Chapter 8 – Gases – Practice Problems

Section 8.1 – Properties of Gases

Goal: Describe the kinetic molecular theory of gases and the units of measurement used for gases.

Summary:

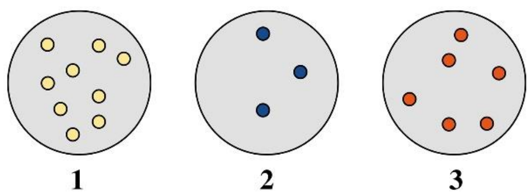
- In a gas, particles are so far apart and moving so fast that their attractions are negligible.
- A gas is described by the physical properties: pressure (P), volume (V), temperature (T) in Kelvins (K) and the amount in moles (n).
- A gas exerts pressure, the force of the gas particles striking the walls of its container.
- Gas pressure is measured in units such as torr, mmHg, atm, and Pa.

Kinetic Molecular Theory of Gases:

1. A gas consists of small particles that move randomly with high velocities.
2. The attractive forces between the particles of a gas are usually very small.
3. The actual volume occupied by gas molecules is extremely small compared with the volume that the gas occupies.
4. Gas particles are in constant motion, moving rapidly in straight paths.
5. The average kinetic energy of gas molecules is proportional to the Kelvin temperature.

Understanding the Concepts

Which of the following balloons exerts the
a. highest pressure?
b. lowest pressure?



Practice Problems

1. Use the kinetic molecular theory of gases to explain each of the following:
   a. Gases move faster at higher temperatures.
   b. Gases can be compressed much more than liquids or solids.
   c. Gases have low densities.
   d. A container of nonstick cooking spray explodes when thrown in a fire.
   e. You can smell the odor of cooking onions from far away.

2. Identify the property of a gas that is measured in each of the following (pressure. volume, temperature, or amount):
   a. 350 K
   b. 125 mL
   c. 2.00 g of O_2
   d. 755 mmHg
   e. 1.0 atm
   f. 10.0 L
   g. 0.50 mole of He

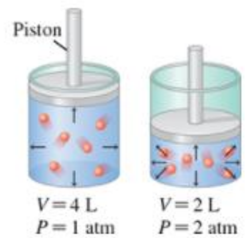
3. Which of the following statement(s) describes the pressure of a gas? (select all that apply)
   a. the force of the gas particles on the walls of the container.
   b. the number of gas particles in a container.
   c. 4.5 L of helium gas
   d. 750 Torr
   e. 7.5 moles

4. Which of the following statement(s) describes the pressure of a gas? (select all that apply)
   a. the temperature of the gas
   b. the volume of the container
   c. 3.00 atm
   d. 0.25 mole of O_2
   e. 101 kPa

5. A tank contains oxygen (O_2) at a pressure of 2.00 atm. What is the pressure in the tank in term of the following units?
   a. torr
   b. mmHg

6. On a climb up Mt. Whitney, the atmospheric pressure drops to 467 mmHg. What is the pressure in terms of the following units?
   a. atm
   b. torr

Section 8.2 – Pressure and Volume (Boyle's Law)
Goal: Use the pressure-volume relationship (*Boyle's Law*) to determine the final pressure or volume when the temperature and amount of gas are constant.
Summary: The volume (V) of a gas changes *inversely* with the pressure (P) of the gas if there is no change in the temperature and the amount of gas.



$$P_1V_1 = P_2V_2$$

- The pressure increases if volume decreases.
- The pressure decreases if volume increases.

Example: A sample of helium gas (He) has a volume 6.8 L and a pressure of 2.5 atm. What is the final volume, in liters, if it has a final pressure of 1.2 atm with no change in temperature and amount of gas?
Answer:
Rearrange the equation to solve for V_2:

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2}$$

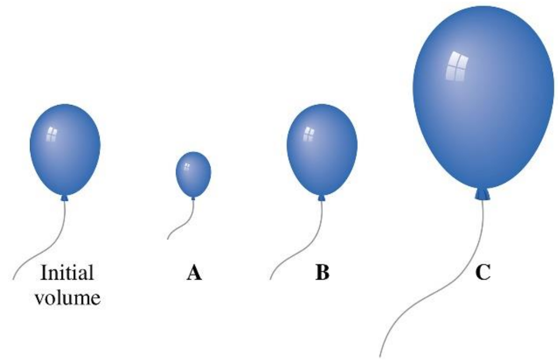
Plug values into equation and solve.

$$V_2 = \frac{(2.5\ \cancel{\text{atm}})(6.8\ \text{L})}{(1.2\ \cancel{\text{atm}})} = 14\ \text{L}$$

Understanding the Concepts

The following balloon is filled with helium gas. For each of the following changes of the initial balloon, select the balloon (A, B, or C) that shows the final volume of the balloon.

a. The balloon floats to a higher altitude where the pressure is less (n and T constant).
b. The balloon is put in a hyperbaric chamber in which the pressure increases.



