$CuBr_{2(s)} \longrightarrow CuBr_{(s)} + \frac{1}{2} Br_{2(g)}$: 1 التمرين

$\Delta G^\circ_{r,298} = \Delta H^\circ_{r,298} - T\Delta S^\circ_{r,298}$

- $\Delta H^\circ_{r,298} = \Delta H^\circ_{f,298}(CuBr_{(s)}) + \frac{1}{2}\Delta H_f(Br_{2(g)}) - \Delta H^\circ_{f,298}$

$\Delta H^\circ_{r,298} = 11.77$ Kcal

- $\Delta S^\circ_{r,298} = S^\circ_{298}(CuBr_{(s)}) + \frac{1}{2} S^\circ_{298}(Br_{2(g)}) - S^\circ_{298}(Cu$

$= 21.12$ cal

- $\Delta G^\circ_{r,298} = 11770 - 298 \cdot 21.12 = 5500\,cal = 5,471$

حيث التفاعل في الإتزان الكيميائي

$\Delta G^\circ_{r,298} = \Delta H^\circ_{r,298} - T\Delta S^\circ_{r,298} = 0$

$\Rightarrow T = \frac{\Delta H^\circ_{298}}{\Delta S^\circ_{298}} = 557,3K$

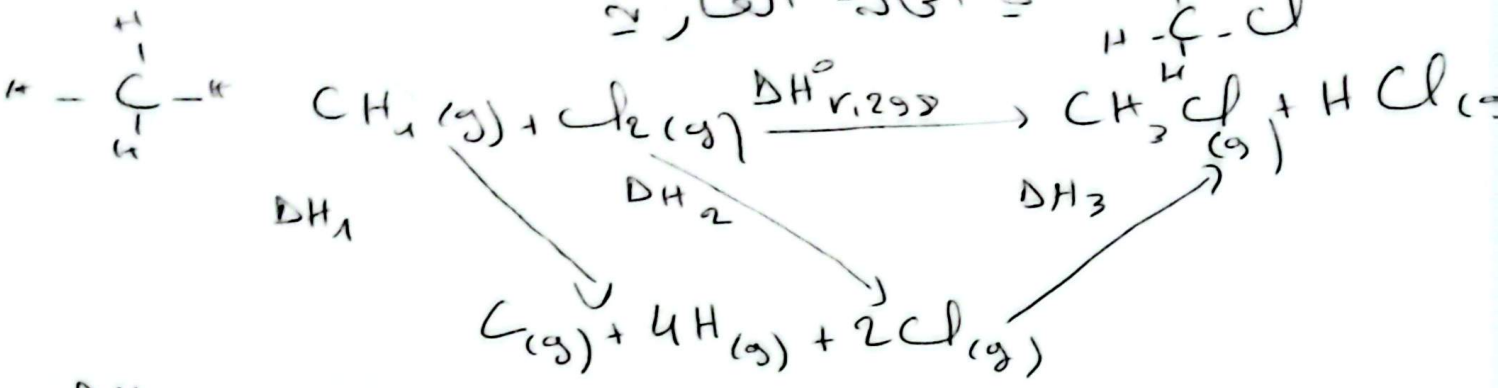
التمرين 2 :

$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

- $\Delta H^\circ_{r,298} = \Delta H^\circ_{f,298}(CH_3Cl) + \Delta H_f(HCl) - \Delta H_f(CH_4$

$\Delta H^\circ_{r,298} = -24,1\,Kcal$

ـ سـ عمل طريقة الحالة الأولى و قانون Hess مباشرة لأن كل المواد في الحالة الغازية



$\Delta H_1 = -4\,\Delta H(C-H)$

$\Delta H_2 = -\Delta H(Cl-Cl)$

$\Delta H_3 = 3\Delta H(C-H) + \Delta H(C-Cl) + \Delta H(H-Cl)$

$\Sigma\,\Delta H_{i\,(\text{حالة})} = 0$

$-4\Delta H(C-H) - \Delta H(Cl-Cl) + 3\Delta H(C-H) + \Delta H(C-Cl) + \Delta H$

$-\Delta H^\circ_{r,298} = 0$

$\Delta H(C-H) = -\Delta H(Cl-Cl) + \Delta H(C-Cl) + \Delta H(H-Cl$

$\Delta H^\circ_{r,298} = 0$

$$\boxed{\Delta H(C-H) = -99\ \text{Kcal.mol}^{-1}}$$

$\underset{R}{CH_4 + Cl_2} \xrightarrow{\Delta H_r} \underset{P}{CH_3Cl + HCl}$: Hess عمل قانون

$\Delta H_r = \Sigma\, n\,\Delta H(P) - \Sigma\, n\,\Delta H(R)$

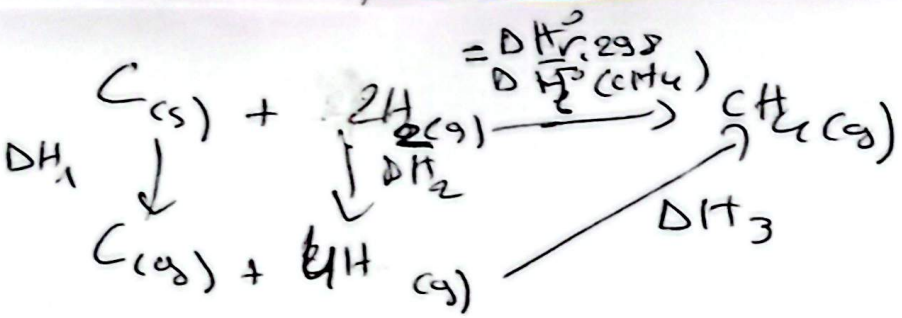
$\Delta H_r = 3\Delta H(C-H) + \Delta H(C-Cl) + \Delta H(H-Cl) - (4\Delta H(C-H) + \Delta H$

$= -\Delta H(C-H) + \Delta H(C-Cl) + \Delta H(H-Cl) - \Delta H(Cl-Cl$

$\Delta H(C-H) = \Delta H(C-Cl) + \Delta H(H-Cl) - \Delta H(Cl-Cl) - \Delta H_r$

$= -78 - 103 + 58 + 24{,}1$

$$\boxed{\Delta H(C-H) = -99\ \text{Kcal.mol}^{-1}}$$



$$\Sigma \Delta H_{i\,(cycle)} = 0$$

$$\Delta H_1 = \Delta H_{sub}$$

$$\Delta H_2 = -2\,\Delta H\,(H-H)$$

$$\Delta H_3 = 4\,\Delta H\,(C-H)$$

$$\Delta H_{sub} + 2\Delta H(H-H) + 4\,\Delta H\,(C-H) - \Delta H_f(CH_4) = 0$$

$$\Delta H_{sub} = \Delta H_f\,(CH_4) + 2\,\Delta H\,(H-H) - 4\,\Delta H(C-H)$$

$$= 2(-104) - 4(99) + (-17,9)$$

$$\boxed{\Delta H_{sub\,(C)} = 170\ Kcal.mol^{-1}}$$