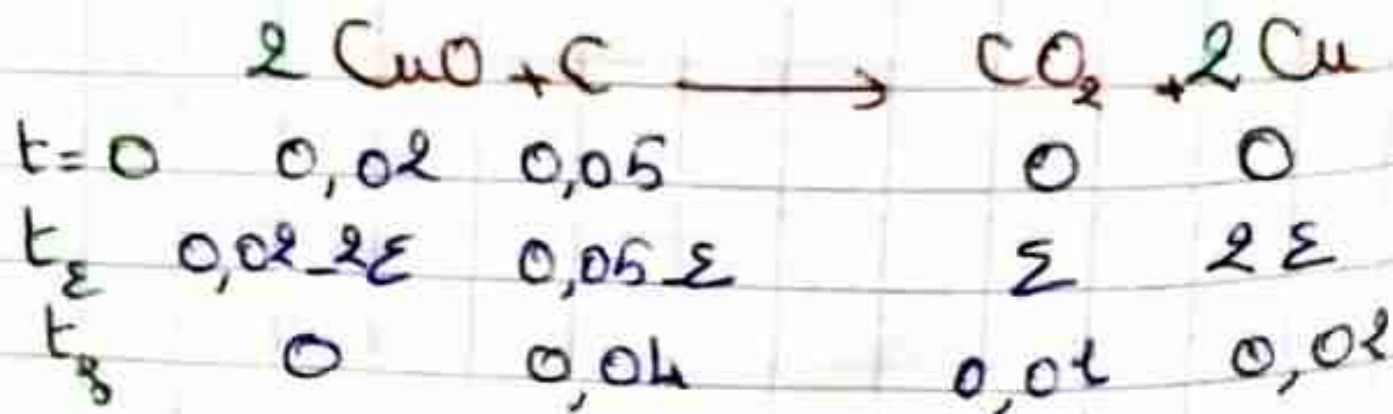


# Thermochimie

## Exercice 1:

$$R = \frac{P \cdot V}{n \cdot T} = \frac{1 \times 22,4}{1 \times 273,15} = 0,082 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$
$$= 0,082 \times 10^{-3} \times 10^5$$
$$= 8,2 \text{ Pa} \cdot \text{m}^3 \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$
$$= 8,2 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$
$$= 1,96 \text{ cal} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

## Exercice 2:



avec  $\varepsilon = 0,01$

thermodynamiquement possible, donc S (blanc)  
et plus stable.

### Exercice 7:



a)  $\Delta G = \Delta H - T \Delta S$

"Hess"  $\Delta H_r = \sum \Delta H_f(\text{products}) - \sum \Delta H_f(\text{reactifs})$   
 $= \Delta H_f(\text{CaO}(s)) + \Delta H_f(\text{CO}_2(g)) - \Delta H_f(\text{CaCO}_3(s))$   
 $= -393,14 - 634,14 - (-1207,14)$   
 $= \underline{\underline{182,86 \text{ kJ/mol}}}$

$$\Delta S_r = \sum S(\text{product}) - \sum S(\text{réactifs})$$
$$= S_{\text{CaO}(s)} + S_{\text{CO}_2(g)} - S_{\text{CaCO}_3(s)}$$
$$= 213,6 + 305,71 - 228,8$$
$$= \underline{\underline{160,51 \text{ J/mol}\cdot\text{K}}}$$

$$\Delta G = \Delta H + T \Delta S = 182,86 \times 10^3 - 298$$
$$\times 160,51 = \textcircled{+} 135,330$$

La réaction est spontanée thermodynamiquement.

b)

$$\Delta G < 0 \Rightarrow \Delta H - T \Delta S < 0$$

$$T > \frac{\Delta H_r}{\Delta S_r} = \frac{182,86 \text{ kJ}}{160,51 \text{ J/K}}$$
$$= 866^\circ\text{C}$$

$$\delta Q = d(U + pV) \Rightarrow Q = \Delta U + RT \Delta n$$

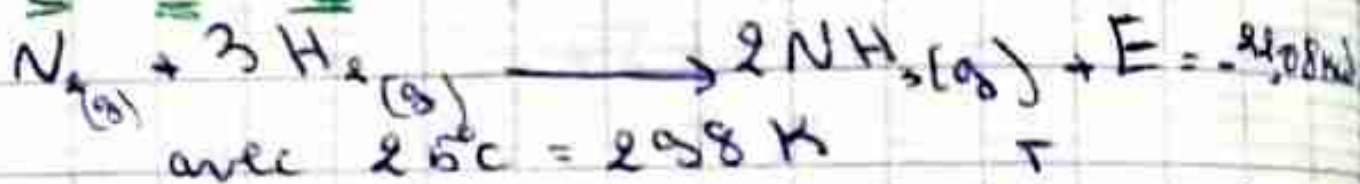
$$\Delta H = \Delta U + R T \Delta n$$

$$\text{à } T_0 \Rightarrow \Delta U = Q = \Delta H - R T \Delta n \quad \text{2-3 (gaz)}$$

$$\Delta U = \Delta H + RT$$

$$= -1362,5 \text{ kJ/mol}$$

Exercice 4:



$$\text{donc } \Delta H_n(T) = \Delta H_n^\circ(298^\circ) + \int \Delta C_p dT$$

$$= -22,08 + \int_{T_0}^T [2 C_p(\text{NH}_3) - C_p(\text{N}_2) - 3 C_p(\text{H}_2)] dT$$

