Key

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

Example 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.

V T P n=?

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

$$\frac{8.56\,L \mid 1.50\,atm \mid mol \cdot K}{\mid 273\,K \mid .0821\,L \cdot atm} = .57287 4142$$

$\boxed{.573\ mol\ H_2}$

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

P n V T

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

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

$\boxed{9.65\ atm}$

T

298.0 K

V

3. 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!)

P

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

CONV.

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

$n = .2043669$

$\boxed{.20\ mol}$

289 K

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

$PV = nRT \qquad P = \frac{nRT}{V}$ 1.65 g He He = 4.00 g/mol

$$P = \frac{1.65\ g \mid mol \mid .0821\ L \cdot atm \mid 289\ K}{\mid 4.00\ g \mid mol \cdot K \mid 3.25\ L} = 3.01149154$$

$\boxed{3.01\ atm}$

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

$N_2 = 28.0\ g/mol$

$T = 273\ K$

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

CONV

$$V = \frac{.70\ g \mid mol \mid .0821\ L \cdot atm \mid 273\ K \mid 101.3\ kPa}{\mid 28.0\ g \mid mol \cdot K \mid 150\ kPa \mid 1\ atm}$$

$V = .37841125$ $\boxed{V = .38\ L}$

Homework Problems p. 436-7: 23 - 30