Practice Problems

7. The air in a cylinder with a piston has a volume of 220 mL and a pressure of 650 mmHg. If the pressure inside the cylinder increases to 1.2 atm, what is the final volume, in mL, of the cylinder?
   a. 0.572 mL
   b. 157 mL
   c. 0.00638 mL
   d. 309 mL
   e. 226 mL

8. A gas with a volume of 4.0 L is in a closed container. Indicate the changes (*increases, decreases, or does not change)* in pressure when the volume undergoes the following changes at constant temperature and amount of gas:
   a. The volume is compressed to 2.0 L.
   b. The volume expands to 12 L.

9. A gas at a pressure of 2.0 atm is in a closed container. Indicate the changes (*increases, decreases, or does not change)* in its volume when the pressure undergoes the following changes at constant temperature and amount of gas:
   a. The pressure remains at 2.0 atm.
   b. The pressure drops to 4.0 atm.

10. A 10.0 L balloon contains helium gas at a pressure of 655 mmHg. What is the final pressure, in mmHg, of the helium gas if the volume changes to 20.0 L?
   a. 328 mmHg
   b. 1310 mmHg
   c. 0.00305 mmHg
   d. 131000 mmHg
   e. 123 mmHg

11. The air in a 5.00 L tank has a pressure of 1.20 atm. What is the final pressure if the volume changes to 1.00 L?
   a. 116 atm
   b. 0.167 atm
   c. 4.17 atm
   d. 0.240 atm
   e. 6.00 atm

12. The air in a 14.0 L tank has a pressure of 1.50 atm. What is the final pressure if the volume changes to 750 mL?
    a. 46.1 atm
    b. 15.8 atm
    c. 28.0 atm
    d. 7.00 atm
    e. 0.0804 atm

13. A sample of methane (CH_4) has a volume of 25 mL at a pressure of 0.80 atm. What is the final volume, in millimeters, of the gas if the pressure changes to 2500 mmHg?
    a. 0.0823 mL
    b. 95.0 mL
    c. 6.58 mL
    d. 6.08 mL
    e. 10.3 mL

14. A sample of nitrogen (N_2) has a volume of 60.0 L at a pressure of 725 mmHg. What is the final volume of the gas if the pressure changes to 850 torr?
    a. 51.2 L
    b. 6.00 L
    c. 21.3 L
    d. 70.3 L
    e. 0.0142 L

15. Cyclopropane (C_3H_6) is a general anesthetic. A 5.0 L sample has a pressure of 5.0 atm. What is the volume, in liters, of the anesthetic given to a patient at a pressure of 1.0 atm with no change in temperature and amount of gas?
    a. 5.0 L
    b. 0.20 L
    c. 1.0 L
    d. 0.80 L
    e. 25 L

Section 8.3 – Temperature and Volume (Charles' Law)

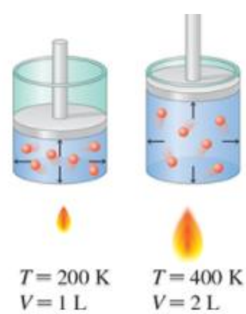
Goal: Use the temperature – volume relationship (*Charles' Law*) to determine the final temperature or volume when the pressure and amount of gas are constant.

Summary:

The volume (V) of a gas is *directly* related to its Kelvin temperature (T) when there is no change in the pressure and amount of gas.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

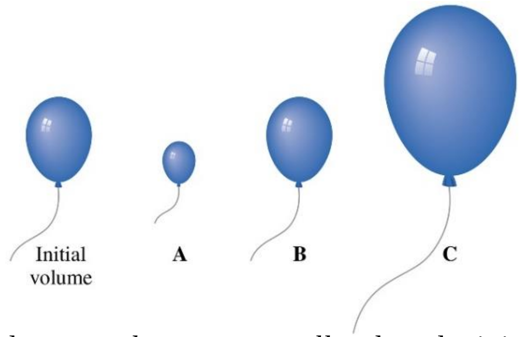
- As temperature of a gas increases, its volume increases.
- As temperature of a gas decreases, its volume decreases.



