Name:_____ Date:_____

H. Chemistry

Ch. 12.5 Lecture Guide

- 12.5 Ideal Gas Law
  - Deriving the Ideal Gas Law
    - Boyle's Law: $PV = k$ or $V = \frac{k}{P}$ (at a constant T + n)
    - Charles's Law: $V = bT$ (at a constant P + n)
    - Avogadro's Law: $V = an$ (at a constant T + P)
    - So... $V = R(Tn/P)$ where R is a combined constant
    - More commonly written as $PV = nRT$

↳ A gas that behaves according to this law is said to behave "ideally".

$0.08206 \frac{L\,atm}{K\,mol}$

  - Using Ideal Gas Law in Calculations
    - A sample of hydrogen gas, H_2, has a volume of 8.56 L at a temperature of 0 °C and a pressure of 1.5 atm. Calculate the number of moles of H_2 present in this gas sample.

What do we know?

$V = 8.56\ L$
$T = 0°C = 273K$
$P = 1.5\ atm$
$n = X$
$R = 0.08206 \frac{L\,atm}{K\,mol}$

$PV = nRT$

$n = \frac{PV}{RT}$

$n = \frac{(1.5\ atm)(8.56\ L)}{(0.08206 \frac{L\,atm}{K\,mol})(273\ K)}$

$n = 0.57\ mol$

  - Practice: pg. 391 q. ~~50~~ 49

a. $P = 782 mmHg = 1.029\ atm$
$V = X$
$n = 0.1021\ mol$
$R = 0.08206 \frac{L\,atm}{K\,mol}$
$T = 26.2°C = 299.2\ K$

$PV = nRT$

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

$V = \frac{(0.1021\ mol)(0.08206)(299.2}{1.029\ atm}$

$V = 2.43 L$

b. $P = X$ mmHg — NOTICE: ANSWER SHOULD BE IN MMHG! NOT ATM!
$V = 27.5\ mL = .0275\ L$
$n = .007812\ mol$
$R = 0.08206 \frac{L\,atm}{K\,mol}$
$T = 16.6°C = 289.6\ K$

$PV = nRT$

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

$P = \frac{(.007812\ mol)(0.08206)(289.6\ K)}{0.0275\ L}$

$P = .675\ atm = 513 mmHg$

c. $P = 1.045\ atm$
$V = 45.2\ mL = .0452\ L$
$n = .002241\ mol$
$R = 0.08206 \frac{L\,atm}{K\,mol}$
$T = X$ °C — NOTICE: ANSWER SHOULD BE IN °C! NOT K!

$PV = nRT$

$T = \frac{PV}{nR}$

$T = \frac{(1.045 atm)(.0452 L)}{(.002241\ mol)(0.08206)}$

$T = 257\ K = -16°C$

- Using Ideal Gas Law Involving Conversion of Units
  - What volume is occupied by 0.250 mol of carbon dioxide gas at 25 °C and 371 torr?

$P = 371 \text{ torr} = .488 \text{ atm}$
$V = X$
$n = 0.250 \text{ mol}$
$R = 0.08206 \frac{\text{L atm}}{\text{K mol}}$
$T = 25°C = 298 \text{ K}$

$PV = nRT$

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

$V = \frac{(0.250 \text{ mol})(0.08206)(298 \text{ K})}{.488 \text{ atm}}$

$V = \boxed{12.5 \text{ L}}$

- Practice: pg. 392, q. 57, 60

57. $P = 500. \text{ torr} = .658 \text{ atm}$
$V = 5.0 \text{ L}$
$n = 1.0 \text{ g Ne} = .050 \text{ mol}$
$R = .08206 \frac{\text{L atm}}{\text{K mol}}$
$T = X$

$PV = nRT$

$T = \frac{PV}{nR} = \frac{(.658 \text{ atm})(5.0 \text{ L})}{(.050 \text{ mol})(.08206)}$

$\boxed{T = 8.0 \times 10^2 \text{ K}}$

60. $P = X$
$V = 125 \text{ L}$
$n = 56.2 \text{ kg } O_2 = 56200 \text{ g } O_2 = 1756.25 \text{ mol } O_2$
$R = 0.08206 \frac{\text{L atm}}{\text{K mol}}$
$T = 21 °C = 294 \text{ K}$

$PV = nRT$

$P = \frac{nRT}{V} = \frac{(1756.25 \text{ mol } O_2)(0.08206)(294 \text{ K})}{125 \text{ L}}$

$\boxed{P = 339 \text{ atm}}$