

5—Change of Phase

A ¹Rub your hands together quickly for 10 seconds then hold them to your face. ²Notice how warm your palms feel. ³When you rubbed your hands, you created *friction*. ⁴Friction produces **heat**, a form of energy.

B ⁵It took muscle energy to move your hands. ⁶Was the muscle energy changed into heat energy when you rubbed your palms together?

C ⁷When you rub your hands together quickly, the atoms that make up your skin move faster. ⁸As they do, they produce friction, and friction produces heat. ⁹Therefore, your palms get warmer. ¹⁰Heat can also come from other sources, such as fire, the sun, or an electric stove. ¹¹When heat from any source is applied to a substance, the atoms in that substance speed up and the substance gets warmer.

You put a warm substance in the refrigerator. Is heat removed from the substance? What happens to the speed of the atoms?

D ¹²The atoms of a solid normally move very little. ¹³As you add more heat to a solid, its atoms move faster and faster. ¹⁴When enough heat is added, the solid melts. ¹⁵That means that when enough heat is applied to a solid, it changes state from a solid to a liquid. ¹⁶This change in state from solid to liquid is called **melting**. ¹⁷Think of a similar definition for *freezing*.

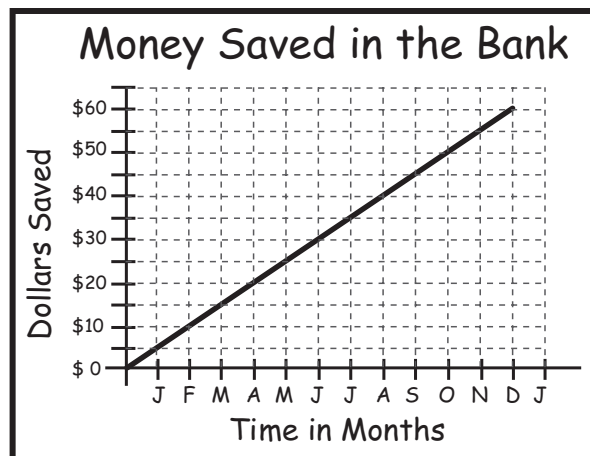
E ¹⁸When there is a change in state because atoms have speeded up or

slowed down, scientists say that there has been a **change in phase**.

F ¹⁹Now think about liquids. ²⁰If enough heat energy is applied to a liquid, it will become a gas. ²¹As water is heated, it gets hotter and hotter until it boils. ²²A gas called water vapor is produced. ²³If the water is left to boil long enough, all the water will vaporize. ²⁴**Vaporization** is the change in phase from a liquid to a gas.

G ²⁵Sometimes a gas will lose heat and return to liquid. ²⁶Think of a hot shower. ²⁷The hot water produces a lot of water vapor. ²⁸You may have seen what happens when hot water vapor touches a cold surface like a bathroom mirror! ²⁹The vapor cools and changes into a liquid. ³⁰The change in phase from a gas to a liquid is called **condensation**.

H ³¹A **line graph** shows how one thing affects another over a period of time. ³²The line graph below shows what happens when you deposit 5 dollars a month in a savings account. ³³Think about how much money you save as time goes by. ³⁴How much money do you save in 3 months?



1. For each statement, circle T or F for true or false. In the blanks, write the letter(s) of the PARAGRAPH(s) that give the best evidence for your answer.

a. Friction produces energy. T F _____

b. Cooling an object speeds up its atoms. T F _____, _____

c. A solid can become a liquid by slowing its atoms. T F _____

d. A vapor is a gas. T F _____

2. Look again at the graph called *Money Saved in the Bank*. How much money has been saved after 1 year and 1 month? (Hint: use a ruler to continue the line.) _____

3. What is the most likely meaning of *applied to*, as used in sentence 15?

- a. taken off c. removed from
- b. made into d. added to

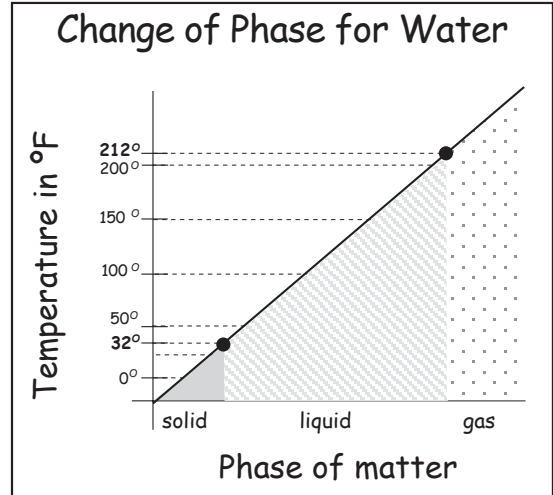
Write the number of the sentence that gives the best evidence for your answer. _____

4. Does it take energy to change liquid water into water vapor? _____

Write the letter of the paragraph that best supports your answer. _____

5. Based on paragraph D, what is a likely definition for *freezing*?

Use the graph below to answer questions 6 and 7.



6. Which statement is supported by the graph? Water is

- a. a solid at 190° F.
- b. a gas at 190° F.
- c. a liquid at 190° F.
- d. a vapor at 0° F.

7. Look at the graph above. Water is in which phase of matter at the following temperatures?

- (S = solid, G = gas, L = liquid)
- a. 19° F _____ c. 230° F _____
 - b. 90° F _____ d. 0° F _____

8. What could you do to a bathroom mirror to prevent it from fogging up during a hot shower?

Write the letter of the paragraph that best supports your answer. _____

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1. a. T A; b. F C, D; c. F D; d. T E
2. \$65
3. d, 14
4. Yes, E
5. Freezing is the change in state from a liquid to a solid.
6. c
7. a. S, b. L, c. G, d. S
8. Heat the mirror. (Use a blow dryer, etc.; also, using a ventilation fan could prevent vapor build-up.)
G