Understanding the Concepts

The following balloon is filled with helium gas. For each of the following changes of the initial balloon, select the balloon (A, B, or C) that shows the final volume of the balloon.

a. The temperature changes from 100 K to 300 K.
b. The balloon is placed in a freezer.
c. The balloon is first warmed and then returned to its starting temperature.



Indicate whether the final volume of gas in each of the following is the *same, larger, or smaller* than the initial volume, if pressure and amount of gas do not change.

a. A volume of 505 mL of air on a cold winter day at -15°C is breathed into the lungs, where body temperature is 37°C.
b. The heater used to heat the air in a hot-air balloon is turned off.
c. A balloon filled with helium at the amusement park is left in a car on a hot day.

Practice Problems

16. A balloon contains 2500 mL of helium gas at 75°C. What is the final volume, in milliliters, of the gas when the temperature changes to -25°C?
a. 7500 mL
b. -833 mL
c. 3510 mL
d. 833 mL
e. 1782 mL

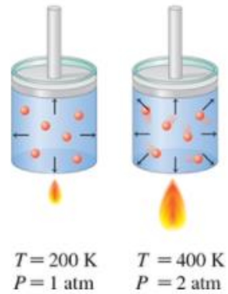
17. An air bubble has a volume of 0.500 L at 18°C. What is the final volume, in liters, of the gas when the temperature changes to 0°C?
a. 0 L
b. 0.533 L
c. 0.469 L
d. 39700 L
e. 0.0821 L

18. A gas has a volume of 4.00 L at 0°C. What final temperature, in degrees Celsius, is needed to change the volume of the gas to 1.50 L?
a. 102°C
b. 455°C
c. 728°C
d. 0°C
e. -171°C

19. A gas has a volume of 4.00 L at 0°C. What final temperature, in degrees Celsius, is needed to change the volume of the gas to 50.0 mL?
a. 3.41°C
b. -270°C
c. 21800°C
d. 21600°C
e. 0°C

Section 8.4 – Temperature and Pressure (Gay-Lussac's Law)
Goal: Use the temperature-pressure relationship (*Gay-Lussac's Law*) to determine the final temperature or pressure when the volume and amount of gas are constant.
Summary:
The pressure (P) of a gas is *directly* related to its Kelvin temperature (T) when there is no change in the volume and amount of the gas.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$



- As temperature of a gas increases, its pressure increases.
- As temperature of a gas decreases, its pressure decreases.

Vapor pressure is the pressure of a gas that forms when a liquid evaporates.

- At the boiling point of a liquid, the vapor pressure equals the external (usually atmospheric) pressure.

Practice Problems

20. Calculate the final pressure, in millimeters of mercury, for a gas with an initial pressure of 1200 torr at 115°C and is cooled to 0°C.
    a. 1705 mmHg
    b. 844 mmHg
    c. 1.11 mmHg
    d. 2.24 mmHg
    e. 0.720 mmHg

21. Calculate the final pressure, in millimeters of mercury, for a gas in an aerosol can at an initial pressure of 1.40 atm at 12°C that is heated to 35°C.
    a. 0.0121 mmHg
    b. 121 mmHg
    c. 82.5 mmHg
    d. 1150 mmHg
    e. 985 mmHg

22. Calculate the final pressure, in atmospheres, for a gas with an initial pressure of 1.20 atm at 75°C that is cooled to -32°C.
    a. 0.831 atm
    b. 1.73 atm
    c. -0.510 atm
    d. 2.80 atm
    e. 40.2 atm

23. A tank of isoflurane, an inhaled anesthetic, at a pressure of 1.8 atm and 5°C. What is the pressure, in atmospheres, if the gas is warmed to a temperature of 22°C, if n and V do not change?
    a. 1.9 atm
    b. 1.7 atm
    c. 7.9 atm
    d. 0.41 atm
    e. 15 atm

24. Calculate the final temperature, in degrees Celsius, for a sample of helium gas with a pressure of 250 torr at 0°C that's heated to give a pressure of 1500 torr?
   a. 0°C
   b. 27.1°C
   c. 1365°C
   d. 1638°C
   e. 1374°C

Section 8.5 – The Combined Gas Law

Goal: Use the combined gas law to calculate the final pressure, volume, or temperature of a gas when changes in two of these properties are given and the amount of gas is constant.

