

DS 2023

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A) A-1) 1 mole de GP
 $C_v = 3/2 R \Rightarrow C_p = 5/2 R$
 $= 12,471 \quad = 20,785 \quad \text{J/mol/K}$

$PV = nRT \Rightarrow T_A = T_c = 273,15 \text{ K}$
 $T_B = 2T_A = 546,30 \text{ K}$

A-2) $A \rightarrow C \quad T^{cst} = \text{isotherme}$
 $A \rightarrow B \quad P^{cst} = \text{isobare}$
 $B \rightarrow C \quad V^{cst} = \text{isochore}$

A-3) $H = U + PV \Rightarrow \Delta H = \Delta U + P\Delta V + V\Delta P$

A-4) (Remarques)
 (Résultats évidents (vérifiables par calculs))

a - $W_{BC} = 0 \text{ J}$ car V^{cst}

b - $\Delta U_{AC} = 0 \text{ J}$ car T^{cst} et $U = f(T)$ pour un GP
 $\Rightarrow Q_{AC} = -W_{AC}$

c - $\Delta H_{AC} = 0 \text{ J}$ car T^{cst} et $\Delta H = \Delta U + \Delta(PV)$
 $= \Delta U + \Delta(nRT)$
 $= \Delta U + nR\Delta T$

d - $\Delta U_{ABCA} = \Delta H_{ABCA} = 0 \text{ J}$ { car cycle fermé }
 e $\Rightarrow Q_{ABCA} = -W_{ABCA}$ (et H et U fonctions d'état.)

f - $Q_{AB} = \Delta H_{AB}$ car P^{cst} .

$A \rightarrow B \quad Q_{AB} = nC_p(T_B - T_A) = +5684,33 \text{ J}$
 $W_{AB} = -P(V_B - V_A) = -2273,73 \text{ J}$

$\Delta U_{AB} = Q_{AB} + W_{AB} = +3410,60 \text{ J}$
 $\Delta H_{AB} = \Delta U_{AB} + P(V_B - V_A) = 5684,33 \text{ J} = Q_{AB}$ (f)

$B \rightarrow C \quad Q_{BC} = nC_v(T_c - T_B) = -3410,60 \text{ J}$
 $W_{BC} = 0 \text{ J}$ (a)

$\Delta U_{BC} = Q_{BC} + W_{BC} = -3410,60 \text{ J}$
 $\Delta H_{BC} = \Delta U_{BC} + V(P_c - P_B) = -5684,33 \text{ J}$

$A \rightarrow C \quad W_{AC} = nRT_A \ln(V_c/V_A) = -1576,03 \text{ J}$
 $Q_{AC} = -W_{AC} = +1576,03 \text{ J}$ (b)

$\Delta U_{AC} = \Delta H_{AC} = 0 \text{ J}$ (b et c)

Cycle $A \rightarrow B \rightarrow C \rightarrow A$

$$\begin{aligned} \Delta Q_{CA} &= -Q_{AC} \\ W_{CA} &= -W_{AC} \end{aligned}$$

(2)

$$\begin{aligned} Q_{\text{cycle}} &= Q_{AB} + Q_{BC} + (-Q_{AC}) = +697,70 \text{ J} \\ W_{\text{cycle}} &= W_{AB} + W_{BC} + (-W_{AC}) = -697,70 \text{ J} \end{aligned} \quad (e)$$

$$\Rightarrow Q_{\text{cycle}} + W_{\text{cycle}} = 0 \text{ J} = \Delta U_{\text{cycle}} = \Delta H_{\text{cycle}} \quad (d)$$

Résumé :

	$Q \text{ (J)}$	$W \text{ (J)}$	$\Delta U \text{ (J)}$	$\Delta H \text{ (J)}$
$A \rightarrow B$	+5684,33	-2273,73	+3410,60	+5684,33
$B \rightarrow C$	-3410,60	0	-3410,60	-5684,33
$C \rightarrow A$	+1576,03	-1576,03	0	0
Cycle	+697,70	-697,70	0	0

