Intermolecular Forces and Properties
3.4 Ideal Gas Law
Worksheet

1) Draw a volume versus temperature graph, and plot the expected results of heating a gas from 0 K to 300 K at a constant pressure.

2) Suppose you have two identical 1.0 L sealed containers. Both containers are kept at exactly 25°C. One vessel contains only neon gas at 1.5 atm, and the other contains only xenon gas at 1.9 atm. Is the value for the moles of neon less than, equal to, or greater than that of xenon? Explain.

3) A container is filled with argon gas at – 48°C and sealed. After sitting on a lab bench at room temperature for several minutes, the lid blows off and the gas escapes. Explain why this happened.

4) What volume of space would 2.68 moles of CO_2 gas occupy at 85°C and 795 mm Hg?

5) One of the problems with using hydrogen gas as a fuel to power cars is that it must be stored in high pressure tanks. The high pressure tanks that would be required to take a car a reasonable distances between refuelling stops are often far too large for the average vehicle. What would be the necessary internal volume of a tank that stored 89.69 moles of $H_2(g)$ at 20.0 atm at 32°C?

6) How many moles of gas can be contained in 32.0 L of space at 25°C and 1.00 atm?

7) How many moles of gas can be contained in 13.74 liters of space at 1.05 atm and 303 K.

8) The density of an unknown gas is found to be 2.45 g/L at 20.0°C and 1.00 atm. Find the molar mass of the gas.

9) The density of an unknown gas is found to be 2.89 g/L at 124°C and 1.41 atm. Find the molar mass of the gas.

10) A gaseous hydrocarbon (a compound that contains only hydrogen and carbon) is found to be 11 % hydrogen by mass.
    a. Find the empirical formula for the compound.
    b. Find the molar mass of the hydrocarbon, if it has a density of 3.16 g/L at 1.43 atm and 25°C.
    c. Find the molecular formula of the compound.

11) A sample of an unknown gaseous hydrocarbon is composed of 37.25 g of carbon and 12.54 g of hydrogen.
    a. Find the empirical formula for the compound.
    b. Find the molar mass of the hydrocarbon, if it has a density of 0.656 g/L at 1.00 atm and 25°C.
    c. Find the molecular formula of the compound.

12) The total pressure inside a 1.62 L cylinder kept at 35°C is 1.15 atm. If the volume of the cylinder drops to 0.74 L and the temperature remains the same, what is the new pressure inside the cylinder?

13) The total pressure inside a 2.7 L cylinder kept at 25°C is 0.85 atm. Suppose the pressure inside that cylinder rises to 1.03 atm. If the temperature remains the same, what is the new volume of the cylinder?

14) The total pressure inside a 1.8 L cylinder at 25°C is 0.96 atm. If the pressure increases to 1.27 atm, and the volume remains the same, what is the new temperature inside the cylinder?

15) Suppose you have two identical 1.0 L cylinders. Both cylinders are kept at exactly 25°C. One cylinder contains 0.3 moles of helium gas and the other contains 0.3 moles of xenon gas.
    a. Is the pressure in the cylinder containing helium less than, equal to, or greater than that of xenon? Justify your answer without performing any calculations. (Hint: Manipulate the ideal gas equation.)
    b. If the volume of the cylinder containing xenon is reduced to 0.25 L and the temperature remains the same, what happens to the pressure inside the cylinder? Justify your answer by manipulating the combined gas law equation.
    c. If the volume of the cylinder containing helium increases to 2.0 L and the temperature remains the same, what happens to the pressure inside the cylinder? Justify your answer by manipulating the combined gas law equation.

16) A rigid 3.4 L sealed vessel contains 0.124 mol $H_{2(g)}$, 0.132 mol $O_{2(g)}$, and 0.0820 mol $Kr_{(g)}$. The total pressure in the vessel is 2.32 atm.
    a. Find the mole fraction of each gas.
    b. Find the partial pressure exerted by each gas.

17) A rigid 2.5 L sealed vessel contains $O_{2(g)}$, $N_{2(g)}$, and $Ar_{(g)}$ with partial pressures of 0.438 atm, 0.284 atm, and 0.625 atm respectively. Find the mole fraction of each gas.

18) A rigid 11.7 L sealed vessel containing 3.3 mol of $O_{2(g)}$, 1.6 mol of $CH_{4(g)}$, and 2.3 mol of $He_{(g)}$ has an internal temperature of 78°C.
    a. Calculate the partial pressure of each gas.
    b. What is the total pressure in the vessel?
    c. Find the mole fraction of each gas in the vessel.

19) A rigid 3.80 L sealed vessel contains 0.650 mol Ne, 0.321 mol Kr, and 0.190 mol Xe. Find the density of the mixture in g/L.
(Hint: density = total mass / volume)

20) A rigid sealed 3.70 L vessel contains 0.12 mol $He_{(g)}$ and 0.24 mol $Ne_{(g)}$ at 25°C. What is the total pressure in the vessel? (Hint: You can do this in one step.)

21) Nitrogen gas was produced in a reaction and collected over water. A 45.2 mL sample of gas was collected over water at 25°C. The reading on the barometer in the laboratory was 0.97 atm. The vapor pressure of water is 23.76 mmHg at 25°C. Find the mass of Nitrogen gas collected.

22) Oxygen gas was produced in a reaction and collected over water. A 136.1 mL sample of gas was collected over water at 25°C and 1.06 atm. The vapor pressure of water is 23.76 mmHg at 25°C. Find the mass of oxygen gas collected.

23) A 0.642 g sample of an unknown gas was collected over water at 25.0°C and 1.04 atm. The collection cylinder contained 151.3 mL of gas after the sample was released. Find the molar mass of the unknown gas.