CHE 102 Midterm Reference Sheet - Sean Yang

SI Prefixes and Conversion

| Factor | Prefix | Symbol |
|------------|--------|--------|
| 10^{12} | tera | T |
| 10^{9} | giga | G |
| 10^{6} | mega | M |
| 10^{3} | kilo | k |
| 10^{2} | hecto | h |
| 10^{1} | deca | da |
| 10^{0} | unit | |
| 10^{-1} | deci | d |
| 10^{-2} | centi | С |
| 10^{-3} | milli | m |
| 10^{-6} | micro | μ |
| 10^{-9} | nano | n |
| 10^{-12} | pico | p |

Temperature Conversion Factors

$$\frac{1 \mathrm{K}}{1.8^{\circ} \mathrm{R}},\, \frac{1 \mathrm{K}}{1.8^{\circ} \mathrm{F}},\, \frac{1^{\circ} \mathrm{C}}{1.8^{\circ} \mathrm{F}},\, \frac{1^{\circ} \mathrm{C}}{1.8^{\circ} \mathrm{R}},\, \frac{1^{\circ} \mathrm{C}}{1 \mathrm{K}},\, \frac{1^{\circ} \mathrm{F}}{1^{\circ} \mathrm{R}}$$

(Relative differences only)

Density

$$\rho = \frac{m}{v}$$

Average Atomic Mass

$$M = \sum_{i} x_i M_i$$

Mole Fraction and Percentage

$$x_A = \frac{n_a}{n_T} = \frac{n_A}{\sum_i n_i}$$

$$\% = x_A \times 100\%$$

Mass Fraction and Percentage

$$w_A = \frac{m_A}{m_T} = \frac{m_A}{\sum_i m_i}$$

$$\% = w_A \times 100\%$$

Average Molar Mass

$$M = \sum_i x_i M_i$$

Concentration

$$molarity = \frac{n}{V}$$

mass
$$\% = \frac{m_{\mathrm{solute}}}{m_{\mathrm{solution}}} \times 100\%$$

volume
$$\% = \frac{V_{\text{solute}}}{V_{\text{solution}}} \times 100\%$$

weight-to-volume
$$\% = \frac{m_{
m solute}}{V_{
m solution}} imes 100\%$$

$$ext{molality} = rac{n_{ ext{solute}}}{m_{ ext{solvent}}}$$

$${
m ppm}=rac{m_{
m solute}}{m_{
m solution}} imes 10^6$$

$${\rm ppb} = \frac{m_{\rm solute}}{m_{\rm solution}} \times 10^9$$

Percentage Yield and Excess

% yield =
$$\frac{\text{actual}}{\text{theoretical}} \times 100\%$$

$$\%~{\rm excess} = \frac{{\rm amount~provided~-~amount~required}}{{\rm amount~required}} \times 100\%$$

Boyle's Law (Constant n, T)

$$P \propto \frac{1}{v}$$

$$P_1V_1 = P_2V_2$$

Charles' Law (Constant n, P)

$$V \propto T$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Temperature in K

Avogadro's Law (Constant T, P)

$$V \propto n$$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

At 0° C and 1 atm: 1 mol gas = 22.414 L

At 25°C and 1 atm: 1 mol gas = 24.465 L

Ideal Gas Law

$$PV = nRT$$

or
$$PV_m = RT$$
, where $V_m = \frac{V}{n}$

Temperature in K

Ideal Gas Assumptions:

- No intermolecular forces between molecules
- · Gas molecules have no volume

Approximation valid at high T, low P

Gas Density

$$\rho = \frac{PM}{RT}$$

Dalton's Law of Partial Pressures

$$P = P_A + P_B$$

Assuming
$$V = V_A = V_B$$

Dalton's Law of Partial Volumes

$$V = V_A + V_B$$

Assuming
$$P = P_A = P_B$$

Dalton's Law (Mole Fraction)

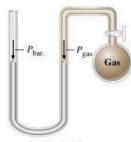
$$y_A = \frac{n_A}{n} = \frac{P_A}{P} = \frac{V_A}{V}$$

$$n_A=y_A n$$

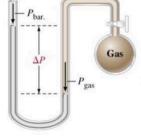
$$P_A = y_A P$$

$$V_A = y_A V$$

Measuring Pressure with an Open-End Manometer

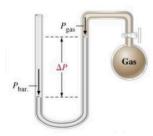


 $P_{\rm gas} = P_{\rm bar.}$



 $P_{\rm bar} + P_{\rm Hg} = P_{\rm gas}$

- (a) Gas pressure equal to barometric pressure
- (b) Gas pressure greater than barometric pressure



$$P_{\rm bar} = P_{\rm gas} + P_{\rm Hg}$$

(c) Gas pressure less than barometric pressure

$$\Delta P_{\mathrm{mmHg}} = \Delta h_{\mathrm{Hg}}$$