B) B-1) $\Delta H_1 + \Delta H_2 = 0$
 $\Rightarrow Q_1 + Q_2 = 0$ $\text{à } P_{\text{c}}^{\text{th}}$

$$m_1 C_p^{\text{eau}} (T_{\text{id}} - T_1) + m_2 C_p^{\text{eau}} (T_{\text{id}} - T_2) = 0$$

$$\Rightarrow T_{\text{id}} = (m_1 T_1 + m_2 T_2) / (m_1 + m_2)$$

RM $T_{\text{id}} = 344,875 \text{ K}$

B-2) $T_{\text{exp}} = 334 \text{ K} \Rightarrow Q_{\text{cal}} = -Q_{\text{perte}}^{\text{eau}} = -(m_1 + m_2) C_p^{\text{eau}} (T_{\text{exp}} - T_{\text{id}})$

AM $Q_{\text{cal}} = +18204,75 \text{ J}$

B-3) $Q_{\text{cal}} = C (T_{\text{exp}} - T_1)$

AM $C = 505,69 \text{ J/K}$

B-4) es vérifier numériquement que :

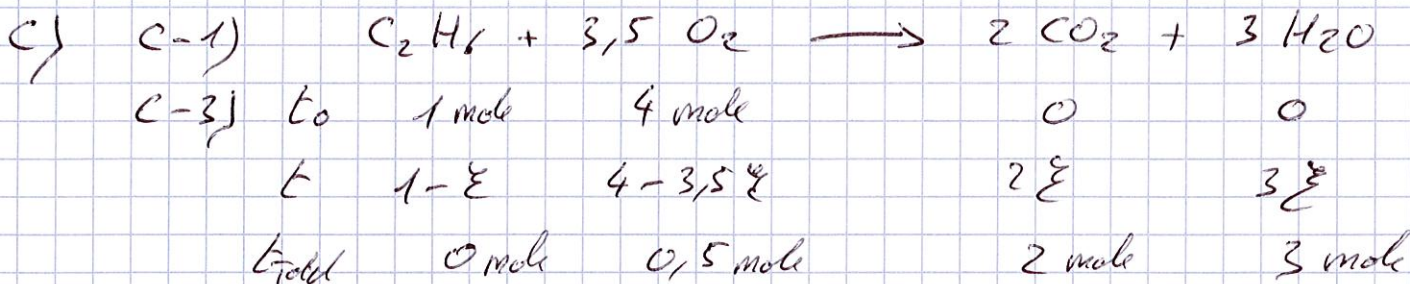
$$Q_1 + Q_2 + Q_{\text{cal}} = 0$$

ou recalculer C .

$$B-5) Q_{eau} + Q_{cal} + Q_{Pb} = 0 \quad (3)$$

$$\Rightarrow m_2 C_p^{eau} (T_{eq} - T_2) + C (T_{eq} - T_2) + m_1 C_p^{Pb} (T_{eq} - T_1) = 0$$

$$\underline{AVY} \quad C_p^{Pb} = 0,1513 \text{ J/g/K} \\ = 151,3 \text{ J/kg/K}$$



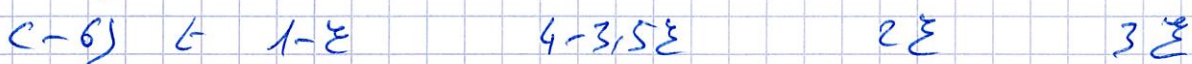
C_2H_6 est le réactif en défaut $\Rightarrow \xi_{max} = 1 \text{ mole}$

$$n_{total}^{max} = 5,5 \text{ mole} \Rightarrow P_{final}^{max} = \frac{nRT}{V} = 51,36 \text{ bar}$$

c-2) Pression initiale : $P_{initiale} = \frac{nRT}{V}$ avec $n = 5 \text{ mole}$
 $\Rightarrow P_{initiale} = 46,69 \text{ bar}$

Done $46,69 \leq P \leq 51,36 \text{ bar}$
 $5 \leq n \leq 5,5 \text{ mole}$

c-4) $P = 49,5 \text{ bar} \Rightarrow n = 5,30 \text{ mole} = 5 + 0,5\xi$
 $\Rightarrow \xi = 0,60 \text{ mole}$



n_i	0,3980 mole	1,8930	1,2040	1,8060	$\xi = 5,30$ mole
p_i	3,72 bar	17,68	11,24	16,86	$\xi = 49,5$ bar

$$p_i = \frac{n_i}{n_{total}} P_{total} = \frac{n_i}{5,30} \times 49,5 \text{ (bar)}$$