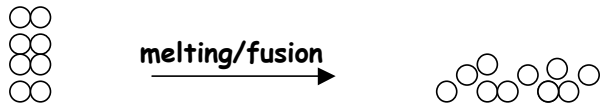
Name: _____

Unit 4 - Topic 5

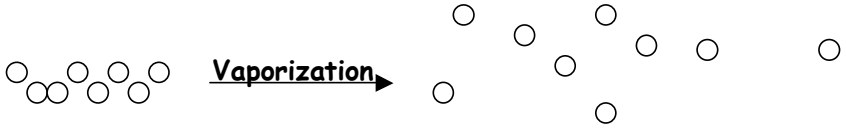
Phase Changes

MELTING, or "FUSION": We can represent phase changes with particle diagrams. The following particle diagram represents melting. Melting is also known as fusion, so chemists refer to the amount of energy needed to make a substance melt as the "heat of fusion".



The added energy *decreases* the attractions between particles, causing them to be *less orderly*, but **still attracted** to one another.

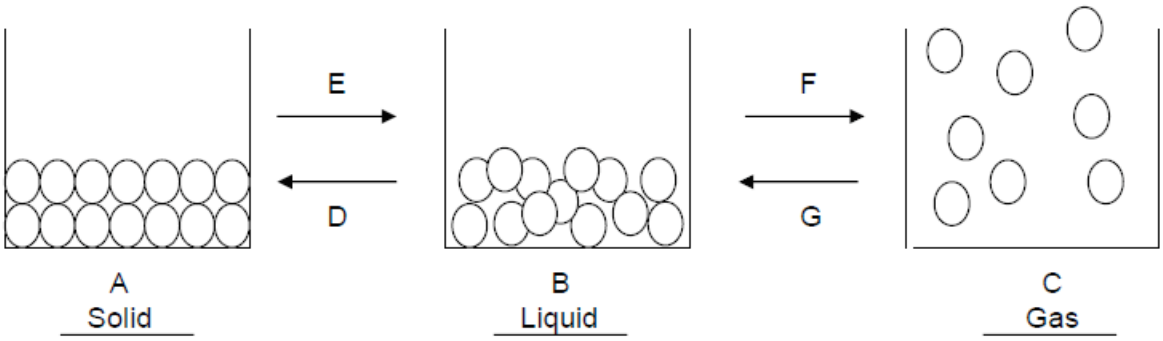
BOILING: We can represent phase changes with particle diagrams. The following particle diagram represents boiling. Boiling is a form of vaporization, so chemists refer to the amount of energy needed to make a substance boil as the "heat of vaporization".



In this case, the added energy *completely overcomes* the attractions between particles, causing them to *become totally dis- orderly* in their conduct, with **no attractions** to one another.

Use Model 1 to answer the following questions:

Model 1: Representations of Molecules in Three Phases



1. Label each arrow (D, E, F, G) with the appropriate phase change (fusion/melting, solidification/freezing, boiling/condensation).

2. Which arrows in Model 1 indicate the addition of energy? _____

3. Which term, endothermic or exothermic, is used to describe the situation when energy is added into a system from the surroundings? _____

4. Which arrows in Model 1 indicate the release of energy? _____ and _____

5. What are the names of the phase changes shown above that would be considered 'exothermic'? _____ and _____

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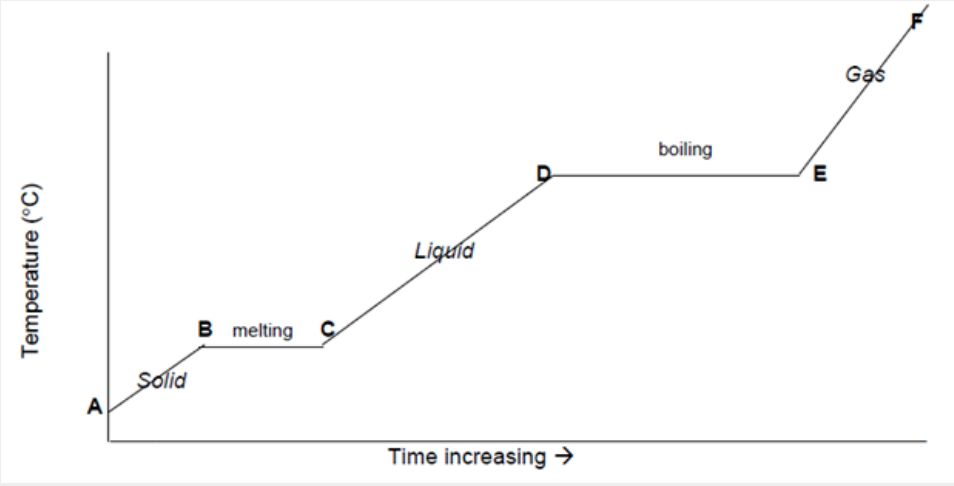
Refer to Model 2 to answer the following questions:

Model 2: A Plot of Temperature of a Substance as Heat is Added Over Time



6. What is plotted on the x-axis and what is plotted on the y-axis of the graph?

7. During which line segments does temperature increase? _____

8. During which line segments is there no change in temperature? _____

9. If this substance were water, at what temperature would segment BC occur? _____

10. If this substance were water, at what temperature would segment DE occur? _____

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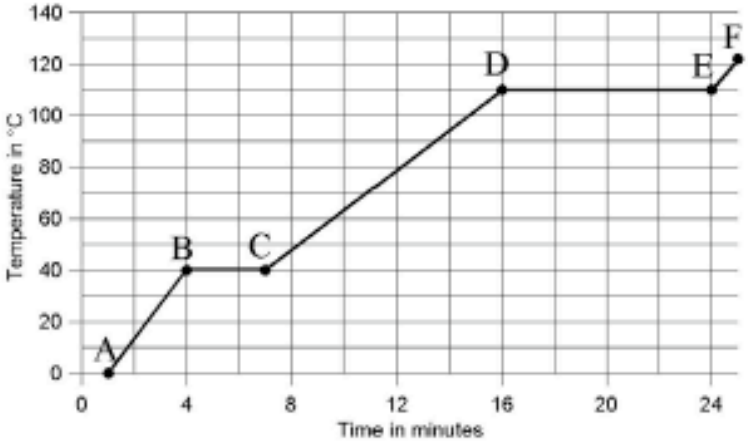
Heating/Cooling Curve



As a substance is heated, its particles begin to move faster and spread apart. The speed of the particles is related to their kinetic energy. The relative position of the particles is related to their potential energy. As solids, liquids, and gases are heated, most of the energy that is absorbed is converted into kinetic energy and the temperature goes up. But as a substance melts or vaporizes, its particle spread out tremendously. As a result, the energy absorbed produces changes in the potential energy of the particles, so the temperature does not change as the phase changes. For that reason, the freezing point and the boiling point of a substance are the same.

Base your answers to the following questions on the graph which shows 10.0 kg of a substance that is a solid at 0˚C and is heated at a constant rate of 60 kilojoules per minute.

1. _____ What is the temperature at which the substance can be both in the solid and the liquid phase?
2. _____ During which lettered intervals is the kinetic energy of the particles increasing?
3. _____ During which lettered intervals is the substance solid?
4. _____ During which lettered intervals is the substance in the liquid phase?
5. _____ During which lettered intervals is the substance in the vapor phase?
6. _____ What is the temperature at which the substance can be both in the liquid and the vapor phase?
7. Which segments represent an increase in kinetic energy? _____
8. Which segments represent kinetic energy staying the same? _____