

Exercise 10.4a

Phase Changes & Phase Diagrams

Name: _____

Date: _____ Per: _____

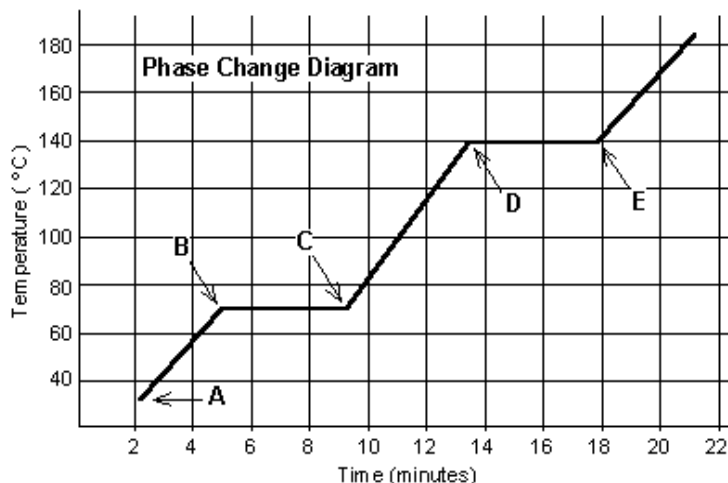
A change in enthalpy (ΔH) is a measurement of energy transfer in the form of heat. Energy may be gained from the surrounding environment by a substance (or system) in an endothermic process ($+\Delta H$), removing heat (i.e., cooling) the surrounding environment. Energy may also be released to the surrounding environment by a substance (or system) in an exothermic process ($-\Delta H$), causing heating of the surrounding environment.

During a phase change the temperature of the substance does not change. Energy is either being absorbed by a substance to overcome intermolecular forces and spread the particles out or is being released as the potential energy of separated particles is converted to motion and particles are drawn together into more condensed arrangements.

Enthalpy of fusion (energy necessary to break solids into liquids) and enthalpy of fusion (energy necessary to separate liquids into gases) may be expressed per gram of substance (kJ/g) or per mole of substance (kJ/mol).

Directions: The graph was drawn from data collected as a substance was heated at a constant rate. Use the graph to answer the following questions.

At (A) the substance exists in a _____ state. Material in this phase has _____ volume and _____ shape. As _____ is added to the substance, the particles of the substance _____ more rapidly causing the _____ to rise. At (B) the temperature of the substance is _____ °C. This represents the _____ point of the substance. Between (B) and (C) temperature remains _____ as energy is added to the substance.



The energy breaks _____ forces and increases the substance's _____ energy. At (C) the substance has completely _____ and exists in a _____ state. Material in this phase has _____ volume and _____ shape. The energy added to the substance between (B) and (C) was used to convert the substance from a _____ to a _____. This heat energy is called the **enthalpy of fusion**. Between (C) and (D), as heat is added, the _____ increases indicating an increase in _____ energy of the substance. At point (D) the temperature of the substance is _____ °C and the substance has reached its _____ point. Additional heat added to the substance after (D) breaks _____ forces and increases the substance's _____ energy. The energy involved in the change from (D) to (E) is _____ than the energy involved in the change from (B) to (C). The change between (D) and (E) is called _____. At (E), the substance is completely in the _____ phase. Material in this phase has _____ volume and _____ shape. The energy added to the substance between (D) and (E) converted the substance from a _____ to a _____ state. This energy is called the **enthalpy of vaporization**. Beyond (E), the substance is in the _____ phase and added heat causes the particles to move _____ as indicated by the increasing temperature. In summation, the sloped regions of the graph represent changes in _____ energy causing particles to _____, and the level regions of the graph represent changes in _____ energy causing particles to _____.

Which of these three substances was likely used in this phase change experiment? _____

Substance	Melting point	Boiling point
X	20 °C	100 °C
Y	40 °C	140 °C
Z	70 °C	140 °C

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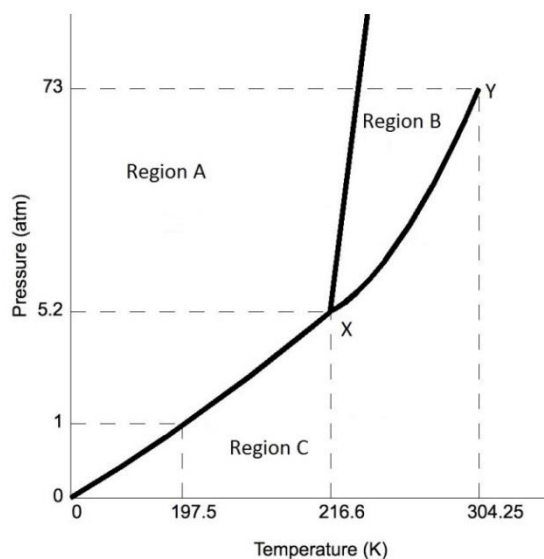
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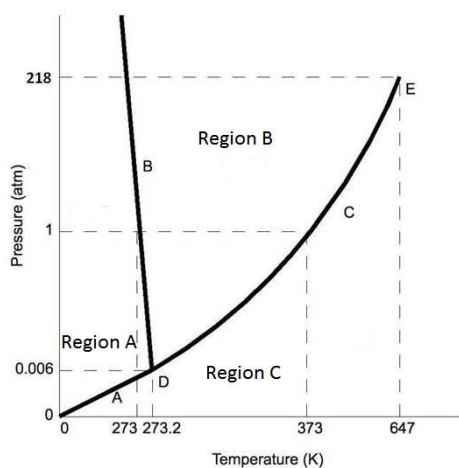
DIRECTIONS: Use the graph at right to answer questions 1-9.

- Which region of the diagram represents the solid phase? _____
- Which region of the diagram represents the liquid phase? _____
- Which region of the diagram represents the gaseous phase? _____
- What is occurring along the line between Region A and Region B? _____
- What is occurring along the line between Region A and Region C? _____
- What is occurring along the line between Region B and Region C? _____
- What is occurring at 1 atm and 197.5 K?



- Describe the triple point of this substance. What point represents the triple point and what is occurring at those conditions?

- Describe the critical point of this substance. What point represents the critical point and what is occurring at those conditions?



DIRECTIONS: Use the graph at left to answer questions 10-16.

- Which region of the diagram represents the solid phase? _____
- Which region of the diagram represents the liquid phase? _____
- Which region of the diagram represents the gaseous phase? _____
- What is the boiling point of this substance at 1 atm? _____
- What is happening at 1 atm and 273 K? _____

- At a constant temperature, what could be done to cause a liquid to gas phase change? _____

- At what point(s) on the graph do multiple phases exist? _____
- Which of the two substances described by these phase diagrams exhibits higher intermolecular forces? Explain your reasoning. _____

