

Boyle's Law

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

Charles' Law

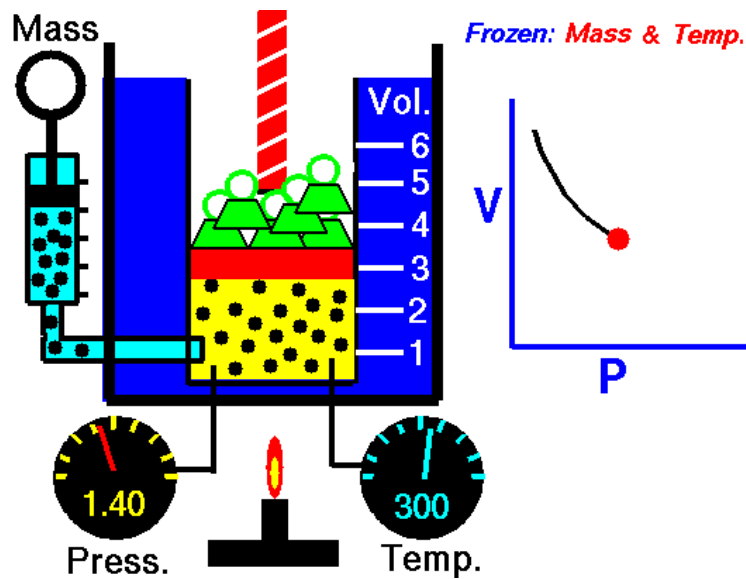
<http://www.grc.nasa.gov/WWW/K-12/airplane/aglussac.html>

specific volume

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

May 24 - 6:57 AM

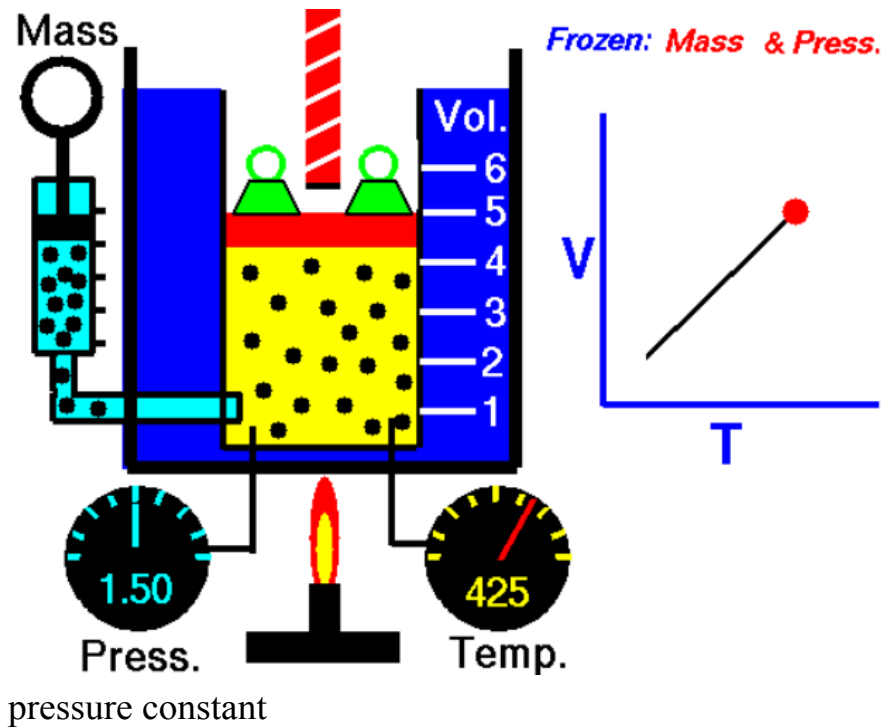
Boyle's Law



Temperature constant

Apr 21-8:01 AM

Charles' Law



Apr 21-8:02 AM

Temp. conversion:

$$\text{C to F} \quad F = 1.8C + 32$$

$$\text{F to C} \quad C = (F - 32)/1.8$$

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

May 24 - 7:38 AM

Boyles: $PV = k$

Charles': $V/T = k$

G-L: $P/T = k$

$PV \approx T$

Combined Gas Law:

$PV/T = k$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

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

May 24 - 7:44 AM

An air bubble in your blood is @ $2.1 \times 10^{-4} \text{ cm}^3$ 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.

Apr 20-6:45 AM

An air bubble in your blood is @ $2.1 \times 10^{-4} \text{ cm}^3$ 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)

$$V_1 = 2.1 \times 10^{-4} \text{ cm}^3$$

$$V_2 = ?$$

$$h_1 = -55 \text{ m}$$

$$h_2 = 0$$

$$t_1 = 6.0^\circ\text{C}$$

$$t_2 = 17^\circ\text{C}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2}$$

Apr 21-8:20 AM

An air bubble in your blood is @ $2.1 \times 10^{-4} \text{ cm}^3$ 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.

