Chapter 5

1. Ideal gases generally have

A. low density
B. high density
C. closely packed particles
D. no decrease in volume when external pressure is increased

2. Which of the following would represent the greatest pressure?

A. 0.501 atm B. 437 mmHg C. 11.7 psi D. 66.1 kPa

3. A glass column is filled with mercury and inverted in a pool of mercury. The mercury column stabilizes at a height of 754 mmHg above the pool of mercury. What is the pressure of the atmosphere?

A. 0.754 atm B.0.992 atm C. 481 atm D. 0.661 atm

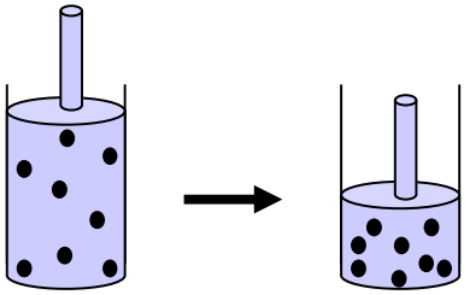
4. Consider a rigid container of gas. The pressure inside the container is equal to 1 atm. Additional gas is added to this container under conditions of constant temperature. The final pressure in the container is 2 atm. Which of these statements explains why the pressure increases in the container?

A. The average kinetic energy of the gas particles increases in the container.
B. The average number of collisions in the container increases.
C. The average speed of the gas particles in the container increases.
D. All of the above.

5. Which statement describes the properties of the particles of an ideal gas?

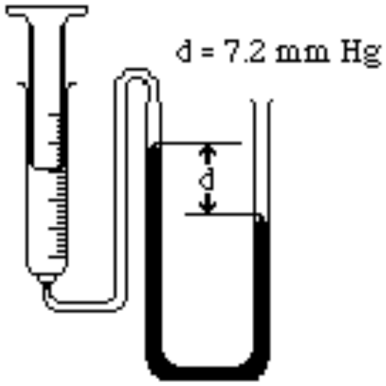
A. The gas particles are relatively far apart and have negligible volume.
B. The gas particles are in constant, defined, nonlinear motion.
C. The gas particles have strong attractive forces between them.
D. The gas particles have collisions that increase the volume of the gas.

6. Consider the diagram below, which represents a sample of gas being compressed at constant temperature. Which of the following properties is increasing during this change?



(A) the mass of the gas sample
(B) the speed of the gas particles
(C) the number of gas particles
(D) the density of the gas sample

7. Consider the manometer shown below. If atmospheric pressure is 0.925 atm, what is the approximate pressure of the gas sample in the syringe?



A. 703 mmHg

B. 86.5 mmHg

C. 710 mmHg

D. 696 mmHg

8. Which one of the following statements is not consistent with the properties of an ideal gas?

A. Individual gas molecules are relatively far apart.
B. The actual volume of the gas molecules themselves is very small compared to the volume occupied by the gas at ordinary temperatures and pressures.
C. The average kinetic energies of different gases are different at the same temperature.
D. There is no net gain or loss of the total kinetic (translational) energy in collisions between gas molecules.

9. A gas sample is held at constant pressure. The gas occupies 3.62 L of volume when the temperature is 21.6°C. Determine the temperature at which the volume of the gas is 3.43 L.

A. 311 K **B. 279 K** **C. 20.5 K** **D. 295 K**

10. Body temperature is about 309 K. On a cold day, what volume of air at 277 K must a person with a lung capacity of 2.1 L breathe in to fill the lungs?

A. 2.34 L **B. 1.88 L** **C. 1.98 L** **D. 3.77 L**

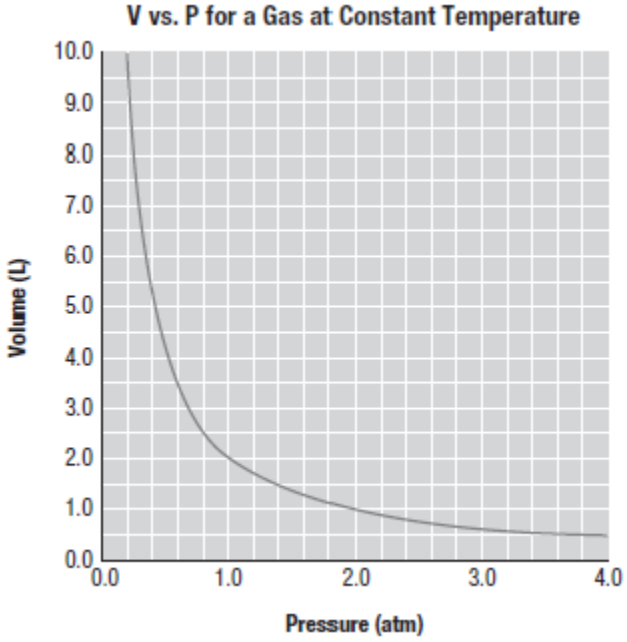
11. You have 49.8 g of O_2 gas in a container with twice the volume as one with CO_2 gas. The pressure and temperature of both containers are the same. Calculate the mass of carbon dioxide gas you have in the container.

