

## Chem.G11-Q2W4-Test-The kinetic theory of matter

### Short Answer

*Explain what is occurring during each of the following processes, in terms of particles and the kinetic theory.*

- A. freezing**
- B. sublimation**
- C. condensation**
- D. boiling**

1. Particles in the liquid state absorb energy and escape into the less highly organized gaseous state, forming bubbles inside the liquid, that rise to the surface.
2. Particles in the solid state absorb energy and escape from their highly ordered crystal lattice directly into the gaseous state.
3. Particles in the gaseous state release energy and enter the liquid state, in which they tend to be closer together and less free to move.
4. Particles in the liquid state release energy and become more highly ordered, forming the crystal lattice that is characteristic of the solid state, and becoming unable to flow around each other.
5. **Rank the following temperature readings in increasing order: -420°F, -270°C, 0°F, 0°C, 0 K.**
  - A. 0 K, -270°C, -420°F, 0°F, 0°C
  - B. 0 K, , -420°F, 0°F, -270°C, 0°C
  - C. -270°C, -420°F, 0°F, 0 K, 0°C
  - D. 0 K, -270°C, 0°C, -420°F, 0°F

	Element	Freezing Point, °C	Boiling Point, °C
A	Cadmium	321	770
B	Chlorine	-101	-34
C	Fluorine	-220	-188
D	Phosphorus	44	280

6. Which element has the smallest temperature range as a liquid?
7. The largest temperature range?
8. Which of the elements are liquids at 50°C?
9. Which of the elements are liquids at -50°C?
10. At -50°C, which of chlorine or fluorine has a higher vapor pressure?
11. Which element has a higher vapor pressure, cadmium at 700°C or phosphorus at 300°C?
12. Which of the elements are solids at 50°C?

## Problem

The table shows the fusion and vaporization data for eight substances. Use the information to answer the following questions.

Substance	Fusion Melting Point (°C)	Heat of fusion (joules/mole) (°C)	Vaporization Boiling Point	Heat of vaporization (joules/mole)
O <sub>2</sub> oxygen	-219	444	-183	6820
N <sub>2</sub> nitrogen	-210	720	-196	5577
NH <sub>3</sub> ammonia	-78	5653	-33	23 351
CO <sub>2</sub> carbon dioxide	-56	8326	-78	25 234*
N <sub>2</sub> O nitrous oxide	-91	6540	-89	16 552
I <sub>2</sub> iodine	114	15 648	183	4347*
H <sub>2</sub> O water	0	6008	100	40 656

\*Goes directly to vapor from solid. These are heats of sublimation.

13. How much energy, in joules, is required to melt 10.00 moles of ice?
- A. 50 080 J.
  - B. 60 080 J.
  - C. 70 080 J.
  - D. 80 080 J.
14. Suppose you have equal volumes of liquid oxygen and liquid nitrogen sitting open in a warm room. Which would boil away first? Explain.
- A. The nitrogen would boil away first because it has a higher heat of vaporization.
  - B. The nitrogen would boil away first because it has a lower heat of vaporization.
  - C. The oxygen would boil away first because it has a higher heat of vaporization.
  - D. The oxygen would boil away first because it has a lower heat of vaporization.
15. Which substance changes from the solid state to the gaseous state with the least total change in temperature?
- A. The oxygen would boil away first because it has a lower heat of vaporization.
  - B. The water would boil away first because it has a lower heat of vaporization.
  - C. The iodine would boil away first because it has a lower heat of vaporization.
  - D. The nitrogen would boil away first because it has a lower heat of vaporization.

**16. Which substance has the highest boiling point? Which has the lowest boiling point?**

- A. Oxygen has the highest boiling point; nitrogen has the lowest.
- B. Water has the highest boiling point; nitrogen has the lowest.
- C. Iodine has the highest boiling point; nitrogen has the lowest.
- D. Nitrogen has the highest boiling point; iodine has the lowest.

**17. Which substance has the lowest melting point? Which has the highest melting point?**

- A. Iodine has the lowest melting point; oxygen has the highest.
- B. Oxygen has the lowest melting point; iodine has the highest.
- C. Nitrous oxide has the lowest melting point; carbon dioxide has the highest.
- D. Carbon dioxide has the lowest melting point; Nitrous oxide has the highest.