Exercice 5:

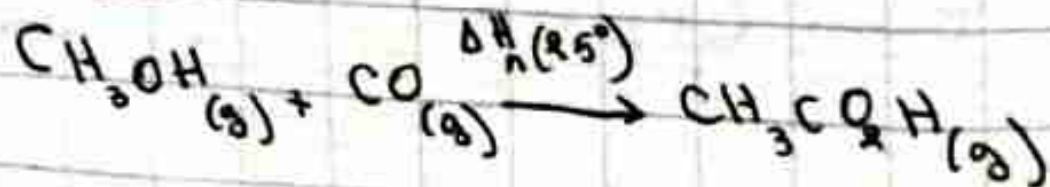
Rappel:

$$S = \int \frac{\delta Q}{T} dT$$

$$\text{et } \Delta S_{\text{univ}} = \Delta S_{\text{sys}} + \Delta S_{\text{ext}}$$

$$\Delta H_n = \sum \Delta H_f^\circ(\text{produit}) - \sum \Delta H_f^\circ(\text{réactif})$$

$$\Delta S_n = \sum S(\text{produits}) - \sum S(\text{réactifs})$$



Exercice 3:

Rappel:

$$\textcircled{1} \quad \Delta U = W + Q \Rightarrow dU = \delta W + \delta Q$$

$$= -p dV + \delta Q$$

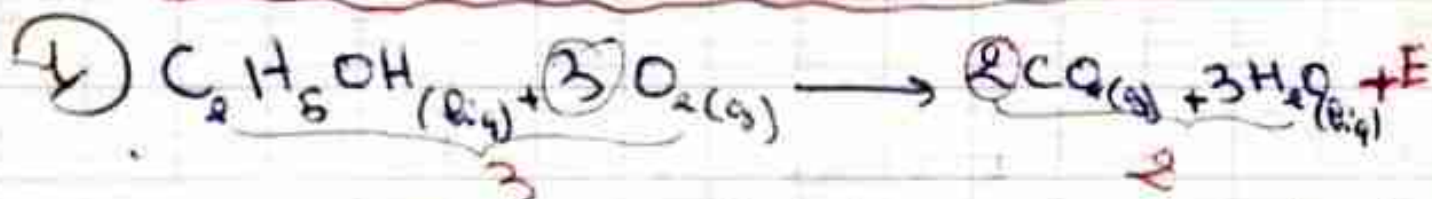
transf. isochore  $\Rightarrow dU = \delta Q \Rightarrow \Delta U = Q$

$$d(p \cdot V) = p dV + V dp$$

$$dU = -d(pV) + \delta Q$$

$$\delta Q = d(U + pV) \Rightarrow \delta Q = dH$$

$$\Delta H = Q_p$$



$$\Delta H_r = \sum \Delta H_f(\text{products}) - \sum \Delta H_f(\text{réactifs})$$

$$= 2 \Delta H_f(\text{CO}_{2(g)}) + 3 \Delta H_f(\text{H}_2\text{O}_{(l)})$$

$$- \Delta H_f(\text{C}_2\text{H}_5\text{OH}_{(l)}) - 3 \Delta H_f(\text{O}_{2(g)})$$

or  $\Delta H_f(\text{O}_2) = 0 = \Delta H_f(\text{N}_2) = \Delta H_f(\text{C}_{(graph)})$

donc  $\Delta H_r = -1365 \text{ kJ/mol}$

$\textcircled{2}$

$$a) \Delta H_n^{\circ}(298) = \Delta H_f^{\circ}(\text{CH}_3\text{CO}_2\text{H}) - \Delta H_f^{\circ}(\text{CO}) - \Delta H_f^{\circ}(\text{CH}_3\text{OH}) = \boxed{-148,8 \text{ kJ mol}^{-1}}$$

$$b) \Delta S_n^{\circ}(298) = S_{\text{CH}_3\text{CO}_2\text{H}} - S_{\text{CO(g)}} - S_{\text{CH}_3\text{OH}} = \boxed{-2155,1 \text{ J K}^{-1} \text{ mol}^{-1}}$$

Exercice 5



$$\Delta H_n^{\circ}(298) = \Delta H_f^{\circ}(\text{CH}_3\text{CO}_2\text{H}) - \Delta H_f^{\circ}(\text{CO}) - \Delta H_f^{\circ}(\text{CH}_3\text{OH})$$

Exercice 6

$$\Delta S_{\text{p,r}} = -\Delta H_n$$

conditions pour la spontanéité :

$$\Delta S_{\text{p,r}} - \frac{\Delta H}{T} > 0$$

$$\Delta S_{\text{p,r}} > \frac{\Delta H}{T} \Rightarrow T > \frac{\Delta H_n}{\Delta S_{\text{p,r}}}$$

$$\Delta H - T \Delta S < 0$$

et  $S_{\text{sol}} < S_{\text{gaz}}$  correct

$$S : 2633 \quad \xrightarrow{298 \text{ K}} \quad S_{\text{sol}}(2633) \quad \leftarrow \text{correct} \quad S_{\text{gaz}}(25,75) \text{ J mol}^{-1} \text{ K}^{-1}$$

$$\Delta G = \Delta H - T \Delta S$$

$$= 2,21 \times 10^3 - 298(25,75 - 2633)$$

$$= +2, \times 10^3 \text{ J mol}^{-1}$$

$\Delta G > 0 \Leftrightarrow$  La réaction n'est pas therm-