density (rho)

MKS cgs

$$\rho \stackrel{\text{def}}{=} \frac{M}{V} \sim \frac{kg}{m^3} \sim \frac{gm}{cm^3}$$

1 atm = 101.3 kPa = 14.7 psi = 760 mmHg = 760 Torr

top P_T

h

P_{Bottom}

$$P_B = P_T + \rho g h$$

$$\rho_{air} = 1 \frac{kg}{m^3}$$

$$\rho_{H_2O} = 1000 \frac{kg}{m^3} = 1 \frac{gm}{cm^3}$$

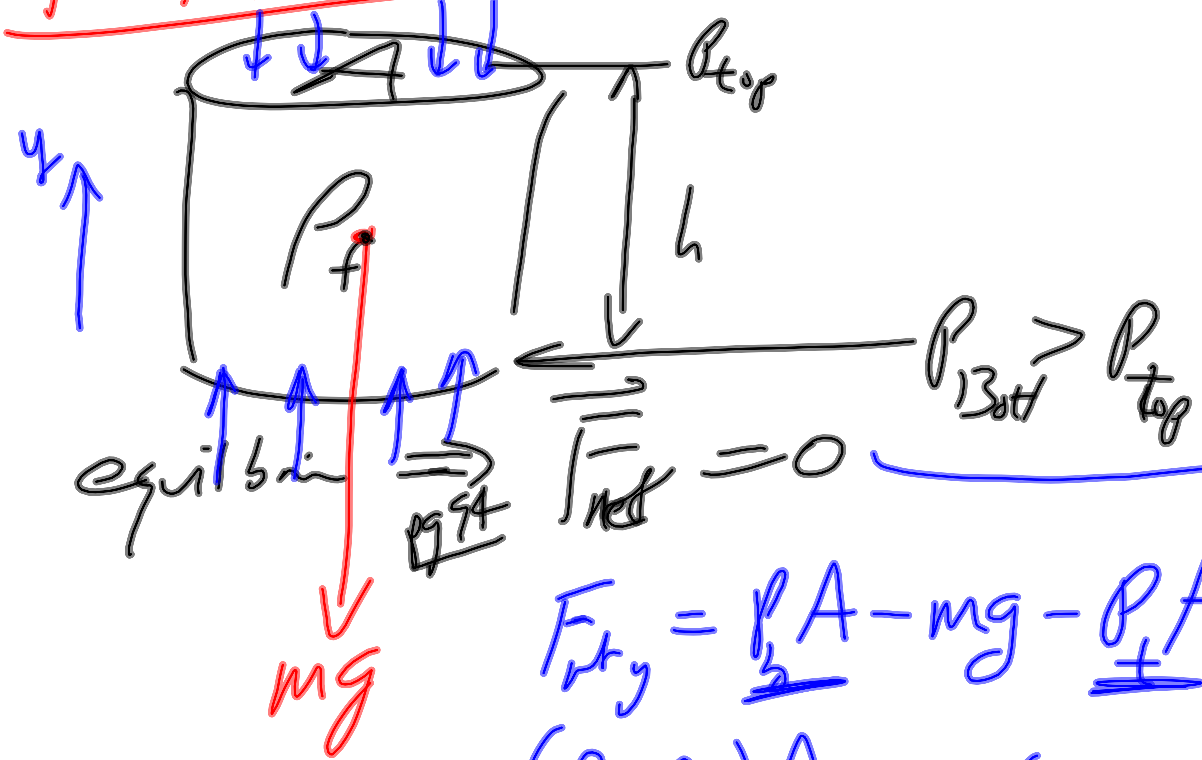
1m

$$\Delta P_{water} = \left(1000 \frac{kg}{m^3}\right)\left(9.8 \frac{m}{s^2}\right)(1m) = 9800 \frac{N}{m^2} = Pa$$

$$= 9800\ Pa \left(\frac{1\ atm}{101300\ Pa}\right) = .097\ atm = 1.42\ psi$$

$$\Delta P_{1m\ air} = \left(1 \frac{kg}{m^3}\right)\left(9.8 \frac{m}{s^2}\right)(1m) = 9.8\ Pa \approx .0001\ atm$$

