

2-3-2015 IV I COMPITO DI TCI

1) È dato un cilindro contenente O_2 $n=2,5$ mol $V=10$ L
 $T=60^\circ C$. Calcolare il lavoro e il ΔS nel ciclo ABC

AB = compressione isoterma fino a 15 bar

BC = espansione isobara fino a 10 L

CA = compressione isocora

A $n=2,5$ mol $V=10$ L $T=333$ K $P = \frac{nRT}{V} = \frac{2,5 \cdot 8,31 \cdot 333}{10 \cdot 10^{-3} \cdot 10^5}$

$P_A = 6,918$ bar

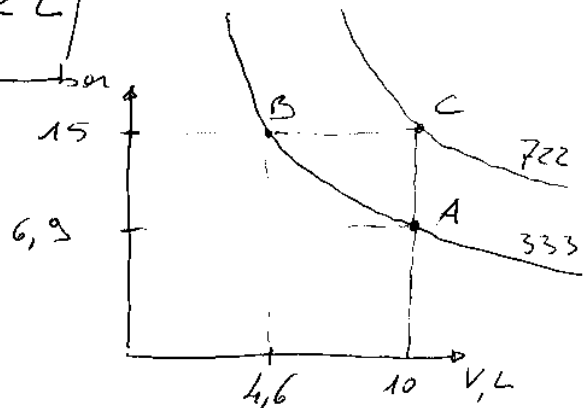
B $n=2,5$ $T=333$ K $P=15$ bar $V = \frac{nRT}{P} = \frac{2,5 \cdot 8,31 \cdot 333}{15 \cdot 10^5 \cdot 10^{-3}} = 4,612$ L

$V = \frac{P_A V_A}{P} = \frac{6,918 \cdot 10 \cdot 10^{-3}}{15 \cdot 10^5} = 4,612$ L

C $n=2,5$ mol $P=15$ bar $V=10$ L

$T = \frac{PV}{nR} = \frac{15 \cdot 10^5 \cdot 10 \cdot 10^{-3}}{2,5 \cdot 8,31} = 722$ K

$T = 722$ K



$L_{AB} = \int_{V_1}^{V_2} P dV = nRT \int_{V_1}^{V_2} \frac{dV}{V} = nRT \ln \frac{V_2}{V_1} = 2,5 \cdot 8,31 \cdot 333 \ln \frac{4,612}{10}$

$L_{AB} = -5354$ J

$L_{BC} = P \Delta V = 15 \cdot 10^5 \cdot (V_2 - V_1) = 15 \cdot 10^5 \cdot 5,388 \cdot 10^{-3} = 8082$ J L_{BC}

$L_{CA} = 0$ $L_{ABC} = -5354 + 8082 = 2728$ J $L_{TOTALE ABC}$

$\Delta S_{AB} = \frac{Q}{T}$ isoterma $\Delta U=0$ $Q=L$ $\Delta S_{AB} = \frac{-5354}{333} = -16,08$ J/K

$\Delta S_{BC} = \frac{Q}{T}$ $Q = n C_p \Delta T$ $\Delta S = n C_p \int_{T_1}^{T_2} \frac{dT}{T} = n C_p \ln \frac{T_2}{T_1} = 2,5 \frac{7}{2} R \ln \frac{722}{333}$

$\Delta S = 2,5 \frac{7}{2} \cdot 8,31 \ln \frac{722}{333} = 56,27$ J/K

$\Delta S_{CA} = \frac{Q}{T} \Rightarrow Q = n C_v \Delta T$ $\Delta S = n C_v \int_{T_1}^{T_2} \frac{dT}{T} = n C_v \ln \frac{T_2}{T_1} = 2,5 \frac{5}{2} R \ln \frac{333}{722}$

$\Delta S_{CA} = -40,19$ J/K $\Delta S_{TOT} = \Delta S_{ABC} = -16,08 + 56,27 - 40,19 = 0$

2) Déterminer une réaction chimique avec $\Delta H = 2,5 \text{ kcal/mol}$ $\Delta S = 6,25 \text{ cal/mol K}$
 Trouver le K_{eq} à $T = 200 \text{ K}$ et $T = 450 \text{ K}$ et commenter.

$$\Delta G = \Delta H - T\Delta S \quad \left[\frac{\Delta G}{200} = 2,5 \cdot 10^3 - 6,25 \cdot 200 = 1250 \text{ cal/mol} \right] \quad \left[\begin{array}{l} \Delta G > 0 \\ \text{NON SPONTANÉE} \end{array} \right]$$

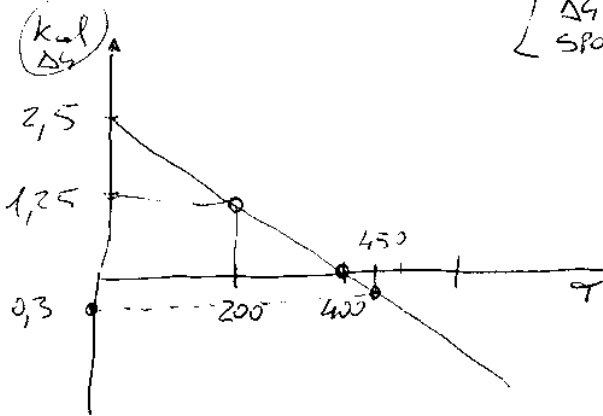
$$\Delta G(450) = 2,5 \cdot 10^3 - 6,25 \cdot 450 = -312,5 \text{ cal/mol}$$

$$\Delta G = 0 = \Delta H - T\Delta S$$

$$T\Delta S = \Delta H \quad T = \frac{\Delta H}{\Delta S}$$

$$T = \frac{2500}{6,25} = 400 \text{ K}$$

$\Delta G < 0$
SPONTANÉE



$$\Delta G^\circ = -RT \ln K$$

$$\ln K = \frac{-\Delta G}{RT} = \frac{-1250 \cdot 4,184}{8,31 \cdot 200}$$

$$\ln K_{200} = -3,147 \quad \left[K_{200} = 4,30 \cdot 10^{-2} \right]$$

$\Delta G < 0$

$$\ln K_{450} = \frac{312,5 \cdot 4,184}{8,31 \cdot 450} = 0,349$$

$$\left[K_{450} = 1,42 \right]$$

$\Delta G > 0$