Summary:

The combined gas law is the relationship of pressure (P), volume (V), and temperature (T) for a constant amount (n) of gas.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

The combined gas law is used to determine the effect of changes in two of the variables on the third.

Practice Problems

25. A sample of helium gas has a volume of 6.50 L at a pressure of 845 mmHg and a temperature of 25°C. What is the final pressure of the gas, in atmospheres, when the volume and temperature of the gas sample are changed to 2.25 L and 12°C?
   a. 3.07 atm
   b. 0.553 atm
   c. 3.35 atm
   d. 102 atm
   e. 2335 atm

26. A sample of helium gas has a volume of 6.50 L at a pressure of 845 mmHg and a temperature of 25°C. What is the final pressure of the gas, in atmospheres, when the volume and temperature of the gas sample are changed to 1850 mL and 325 K?
   a. 3238 atm
   b. 50.7 atm
   c. 0.00931 atm
   d. 4.25 atm
   e. 3.58 atm

27. A sample of helium gas has a volume of 6.50 L at a pressure of 845 mmHg and a temperature of 25°C. What is the final pressure of the gas, in atmospheres, when the volume and temperature of the gas sample are changed to 12.8 L and 47°C?
   a. 0.525 atm
   b. 4.12 atm
   c. 1.06 atm
   d. 2.35 atm
   e. 0.605 atm

28. A sample of argon gas has a volume of 735 mL at a pressure of 1.20 atm and a temperature of 112°C. What is the final volume of the gas, in milliliters, when the pressure and temperature of the gas sample are changed to 658 mmHg and 281 K?
a. 0.743 mL
b. 1395 mL
c. 387 mL
d. 743 mL
e. 123 mL

29. A sample of argon gas has a volume of 735 mL at a pressure of 1.20 atm and a temperature of 112°C. What is the final volume of the gas, in milliliters, when the pressure and temperature of the gas sample are changed to 0.55 atm and 75°C?
a. 0.821 mL
b. 1.39 mL
c. 1450 mL
d. 305 mL
e. 1774 mL

30. A sample of argon gas has a volume of 735 mL at a pressure of 1.20 atm and a temperature of 112°C. What is the final volume of the gas, in milliliters, when the pressure and temperature of the gas sample are changed to 15.4 atm and -15°C?
a. 85.5 mL
b. 38.4 mL
c. 6321 mL
d. -7.67 mL
e. 7.67 mL

31. A 124 mL bubble of hot gases at 212°C and 1.80 atm is emitted from an active volcano. What is the final temperature, in degrees Celsius, of the gas in the bubble outside the volcano if the final volume of the bubble is 138 mL and the pressure is 0.800 atm, if the amount of gas does not change?
a. 1214°C
b. 240°C
c. 194°C
d. -33°C
e. -79°C

32. A scuba diver 60 ft below the ocean surface inhales 50.0 mL of compressed air from a scuba tank at a pressure of 3.00 atm and a temperature of 8°C. What is the final pressure of air, in atmospheres, in the lungs when the gas expands to 150.0 mL at a body temperature of 37°C, if the amount of gas does not change?
a. 38.4 atm
b. 11.2 atm
c. 0.906 atm
d. 9.93 atm
e. 1.10 atm

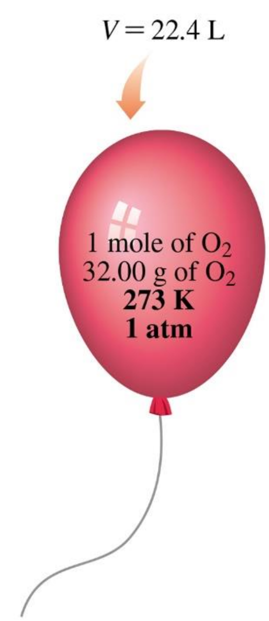
Challenge Questions

33. Your spaceship has docked at a space station above Mars. The temperature inside the space station is a carefully controlled 24°C at a pressure of 745 mmHg. A balloon with a volume of 425 mL drifts into the airlock where the temperature is -95°C and the pressure is 0.115 atm. What is the final volume, in milliliters, of the balloon if *n* remains constant?
a. 2.17 mL
b. 6043 mL
c. 28.7 mL
d. 2171 mL
e. 417 mL

