Resumen termodinámica II

(I) 1. ley

1) $\boxed{dE = dQ - dW}$ / pero $dW = PdV$

$\Rightarrow dQ = dE + PdV$

2) $\boxed{H = E + PV}$ (entalpía) / $(\,)'$

$\Rightarrow dH = dE + PdV + VdP$

$\Rightarrow \boxed{dH = dQ + VdP}$

3) • P cte $\Rightarrow dH = dQ \Rightarrow \boxed{\Delta H = Q_p}$

• V cte $\Rightarrow dE = dQ \Rightarrow \boxed{\Delta E = Q_v}$

4) $\boxed{C_v = \left(\frac{\partial E}{\partial T}\right)_v}$; $\boxed{C_p = \left(\frac{\partial H}{\partial T}\right)_p}$

5) Caso real:

• $dE = n C_v dT + \left(\frac{\partial E}{\partial V}\right)_T dV \overset{G.I.}{\Rightarrow} \boxed{\Delta E = n C_v \Delta T}$

• $dH = n C_p dT + \left(\frac{\partial H}{\partial P}\right)_T dP \overset{G.I.}{\Rightarrow} \boxed{\Delta H = n C_p \Delta T}$

6) $C_p - C_v = \left(\frac{\partial E}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_p + P\left(\frac{\partial V}{\partial T}\right)_p \overset{G.I.}{\Rightarrow} \boxed{\bar{C}_p - \bar{C}_v = R}$

7) Adiabático:

• $PV^\gamma = cte$

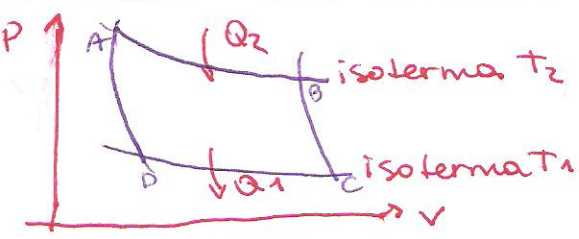
• $TV^{\gamma-1} = cte$

• $T \cdot P^{\frac{1-\gamma}{\gamma}} = cte$

8) Eficiencia térmica

$$\boxed{\eta = \frac{W_{neto}}{Q_{abs}}}$$

9) Ciclo de Carnot:



• AB y BC adiabáticas } $T_2 > T_1$

• BC y DA isotérmicas }

$\Rightarrow \boxed{\eta_{carnot} = 1 - \frac{T_1}{T_2}}$

II) 2° ley

① La entropía "S"

$$dS = \frac{dQ_{reversible}}{T}$$

② P de ⇒ $\Delta S = nC_p \ln\left(\frac{T_2}{T_1}\right)$

V cte ⇒ $\Delta S = nC_v \ln\left(\frac{T_2}{T_1}\right)$

③ Ec. fundamental de la energía:

$$dE = TdS - PdV \quad , \quad dH = TdS + VdP$$

④ P y T ctes:

$$\Delta S_{P,T} = \frac{\Delta H}{T}$$

⑤ Para G.I.:

$$\Delta S = nC_v \ln\left(\frac{T_2}{T_1}\right) + nR\ln\left(\frac{V_2}{V_1}\right)$$

$$\Delta S = nC_p \ln\left(\frac{T_2}{T_1}\right) - nR\ln\left(\frac{P_2}{P_1}\right)$$

III) Termoquímica

① $\Delta H_R = \underbrace{(m\bar{H}_M + n\bar{H}_N)}_{\text{productos}} - \underbrace{(a\bar{H}_a + b\bar{H}_b)}_{\text{reactantes}}$

② $\Delta H_f(\text{elemento}) = 0$

③ Entalpía estándar de formación

$$\bar{H}_f^\circ(i) = \Delta H_f(i, 1\,atm, 25°C)$$

④ $\Delta H_R = \Delta E_R + RT\Delta n_R$; $\Delta n_R = \underbrace{(m+n)}_{\text{prod.}} - \underbrace{(a+b)}_{\text{react.}}$

¡sólo de gases!

