Boyle's Law

http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/gaslab/Images/chprmt.gif

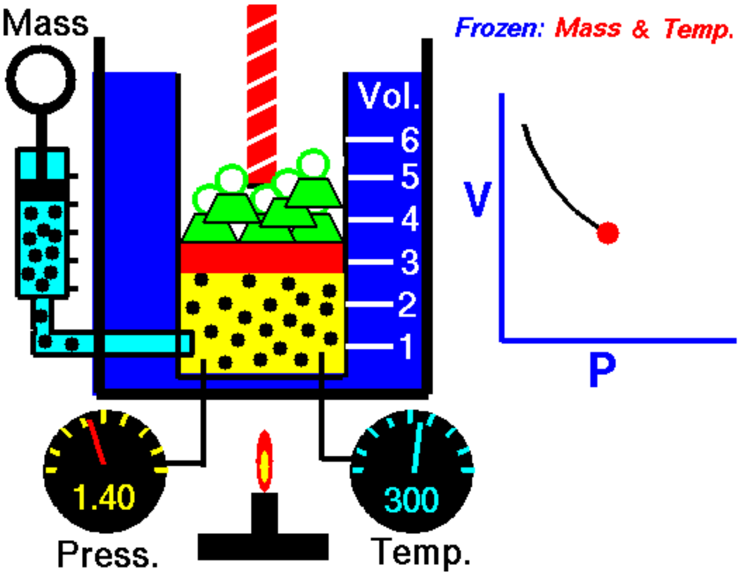
Charles' Law

http://www.grc.nasa.gov/WWW/K-12/airplane/aglussac.html

specific volume

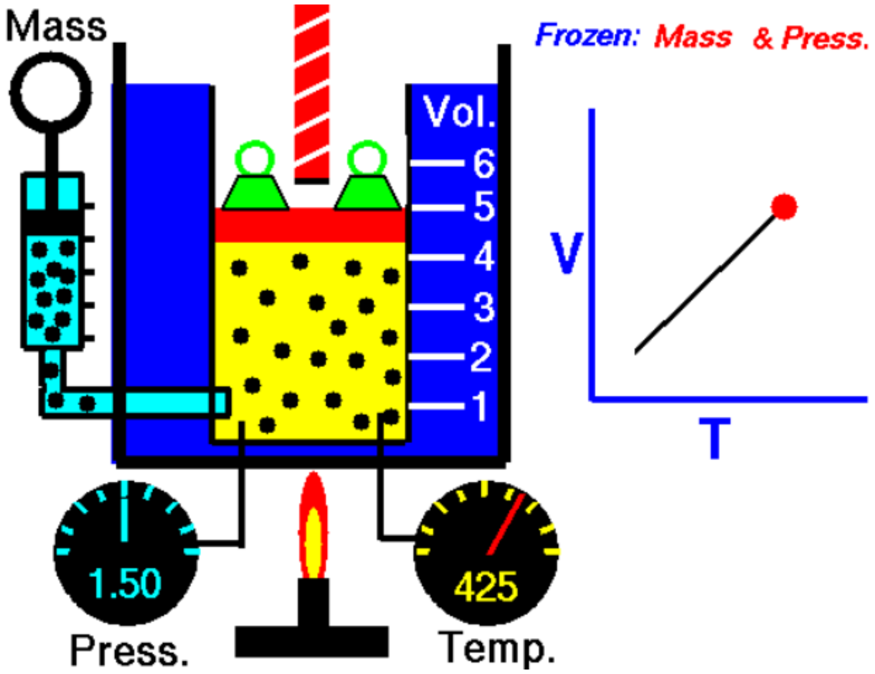
http://www.grc.nasa.gov/WWW/K-12/airplane/specvol.html

Boyle's Law



Temperature constant

Charles' Law



pressure constant

Temp. conversion:

C to F F = 1.8C + 32

F to C C = (F - 32)/1.8

Zeroth Law:

A = B = C

important because "B" could be a thermometer and "A" and "C" substances. Temp. is measured indirectly you have a third variable when doing thermal interaction

Boyles: $PV = k$

Charles': $V/T = k$

G-L: $P/T = k$

$PV \approx T$

Combined Gas Law:

$PV/T = k$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Use temperature in "K"
"V" and "P" can be in any units!

An air bubble in your blood is @ $2.1x10^{-4} cm^3$ in size. What change in V does the bubble undergo if you go from 55 m at 6 degrees C to the surface at 17 degrees C.

An air bubble in your blood is @ $2.1x10^{-4}\,cm^3$ in size. What change in V does the bubble undergo if you go from 55 m at 6 degrees C to the surface at 17 degrees C. (you're in water)

$V_1 = 2.1 \times 10^{-4}\ \text{cm}^3$
$V_2 = ?$
$h_1 = -55\ \text{m}$
$h_2 = 0$
$t_1 = 6.0^0\text{C}$
$t_2 = 17^0\text{C}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P_1V_1T_2}{T_1P_2}$$

Apr 21-8:20 AM

An air bubble in your blood is @ $2.1x10^{-4}\,cm^3$ in size. What change in V does the bubble undergo if you go from 55 m at 6 degrees C to the surface at 17 degrees C.