34. You are doing research on Planet X. the temperature inside the space station is a carefully controlled 24°C and the pressure is 755 mmHg. Suppose that a balloon, which as a volume of 850 mL inside the space station, is placed into the airlock and floats out to planet X. If planet X has an atmospheric pressure of 0.150 atm and the volume of the balloon changes to 3.22 L, what is the temperature, in degrees Celsius, on planet X (*n* does not change)?
a. 170°C
b. -103°C
c. 7448°C
d. 11.8°C
e. 7175°C

35. A gas sample has a volume of 4250 mL at 15°C and 745 mmHg. What is the final temperature, in degrees Celsius, after the sample is transferred to a different container with a volume of 2.50 L and a pressure of 1.20 atm when *n* is constant?
a. 215°C
b. 347°C
c. -66.0°C
d. 620°C
e. -12.1°C

Section 8.6 – Volume and Amount of Gas (Avogadro's Law)
Goal: Use Avogadro's law to calculate the amount or volume of a gas when the pressure and temperature are constant.



Summary:
The volume (V) of a gas is *directly* related to the number of moles (n) of the gas when the pressure and temperature of the gas do not change.

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

- If the moles of gas increases, the volume increases.
- If the moles of gas decreases, the volume decreases.

At standard temperature (273 K) and standard pressure (1 atm), abbreviated STP, one mole of any gas has a volume of 22.4 L.

Practice Problems

36. A sample containing 1.50 moles of Ne gas has an initial volume of 8.00 L. What is the final volume of the gas if a leak allows one-half of the Ne atoms to escape?
    a. 2.3 L
    b. 16 L
    c. 9.2 L
    d. 4.0 L
    e. 1.6 L

37. A sample containing 5.0 moles of Ne gas has an initial volume of 7.00 L. What is the final volume of the gas if a sample of 3.50 moles of Ne is added to the container?
    a. 12 L
    b. 4.1 L
    c. 4.9 L
    d. 10 L
    e. 9.6 L

38. A sample containing 2.0 moles of He gas has an initial volume of 6.40 L. What is the final volume of the gas if a sample of 25.0 g of He is added to the container?
    a. 26 L
    b. 41 L
    c. 2.1 L
    d. 20 L
    e. 1.6 L

39. Use molar volume to calculate the number of moles of O_2 in 44.8 L of O_2 gas at STP.
    a. 1000 moles
    b. 2.00 moles
    c. 1.00 moles
    d. 0.500 moles
    e. 7.00 moles

40. Use molar volume to calculate the volume, in liters, occupied by 0.420 mole of He gas at STP.
    a. 0.431 L
    b. 1.12 L
    c. 0.0188 L
    d. 53.3 L
    e. 9.41 L

41. Use molar volume to calculate the volume, in liters, occupied by 6.40 g of O_2 gas at STP.
    a. 143 moles
    b. 9.14 moles
    c. 4.48 moles
    d. 0.223 moles
    e. 1.50 moles

42. Use molar volume to calculate the number of grams of Ne in 11.2 L of Ne gas ta STP.
   a. 0.500 g
   b. 10.1 g
   c. 12.4 g
   d. 2.00 g
   e. 40.4 g

Section 8.7 – The Ideal Gas Law
Goal: Use the ideal gas law to solve for P, V, T, or n of a gas when given three of the four values in the ideal gas law equation. Calculate mass or volume of a gas in a chemical reaction.
Summary:
The ideal gas law gives the relationship of the quantities P, V, n, and T that describe and measure a gas.

$$PV = nRT$$

R is the Ideal Gas Constant. **R = 0.0821 L•atm/mol•K or 62.4 L•mmHg/mol•K**
Use the R value with pressure units that match your problem (atm or mmHg) to make life easier. Because of the units in R, V must be in L, n must be in moles, and T must be in K.

Using the Ideal Gas Law
When three of the four properties are given, we rearrange the ideal gas law equation for the needed quantity.