$P \doteq F/A$ ~ psi or Pa ← caused by



equilibrium ⇒ $\vec{F}_{net} = 0$ pg 94

$$F_{net_y} = P_b A - mg - P_t A \doteq 0$$

$$B = (P_b - P_t)A = mg$$

$$B = \rho_f V g$$

$$P_b - P_t = \rho_f h g$$

b/c $\frac{V}{A} = \frac{A \cdot h}{A} = h$

pg 322 $\rho_{blood} = 1060 \frac{kg}{m^3} = 1.06\ g/cm^3$

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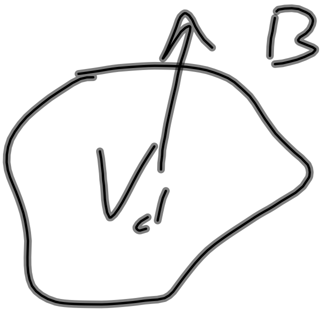
ρ_f



$$B = \rho_f g V_d$$

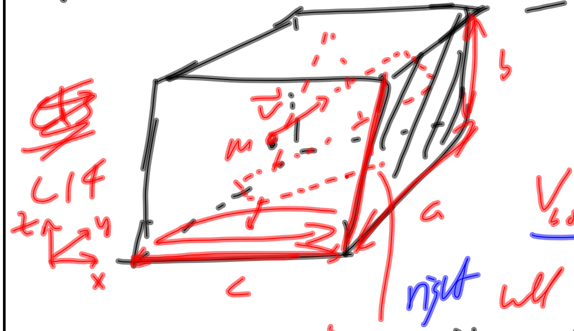
Labs

$$\left(\frac{B}{g}\right) = \rho_f V_d$$

$$1 \frac{gm}{cm^3} 12\ cm^3$$

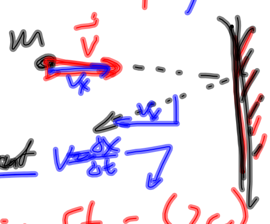
pressure

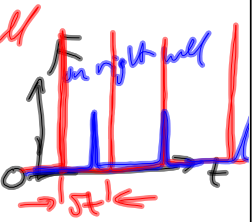
$P \doteq F/A$ empty box w/ 1 atom



$V_{box} = abc$

right wall





· Assumption
speed ~ constant

$v_x = \frac{\delta x}{\delta t}$

transit time $\delta t = \frac{(2c)}{v_x}$

N2L: $F_{W \to x} = m\frac{\Delta v_x}{\delta t} = m\frac{(-v_x - v_x)}{\delta t} = \frac{-2mv_x}{\delta t}$

time averaged $\langle F_{W \to x} \rangle = \frac{-2mv_x}{\delta t} = \frac{-2mv_x}{(2c/v_x)}$

$= \frac{-mv_x^2}{c}$

$P_{\text{right wall}} = \frac{F}{A} = \frac{mv_x^2/c}{ab} = \frac{mv_x^2}{abc}$

$P \cdot V = mv_x^2$

N atoms in box

$P \cdot V = N\langle mv_x^2 \rangle$

$= N\frac{2}{3}\langle K \rangle$

1 mol = N_A = 6.02E23 things ~ chemist's dozen

Avogadro

$K = \frac{1}{2}mv^2 = \frac{1}{2}m(v_x^2 + v_y^2 + v_z^2)$

$\langle K \rangle = \frac{m}{2}\langle v_x^2 + v_y^2 + v_z^2 \rangle = \frac{m}{2}(\langle v_x^2 \rangle + \langle v_y^2 \rangle + \langle v_z^2 \rangle)$

