$$\boxed{PV = nRT}$$

P = pressione $[Pa]$
V = volume $[m^3]$
T = temperatura $[K]$

n = n. di moli
$R = 8,31 \ J/mol\,K$

$N_A = 6,022 \cdot 10^{23}$

1) $T = 30K$

$\eta = 10^{25}$ molecole $/m^3$ (DENSITÀ MOLECOLARE)

? P

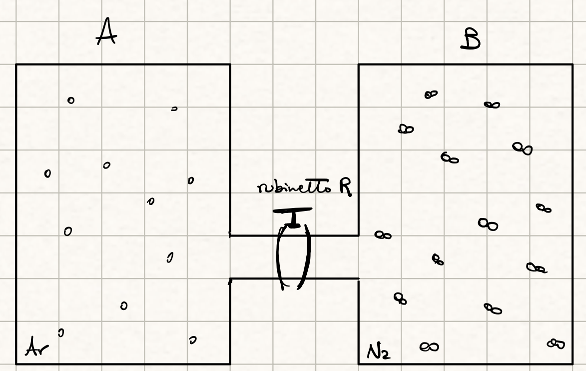
1 mole = N_A molecole

$\rightarrow n = \frac{\eta}{N_A} V$

$\rightarrow PV = nRT \Rightarrow P\cancel{V} = \frac{\eta}{N_A} \cancel{V} RT \rightarrow P = \frac{\eta}{N_A} RT = 4,14 \ kPa$

$\frac{R}{N_A} = k_B = 1,38 \cdot 10^{-23} \ J/K$

2)



$V_A = 400 \ cm^3$
$n_{Ar} = 0,06 \ mol$
$V_B = 550 \ cm^3$
$P_B = 450$ torr
$T_B = 23 \ °C$

? pressione parziale

! due gas perfetti diversi non interagiscono tra di loro

! 760 torr = 760 mmHg = 1 atm

1 atm = $1,01 \cdot 10^5$ Pa

PRESSIONE PARZIALE $\quad p_i$ = pressione del gas i-esimo se occupasse da solo il volume

LEGGE DI DALTON $\quad P_{tot} = \sum_{i=1}^{N} p_i = p_{Ar} + p_{N_2}$

$$\left.\begin{array}{l} p_i V = n_i RT \\ P_{tot} V = n_{tot} RT \end{array}\right\} \rightarrow \frac{p_i}{P_{tot}} = \frac{n_i}{n_{tot}} \rightarrow p_i = \frac{n_i}{n_{tot}} P_{tot} = X_i P_{tot}$$

X_i (FRAZIONE MOLARE del gas i-esimo)

$P_B V_B = n_{N_2} R T_B \rightarrow n_{N_2} = \frac{P_B V_B}{R T_B} = 0,013 \ mol$

$n_{tot} = n_{Ar} + n_{N_2} = 0,06 + 0,013 = 0,073 \ mol$

APERTURA RUBINETTO : $\quad P_{TOT} V_{TOT} = n_{TOT} RT \rightarrow P_{TOT} = \frac{n_{TOT} RT}{V_{TOT}} = \frac{n_{TOT} RT}{V_A + V_B} =$

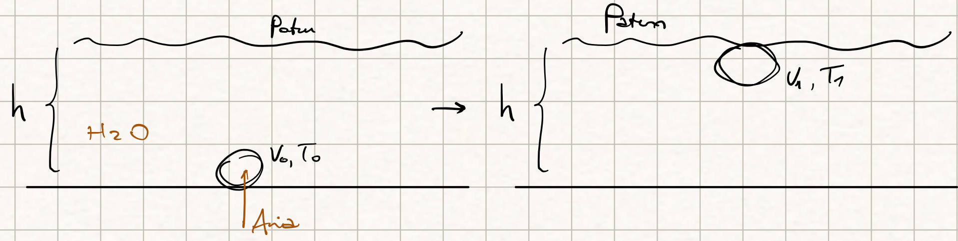
$= 1,88 \ atm = 1,9 \cdot 10^5 \ Pa$

$p_{Ar} = \frac{n_{Ar}}{n_{TOT}} P_{tot} = 1,55 \ atm$

$p_{N_2} = \frac{n_{N_2}}{n_{tot}} P_{TOT} = 0,33 \ atm$

$\Big\} \ p_{Ar} + p_{N_2} = P_{TOT}$

5) $V_0 = 1\ dm^3 = 1\ \ell$
$h = 10\ m$
$T_0 = 6{,}8\ °C$
$T_1 = 21{,}8\ °C$



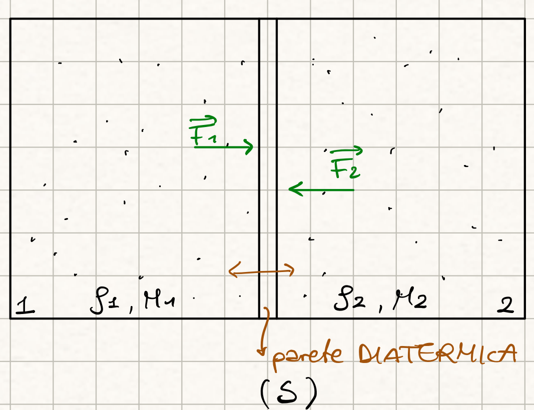
a) ?n
b) $?V_1$

a) $P_0 V_0 = nRT_0 \rightarrow n = \frac{P_0 V_0}{RT_0} = \frac{V_0}{RT_0}\left(P_{atm} + \rho_{H_2O}\, g h\right) = 86 \cdot 10^{-3}\ mol$