Example: What is the volume, in liters, of 0.750 moles of CO_2 at a pressure of 1340 mmHg and a temperature of 295 K?
Answer:

$$V = \frac{nRT}{P}$$

$$V = \frac{(0.750\ \cancel{moles})(62.4\frac{L \bullet \cancel{mmHg}}{\cancel{moles \bullet K}})(295\cancel{K})}{1340\ \cancel{mmHg}} = 10.3\ L$$

Calculating Mass or Volume of a gas in a chemical reaction
The ideal gas law equation is used to calculate the pressure, volume, moles (or grams) of a gas in a chemical reaction.

Example: What is in volume, in liters of N_2 required to react with 18.6 g of magnesium at a pressure of 1.20 atm and a temperature of 303K?

$$3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$$

Answer: Initially we convert the grams of Mg to moles and use a mole-mole actor from the balanced equation to calculate the moles of N_2 gas.

$$18.5\ \cancel{g\ Mg} \times \frac{1\ \cancel{mole\ Mg}}{24.31\ \cancel{g\ Mg}} \times \frac{1\ mole\ N_2}{3\ \cancel{moles\ Mg}} = 0.254\ mole\ of\ N_2$$

Now we use the moles of N_2 in the ideal gas law equation and solve for liters, the needed quantity.

$$V = \frac{nRT}{P}$$

$$V = \frac{(0.254\ \cancel{moles})(0.0821\,\frac{L \bullet \cancel{atm}}{\cancel{moles} \bullet \cancel{K}})(303\cancel{K})}{1.20\ \cancel{atm}} = 5.27\ L$$

Practice Problems

43. Calculate the pressure, in atmospheres, of 2.00 moles of helium gas in a 10.0 L container at 27°C.
    a. 3744 atm
    b. 493 atm
    c. 0.443 atm
    d. 4.93 atm
    e. 374400 atm

44. What is the volume, in liters, of 4.00 moles of methane gas, CH_4, at 18°C and 1.40 atm?
    a. 68.3 L
    b. 4.22 L
    c. 101 L
    d. 3209 L
    e. 51900 L

45. An oxygen gas container has a volume of 20.0 L. How many grams of oxygen are in the container if the gas has a pressure of 845 mmHg at 22°C?
    a. 0.0287 g
    b. 0.574 g
    c. 14.7 g
    d. 29.4 g
    e. 0.918 g

46. A 10.0 g sample of krypton (Kr) has a temperature of 25°C at 575 mmHg. What is the volume, in millimeters, of the krypton gas?
    a. 3.86 mL
    b. 3859 mL
    c. 0.00506 mL
    d. 5.06 mL
    e. 323 mL

47. A 25g sample of carbon dioxide, CO_2, has a volume of 525 mL and a pressure of 455 mmHg. What is the temperature, in kelvins, of the gas?
    a. 5122 K
    b. -266 K
    c. 6.74 K
    d. 32.1 K
    e. 6740 K

48. Mg metal reacts with HCl to produce hydrogen gas.

$$Mg(s) + 2HCl(aq) \rightarrow H_2(g) + MgCl_2(aq)$$

What volume, in liters, of hydrogen at O°C and 1.00 atm (STP) is released when 8.25 g of Mg reacts?
a. 5775 L
b. 185 L
c. 7.60 L
d. 0.412 L
e. 1.00 L

49. Mg metal reacts with HCl to produce hydrogen gas.

$$Mg(s) + 2HCl(aq) \rightarrow H_2(g) + MgCl_2(aq)$$

How many grams of magnesium are needed to prepare 5.00 L of H2 at 735 mmHg and 18°C?
a. 0.202g
b. 4.92g
c. 154g
d. 0.143g

50. When heated to 350°C at 0.950 atm, ammonium nitrate decomposes to produce nitrogen, water, and oxygen gases.

$$2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$$

How many liters of water vapor (H_2O) are produced when 258 g of NH_4NO_3 decomposes?
a. 257 L
b. 129 L
c. 72.3 L
d. 57900 L
e. 97800 L

51. When heated to 350°C at 0.950 atm, ammonium nitrate decomposes to produce nitrogen, water, and oxygen gases.

$$2NH_4NO_3(s) \rightarrow 2N_2(g) + 4H_2O(g) + O_2(g)$$

How many grams of NH_4NO_3 are needed to produce 10 L of oxygen (O_2)?
a. 0.0528g
b. 40.2g
c. 0.264g
d. 20.1g
e. 0.186g

52. Butane undergoes combustion when it reacts with oxygen to produce carbon dioxide and water. What value, in liters, of oxygen (O_2) is needed to react with 55.2 g of butane (C_4H_{10}) at 0.850 atm and 25°C?

