LAB ICEWATER MIXTURE TEMPERATURE VS. TIME

STUDENT COPY

**BACKGROUND**

**C5.4B**

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| **Change of state and latent heat**: For example: ice is in a solid state. When heat is applied, it turns into liquid water. When more heat is supplied, water changes into gaseous form that is steam.   |  |  | | --- | --- | | The change from solid http://home.att.net/~cat4a/images/eq.jpg liquid http://home.att.net/~cat4a/images/eq.jpggas is called as a change of state of a substance or a compound.    We know by now that solids are bound together by tight bonds. As we supply energy, the bonds start to stretch. This transforms the solid into liquid state. As more energy is given to the system, the bonds stretch even more and ultimately break. The liquid then is turned into gaseous matter. The inter-molecular forces become weaker as we go from solid to liquid to gaseous state. | http://home.att.net/~cat4a/images/heat_1.gif | |  | **Change In State** |   The process of converting a solid into liquid is known as melting. The temperature at which melting occurs is called the **melting point**. The inverse of melting is called as freezing or solidification. If solidification makes the solid into properly structured crystals, the process is also known as crystallization process. The process of converting liquid into gas is called vaporizing. The inverse of vaporizing is known as condensation. The temperature at which the liquid turns into gas is called the **boiling point** of the substance.  Some solids like solid iodine, carbon dioxide, naphthalene balls convert to gaseous state directly from their solid state. They jump the liquid state. The process of going from solid state to gaseous state directly is known as sublimation. Inverse of sublimation is called as condensation.  Thus temperature of a substance remains steady during the change of state despite addition (or withdrawal) of energy. **The absorption (or release) of heat while changing state is known as the latent heat.**  **Latent heat of a substance is the amount of heat absorbed (or released) by a unit mass of substance to change its state without any change in temperature.** The unit for latent heat is joules per kilogram or J/kg. Latent heat is denoted by L. The latent heat for solid to liquid is known as the latent heat of fusion. The latent heat from liquid to gas is known as latent heat of vaporization.  If L is the latent heat of a substance and m is the mass of the substance, then the heat Q required (absorbed or released) to change its state = QL  It may be clear now, that the latent heat of ice (to water) is different from the latent heat of steam (water to steam).   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Materials**  100ml Beaker Stirrer  Ice Thermometer  Ring Stand Ring  Mesh Bunsen Burner  *Caution: Heat/flame observe laboratory precautions for using gas, flame and heat.*  **Procedure**   1. Fill beaker with approximately 10-15 cubes of ice. 2. Record the temperature in chart (provided). 3. Record the temperature over the next 5 minutes. (While stirring continuously) 4. Slowly heat ice and record temperature at minute intervals. (Continue to stir for temperature to remain constant throughout mixture). 5. Record the temperature when the mixture first begins to boil. 6. Record temperature until the mixture has reduced its volume by half. 7. Record your final volume. 8. Graph your results   **DATA**   |  |  | | --- | --- | | TIME  (mins) | TEMP  (C°) | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  | | Initial Temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_°C Final Temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_°C |  | |  |  |     **QUESTIONS**  ANSWER QUESTIONS USING YOUR GRAPH   1. What happens to the temperature when the ice begins to melt? Does the temperature change when it becomes an ice water mixture? 2. Discuss what happens to the temperature when the mixture is heated. 3. At what temperature does the water mixture boil? (BOILING POINT) 4. What happens to the temperature as you continue to boil the mixture? 5. Explain what happened to the final volume. 6. Interpret your graph by describing what happens from the time the ice is placed in the beaker to the end of the experiment. (Include the following words: latent heat of ice, latent heat of steam, solid, liquid, gas, melting point, boiling point, and evaporation). |

