Class Examples: The Gas Laws

Simple Gas Laws

1. Sketch a qualitative graph for each of the following variables, assuming 1 mole of an ideal gas:
   a. $P$ versus $1/V$ (at constant $T$)
   b. $P$ versus $V$ (at constant $T$)
   c. $PV$ versus $V$ (at constant $T$)

2. A spherical balloon filled with 0.656 moles of oxygen gas has a radius of 15.2 cm. Some of the oxygen then leaks out. If the balloon volume is now 10.1 L, what mass of oxygen gas leaked out?

3. A 15.0 L tank is filled with $H_2$ gas to a pressure of 200. atm. How many balloons, each 2.00 L, can be inflated to a pressure of 1.00 atm using the $H_2$ in the tank? Assume $T$ is constant, and that the tank cannot be emptied below 1.00 atm pressure.

4. A sample of helium gas at $25.0 \, ^\circ C$ inflates a balloon to $15.0 \, m^3$ at 740. torr (at sea-level). The balloon is released and drifts up to an altitude of 5000 m, where the temperature is $-23.0 \, ^\circ C$ and the pressure is 370. torr. Calculate the balloon volume, in $m^3$, at this altitude.

5. A compressed gas cylinder contains 675 g of sulfur trioxide gas. The pressure inside the cylinder is 120. psi. What mass of gas remains in the cylinder if the pressure is decreased to 5.8 atm? Assume temperature remains constant.

Ideal Gas Law

6. A 12.0 mL sample of liquid methanol ($CH_3OH, d = 0.850 \, g/mL$) is placed in an evacuated, sealed 250. mL flask and then heated to a temperature of 90.0 $^\circ C$ to vaporize it completely. At this temperature, what is the pressure of the gaseous methanol in this flask?

7. An unknown diatomic gas has a density of 1.53 g/L at 18.0 $^\circ C$ and 986 torr. Determine its molar mass, and identify this gas.

8. Determine the density of argon gas at STP. Which noble gases are predicted to have a greater density than argon at STP?

9. A sample of propane gas ($C_3H_8$) is placed in a sealed, evacuated 500. mL bulb at 110. $^\circ C$. The bulb is then attached to an open-tube manometer, the results of which are illustrated in the figure below. If atmospheric pressure is 762.0 torr, determine the mass of propane in the bulb. Assume the tube connecting the bulb to the manometer as a negligible volume.

10. At what pressure is the density of $O_2$ gas at 100 $^\circ C$ identical to the density of $Cl_2$ gas at STP?