

# 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  | c      |
| $10^{-3}$  | milli  | m      |
| $10^{-6}$  | micro  | $\mu$  |
| $10^{-9}$  | nano   | n      |
| $10^{-12}$ | pico   | p      |

## Temperature Conversion Factors

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

(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

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

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

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

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

$$\text{molality} = \frac{n_{\text{solute}}}{m_{\text{solvent}}}$$

$$\text{ppm} = \frac{m_{\text{solute}}}{m_{\text{solution}}} \times 10^6$$

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

## Percentage Yield and Excess

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

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

## Boyle's Law (Constant n, T)

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

$$P_1 V_1 = P_2 V_2$$

## 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

$$PV = nRT$$

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

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)

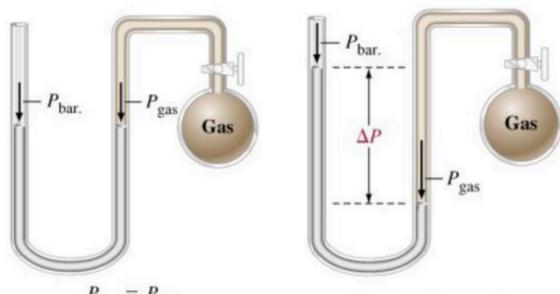
$$y_A = \frac{n_A}{n} = \frac{P_A}{P} = \frac{V_A}{V}$$

$$n_A = y_A n$$

$$P_A = y_A P$$

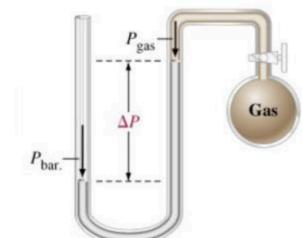
$$V_A = y_A V$$

## Measuring Pressure with an Open-End Manometer



(a) Gas pressure equal to barometric pressure

(b) Gas pressure greater than barometric pressure



$$P_{\text{bar.}} = P_{\text{gas}} + P_{\text{Hg}}$$

(c) Gas pressure less than barometric pressure

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