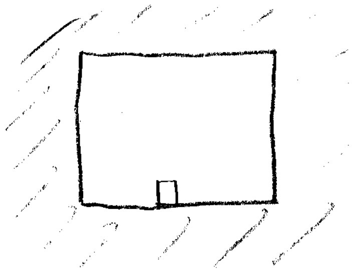
Esercizio del bicchiere di vapore acqueo in una stanza



Contenitore con 10^2 g di H_2O allo stato gassoso. Contenitore inizialmente chiuso. Stanza a
$$\begin{cases} P_0 = 10^5\ Pa \\ V_0 = 3\times 3\times 2\ m^3 \\ T_0 = 293\ K \end{cases}$$

Si stappa il contenitore. Il vapore condensa e si raffredda. Trovare la T_f del sistema contenitore + stanza

1) $n_0 = \dfrac{P_0 V_0}{R T_0}$ # moli di N_2 (supponiamo) nella stanza.

$m_{H_2O} = m_0$ quante moli sono?

$n = \dfrac{m(g)}{P_m}$ $\qquad P_m \overset{def}{=} \dfrac{\text{massa molecolare}}{\frac{1}{12} m(^{12}_{6}C)}$

$m(^{12}C) = 19.93 \times 10^{-24}\ g \Rightarrow \frac{1}{12} m(^{12}C) = 1.66 \times 10^{-24}\ g$

$H_2O = 2H + O \Rightarrow P_m(H_2O) = 2 P_m(H) + P_m(^{16}_{8}O) \cong 18$

$\Rightarrow n = \dfrac{10^2}{18} \cong 5.56$

Nota $n_0 \cong 740$!!

2) $Q_{H_2O \to stanza} + Q_{stanza \to H_2O} = 0$

$Q_{H_2O \to st} = - m_{H_2O} \lambda_e + m_{H_2O} c_{H_2O} (T_f - T_e)$

$Q_{st \to H_2O} = \underbrace{n_0 C_p}_{m_0 c_p} (T_f - T_0)$

$\Rightarrow$

$$T_f = \frac{n_0 C_p T_0 + m_{H_2O} c_{H_2O} T_e + m_{H_2O} \lambda_e}{m_{H_2O} c_{H_2O} + n_0 C_p}$$

È interessante mettere i numeri

$$n_0 C_p T_0 \approx 740 \times \frac{7}{2} \times 2 \frac{cal}{K} \times 293\ K = 1.52 \times 10^6\ cal$$

$$m_{H_2O} c_{H_2O} T_e \approx 10^2\ g \times 1 \frac{cal}{g\,K} \times 393\ K = 3.93 \times 10^4\ cal$$

$$m_{H_2O} \lambda_e \approx 10^2\ g \times 540 \frac{cal}{g} = 5.40 \times 10^4\ cal$$

$$m_{H_2O} c_{H_2O} = 10^2 \frac{cal}{K}$$

$$n_0 C_p = 5.2 \times 10^3 \frac{cal}{K}$$

$\Rightarrow T_f = 305\ K$

Supponiamo che $m_{H_2O} = 1\ kg$ (1 litro d'acqua)

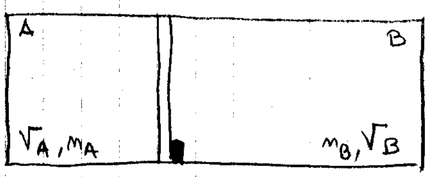
$\Rightarrow$ $m_{H_2O} c_{H_2O} T_e = 3.93 \times 10^5\ cal$

$m_{H_2O} \lambda_e = 5.4 \times 10^5\ cal$ $\Rightarrow T_f = 396\ K$!

$m_{H_2O} c_{H_2O} = 10^3\ cal/K$

$T_f > T_e \Rightarrow$ rievapora! $\Rightarrow$ la stanza non ce la fa a condensare il tutto.

Esercizio su gas perfetto

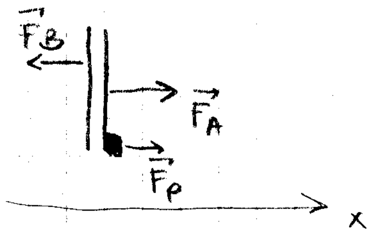


T_0 cost.

1) F esercitata dal piolo

2) tolgo piolo (T resta cost) $V_{A,f}$ e $V_{B,f}$, P_f

1) $$P_A = \frac{n_A R T_0}{V_A} \quad ; \quad P_B = \frac{n_B R T_0}{V_B}$$

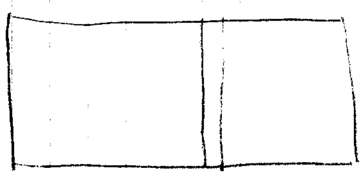


$$\vec{F}_A + \vec{F}_B + \vec{F}_p = 0$$

$$F_p = P_B S - P_A S$$

$$= \left(\frac{n_B}{V_B} - \frac{n_A}{V_A} \right) R T_0 S$$

2)



$$P_{A,f} = P_{B,f} = P_f$$

$$V_{A,f} + V_{B,f} = V_A + V_B$$

$$\frac{P_{A,f} V_{A,f}}{R T_0} = n_A$$

$$\frac{P_{B,f} V_{B,f}}{R T_0} = n_B$$

$$\Rightarrow \quad V_{A,f} = \frac{R T_0 n_A}{P_f} \quad ; \quad V_{B,f} = \frac{R T_0 n_B}{P_f}$$

$$\frac{R T_0}{P_f} (n_A + n_B) = V_A + V_B$$

$$\Rightarrow \quad P_f = R T_0 \frac{n_A + n_B}{V_A + V_B}$$

$$V_{A,f} = n_A \frac{V_A + V_B}{n_A + n_B}$$

$$V_{B,f} = n_B \frac{V_A + V_B}{n_A + n_B}$$