$= \frac{m}{2} 3\langle v_x^2 \rangle$

$PV = N\frac{2}{3}\langle K \rangle = Nk_BT$

Boltzmann

$k_B = 1.381E-23$ J/K

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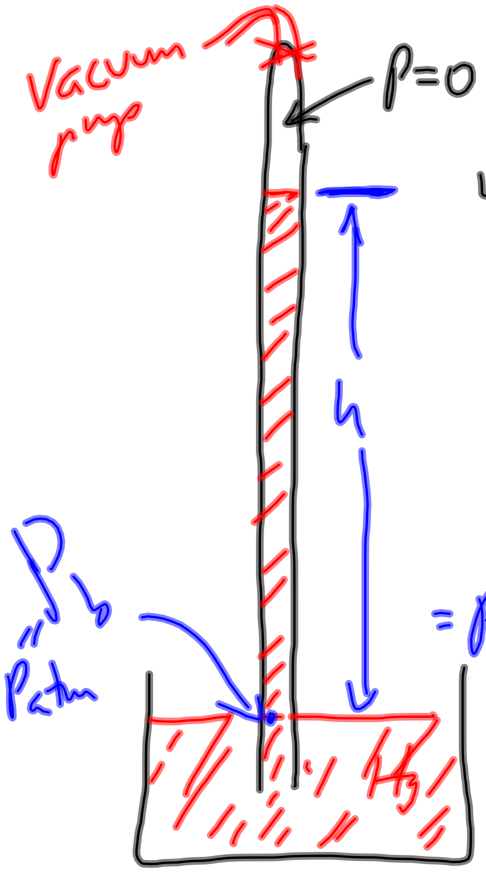


622 mmHg

baro ~ pressure

isobaric ~ same pressure

isobars

barometer - absolute pressure meter

$$\Delta P = \rho_{Hg} g h$$

$$= P_b - \cancel{P_{top}}\ 0$$

$$\Rightarrow P_b = \rho_{Hg} g h$$

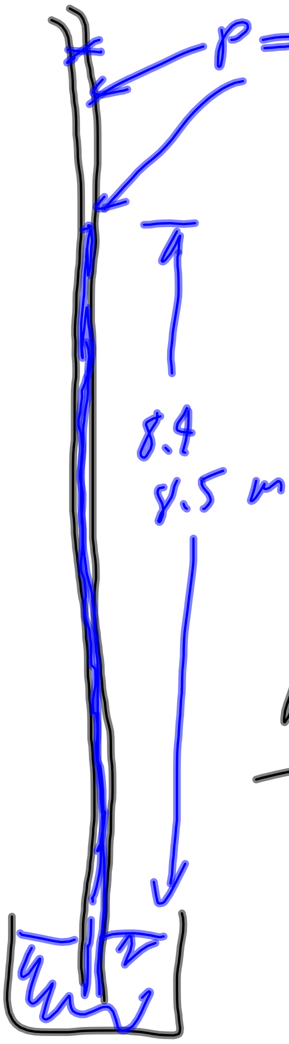
$$P_{atm} = \rho_{Hg} g h$$

$$\left(13560 \frac{kg}{m^3}\right)\left(9.793 \frac{m}{s^2}\right)(.622\,m) \quad N/m^2$$

$$= 82600\ Pa$$

$$82600\ Pa \left(\frac{760\ mmHg}{101300\ Pa}\right)$$

$$= 620\ mmHg$$



water barometer

$$\Delta P = \rho g h$$

$$P_b - P_{top} = \left(1000\,\frac{kg}{m^3}\right)\left(9.8\,\frac{m}{s^2}\right)\left(8.45\,m\right) \quad \left(\frac{N}{m^2}\right)$$

$$P_b = 82810\ Pa$$

$$= \rho g h$$

$$\cdot\left(\frac{1\ atm}{101300\ Pa}\right) = .817\ atm$$

$$\cdot\left(\frac{760\ Torr}{1\ atm}\right) = 621\ Torr = 621\ mmHg$$

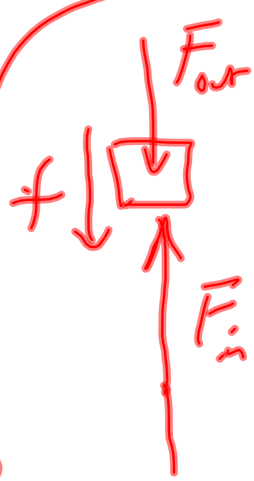
$$\cdot\left(\frac{14.7\ psi}{1\ atm}\right) = 12.0\ psi$$

Hg barom → 619.5 mmHg

P2)

