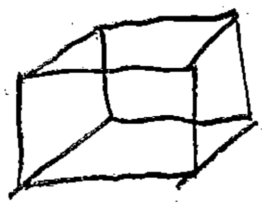
CHAPTER 10 OBJECTIVES

- WHY IS GAS PHASE DIFFERENT THAN SOLID OR LIQUID PHASES?
- UNITS OF PRESSURE
- DERIVATION OF IDEAL GAS LAW
- WHEN IS I.G.L. NOT APPLICABLE?
- STATIC SITUATIONS
- DYNAMIC SITUATIONS
- PARTIAL PRESSURE OF GAS MIXTURES

- FORCE VS. PRESSURE
- COMMON UNITS OF PRESSURE

  PSI / ATM / MM Hg. / TORR

  SLIDES 3 – 5
- DERIVATION OF IDEAL GAS LAW



HOW ARE P, V, n, T RELATED?

- GIVEN $R = 0.08206 \frac{L \cdot ATM}{K \cdot mol}$
- AND STP = 213 K
  1.00 ATM

SLIDES 12, 13

WHAT IS MOLAR VOLUME OF IDEAL GAS AT STP?

$$V = \frac{nRT}{P}$$

UNITS $V = \frac{(\text{mol})\left(\frac{\text{L} \cdot \text{ATM}}{\text{K} \cdot \text{mol}}\right)(\text{K})}{(\text{ATM})}$

$$\boxed{V = 22.4\,\text{L}}$$

IMPORTANT CONSIDERATIONS

- $PV = nRT$ IS NOT APPLICABLE FOR ALL P, V, AND T. THERE ARE MORE COMPLICATED VERSIONS OF THE EQUATION
  SEE SLIDES 26-28 TRANS T-125
- STATIC NO CHANGES
- DYNAMIC P, V, OR T CHANGES

DYNAMIC SITUATIONS

INIT

$$R = \frac{P_1 V_1}{n_1 T_1}$$

FINAL

$$R = \frac{P_2 V_2}{n_2 T_2}$$

FOR A CLOSED SYSTEM

$$n_1 = n_2$$

$$\boxed{\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}}$$

EXAMPLE:

GIVEN 2 MOLES OF IDEAL GAS AT 1.0 ATM AND 273 K. WHAT IS P WHEN T IS DOUBLED AT CONSTANT V?

PARTIAL PRESSURES FOR GAS MIXTURES

$P_i = X_i P_{TOTAL}$

X_i = MOLE FRACTION = $\frac{\text{moles } i}{\text{All moles}}$

UNITLESS!

GIVEN MIXTURE OF He, Ne, Ar

WITH moles He = .20
" Ne = .30
" Ar = .50

$P_{TOTAL} = 1.50$ ATM

WHAT IS PARTIAL P OF Ar?

(1) FIND X_{Ar}

(2) USE $P_i = X_i P_{TOTAL}$

0.75 ATM

PARTIAL PRESSURES

FOR A MIX OF GASES A + B + C

$P_{TOTAL} = P_A + P_B + P_C$

$P_T = (n_A + n_B + n_C)\frac{RT}{V}$

$\boxed{P_A = X_A P_T}$

10.61

.477 mol He
.280 mol Ne
.110 mol Ar

0.867 mol TOTAL

$V = 7\,L$

$T = 25\,^{\circ}C$

$P_T = \frac{.867(.08206)(298)}{7}$

$P_T = 3.029$ ATM

$P_{He} = \frac{.477}{.867}(3.03) = 1.67$ ATM

$P_{Ne} = \frac{.280}{.867}(3.03) = 0.979$ ATM

$P_{Ar}\ \frac{.110}{.867}(3.03) = 0.384$