# States of Matter Practice Items

1. As a researcher decreases the volume of helium gas at constant temperature

    A. heat flow occurs into the gas.
    B. the temperature increases.
    C. the temperature decreases.
    D. the pressure increases.

2. Approximately how many atoms are in 1 liter of helium at STP?

    A. 2×10^{19}
    B. 3×10^{23}
    C. 6×10^{24}
    D. 1×10^{26}

3. Which of the following statements about gases is **untrue**?

    A. An equal number of molecules occupies equal volumes of two ideal gases at the same temperature an pressure.
    B. The internal energy of an ideal gas depends only upon the average kinetic energy of its particles.
    C. An ideal gas would be predicted to occupy zero volume at absolute zero.
    D. The pressure of real gases will tend to be slightly greater than predicted by the ideal gas law.

4. For a mixture of gases within a vessel of fixed dimensions the volume of each component is

    A. proportional to its mole fraction in the gaseous mixture
    B. equal
    C. dependent on the temperature
    D. proportional to its partial pressure

The following passage pertains to questions 5 - 9.

An apparatus is used to collect a sample of a gaseous substance in the laboratory. In the initial state the flask is completely filled with water. The atmospheric pressure on the water in the surrounding tank enables the water in the flask to be suspended. Gas is collected by displacing the water in the flask until the state illustrated below is attained, in which the level of the water in the flask equals the level in the tank and the collection is completed.
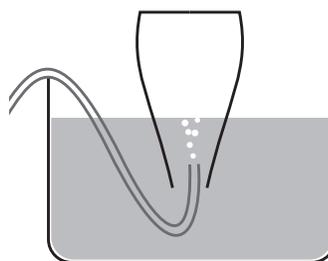
5. At the time collection is completed, which of the following statements is **true** regarding the pressure of the gas, P_{gas}?

    A. P_{gas} equals 760 torr.
    B. P_{gas} will be greater than atmospheric pressure if temperature of the gas is higher than the ambient temperature.
    C. The ratio of P_{gas} to the atmospheric pressure equals the ratio of their densities.
    D. P_{gas} equals atmospheric pressure.

6. After the collection of gas is first initiated, and the level of water in the flask begins to fall the pressure of the trapped gas

    A. is less than 760 torr.
    B. equals 760 torr.
    C. is greater than 760 torr.
    D. is decreasing.

7. Suppose that the temperature in the laboratory is 33°C (in which case the vapor pressure of water is 37.7 torr.) The gas being collected is argon. What is its approximate mole fraction of argon in the space above the water at the time collection is completed?

   A. 0.05
   B. 0.80
   C. 0.90
   D. 0.95

8. Student A begins collecting methane gas (CH_4) in this manner and student B begins collecting propane gas (C_3H_8). After each has collected one gram of substance

   A. the gaseous phase in student A's flask has greater volume.
   B. the gaseous phase in student B's flask has greater volume.
   C. the volume of the gaseous phases of both flasks are equal.
   D. the gaseous phase in student A's flask has greater density.

9. Although the atmospheric pressure did not change, the temperature in the laboratory increased between experiments with the same gas.

   A. Fewer moles of gas are collected in the flask than before.
   B. The mole fraction of water vapor in the flask is lower than before.
   C. The volume of the gaseous phase is greater than before.
   D. More than one of the above is correct.

10. A manometer is a device used for pressure measurements. An open-end manometer is simply a U-shaped tube containing mercury. One arm of the tube is connected to a system whose pressure is to be measured while the other arm remains open to the atmosphere. Which of the following statements is not necessarily true regarding the monatomic gas in the manometer below if the gas is in thermal equilibrium with its surroundings?

