Name Key Date ________ Class ____________

SECTION 2-3 SECTION SUMMARY

Graphing Gas Behavior

Guide for Reading

- What do graphs for Charles's law and Boyle's law look like?

Graphs are diagrams that tell how two variables are related. Graphs show how changes in one variable result in changes in a second variable. Graphs can be used to show the relationships between the volume, temperature, and pressure of gases.

A graph consists of a grid set up by two lines, one horizontal and one vertical. Each line, or axis, is divided into equal units. The horizontal, or *x*-, axis shows the manipulated variable (the variable that is changed). The vertical, or *y*-, axis shows the responding variable. Each axis must be labeled with the correct unit of measurement.

Charles's law relates the temperature and volume of a gas kept at a constant pressure. To investigate Charles's law, an experiment can be performed in which you change the temperature of a gas and measure its volume. Pressure is kept constant as the expanding gas moves a piston.

A data table of the results is created. Each temperature in Celsius degrees is converted to kelvins by adding 273. The Kelvin temperatures are used to graph the data. In this graph, all the points from the temperature and volume table lie on a straight line. If you extend the line downward, it would pass through the point (0, 0). When a graph of two variables is a straight line passing through the (0, 0) point, the variables are **directly proportional** to each other. **The graph of Charles's law shows that the volume of a gas is directly proportional to its Kelvin temperature under constant pressure.**

The relationship between pressure and volume, Boyle's law, can also be examined by containing a gas in a cylinder with a movable piston. The piston is slowly pushed in, compressing the gas to a smaller volume. As the volume changes, the pressure of the gas is recorded. In this experiment, the volume, shown on the *x*-axis, is the manipulated variable. The responding variable is pressure, which is shown on the *y*-axis.

The data points on the pressure-volume graph lie on a curve. The curve slopes downward from left to right, and is steeper closer to the vertical axis. When a graph of two measurements forms this kind of curve, the measurements **vary inversely. The graph for Boyle's law shows that the pressure of a gas varies inversely with its volume at constant temperature.** The pressure of a gas decreases as its volume increases.

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SECTION 2-3 ENRICH

Grasping Gas Graphs

You have examined the relationship between the temperature and volume of a gas, and between the pressure and volume of a gas. Suppose a scientist wants to determine whether the number of particles of a gas is related to its pressure. Data for this experiment can be collected by increasing the number of gas particles in a container with a constant volume and temperature, and measuring the pressure of the gas. The number of gas particles can be increased by pumping more gas into the container. Sample data from such an experiment are shown by the solid line in Figure 1. The dotted line shows how the resulting graph can be extended.

The relationship between the number of particles of a gas and its volume at a constant temperature can be determined in a similar way. Data for this experiment can be collected by increasing the number of gas particles in a cylinder that has a movable piston and measuring the effect on the volume. The graph in Figure 2 shows sample data from such an experiment.

Figure 1

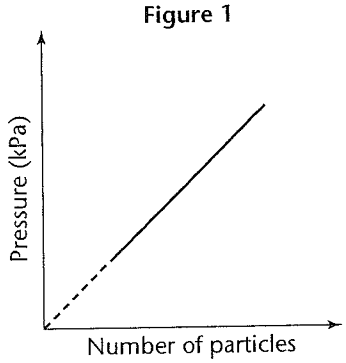
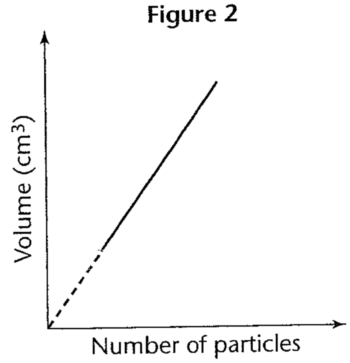


Figure 2



Answer the following questions on a separate sheet of paper.

1. What is the manipulated variable in each graph? What is the responding variable?
2. What is the relationship between the number of gas particles and pressure? Are these two variables directly proportional or do they vary inversely?
3. What is the relationship between the number of gas particles and volume? Are these two variables directly proportional or do they vary inversely?
4. When the number of gas particles in a container with constant volume decreases, how will the pressure of the gas change?
5. When the number of gas particles at constant pressure increases, how will the volume of the gas change?

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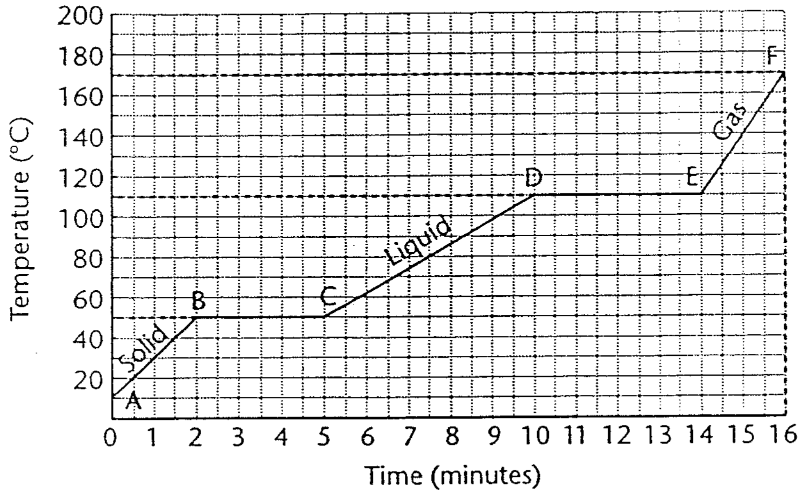
Chapter 8

REINFORCEMENT

Use with Text Pages 224–227

Changes in State

Look carefully at the graph. It was drawn from the data collected when a substance was heated at a constant rate. To heat at a constant rate means to add heat evenly as time passes. Use the graph to complete the paragraphs that follow.



