TD (thermodynamique chimique)
Série 1 (Corrigé)

Exercice 1 :

1) Robinet fermé :

$P_{H2}\,.V_{H2} = n_{H2}.RT \quad \Rightarrow P_{H2} = \frac{n_{H2}\ RT}{V_{H2}} = \frac{\frac{0,1}{2}\times 0,082\times 300}{1}$ = 1,23 atm

$P_{N2} = \frac{n_{N2}\ RT}{V_{N2}} = \frac{\frac{5,6}{28}\times 0,082\times 300}{2}$ = 2,46 atm

2) Robinet ouvert :

$P'_{H2} = \frac{n_{H2}\ RT}{V_t} = \frac{\frac{0,1}{2}\times 0,082\times 300}{3}$ = 0,41 atm ; $P'_{N2} = \frac{n_{N2}\ RT}{V_t} = \frac{\frac{5,6}{28}\times 0,082\times 300}{3}$ = 1,64 atm

ΣPi = Pt = 2,05 atm ; $X_{H_2} = \frac{P'_{H2}}{P_t}$ = 0,2 ; $X_{N_2} = \frac{P'_{N2}}{P_t}$ = 0,8

Exercice 2 :

P_1 = 140 bars ; T_1 = 27 °C ; P_{max} = 490 bars ; $T_f = T_2$ = 1535 °C

Gaz parfait $\Rightarrow$ $P_1V = nR\,T_1$ condition initiale

$P_2V = nR\,T_2$ après avoir pris feu

$\Rightarrow \frac{P1}{P2} = \frac{T1}{T2}$ d'où $P_2 = P_1\frac{T2}{T1} = 140\,\frac{1535+273}{27+273}$ = 844 bars

Conclusion : $P_2 > P_{max}$ $\Rightarrow$ le réservoir explosera avant de fondre

Exercice 3:

Etat (1) $\begin{cases} V_1 = 2\ l \\ T_1 = 298\ K \\ P_1 = 5\ atm \end{cases} \xrightarrow{\text{Isotherme}}$ Etat (2) $\begin{cases} V_2 = 10\ l \\ T_2 = 298\ K \\ P_2 = \frac{P_1V_1}{V_2} = \frac{5\times 2}{10} = 1\ atm \end{cases}$

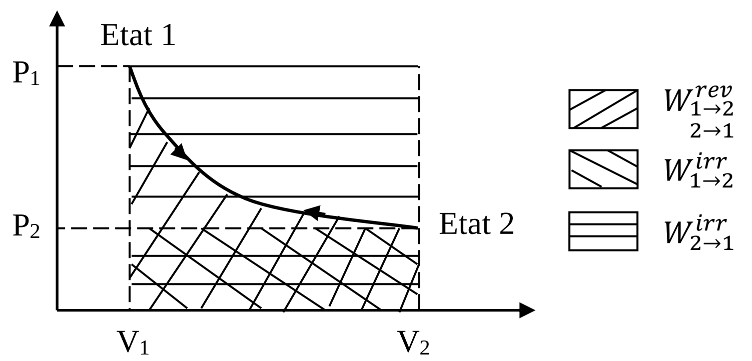
a) $W^{rev}_{1\to 2} = -\int_1^2 \mathrm{P_{ext}\,dV} = -\mathrm{nRT_1Ln}\frac{\mathrm{V_2}}{\mathrm{V_1}} = -\mathrm{P_1V_1\,Ln}\frac{\mathrm{V_2}}{\mathrm{V_1}} = -1630,4$ J

b) $W^{irr}_{1\to 2} = -\int_1^2 \mathrm{P_{ext}\,dV} = -\mathrm{P_2(V_2 - V_1)} = -1\times 1,013.10^5\times(10-2)10^{-3} = -810,4$ J

c) $W^{rev}_{2\to 1} = -\int_2^1 \mathrm{P_{ext}\,dV} = -\mathrm{nRT_1Ln}\frac{\mathrm{V_1}}{\mathrm{V_2}} = -\mathrm{P_1V_1\,Ln}\frac{\mathrm{V_1}}{\mathrm{V_2}} = 1630,4$ J

d) $W^{irr}_{2\to 1} = -\int_2^1 \mathrm{P_{ext}\,dV} = -\mathrm{P_1(V_1 - V_2)} = 4052$ J

La compression irréversible demande plus de travail



Exercice 4 :

Gaz parfait $\Rightarrow$ $n = \frac{PV}{RT} = \frac{1 \times 20.10^{-3}}{0,082 \times 273} = 8,934.10^{-4}$ mol

$\Delta U = Q + W = nc_v.\Delta T = nc_v\,(T_2 - T_1)$

$\Rightarrow \quad T_2 = \frac{Q+W}{nC_v} + T_1 = \frac{0,6 \times 4,18 - 2,1}{8,934.10^{-4} \times \frac{5}{2} \times 8,31} + 273 = 294,98$ K

Exercice 5:

$C_3H_6\,(g) + H_2\,(g) \xrightarrow{\Delta H_1} C_3H_8\,(g)$

$+ 9/2\ O_2\,(g)$ $\quad + ½\ O_2\,(g)$ $\quad + 5\ O_2\,(g)$

$\Delta H°_3$ $\quad \Delta H°_f(H_2O)liq$ $\quad \Delta H°_2$ $\quad (+)$

$3CO_2\,(g) + 3\ H_2O\,(liq) + H_2O\,(liq)$

Loi de HESS :

$\Delta H°_1 + \Delta H°_2 - \Delta H°_f(H_2O)liq - \Delta H°_3 = 0$

$\Rightarrow \quad \Delta H°_3 = \Delta H°_1 + \Delta H°_2 - \Delta H°_f(H_2O)liq = -\ 492,46\ kcal.mol^{-1}$