   A. The pressure of the gas is greater than atmospheric pressure.
   B. The density of the gas is greater than the density of the atmosphere.
   C. No net heat flow is occurring between the gas and its surroundings.
   D. The molar heat capacity of the gas is lower than the molar heat capacity of N_2.
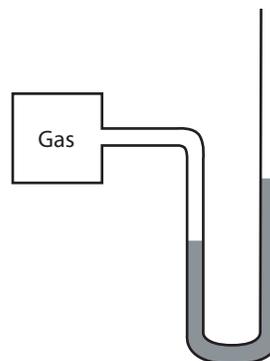
11. What volume will 14g of N_2 occupy at 25°C and a pressure of 0.8 atm?
($R = 0.0821$ liter atm mol^{-1} K^{-1})

   A. 1.5 L
   B. 15 L
   C. 25 L
   D. 30 L

12. If 100 ml of N_2 at 25°C and a pressure of 200 torr along with 200 ml of O_2 at 25°C and a pressure of 250 torr are introduced in mixture into a 200 ml container, what would be the final pressure of the mixture at 25°C?

   A.   200 torr
   B.   250 torr
   C.   350 torr
   D.   450 torr

13. When a liquid attains such a temperature that its vapor pressure equals the external pressure

   A.   the liquid and its vapor achieve a state of dynamic equilibrium.
   B.   it melts.
   C.   the cohesive forces in the liquid become weaker than the adhesive forces.
   D.   it boils.

14. The phase diagram below is for which substance?

   A.   carbon dioxide
   **B.**   sodium
   C.   water
   D.   argon
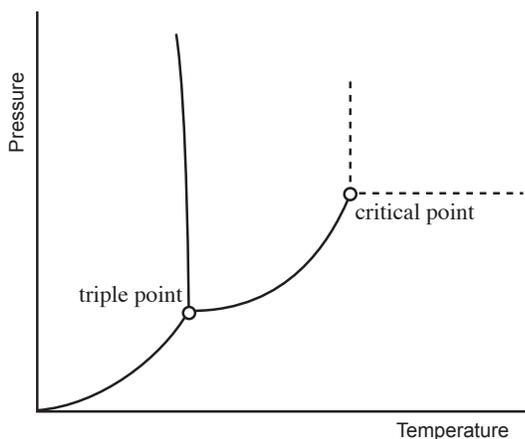
15. The van der Waal equation of state describes the deviation of a real gas from ideal gas behavior.

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

What is the physical basis of the constant '*a*' in the van der Waal equation of state?

   A.   the attractive forces between molecules of the gas
   B.   the effective size of the gas particles
   C.   rotational and vibrational modes of internal energy
   **D.**   super-elastic collisions

16. The graph below shows the heating curve for 1 mol of an unknown substance.
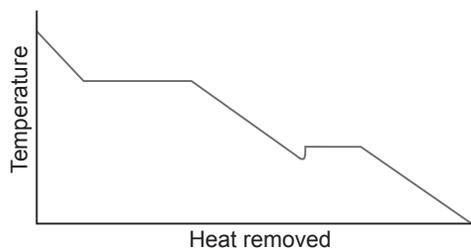
From the graph it can be seen that the substance

   A.   exhibits the properties of a liquid crystal
   B.   has a greater heat of fusion than heat of vaporization
   C.   undergoes supercooling
   D.   has a higher molar heat capacity as a gas than as a liquid

17. Why is the level of mercury lower in a capillary tube than the level outside when the capillary tube is inserted into mercury?

Hg
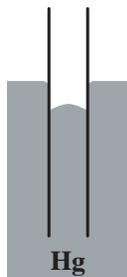
A. Cohesive forces are stronger than adhesive forces in the case of mercury

B. The pressure exerted by the atmosphere is greater within the capillary tube.

C. The high specific gravity of mercury overcomes the cohesive forces.

D. The vapor pressure of mercury can be established within the capillary tube but not on the open surface.

18. Dry ice, the solid form of carbon dioxide, is a

A. covalent network solid
B. molecular solid
C. ionic solid
D. atomic solid

19. Which of the following crystal structures is capable of greatest density?

A. face-centered cubic structure
B. body-centered cubic structure
C. primitive cubic structure
D. all can be equally dense

20. Potassium metal crystallizes in a body-centered cubic lattice. How many potassium atoms are contained within one unit cell?

A. 1
B. 2
C. 5
D. 9