⑤ ley de Lavoisier-Laplace

$$\Delta\vec{H}_r = -\Delta\overleftarrow{H}_r \qquad \Delta\vec{E}_R = -\Delta\overleftarrow{E}_R$$

⑥ ley de Hess

$A + B \longrightarrow C \quad ; \quad \Delta H_1$

$C + 2F \longrightarrow D \quad ; \quad \Delta H_2$

$A + B + 2F \longrightarrow D \quad ; \quad \Delta H_R = \Delta H_1 + \Delta H_2$

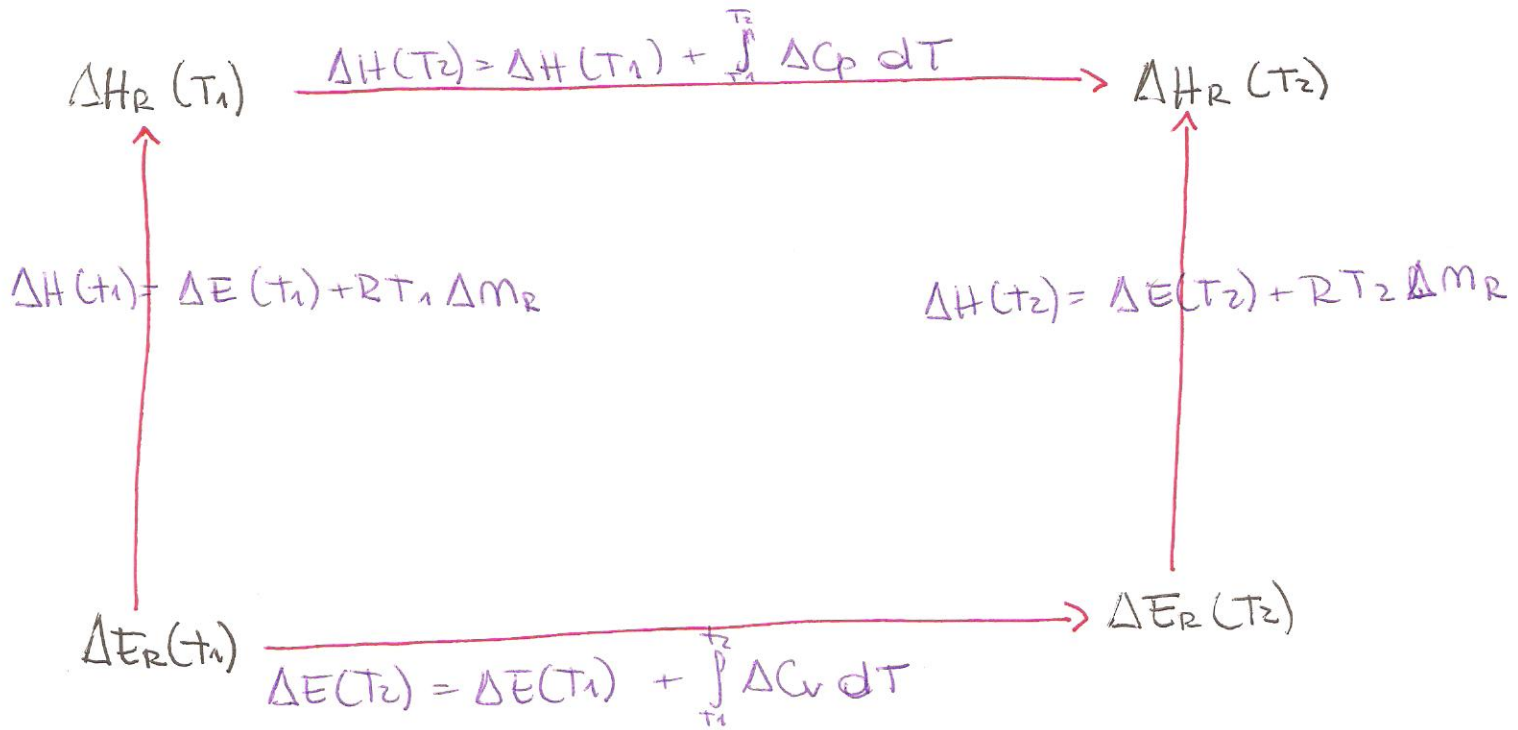
⑦ Ec. de Kirchoff:

- $\left(\frac{\partial \Delta H_R}{\partial T}\right)_p = \Delta C_p$
- $\left(\frac{\partial \Delta E_R}{\partial T}\right)_V = \Delta C_V$

⑧ $\Delta H_R(T_2) = \Delta H_R(T_1) + \int_{T_1}^{T_2} \Delta C_p \, dT \quad ; \quad \overline{C_{p_i}} = a + bT + cT^2 + \dots$

⑨ $\Delta E_R(T_2) = \Delta E_R(T_1) + \int_{T_1}^{T_2} \Delta C_V \, dT$

★ Esquema resúmen ecs. ④, ⑧ y ⑨



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