Key

Honors Ideal Gas Law

Combines all four gas variables into one uber equation!

PV = nRT

P = pressure (atm)
V = volume (L)
n = number of moles
R = universal gas constant (0.0821 L-atm/mole-K)
T = temperature (K)

Review

1 mole = 6.022×10^{23} "things"

1 mole = molecular mass in grams "molar mass"

Problems

1. A sample of hydrogen gas, H_2, has a volume of 8.56 L at a temperature of 273K and a pressure of 1.50 atm. Calculate the number of moles of H_2 present in this gas sample.

$PV = nRT$

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

$\frac{8.56\ L \,/\, 1.50\ atm \,/\, mol \cdot K}{273\ K \,/\, .0821\ L \cdot atm} = .5728\ldots\ mol$

(3) (3) (3) (3)

$\Downarrow$ (3)

.573 mol H_2

2. Calculate the pressure (in atm) of .456 mol of carbon dioxide in a 1.21 liter container at 312K.

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

$\frac{.456\ mol \,/\, .0821\ L \cdot atm \,/\, 312\ K}{mol \cdot K \,/\, 1.21\ L} = 9.65333\ldots$

(3) (3) (3) (3)

$\Downarrow$ (3)

9.65 atm

1 mol He = 4.002602 g (use 4.00 g)

3. Calculate the pressure of 1.65g of helium gas at 16.0°C and occupying 3.25L.

+273 = 289.0 K

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

$\frac{1.65\text{ g}}{4.00\text{ g}} \cdot \frac{\text{mol He}}{\text{mol}} \cdot \frac{.0821\ \text{atm}\cdot\text{K}}{\text{mol}\cdot\text{K}} \cdot \frac{289.0\text{ K}}{3.25\text{ L}} = 3.01149\ldots \text{ atm}$

(3) (3) (3) (4)

3.01 atm (3)

4. How many moles of oxygen gas are in 5.00 L container at 25.0 °C and 760 torr? (NOTE: This problem has many conversions!)

+273
298.0 K

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

$\frac{760\text{ torr}}{} \cdot \frac{5.00\text{ L}}{} \cdot \frac{\text{mol}\cdot\text{K}}{.0821\ \text{L}\cdot\text{atm}} \cdot \frac{}{298.0\text{ K}} \cdot \frac{1\text{ atm}}{760.\text{ torr}}$

(2) (3) (3) (4) (4) (3)

$= .2043669\ldots$ mol

.20 mol (2)

5. What will be the volume of 0.70 g of nitrogen gas at standard temperature and 150 kPa pressure?

273 K

1 mol N_2 = 28.01 g

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

$\frac{.70\text{ g } N_2}{28.01\text{ g}} \cdot \frac{1\text{ mol}}{\text{mol}} \cdot \frac{.0821\ \text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \cdot \frac{273\text{ K}}{150\text{ kPa}} \cdot \frac{101.325\text{ kPa}}{1\text{ atm}}$

(2) (4) (3) (2) (3) (5)

$= .37836\ldots$ L

.38 L (2)

Homework Read Zumdahl 458 - 464