A. 68.5 g **B. 0.778 g** **C. 34.2 g** **D. 3.11 g**

12. A sample of oxygen occupies 47.2 liters under a pressure of 1240 torr at 25°C. What volume would it occupy at 25°C if the pressure were decreased to 730 torr?

A. 29.3 L **B. 32.3 L** **C. 47.8 L** **D. 80.2 L**

The graph below shows a plot of volume versus pressure for a particular gas sample at constant temperature. Use it to answer questions 13 and 14.



13. What is the volume of this gas at 4.0 atm pressure?

A. 0.68 L **B. 1.0 L** **C. 0.5 L** **D. 4.0 L**

14. At what pressure would this gas occupy a volume of 5.0 L?

A. 0.4 atm **B. 0.33 atm** **C. 2.0 atm** **D. 0.5 atm**

15. The volume of a sample of nitrogen is 6.00 liters at 35°C and 740 torr. What volume will it occupy at STP?

A. 6.59 L **B. 5.46 L** **C. 6.95 L** **D. 5.18 L**

16. You are holding two balloons, an orange balloon and a blue balloon. The orange balloon is filled with neon (Ne) gas and the blue balloon is filled with argon (Ar) gas. The orange balloon has twice the volume of the blue balloon. Which of the following best represents the mass ratio of Ne : Ar in the balloons?

A. 1:1 B. 1:2 C. 2:1 D. 1:3

17. A 37.8-g sample of Ne gas exerts a certain pressure in a container of fixed volume. What mass of Ar is required to exert half the pressure at the same conditions of volume and temperature?

A. 74.8 g Ar B. 37.4 g Ar C. 150 g Ar D. 755 g Ar

18. The temperature of a specific amount of gas in a sealed container change from 40.0°C to 80.0°C. If the volume remains constant, the pressure will change from 715 mmHg to

A. 634 mmHg B. 358 mmHg C. 806 mmHg D. 715 mmHg

19. What pressure (in atm) would be exerted by 76 g of fluorine gas in a 1.50-Liter vessel at -37°C?

A. 26 atm B. 4.1 atm C. 38.7 atm D. 84 atm

20. A 0.580 g sample of a compound containing only carbon and hydrogen contains 0.480 g of carbon and 0.100 g of hydrogen. At STP, 33.6 mL of the gas has a mass of 0.087 g. What is the molecular (true) formula for the compound?

A. C_2H_6 B. C_2H_5 C. C_4H_{10} D. C_4H_{12}

21. The volume of a gas collected when the temperature is 11.0^{0}C and the pressure is 710 mm Hg measures 14.8 mL. What is the calculated volume of the gas at 20.0^{0}C and 740 mm Hg?

a. 7.8 mL B. 13.7 mL C. 14.6 mL D. 15 mL

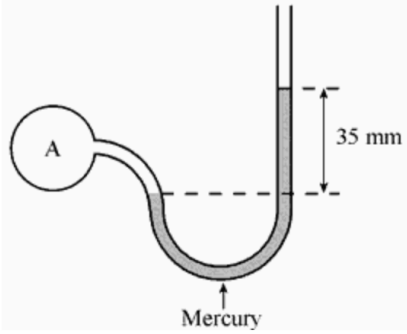
22. The mass of 1.12 liters of gas Y at STP is found to be 6.23 g. The density of gas Y is

A. 10.6 g/L **B. 5.56 g/L** **C. 15.6 g/L** **D. 0.180 g/L**

23. What is the molecular weight of a pure gaseous compound having a density of 4.95 g/L at -35 ^{0}C and 1020 torr?

A. 44 g/mol **B. 11 g/mol** **C. 72 g/mol** **D. 120 g/mol**

Base your answer to the following question on the image below.