$$V_1 = 2.1 \times 10^{-4} \text{ cm}^3$$

$$V_2 = ?$$

$$h_1 = -55 \text{ m}$$

$$h_2 = 0$$

$$t_1 = 6.0^\circ\text{C}$$

$$t_2 = 17^\circ\text{C}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2}$$

$$P_1 = \rho h g$$

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

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

539 kPa above standard
atmospheric pressure

$$6.34 \text{ atm}$$

Apr 21-8:10 AM

An air bubble in your blood is @ $2.1 \times 10^{-4} \text{ cm}^3$ 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.

$$V_1 = 2.1 \times 10^{-4} \text{ cm}^3$$

$$V_2 = ?$$

$$h_1 = -55 \text{ m}$$

$$h_2 = 0$$

$$t_1 = 6.0^\circ\text{C}$$

$$t_2 = 17^\circ\text{C}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2}$$

$$P_1 = \rho h g$$

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

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

$$6.34 \text{ atm}$$

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

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{6.34 \text{ atm} (2.1 \times 10^{-4} \text{ cm}^3) 290 \text{ K}}{279 \text{ K} (1 \text{ atm})} = 1.38 \times 10^{-3} \text{ cm}^3$$

6.6 x greater

May 8 - 7:07 AM

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

$$\frac{1.013 \times 10^5 \text{ Pa} (22.4 \text{ m}^3)}{273 \text{ K}} = R$$

$$R = 8.315 \text{ J/mol K}$$

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

$$R = 0.0821 \text{ L} \cdot \text{atm} / \text{mol K}$$

May 24 - 8:08 AM

mole: amount of a substance

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

CO₂

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

ex. 2 mol of CO₂

m = ?

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

$$m = nM$$

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

$$m = 8.8g$$

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

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

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

$$PV = nRT$$

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

$$V = 0.0224 \text{ m}^3$$

May 24 - 8:20 AM

equalities

$\begin{array}{c} \text{CO}_2 \quad \textcircled{1} \\ \swarrow \quad \searrow \\ 12 \quad 16 \quad 16 \\ \hline 44 \end{array} \quad n = \frac{m}{M} = \frac{44 \text{ g}}{44} = 1 \text{ mole}$

$\textcircled{2} \quad \rho = \frac{m}{V} \quad m = \rho V$
 $m = 1.98 \text{ kg/m}^3 (0.0224 \text{ m}^3)$
 $m = 0.044 \text{ kg} \rightarrow 44 \text{ g}$

$\textcircled{3} \quad 1 \text{ mole} = 6.02 \times 10^{23} \text{ molecules}$
 $6.02 \times 10^{23} \text{ molecules} (44 \text{ part/mole})$
 $\therefore 2.65 \times 10^{25} \text{ part} (1 + \rho)$
 $2.65 \times 10^{25} \text{ part} (1.67 \times 10^{-27} \text{ kg/part})$
 $\therefore 0.044 \text{ kg} \rightarrow 44 \text{ g}$

May 24 - 8:22 AM

ex:

100 ml of CO_2

$m = ? \quad \rho = m/V$

$m = \rho V$

$m = 1.98 \text{ kg/m}^3 (1 \times 10^{-4} \text{ m}^3)$

$m = 1.98 \times 10^{-4} \text{ kg}$

moles?

$n = \frac{m}{M} = \frac{1.98 \times 10^{-4} \text{ kg}}{.044 \text{ (car of kg)}} = .0045 \text{ moles}$

set up proportion

$\frac{n_1}{V_1} = \frac{n_2}{V_2} \quad \frac{1 \text{ mole}}{.0227 \text{ m}^3} = \frac{n_2}{1 \times 10^{-4} \text{ m}^3} \quad n_2 = .0045 \text{ moles}$

$N = n N_A = .0045 \text{ moles} (6.02 \times 10^{23} \text{ molecules})$

$N = 2.71 \times 10^{21} \text{ molecules}$

$2.71 \times 10^{21} \text{ molecules} (44 \text{ g/mole}) (1.67 \times 10^{-27} \text{ kg/molecule}) =$

$n = m/M \quad = 1.99 \times 10^{-4} \text{ kg}$

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

$\frac{1 \text{ mole}}{44 \text{ g}} = \frac{.0045 \text{ moles}}{m_2} \quad m_2 = .178 \text{ g}$

$\text{or } 1.78 \times 10^{-4} \text{ kg}$

May 24 - 8:29 AM

$PV = nRT$

$N = n N_A$ # moles / molecules per mole $6.02 \times 10^{23} \text{ molecules}$

$n = \frac{N}{N_A}$ # of molecules

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

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

$\frac{8.315 \text{ J/molK}}{6.02 \times 10^{23} / \text{mol}} = K$

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

$\therefore PV = NKT$

May 25 - 8:09 AM

Energy in a gas

most translational

$$K \bar{E} = \frac{1}{2} m v^2 = \underline{\underline{\frac{3}{2} K T}}$$

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

May 25 - 8:15 AM

$$N = n N_A$$

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

and

$$pV = nRT$$

$$pV = \frac{N}{N_A} R T$$

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

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

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

$$K \bar{E} = \frac{1}{2} m v^2 = \frac{3}{2} K T$$

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

$$U = N \left(\frac{3}{2} K T \right)$$

$$U = N \frac{3}{2} \left(\frac{R n}{N} \right) T$$

$$U = \frac{3}{2} R n T$$

May 25 - 8:18 AM