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$

a. 1589 L
b. 11300 L
c. 311 L
d. 178 L
e. 27.3 L

53. Potassium nitrate decomposes to potassium nitrite and oxygen. What volume in liters of O_2 can be produced from the decomposition of 50g of KNO_3 at 35°C and 1.19 atm?

$$2KNO_3(s) \rightarrow 2KNO_2(s) + O_2(g)$$

a. 5.25 L
b. 10.5 L
c. 3990 L
d. 7990 L
e. 21.3 L

54. Nitrogen dioxide reacts with water to produce oxygen and ammonia. How many grams of NH_3 can be produced when 4.00 L of NO_2 reacts at 415°C and 725 mmHg?

$$4NO_2(g) + 6H_2O(g) \rightarrow 7O_2(g) + 4NH_3(g)$$

a. 611g
b. 874g
c. 51.3g
d. 1.15g
e. 0.0675g

Section 8.8 – Partial Pressure (Dalton's Law)

Goal: Use Dalton's Law of partial pressures to calculate the total pressure of a mixture of gases.

Summary: In a mixture of two or more gases, the total pressure is the sum of the partial pressures of the individual gases:

$$P_{total} = P_1 + P_2 + P_3 + \ldots$$

The **partial pressure** of a gas in a mixture is the pressure it would exert if it were the only gas in the container.

Example: A gas mixture with a total of 1.18 atm contains helium gas at a partial pressure of 465 mmHg and nitrogen gas. What is the partial pressure, in atmospheres, of the nitrogen gas?

Answer: Initially we convert the partial pressure of helium gas from mmHg to atm so all the pressures are in the same units:

$$465\ \cancel{\text{mmHg}} \times \frac{1\ \text{atm}}{760\ \cancel{\text{mmHg}}} = 0.612\ \text{atm of He gas}$$

Use Dalton's law, we solve for the needed quantity, P_{N2} in atmospheres.

$$P_{total} = P_{N_2} + P_{He}$$
$$P_{N_2} = P_{total} - P_{He}$$
$$P_{N_2} = 1.18\ \text{atm} - 0.612\ \text{atm} = 0.57\ \text{atm}$$

Practice Problems

55. In a gas mixture, the partial pressures are nitrogen 425 torr, oxygen 115 torr, and helium 225 torr. What is the total pressure, in torr, exerted by the gas mixture?
    a. 765 torr
    b. 425 torr
    c. 115 torr
    d. 336 torr
    e. -765 torr

56. In a gas mixture, the partial pressures are argon 415 mmHg, neon 75 mmHg, and nitrogen 125 mmHg. What is the total pressure, in millimeters of mercury, exerted by the gas mixture?
    a. 415 mmHg
    b. 75 mmHg
    c. 615 mmHg
    d. 3.89×10^6 mmHg
    e. 125 mmHg

57. A gas mixture containing oxygen, nitrogen, and helium exerts a total pressure of 925 torr. If the partial pressures are oxygen 425 torr and helium 75 torr, what is the partial pressure, in torr, of the nitrogen in the mixture?
    a. 30950 torr
    b. 425 torr
    c. 1425 torr
    d. 925 torr
    e. 75 torr

58. A gas mixture containing oxygen, nitrogen, and neon exerts a total pressure of 1.20 atm. If helium added to the mixture increases the pressure to 1.50 atm, what is the partial pressure, in atmospheres, of the helium?
    a. 3.0 atm
    b. 0.2 atm
    c. 4.7 atm
    d. 1.5 atm
    e. 0.3 atm

59. A gas mixture containing hydrogen and helium exerts a total pressure of 14.0 atm. If hydrogen has a partial pressure of 721 torr, what is the partial pressure of helium in <u>millimeters of mercury</u>?
    a. 721 mmHg
    b. 10600 mmHg
    c. 9920 mmHg
    d. 11400 mmHg
    e. 14.0 mmHg