or crayons, then you can just neatly label the different sections of the cooling curve.

Red = Solid phase

Yellow = Liquid phase

Blue = Gas phase

Orange = Phase change between solid and liquid

Green = Phase change between liquid and gas

**Data for Heating Curve**

**Questions:**

1. In what way is the graph in part B different from the graph in part A?
2. What temperature (on both graphs) would you say is the boiling point?
3. What temperature (according to both graphs) is the melting point?
4. What do you notice about the phase changes?
5. Define molar heat of fusion. (Look this up.)
6. Define molar heat of vaporization. (Look this up.)
7. Explain the diagonal parts of the cooling curve in terms of changes in kinetic and potential energy. Do the same for the horizontal parts of the cooling curve.
8. What phase changes are exothermic? What phase changes are endothermic? Explain your answer.
9. In which phase of a substance do the particles have the greatest kinetic energy?

|  |  |
| --- | --- |
| Time (minutes) | Temp (°C) |
| 0 | 170 |
| 0.5 | 154 |
| 1.0 | 140 |
| 1.5 | 120 |
| 2.0 | 110 |
| 2.5 | 110 |
| 3.0 | 110 |
| 3.5 | 110 |
| 4.0 | 110 |
| 4.5 | 110 |
| 5.0 | 110 |
| 5.5 | 110 |
| 6.0 | 110 |
| 6.5 | 100 |
| 7.0 | 98 |
| 7.5 | 93 |
| 8.0 | 86 |
| 8.5 | 80 |
| 9.0 | 75 |
| 9.5 | 68 |
| 10.0 | 62 |
| 10.5 | 58 |
| 11.0 | 50 |
| 11.5 | 50 |
| 12.0 | 50 |
| 12.5 | 50 |
| 13.0 | 50 |
| 13.5 | 50 |
| 14.0 | 50 |
| 14.5 | 40 |
| 15.0 | 30 |
| 15.5 | 20 |
| 16.0 | 10 |