↳ Legge di Stevino : $P_0 = P(h) = P_{atm} + \rho_{H_2O}\, g h$

b) $P_1 V_1 = nRT_1 \rightarrow P_{atm} V_1 = nRT_1 \rightarrow V_1 = \frac{nRT_1}{P_{atm}} = 2{,}1\ dm^3$

3)



$\rho_1, M_1 \overset{?}{\longleftrightarrow} \rho_2, M_2$ ($\frac{Kg}{m^3}$)

Equilibrio :

$T_1 = T_2$ — equilibrio termico

$\frac{F_1}{S} = \frac{F_2}{S} \Rightarrow P_1 = P_2$ — equilibrio meccanico

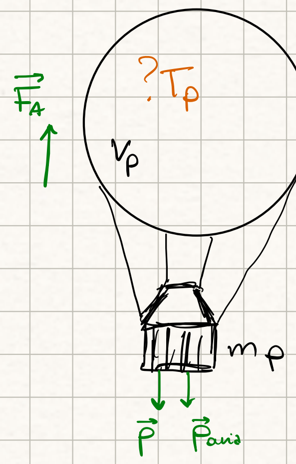
↳ perché parete libera di muoversi → ferma all'equilibrio → bilancio forze

$\rho_1 = \frac{m_1}{V_1} = \frac{n_1 M_1}{V_1}$ (massa molare) ; $\rho_2 = \frac{m_2}{V_2} = \frac{n_2 M_2}{V_2}$

$\left.\begin{array}{l} P V_1 = n_1 RT \\ P V_2 = n_2 RT \end{array}\right\} \frac{V_1}{V_2} = \frac{n_1}{n_2} \rightarrow \frac{n_1}{V_1} = \frac{n_2}{V_2} = \frac{\rho_1}{M_1} = \frac{\rho_2}{M_2}$

$\Rightarrow \frac{\rho_1}{M_1} = \frac{\rho_2}{M_2}$

6)



$m_p = 200$ kg
$V_p = 400\ m^3$
$T = 10°C$

$\rho_{aria} = 1{,}25\ kg/m^3$ (a 10°C)

20% O_2 80% N_2

aumento T_p
↳ diminuzione densità

! forza di Archimede

DECOLLO : $F_A \geq P + P_{aria}$ $\Rightarrow$ limite : $F_A = P + P_{aria}$

$F_A = m_{\substack{aria\\spostata}}\cancel{g} = m_p\cancel{g} + m_{\substack{aria\\nel\ pallone}}\cancel{g} \Rightarrow \rho_{aria}V_p = m_p + m_{ap}$

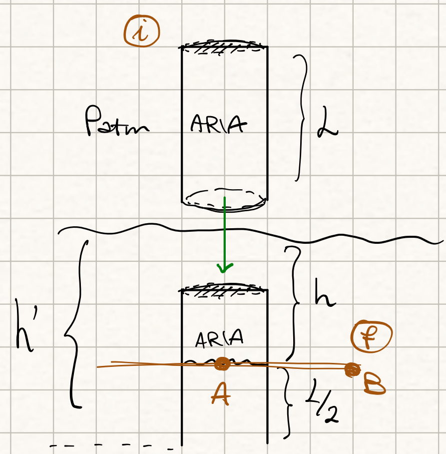
$\Rightarrow m_{ap} = \rho_{aria}V_p - m_p = 300$ kg non trascurabile rispetto m_p

$$n = \frac{m_{ap}}{M} = \frac{m_{ap}}{0{,}2M_{O_2} + 0{,}8M_{N_2}} = 1{,}04 \cdot 10^4\ mol$$

$$P_{atm}V_p = nRT \rightarrow T = \frac{P_{atm}V_p}{nR} = 468\ K \approx 200°C$$

4) $L = 4$ m
$P = 1$ atm

?h', T ~ uniforme



$P_A = P_B$
↓ ↓
P_2 $P_{atm} + \rho_{H_2O}gh$

(i) $\overset{P_{atm}}{P_1}V_1 = nRT_1$

(f) $P_2V_2 = nRT_2$; $T_2 = T_1$ $\rightarrow P_2V_2 = nRT_1 = P_1V_1$

$\rightarrow P_1V_1 = P_2V_2 \Rightarrow P_2\cancel{V_2} = P_1 2\cancel{V_2} \rightarrow P_2 = 2P_1 = 2P_{atm}$

LEGGE di STEVINO : $P_2 = P_{atm} + \rho_{H_2O}gh = 2P_{atm} \Rightarrow h = \frac{P_{atm}}{\rho_{H_2O}g}$

$$\rightarrow h' = h + \frac{L}{2} = \frac{P_{atm}}{\rho_{H_2O}g} + \frac{L}{2} = 12{,}3\ m$$