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).

- Exam next Monday.
- By tomorrow morning all review material will be posted.

- Quiz Today 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

Review

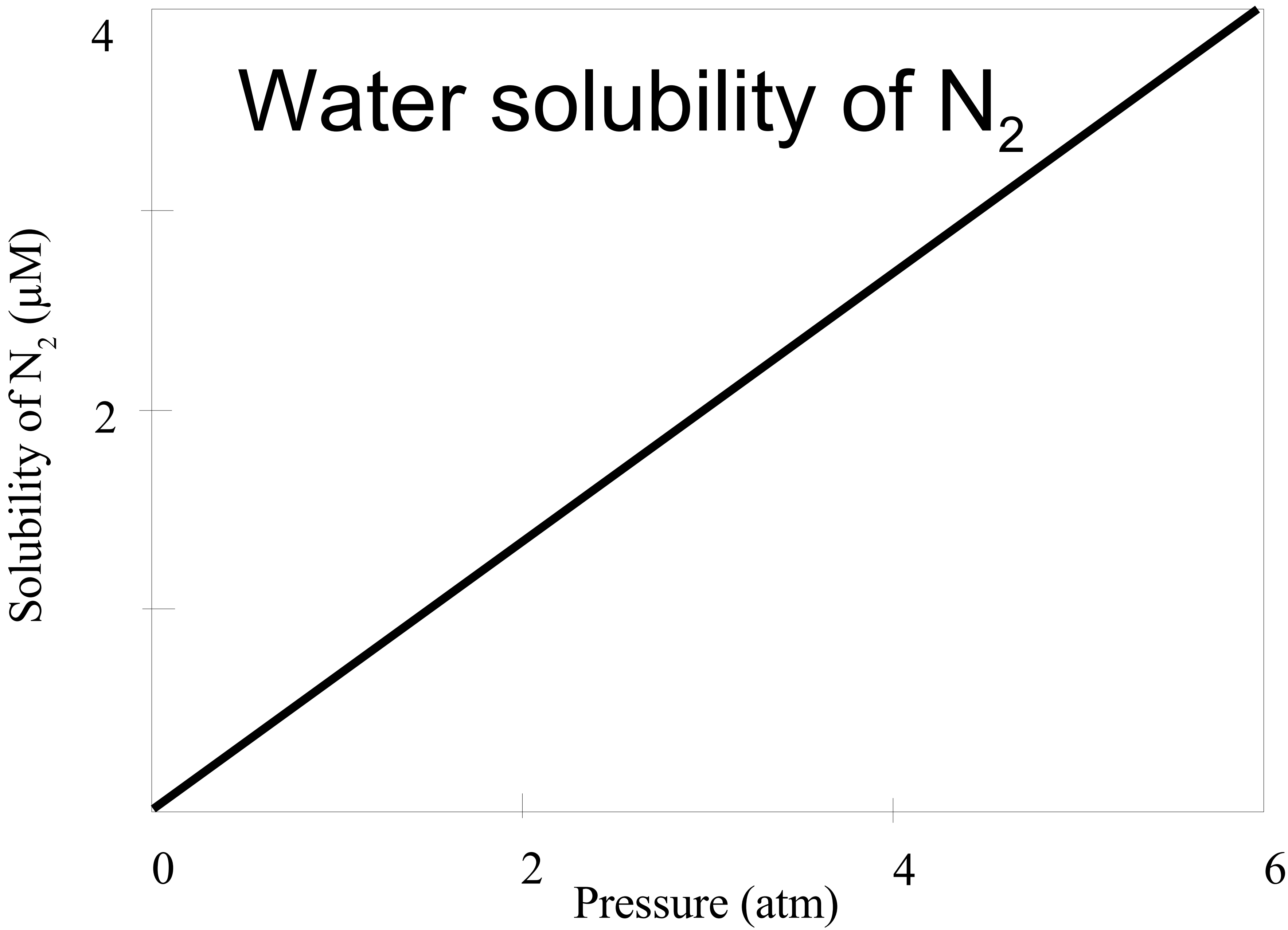
- PV = nRT, solved for P, V, n or T
- Used as intermediate values in multistep calculations, including finding finding density and molar mass or going between the two.
- Partial pressures
  - $P_{tot} = P_1 + P_2 + \ldots = (n_1 + n_2 + \ldots)RT/V$
  - $P_i = X_i P_{tot}$
  - $\sum_i X_i = 1$ or $X_1 + X_2 + X_3 + \ldots = 1$
  - Example of finding volume that would be occupied by one of the gases in a mixture, if it were separated out.
  - Clicker example of finding P_{O2} given P_{tot} and X_i for all components but O_2.

Dalton's Law to find volume contributed by a gas.

- $PV = nRT$ & $P_{tot} = (n_1+n_2+..)RT$
- Calculated @60˚C $P_{H2O} = 0.20$ atm, if $P_{tot} = 1.00$ atm => $P_{N2} = 1.00 – 0.20 = 0.80$ atm.
- Given total V = 0.045 L calculated $n_{N2}=P_{N2}V_{tot}/RT=1.3 \times 10^{-3}$ mol N_2.
- If there had been no water vapor than $P_{N2} = 1.00$ atm. Used this to calculate $V_{N2} = n_{N2}RT/P_{tot} = 36.$ mL.)
- Can be shorter if do it symbolically first. Final equation: $V_{N2} = P_{N2}V_{tot}/P_{tot}$= (0.80 atm)(45 mL)/(1.00 atm)= 36. mL!

Henry's Law of Gas Solubility

- $C_{gas} = k_H P_{gas}$
  - C_{gas} = molarity of gas in solution
  - k_H = the Henry's law constant for a particular gas in a particular solvent
  - P_{gas} = the partial pressure of the gas
  - This law is an empirical observation.


Water solubility of N2
Solubility of N2 (μM)
4
2
0
2
4
6
Pressure (atm)

Cartoon of why solubility increases with P

Chang Figure 13.5

Kinetic Molecular Theory of Gases

- Molecules assumed to be very small (essentially points with no volume)
- They are constantly moving and exchanging kinetic energy through elastic collisions => they are changing direction and speed randomly, but total kinetic energy constant.
- Pressure = sum of the force of many collisions with the walls of the container.

- Based on $KE = (1/2)mu^2$ (u = speed).
  - Each sample has a distribution of speeds.
  - lighter particles move faster.
  - $\langle KE \rangle = (1/2)mu^2_{rms}$ is independent of type of gas.
- Key result: $u_{rms} = (3RT/\mathscr{M})^{1/2}$
  - Higher temperature => higher average speeds.

Diffusion and Effusion

- $u_{rms} = (3RT/\mathcal{M})^{1/2}$
- Diffusion = spread of one substance through another.
- Effusion = process of a gas escaping through a small hole.
- Rate for both depends on u_{rms}
  - Higher T => faster diffusion or effusion.
  - relative rates $r_1/r_2 = u_{rms}(1)/u_{rms}(2) = (\mathcal{M}_2/\mathcal{M}_1)^{1/2}$