24. If the atmospheric pressure is 730 torr, what is the pressure of the gas labeled A?

A. 35 torr **B. 630 torr** **C. 695 torr** **D. 765 torr**

25. As a balloon floats higher, the surrounding air becomes colder. Soon the balloon stops floating higher and begins sinking. Assuming that there is no air loss, which of the following is the best explanation for this observation?

A. The difference in temperature between the air inside and outside the balloon produces convection currents, which lose strength at high altitude.
B. The air density inside the balloon has become greater than the surrounding air density.
C. The cooler air outside the balloon pushes in on the walls of the balloon.

D. The pressure on the walls of the balloon decreases with decreasing temperature.

26. Given the reaction $2NH_3(g) + 3Cl_2(g) \rightarrow N_2(g) + 6HCl(g)$, you react 5.0 L of NH_3 with 5.0 L of Cl_2 measured at the same conditions in a closed container. Calculate the ratio of pressures in the container ($P_{final}/P_{initial}$).

A. 1.33 **B. 0.75** **C. 1.00** **D. 1.50**

27. When 0.72 g of a liquid is vaporized at 110°C and 0.967 atm, the gas occupies a volume of 0.559 L. The empirical formula of the gas is CH_2. What is the molecular formula of the gas?

A. CH_2 **B. C_2H_4** **D. C_3H_6** **D. C_4H_8**

28. A 2.005-gram sample of a certain diatomic gas occupies a volume of 3.73-L at 50.65 kPa and a temperature of 45°C. Identify this gas.

A. N_2 **B. O_2** **C. F_2** **D. Cl_2**

29. What volume of carbon dioxide, measured at 570 mmHg and 25^0C, will be formed by the reaction of 1.42 moles of oxygen with 0.900 moles of ethanol, CH_3CH_2OH?

Hint-Write a balanced equation for the combustion of ethanol.

A. 40.2 L **B. 30.9 L** **C. 21.2 L** **D. 47.7 L**

30. Into a 4.19-liter container at 25°C are placed 1.23 moles of O_2 gas and 3.20 moles of solid C (graphite). If the carbon and oxygen react completely to form CO(g), what will be the final pressure in the container at 25°C?

Hint-Write a balanced equation for the reaction as described above.

A. 14.4 atm **B. 7.17 atm** **C. 1.20 atm** **D. 18.7 atm**

One way to isolate metals from their ores is to react the metal oxide with carbon as shown in the following reaction:

31. If 31.87 g of a metal oxide reacted with excess carbon and 4.08 L of CO_2 formed at 100°C and 1.50 atm, what is the identity of the metal?

A. Hg **B. Cu** **C. Mg** **D. Cr**

32. A sample of hydrogen gas collected by displacement of water occupied 30.0 mL at 24°C on a day when the barometric pressure was 736 torr. What volume would the hydrogen occupy if it were dry and at STP? The vapor pressure of water at 24.0°C is 22.4 torr.

A. 32.4 mL **B. 21.6 mL** **C. 36.8 mL** **D. 25.9 mL**

33. A vessel with a volume of 18.9 L contains 2.80 g of nitrogen gas (N_2), 0.807 g of hydrogen gas (H_2), and 79.9 g of argon gas. At 25°C, what is the pressure in the vessel?

A. 0.271 atm **B. 3.88 atm** **C. 3.23 atm** **D. 61.1 atm**

Oxygen gas, generated by the reaction below, is collected over water at 27°C in a 2.87-L vessel at a total pressure of 1.00 atm. (The vapor pressure of H_2O at 27°C is 26.0 torr.)

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

34. How many grams of $KClO_3$ were consumed in the reaction? The molar mass of is 122.55 g/mol.

A. 13.7 g **B. 20.6 g** **C. 9.20 g** **D. 7.84 g**

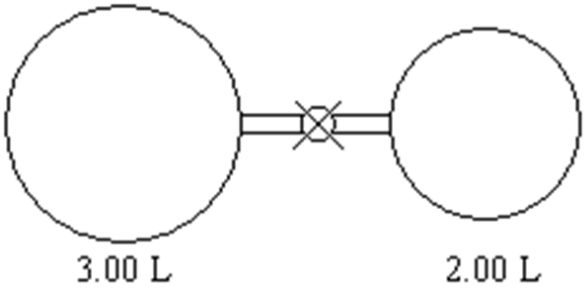
35.The valve between a 5-L tank containing a gas at 9 atm and a 10-L tank containing a gas at 6 atm is opened. Calculate the final pressure in the tanks.