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$$V_2 = \frac{P_1V_1T_2}{T_1P_2}$$

$$P_1 = \rho hg$$

$$P_1 = 1000\ \text{kg/m}^3(-55\text{m})(9.8\ \text{m/s}^2)$$

$$P_1 = 539\ \text{kPa} + 101\ \text{kPa} = 640\ \text{kPa}$$

539 kPa above standard atmospheric pressure

6.34 atm

Apr 21-8:10 AM

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$t_2 = 17^0C$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P_1V_1T_2}{T_1P_2}$$

subscript "1" is under the water
subscript "2" is at surface

$$P_1 = \rho hg$$
$$P_1 = 1000 \text{ kg/m}^3(-55\text{m})(9.8 \text{ m/s}^2)$$
$$P_1 = 539 \text{ kPa} + 101 \text{ kPa} = 640 \text{ kPa}$$

6.34 atm

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{6.34 \text{ atm}(2.1 \times 10^{-4}\text{cm}^3)290 \text{ K}}{279 \text{ K}(1 \text{ atm})} = 1.38 \times 10^{-3}\text{cm}^3$$

6.6 x greater

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

$$\frac{1.013 \times 10^5 Pa(.0224 m^3)}{273 K} = R$$

$R = 8.315 J/mol K$

$$\frac{1 atm(22.4 L)}{273 K} = R$$

$R = .0821 \; L \cdot atm/mol K$

mole: amount of a substance

$$n = \frac{m}{M} = \frac{\text{mass (g)}}{\text{molecular mass}}$$

CO_2

$$1\text{ mole} = \frac{m}{C+O+O} = \frac{m}{12+16+16} = \frac{44g}{44}$$

ex .2 mol of CO_2

$m = ?$

$$n = \frac{m}{M} \qquad m = nM$$

$m = .2\text{ moles }(44)$

$m = 8.8g$

May 24 - 8:13 AM

# of moles of the gas

$$n = \frac{N}{N_A}$$

# of molecules in gas

# of molecules/mole

(Avogadro's #)

$$n = \frac{m}{M}$$

May 9 - 7:38 AM

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

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

$$PV = nRT$$

$$V = \frac{1\,mol\,(8.315\,J/mol\,K)\,273\,K}{1.013 \times 10^5\,Pa}$$

$$V = .0224\,m^3$$

May 24 - 8:20 AM

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equalities

CO_2

12 16 16

44

① $n = \frac{m}{M} = \frac{44g}{44} = 1\,mole$

② $\rho = \frac{m}{V}$ $\quad m = \rho V$

$m = 1.98\,kg/m^3\,(.0224\,m^3)$

$m = .044\,kg \rightarrow 44g$

③ $1\,mole = 6.02 \times 10^{23}$ molecules

6.02×10^{23} molecules $(44\,part/molec)$

$\therefore 2,65 \times 10^{25}$ part $(n+p)$

$2.65 \times 10^{25}\,p+N\,(1.67 \times 10^{-27}\,kg/part)$

$\therefore .044\,Kg \rightarrow 44g$

May 24 - 8:22 AM

ex:

100 ml of CO_2

m : ? $\rho = m/V$

$m = \rho V$

$m = 1{,}98\,kg/m^3 (1\times10^{-4}\,m^3)$

$m = 1{,}98\times10^{-4}\,kg$

moles?

$n = \frac{m}{M} = \frac{1{,}98\times10^{-4}\,kg}{.044} = .0045\,moles$

(cuz of kg's)

set up proportion

or $\frac{n_1}{V_1} = \frac{n_2}{V_2}$ $\frac{1\,mole}{.0224\,m^3} = \frac{n_2}{1\times10^{-4}\,m^3}$ $\underline{\underline{n_2 = .0045\,moles}}$

$N = nN_A = .0045\,moles\,(6{,}02\times10^{23}\,molecules/mol)$

$N = 2{,}71\times10^{21}\,molecules$

$2.71\times10^{21}\,molecules\,(44\,\frac{part}{molecule})(1{,}67\times10^{-27}\,kg/part) =$

$\underline{\underline{= 1{,}99\times10^{-4}\,kg}}$

n = m/M

or $\frac{n_1}{m_1} = \frac{n_2}{m_2}$

$\frac{1\,mole}{44\,g} = \frac{.0045\,moles}{m_2}$ $m_2 = .198\,g$ or $1{,}98\times10^{-3}\,kg$

May 24 - 8:29 AM

$PV = nRT$

moles

$N = nN_A$

# of molecules

molecules per mole $6{,}02\times10^{23}$ molecules

n=N/N$_A$

$n = \frac{N}{N_A}$

$PV = \frac{N}{N_A}(RT)$

$\frac{R}{N_A} = K$ Boltzmann's constant

$\frac{8{,}315\,J/mol\,K}{6{,}02\times10^{23}/mol} = K$

$1{,}38\times10^{-23}\,J/K = K$

$\therefore PV = NKT$

May 25 - 8:09 AM

Energy in a gas

most translational

$$KE = \frac{1}{2} m v^2 = \underline{\underline{3/2\, K T}}$$

$$k = 1.38 \times 10^{-23}\, J/K$$

May 25 - 8:15 AM

$$N = n N_A$$

$$N_A = \frac{N}{n}$$

and

$$PV = nRt$$

$$PV = \frac{N}{N_A} R t$$

$$\frac{R}{N_A} = K$$

$$K = \frac{R}{N/n}$$

$$K = \frac{Rn}{N}$$

$$KE = \frac{1}{2} m v^2 = 3/2\, kT$$

$$U = N\left(\frac{1}{2} m v^2\right)$$

$$U = N\,(3/2\, K T)$$

$$U = N\, 3/2 \left(\frac{Rn}{N}\right) T$$

$$U = 3/2\, R n T$$

May 25 - 8:18 AM