$P_{out} = 14.7$ psi @ sea lvl
12.0 psi @ Tdaal

$P_{in} = 4.5\,atm + P_{out}$



$F_{in} = P_{in} \cdot A$

$F_{out} = P_{out} \cdot A$

$a = 0$

$F_{net} = 0$

$F_{out} + f - F_{in} = 0$

$f = F_{in} - F_{out} = P_{in}A - P_{out}A$

$= (P_{in} - P_{out})A$

$= (4.5\,atm)(3.14\,cm^2)$

$= \left(4.5\,atm \cdot \frac{101300\,Pa}{1\,atm}\right)(3.14E{-4}\,m^2)$

$= 143 \quad Pa \cdot m^2 = N$

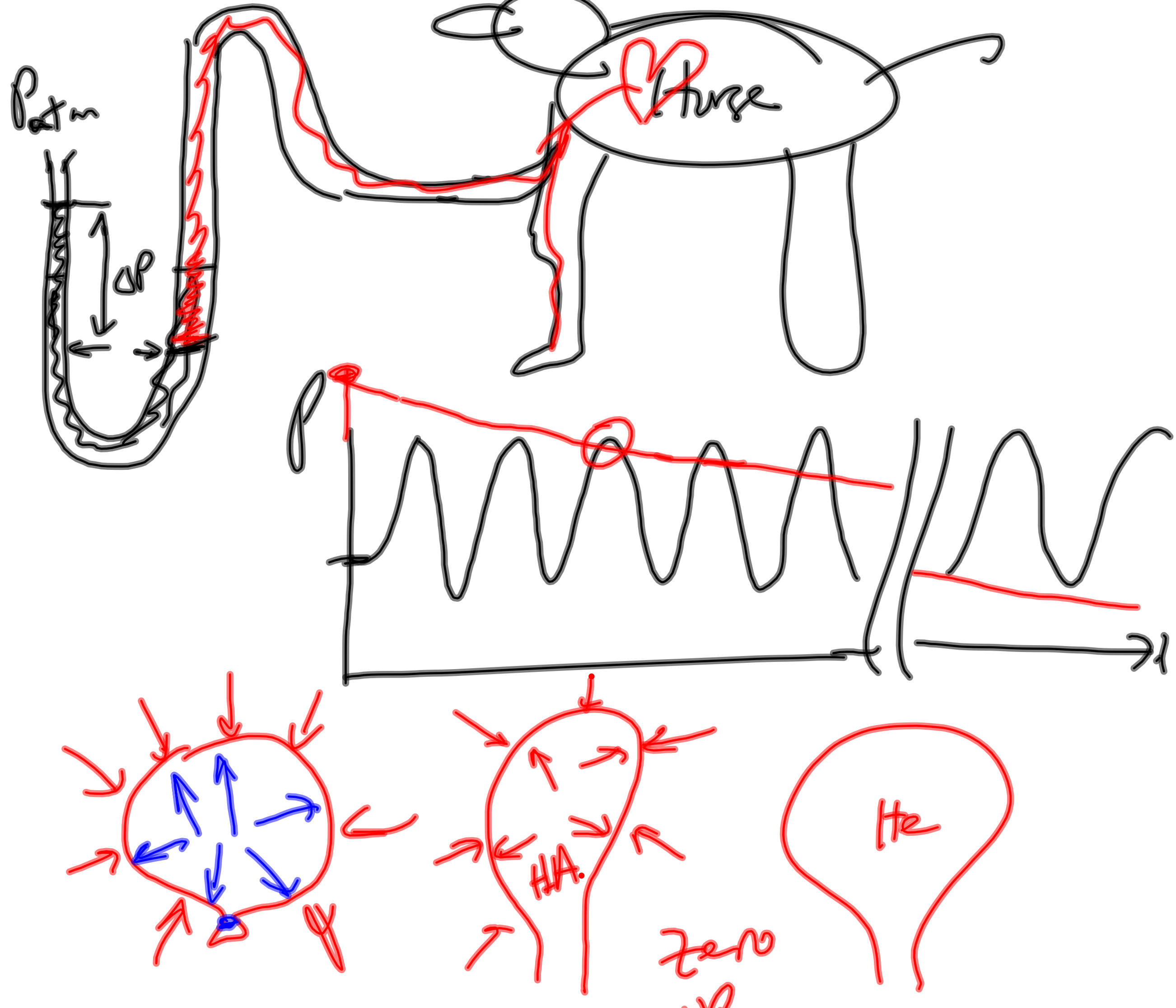
$A = \pi r^2 \quad r = 1\,cm$

$= 3.14\,cm^2 \left(\frac{1\,m}{10^2\,cm}\right)^2$

$= \pi(.01\,m)^2 = 3.14E{-4}\,m^2$

C9 HW

gauge $P = \Delta P = P_{in} - P_{out}$



$PV = nRT$

$PV = nRT$