Ideal Gas Law

$$PV = nRT$$

P = pressure (atm)
V = volume (L)
n = number of moles (mol)
T = temperature (K)

R = ideal gas constant
$R = .08206 \frac{L \cdot atm}{mol \cdot K}$

Examples

1) 1.33 mol (n) of oxygen gas exerts .850 atm (P) of pressure at -11.0°C (T). What is the volume (V) of the container?

P = .850 atm
V = ?
n = 1.33 mol
$R = .08206 \frac{L\,atm}{mol\,K}$
T = -11.0°C + 273
= 262 K

$PV = nRT$

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

$V = \frac{(1.33\,mol)(.08206 \frac{L\,atm}{mol\,K})(262\,K)}{.850\,atm}$

V = 33.64 L

2) .8765 mol (n) of helium gas occupies a 2.006 L (V) container with a pressure of .921 atm (P). What is the temperature of the gas?

P = .921 atm
V = 2.006 L
n = .8765 mol
$R = .08206 \frac{L\,atm}{mol\,K}$
T = ?

$PV = nRT$

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

$T = \frac{.921\,atm \cdot 2.006\,L}{(.8765\,mol \cdot .08206 \frac{L\,atm}{mol\,K})}$

T = 25.69 K

3) How many moles (n) of nitrous oxide (N_2O) is contained in a 20.0 L balloon at a pressure of (P) 10.86 atm and a temperature of 100.0°C (T). What is the mass of N_2O in the balloon?

$PV = nRT$

MM
2N × 14.01 g = 28.02 g
1 O × 16.00 g = + 16.00 g
44.02 g

P = 10.86 atm
V = 20.00 L
n = ?
R = .08206 $\frac{L\,atm}{mol\,K}$
T = 100.0°C + 273
= 373 K

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

$n = \frac{10.86\,atm \cdot 20.00\,L}{(.08206\,\frac{L\,atm}{mol\,K} \cdot 373\,K)}$

n = 7.10 mol

$\frac{7.10\,mol\,N_2O \mid 44.02\,g}{\mid 1\,mol} = g$

= 312.54 g

Practice

4) A 52.6 L tank is filled with Neon gas, 115.0 mol, at a temperature of 45.0°C. What is the pressure in the tank?

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

P = ?
V = 52.6 L
n = 115.0 mol
R = .08206 $\frac{L\,atm}{mol\,K}$
T = 45.0°C + 273
= 318 K

$P = \frac{115.0\,mol \cdot .08206\,\frac{L\,atm}{mol\,K} \cdot 318\,K}{52.6\,L}$

P = 57.05 atm

5) A scuba tank with a volume of 350.0 L holds oxygen gas at a pressure of 195.0 atm and 10.0°C. How many moles of oxygen are in the tank? What mass of oxygen is in the tank? (Remember oxygen is a diatomic molecule.)

$PV = nRT$

P = 195.0 atm
V = 350.0 L
n = ?
R = .08206 $\frac{L\,atm}{mol\,K}$
T = 10.0°C + 273
= 283 K

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

$n = \frac{195.0\,atm \cdot 350.0\,L}{(.08206\,\frac{L\,atm}{mol\,K} \cdot 283\,K)} = 2938.90\,mol$

$\frac{2938.90\,mol\,O_2 \mid 32.00\,g}{\mid 1\,mol\,O_2} = 94{,}044.80\,g\,O_2$

2 × 16.00 g
= 32.00 g