A. 7 atm **B. 4 atm** **C. 3 atm** **D. 15 atm**

36. A gaseous mixture containing 1.5 mol Ar and 3.5 mol CO_2 has a total pressure of 8.6 atm. What is the partial pressure of CO_2?

A. 2.58 atm **B. 6.02 atm** **C. 1.65 atm** **D. 20.1 atm**

37. The valve between the 2.00-L bulb, in which the gas pressure is 1.90 atm, and the 3.00-L bulb, in which the gas pressure is 3.20 atm, is opened. What is the final pressure in the two bulbs, the temperature remaining constant?



A. 0.765 atm **B. 2.42 atm** **C. 2.68 atm** **D. 1.92 atm**

38. The partial pressures of CH_4, N_2, and O_2 in a sample of gas were found to be 187 mmHg, 487 mmHg, and 555 mmHg, respectively. Calculate the mole fraction of nitrogen.

A. 0.451 **B. 0.396** **C. 0.73788** **D. 0.358**

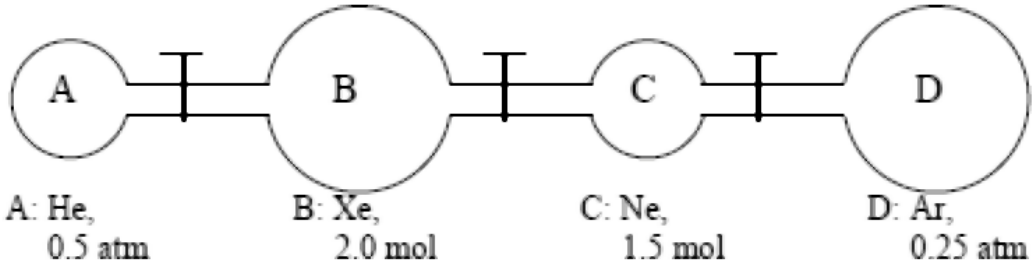
Answer the following question based on the decomposition reaction below:

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

39. A mixture of KCl and $KClO_3$ weighing 1.80 grams was heated; the dry O_2 generated occupied 140 mL at STP. What percent of the original mixture was $KClO_3$?

A. 28.36% **B. 45.45%** **C. 68.21%** **D. 14.18%**

The system below is held at 273 K. The smaller flasks hold 11 L and the larger flasks hold 22 L (the volume of the tubes between the flasks is negligible).



At the beginning, the gases held in A, B, C, and D are separated by the valves.

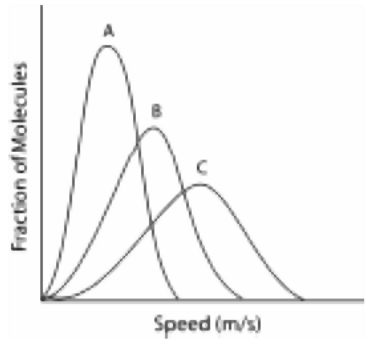
40. What is the partial pressure of Ne if the valve between flask C and D is opened?

A. 0.155 atm **B. 1.02 atm** **C. 1.57 atm** **D. 1.85 atm**

41. Which of the following is not a postulate of the kinetic molecular theory?

A. Gas particles have most of their mass concentrated in the positively charged nucleus of the atom.
B. The moving particles undergo perfectly elastic collisions with the walls of the container.
C. The forces of attraction and repulsion between the particles are insignificant.
D. The average kinetic energy of the particles is directly proportional to the absolute temperature.

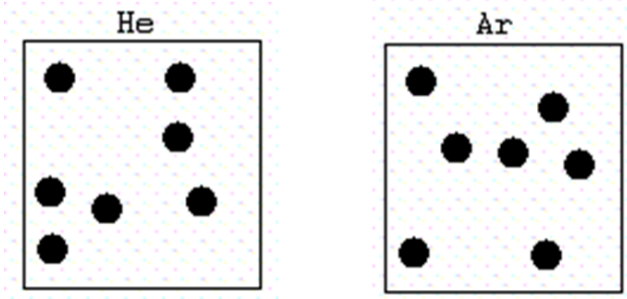
Consider the plot of a flask at 300 K containing a mixture of Ar(g), Ne(g), and Xe(g).



42. After an increase in temperature, which curve will represent the distribution of Ar if B represents the initial Maxwell-Boltzmann distribution for Ar?