LAB ICEWATER MIXTURE TEMPERATURE VS. TIME

TEACHER COPY

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| **Change of state and latent heat**: For example: ice is in a solid state. When heat is applied, it turns into liquid water. When more heat is supplied, water changes into gaseous form that is steam.   |  |  | | --- | --- | | The change from solid http://home.att.net/~cat4a/images/eq.jpg liquid http://home.att.net/~cat4a/images/eq.jpggas is called as a change of state of a substance or a compound.    We know by now that solids are bound together by tight bonds. As we supply energy, the bonds start to stretch. This transforms the solid into liquid state. As more energy is given to the system, the bonds stretch even more and ultimately break. The liquid then is turned into gaseous matter. The inter-molecular forces become weaker as we go from solid to liquid to gaseous state. | http://home.att.net/~cat4a/images/heat_1.gif | |  | **Change In State** |   The process of converting a solid into liquid is known as melting. The temperature at which melting occurs is called the **melting point**. The inverse of melting is called as freezing or solidification. If solidification makes the solid into properly structured crystals, the process is also known as crystallization process. The process of converting liquid into gas is called vaporizing. The inverse of vaporizing is known as condensation. The temperature at which the liquid turns into gas is called the **boiling point** of the substance.  Some solids like solid iodine, carbon dioxide, naphthalene balls convert to gaseous state directly from their solid state. They jump the liquid state. The process of going from solid state to gaseous state directly is known as sublimation. Inverse of sublimation is called as condensation.  **Materials**  100ml Beaker Stirrer  Ice Thermometer  Ring Stand Ring  Mesh Bunsen Burner  *Caution: Heat/flame observe laboratory precautions for using gas, flame and heat.*  **Procedure**   1. Fill beaker with approximately 10-15 cubes of ice. 2. Record the temperature in chart (provided). 3. Record the temperature over the next 5 minutes. (While stirring continuously) 4. Slowly heat ice and record temperature at minute intervals. (Continue to stir for temperature to remain constant throughout mixture). 5. Record the temperature when the mixture first begins to boil. 6. Record temperature until the mixture has reduced its volume by half. 7. Record your final volume. 8. Graph your results  |  |  | | --- | --- | | When heat energy is supplied to a substance, its temperature rises. Take some ice in a beaker. Put a thermometer in the ice. Add a stirrer to make the temperature uniform in the entire mixture. Measure the time and see how the temperature varies. After all the ice has melted into water, heat the water with the help of a lab burner. Heat the water till the water starts boiling. | http://home.att.net/~cat4a/images/heat_2.gif |   Plot a graph of Temperature vs. Time (in minutes), http://home.att.net/~cat4a/images/heat_3.gif                          **Graph of Temperature vs. Time (in minutes)**  **QUESTIONS**  ANSWER QUESTIONS USING YOUR GRAPH   1. What happens to the temperature when the ice begins to melt? **The temp will remain at 0 °**. Does the temperature change when it becomes an ice water mixture? **NO** 2. Discuss what happens to the temperature when the mixture is heated. **The graph/temperature increases**. 3. At what temperature does the water mixture boil? (BOILING POINT) **100 ° C** 4. What happens to the temperature as you continue to boil the mixture? **It remains at 100 °C** 5. Explain what happened to the final volume. **The volume decreased because the liquid changed to vapor**. 6. Interpret your graph by describing what happens from the time the ice is placed in the beaker to the end of the experiment. (Include the following words: latent heat of ice, latent heat of steam, solid, liquid, gas, melting point, boiling point, and evaporation). **Answers will vary, but should recapitulate the paragraphs below.**   You will notice that the ice is at 0°C. Even when some of the ice is turned into water, the mixture of ice and water still stays at 0°C. The mixture remains at 0°C till all the ice has melted. As the heat is applied, the temperature of the water rises. Then the water starts boiling. The temperature now is 100°C. Even if you apply more heat the temperature of the boiling water remains same at 100°C. This will happen till all the water is boiled off!! The same observation you will be able to see if you reverse the whole process.  Thus temperature of a substance remains steady during the change of state despite addition (or withdrawal) of energy. **The absorption (or release) of heat while changing state is known as the latent heat.**  **Latent heat of a substance is the amount of heat absorbed (or released) by a unit mass of substance to change its state without any change in temperature.** The unit for latent heat is joules per kilogram or J/kg. Latent heat is denoted by L. The latent heat for solid to liquid is known as the latent heat of fusion. The latent heat from liquid to gas is known as latent heat of vaporization.  If L is the latent heat of a substance and m is the mass of the substance, then the heat Q required (absorbed or released) to change its state = QL  It may be clear now, that the latent heat of ice (to water) is different from the latent heat of steam (water to steam). |