Advanced Chemistry
Gas Density & Molar Mass WS

NAME: Key **PER:** _____

Gas Density & Molar Mass Relationship

1. Rank the following gases from least dense to most dense at 1.00 atm and 298K: SO_2, HBr, CO_2. Explain.

SO_2 = 64.063 g/mol
HBr = 80.9119 g/mol
CO_2 = 44.009 g/mol

$CO_2 \rightarrow SO_2 \rightarrow HBr$
CO_2 is least dense because it has the smallest molar mass

Instructions: Using variations of the ideal-gas law, complete the following problems. SHOW ALL WORK in the empty space below the questions. Write the final answer on the blanks provided. Remembers the units. Round to the correct number of significant figures.

Finding Gas Density

1. Calculate the density of NO_2 gas at 0.9700 atm and 35.00°C.

46.005 g/mol

+273.15
308.15

$$d = \frac{(.9700)(46.005)}{(.08206)(308.15)} = \frac{44.62485}{25.286789} =$$

1.764749569

4 sig fig
1. 1.765 g/L

2. Calculate the density of sulfur hexafluoride (SF6) gas at 707.0 torr and 21.0°C.

$707\ torr \times \frac{1\ atm}{760\ torr} = .930263579$

146.053

+273.15
294.15

$$d = \frac{(.930263579)(146.053)}{(.08206)(294.15)} = \frac{135.867725}{24.137949} =$$

5.628801561

3 sig fig
2. 5.63 g/L

3. Anhydrous aluminum chloride ($AlCl_3$) sublimes at high temperatures. What density will the vapor have at 225.5 degrees Celsius and 0.9390 atm of pressure?

133.341

+273.15
498.65

$$d = \frac{(.9390)(133.341)}{(.08206)(498.65)} = \frac{125.207199}{40.919219}$$

3.059862873

4 sig fig
3. 3.060 g/L

Finding Molar Mass $M = \frac{gRT}{P}$

5. Calculate the molar mass of a gas if 2.500 g occupies 0.8750 L at 685.0 torr and 35.00°C.

$d = 2.5\,g / .8750\,L = 2.857142857\,g/L$

$685\,torr \times \frac{1\,atm}{760\,torr} = .901315789\,atm$

$+273.15$ / 308.15

$M = 80.15833009$

$M = \frac{(2.857142857)(.08206)(308.15)}{.901315789}$

4 sig fig

5. 80.16 g/mol

6. Calculate the molar mass of a vapor that has a density of 7.135 g/L at 12.50°C and 743.0 torr.

$743\,torr \times \frac{1\,atm}{760\,torr} = 0.977631579\,atm$

$+273.15$ / 285.65

$\frac{(7.135)(.08206)(285.65)}{.977631579}$ $M = 171.0741918$

4 sig fig

6. 171.1 g/mol

7. The density of a gas is measured at 1.853 g / L at 745.5 mmHg and 23.85 °C. What is its molar mass?

$745.5\,mmHg \times \frac{1\,atm}{760\,mmHg} = .980921052\,6\,atm$

$+273.15$ / 297

$\frac{(1.853)(.08206)(297)}{.980921052\,6}$

$X = 46.03936508$

4 sig fig

7. 46.04 g/mol

8. What is the molar mass of a gas which has a density of 0.002490 g/mL at 20.05 °C and 744.0 mm Hg? (Note: Make sure density is in proper units!)

$744\,mmHg \times \frac{1\,atm}{760\,mmHg} = 0.978947368\,4\,atm$

$\frac{.002490\,g}{1\,mL} \times \frac{1000\,mL}{1\,L} = 2.49\,g/L$

$+273.15$ / 293.2

$X = 61.19\,775\,385$

$\frac{(2.49)(.08206)(293.2)}{.978947368\,4}$

4 sig fig

8. 61.20 g/mol