A. A **B. B** **C. C** **D. Not shown**

Consider the following containers, one with helium at 27°C and the other with argon at 27°C.



43. Which of the following statements are true?

A. He effuses slower than Ar in a porous container.
B. The speeds of the He and the Ar atoms are the same.
C. The average kinetic energy of the two samples is equal.
D. All of the above are true.

44. A sample of N_2 gas is contaminated with a gas (A) of unknown molar mass at 25°C. The gases are allowed to effuse through a pinhole, and it is found that gas A escapes at 3 times the rate of N_2. The molar mass of gas A is:

A. 3.11 g/mol B. 84.0 g/mol C. 9.34 g/mol D. 252 g/mol

45. Order the following in increasing rate of effusion:

F_2, Cl_2, NO, NO_2, CH_4

A. $Cl_2 < F_2 < NO_2 < CH_4 < NO$
B. $CH_4 < NO_2 < NO < F_2 < Cl_2$
C. $CH_4 < NO < F_2 < NO_2 < Cl_2$
D. $Cl_2 < NO_2 < F_2 < NO < CH_4$

46. Which of the following statements is false?

A. The properties of $N_2(g)$ will deviate more from ideality at -100°C than at 200°C.
B. Molecules of $CH_4(g)$ at high pressures and low temperatures have no attractive forces between each other.
C. Molecules of an ideal gas are assumed to have no significant volume.
D. Real gases do not occupy significant space/volume in their container.

47. A sample of oxygen gas is sealed in container *X*. A sample of hydrogen gas is sealed in container *Z*. Both samples have the same volume, temperature, and pressure. Which statement is true?

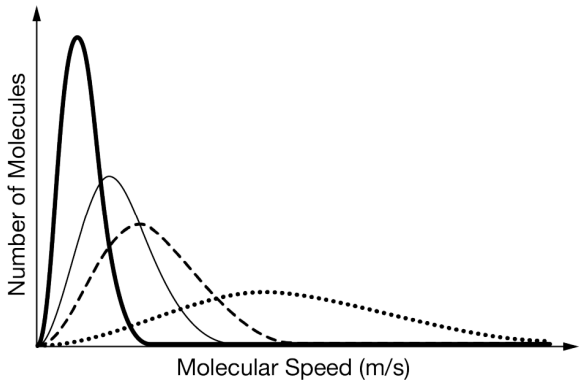
A. The particles in container *X* have a greater average KE than the particles in container *Z*.
B. Containers *X* and *Z* both contain the same number of gas molecules.
C. Containers *X* and *Z* both contain the same mass of gas.

D. The particles in container *X* have a faster speed than the particles in container *Z*.

48. A sample of a gas is contained in a closed rigid cylinder. According to kinetic molecular theory, what occurs when the gas inside the cylinder is heated?

A. The number of gas molecules increases.
B. The number of collisions between gas molecules per unit time decreases.
C. The average velocity of the gas molecules increases.
D. The particles undergo deposition.

The graph above shows the distribution of molecular speeds for four different gases at the same temperature.



49. What property of the different gases can be correctly ranked using information from the graph, and why?

A. The densities of the gases, because as the density of a gas increases, the average speed of its molecules decreases.
B. The pressures of the gases, because the pressure exerted by a gas depends on the average speed with which its molecules are moving.
C. The volumes of the gases, because at a fixed temperature the volume of a gas can be calculated using the equation PV=nRT.
D. The molecular masses of the gases because the gas molecules have the same average kinetic energy and mass can be calculated using the equation $KE_{avg} = \frac{1}{2}mv^2$.

50. Which of the following best helps explain why the pressure of a sample of CH_4(g) (molar mass 16g/mol) is closer to the pressure predicted by the ideal gas law than a sample of NH_3(g) (molar mass 17g/mol)?

A. NH_3 molecules are polar while CH_4 molecules are not, and the greater attractions between NH_3 molecules cause the molecules to collide with the walls of the container with less force.
B. NH_3 molecules have a greater molar mass than CH_4 molecules, so the NH_3 molecules collide with the walls of the container with more force.
C. CH_4 molecules have more hydrogen atoms than NH_3 molecules, so CH_4 molecules have more hydrogen bonding and greater intermolecular forces.
D. CH_4 molecules are larger than NH_3 molecules, so the actual CH_4 molecules take up a significant portion of the volume of the gas