*The graph in Figure 10-1 shows what happens when 1 kg sample of each of two different substances are heated. Use the information in the graph to answer the questions. Assume that room temperature in this case is 300 K.*

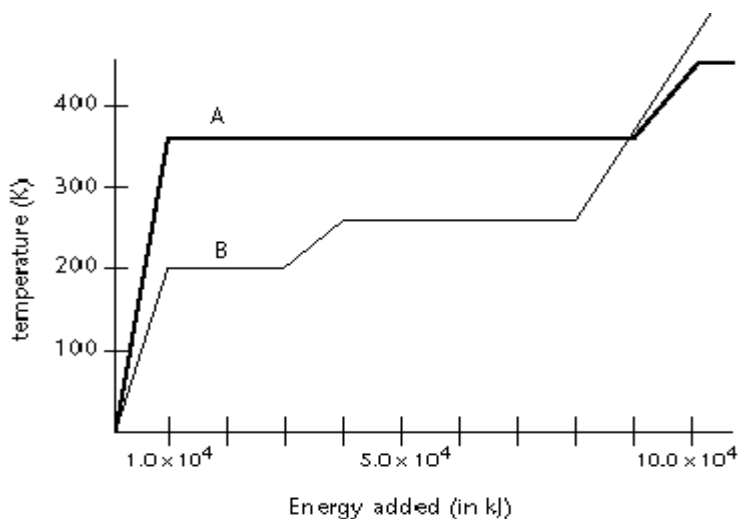


Figure 10-1

**18. What is the physical state of substance B at room temperature?**

- A. solid.
- B. liquid.
- C. gas.
- D. plasma.

**19. Estimate the heat of fusion of substance B.**

- A. It is approximately  $1.0 \times 10^4$  kJ.
- B. It is approximately  $2.0 \times 10^4$  kJ.
- C. It is approximately  $3.0 \times 10^4$  kJ.
- D. It is approximately  $4.0 \times 10^4$  kJ.

**20. What is the physical state of substance A at room temperature?**

- A. solid.
- B. liquid.
- C. gas.
- D. plasma.

**21. What is the melting point of substance A?**

- A. The melting point is approximately 050 K.
- B. The melting point is approximately 150 K.
- C. The melting point is approximately 250 K.
- D. The melting point is approximately 350 K.

**22. If you mixed substance A, substance B, and water, and steadily increased the temperature, which would boil last?**

- A. Substance A would boil last.
- B. Substance B would boil last.

**23. Estimate the heat of vaporization of substance B.**

- A. It is approximately  $1.5 \times 10^4$  kJ.
- B. It is approximately  $2.5 \times 10^4$  kJ.
- C. It is approximately  $3.5 \times 10^4$  kJ.
- D. It is approximately  $4.5 \times 10^4$  kJ.

**24. Estimate the heat of fusion of substance A. (Hint: Consider the length of the appropriate plateau.)**

- A. It is approximately  $6.0 \times 10^4$  kJ.
- B. It is approximately  $7.0 \times 10^4$  kJ.
- C. It is approximately  $8.0 \times 10^4$  kJ.
- D. It is approximately  $9.0 \times 10^4$  kJ.

**25. What is the melting point of substance B?**

- A. It is approximately 100 K.
- B. It is approximately 200 K.
- C. It is approximately 300 K.
- D. It is approximately 400 K.

**Matching**

*Match each statement with the correct item below.*

- a. absolute zero
- b. flows but has definite volume
- c. boiling point of water = 100 degrees
- d. states that submicroscopic particles are in constant, random motion
- e. formation of dew on grass in the morning
- f. for example,  $3.34 \times 10^5$  J/kg for water
- g. state of matter that is easily compressible
- h. for water, 0°C
- i. ice directly to water vapor, for example
- j. increased kinetic energy of particles
- k. striking of particles that involves no loss of energy
- l. exists on the sun and in fluorescent lights
- m. occurs only at the surface of a liquid
- n. spreading process due to random motion
- o. candle wax or glass, for example
- p. determined by temperature, surface area, nature of liquid, humidity
- q. vapor pressure = atmospheric pressure
- r. normally, 14.7 pounds per square inch at sea level
- s.  $2.26 \times 10^6$  J/kg for water
- t. temperature directly proportional to kinetic energy

- \_\_\_ 26. amorphous material
- \_\_\_ 27. kinetic theory
- \_\_\_ 28. increased temperature
- \_\_\_ 29. Sublimation
- \_\_\_ 30. Kelvin scale
- \_\_\_ 31. Condensation
- \_\_\_ 32. freezing point
- \_\_\_ 33. Liquid

*Match each item with the correct statement below.*

- a. **absolute zero**
- b. **condensation**
- c. **crystal lattice**
- d. **Diffusion**

- e. **freezing point**
- f. **gas**
- g. **heat of fusion**
- h. **joule (J)**

- i. **kinetic theory**
- j. **plasma**
- k. **pressure**
- l. **sublimation**

- m. **temperature**
- n. **volatile**

- \_\_\_\_ 34. \_\_\_\_ is the force acting on a unit area of surface.
- \_\_\_\_ 35. \_\_\_\_ is a measure of the average kinetic energy of the particles that make up a substance.
- \_\_\_\_ 36. The SI unit of energy is the \_\_\_\_.
- \_\_\_\_ 37. Matter in the \_\_\_\_ state consists of ionized gas.
- \_\_\_\_ 38. The idea that submicroscopic particles of all matter are in constant, random motion is known as the \_\_\_\_.
- \_\_\_\_ 39. The amount of energy released by one kilogram of a substance at its freezing point is called the \_\_\_\_.
- \_\_\_\_ 40. The process by which particles spread out and fill a space because of random motion is called \_\_\_\_.

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