At the start of observations, Point A, the substance exists in the ________ state. The temperature at this point is ________. As energy is ________, the temperature of the substance rises at a constant rate for two minutes. At Point B, the temperature is ________, and the solid begins to ________. The temperature remains constant until the change from solid to ________ is complete. It has taken three minutes to add enough energy 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 constant while the liquid changes to a ________. At Point E, the substance exists as a ________. Its temperature rises ________ as energy is added.

When the gaseous substance is allowed to cool, it ________ energy. The cooling curve will be the reverse of the warming curve. Energy will be released as the substance changes from a ________ to a ________ and also from a ________ to a ________. The amount of energy released during condensation will be the same as the amount ________ during vaporization.

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SECTION 2-3 **ENRICH**

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Grasping Gas Graphs

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Figure 1

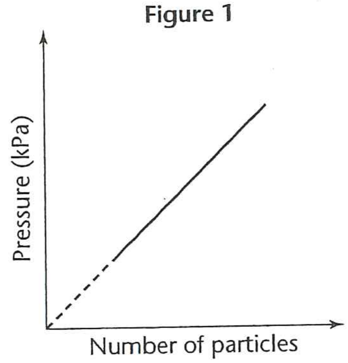
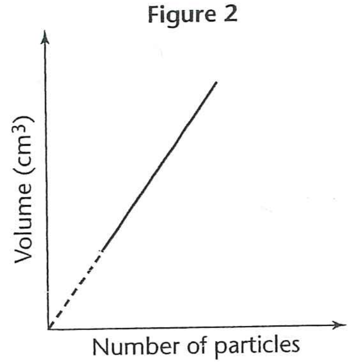


Figure 2



Answer the following questions on a separate sheet of paper.

1. What is the manipulated variable in each graph? What is the responding variable? # particles (pressure + volume
2. What is the relationship between the number of gas particles and pressure? Are these two variables directly proportional or do they vary inversely? → one goes up, other goes up.
3. What is the relationship between the number of gas particles and volume? Are these two variables directly proportional or do they vary inversely? - same
4. When the number of gas particles in a container with constant volume decreases, how will the pressure of the gas change? decrease
5. When the number of gas particles at constant pressure increases, how will the volume of the gas change? increase

NAME Key DATE CLASS

Chapter 8

REINFORCEMENT

Use with Text Pages 224–227

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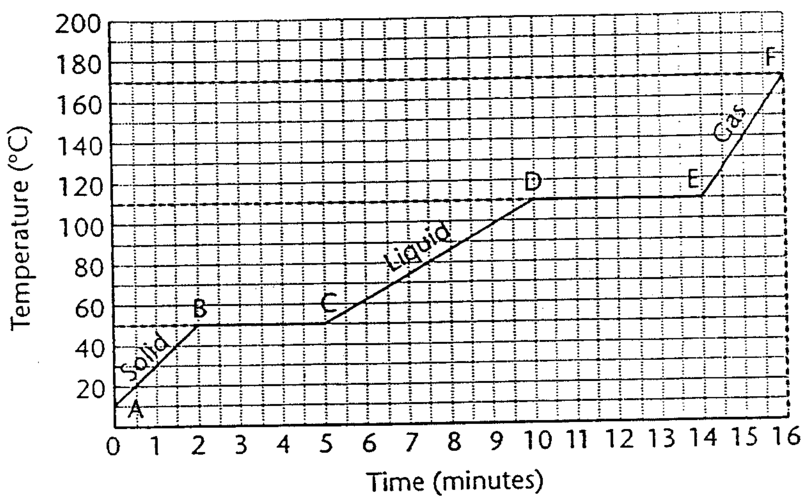

At the start of observations, Point A, the substance exists in the Solid state. The temperature at this point is 10°C. As energy is absorbed, the temperature of the substance rises at a constant rate for two minutes. At Point B, the temperature is 50°C, and the solid begins to Melt. The temperature remains constant until the change from solid to Liquid is complete. It has taken three minutes to add enough energy to melt the solid completely. From Point C to Point D, the substance is in the Liquid state. Its temperature rises at a constant rate to 110°C. The temperature remains constant while the liquid changes to a gas. At Point E, the substance exists as a gas. Its temperature rises quickly as energy is added.

When the gaseous substance is allowed to cool, it releases energy. The cooling curve will be the reverse of the warming curve. Energy will be released as the substance changes from a gas to a Liquid and also from a Liquid to a Solid. The amount of energy released during condensation will be the same as the amount absorbed during vaporization.