Announcements

To join clicker to class today (Clickers with LCD display join automatically):

- Turn on the Clicker (the red LED comes on).
- Push "Join" button followed by "20" followed by the "Send" button (switches to flashing green LED if successful).

- Next Exam one week from today.
- Most review material is already posted.

- Quiz Wednesday covers to PV=nRT problems like those on Friday.
- No shorts, sandals or skirts allowed in Lab!!
- Volunteer to help with Earth Day Science Fun

PV=nRT

- P = pressure. We will use units of atm, but can also be in other units (you are responsible for conversions, 1 atm = 760 Torr = 760 mmHg, Pa = Nm^{-2},1 atm = 101325 Pa, 1 bar = 10^5 Pa).
- R = the gas constant = 0.082058 $L \bullet atm \bullet mol^{-1} K^{-1}$ or 8.3145 $J \bullet mol^{-1} \bullet K^{-1}$ (used when P in Pa)
- T = temperature in <u>Kelvin</u>
- Model works well near 298 K (rm temp) and 1 atm.
- Be able to solve for individual variables.
- How includes Boyle's, Charles & Avogadro's Laws.
- Graphs of relationships between the variables.
- Be able to use in multistep calculations where physical situation makes one or more of P,V, T or n constant.

One or more variables constant

- Example 1: An expandable but closed container (balloon, piston) is maintained at constant T. It is found that $V_2 = (0.5)V_1$. How is the final P related to the initial P? $(P_2 = nRT/V_2 = nRT/\{0.5V_1\} = 2nRT/V_1 = 2P_1)$
- Example 2: An ideal gas inside a piston is initially at STP (0˚C=273. K, 1.00 atm) and occupies a volume of 10.0 L. What volume does it occupy at 25 ˚C = 298. K and 3.00 atm?

$V_f = nRT_f/P_f$ & $n = P_iV_i/(RT_i)$ => $V_f = P_iV_iT_f/[P_fT_i]$ = (1.00 atm)(10.0 L)(298 K)/[(3.00 atm)(273 K)] = 3.64 L

Molar Mass

- MM = m/n, m = mass of sample, n=# moles in sample.
- Moles n = PV/(RT)
- Substituting: MM = m•RT/(PV)

Density

- Density d = m/V = n(MM)/V
- PV = nRT => n/V = P/(RT)
- Substituting: d = (MM)P/(RT)

- Example: Assume O_2 at STP (0˚C=273 K and 1 atm)

$$d_{O_2} = \frac{(31.998\ g/mol)\,(1.00\ atm)}{(0.08206\ \frac{L \cdot atm}{mol \cdot K})\,(273\ K)} = 1.43\ g/L$$

Dalton's Law of partial pressures

- $P_{tot} = P_1 + P_2 + \ldots = (n_1 + n_2 + \ldots)RT/V$
- P_i/P_{tot} = mole fraction of gas i, Written as X_i
  - $P_i = X_i P_{tot}$
  - $\sum_i X_i = 1$ or $X_1 + X_2 + X_3 + \ldots = 1$