Chem 122 **Chapter 5 Worksheet** **Gas Law & KMT Calculations**

Gas Law Formulas $R = 0.082058\ \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} = 8.3145\ \frac{\text{J}}{\text{mol}\cdot\text{K}} = 62.4\ \frac{\text{L}\cdot\text{mm Hg}}{\text{mol}\cdot\text{K}}$ $T\,(\text{K}) = T\,(°\text{C}) + 273.15$

Formula	When to be applied
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	**Combined gas law** Use when there is a *change* in conditions, but not in number of moles.
$PV = nRT$	**Ideal gas law** Must match the units with the value of R!
$d = \frac{m}{V} = \frac{PM_m}{RT}$	**Density of an ideal gas** Must know the molar mass (M_m) of the gas.
$\chi_a = \frac{n_a}{n_{total}}$	**Mole fraction** of component a in a mixture Use in gas mixture problems.
$P_{\text{total}} = P_a + P_b + \ldots$ $P_a = \chi_a \times P_{total}$	**Dalton's law of partial pressures** Use to find the pressure exerted by one gas component in a mixture of ideal gases.
$\frac{3}{2}RT = \frac{1}{2}mu^2$	**Kinetic energy of an ideal gas** Shows that average kinetic energy is measured by temperature.
$u = \sqrt{\frac{3RT}{M_m}}$	**RMS speed of an ideal gas** Molar mass (M_m) must be in kg/mol in this formula to yield speed in m/s.
$\frac{\text{rate of a effusion}}{\text{rate of b effusion}} = \sqrt{\frac{M_b}{M_a}}$	**Graham's Law of Effusion** Use to find the relative rate of effusion of gases a & b at a given temperature.

1) Consider a gas mixture of Ne and Ar ($x_{Ne} = 0.40$) is in a rigid, 50-L vessel at 10 atm and at 22°C.
   a) What is the partial pressure of Ar in kPa?
   b) What is the mass of the gas in the container?
   c) If the temperature were to rise to 88°C, what would the gas pressure be?

2) At STP, 700. mL of a gas has a mass of 1.452 g.
   a) What is the molar mass of the gas?
   b) If the temperature and pressure increased by 25%, what is the new gas volume?

3) Consider dry air at STP with the following composition:

N_2	78.00% (*by volume*)
O_2	21.00%
Ar	0.800%
CO_2	0.200%

   a) What is the *molar* density (mol/L) of air at STP?
   b) What is the density of air at STP in g/L?