Clase 31 28 octubre 2020

Título de la nota 28/10/2020

W_R Adiabático

$$\Delta U_R = -W_R$$

$$W_R = -\Delta U_R \quad \text{exp. } \Delta T = -$$

$$W_R = +$$

$$W_R = -\Delta U_R \quad \text{comp. } \Delta T = +$$

$$W_R = -$$

$$pV^{\gamma} = cte \qquad W = p\,dv$$

$$\int_1^2 \delta W_R = cte \int_{V_1}^{V_2} \frac{dV}{V^\gamma} \qquad p = \frac{cte}{V^\gamma}$$

$$W_R = cte \int_{V_1}^{V_2} V^{-\gamma}\, dV = \left. \frac{cte\, V^{-\gamma+1}}{1-\gamma} \right|_{V_1}^{V_2}$$

$$W_R = \left. \frac{p \cancel{V^\gamma}\, \cancel{V^{-\gamma}}\, V^1}{1-\gamma} \right|_{V_1}^{V_2} = \frac{pV \Big|_{V_1}^{V_2}}{1-\gamma}$$

$$W_R = \frac{(p_2V_2 - p_1V_1)}{1-\gamma} \qquad p_2V_2 < p_1V_1 = +$$

expansión

$$W_R = \frac{(N/\cancel{m^2})(m^{\cancel{3}})}{1-\gamma}$$

$$= N \cdot m = J$$

$\gamma \to 1$

proceso $\to$ Isot.

$$\boxed{p_2 V_2 = p_1 V_1}$$

Isot.

$$\boxed{W_R = \frac{nR\,\Delta T}{1-\gamma}} = \frac{\cancel{mol}\, J\, \cancel{K}}{\cancel{mol}\,\cancel{K}} = J$$

$$\boxed{\Delta p V = nR\Delta T}$$

$$\boxed{W_R = \frac{nR\Delta T}{1-\gamma}}$$

Adiabático Irreversible (IR)

$$\Delta U_{IR} = -W_{IR}$$

$$\boxed{P = \frac{nRT}{V}}$$

$$n\bar{C}_V\, dT = -p\, dV$$

$$\boxed{V = \frac{nRT}{P}}$$

$$n\bar{C}_V\, dT = -p\,(V_2 - V_1)$$

$$n\bar{C}_V\,(T_2 - T_1) = -p_2\,(V_2 - V_1)$$

$$\cancel{n}\bar{C}_V\,(T_2 - T_1) = -p_2\left[\frac{\cancel{n}RT_2}{p_2} - \frac{\cancel{n}RT_1}{p_1}\right]$$

$$n\bar{C}_V\,(T_2 - T_1) = -\frac{\cancel{p_2}RT_2}{\cancel{p_2}} + \frac{p_2RT_1}{p_1}$$

$$\bar{C}_V\,(T_2 - T_1) = R\left[\frac{p_2T_1}{p_1} - T_2\right]$$

$$(T_2 - T_1) = \frac{R}{\bar{C_v}}\left[\frac{p_2 T_1}{p_1} - T_2\right]$$

$$R = \bar{C_p} - \bar{C_v}$$

$$(T_2 - T_1) = \frac{\bar{C_p} - \bar{C_v}}{\bar{C_v}}\left[\frac{p_2 T_1}{p_1} - T_2\right]$$

$$(T_2 - T_1) = (\gamma - 1)\left[\left(\frac{p_2 T_1}{p_1} - T_2\right)\right]$$

$$T_2 = (\gamma - 1)\left[\left(\frac{p_2 T_1}{p_1} - T_2\right)\right] + T_1$$

$$T_2 = \left[(\gamma - 1)\frac{p_2 T_1}{p_1} - (\gamma - 1) T_2\right] + T_1$$

$$T_2 + T_2(\gamma-1) = (\gamma-1)\frac{p_2 T_1}{p_1} + T_1$$

$$\cancel{T_2} + T_2\gamma - \cancel{T_2} = T_1\left[(\gamma-1)\frac{p_2}{p_1} + 1\right]$$

$$T_2\gamma = T_1\left[(\gamma-1)\frac{p_2}{p_1} + 1\right]$$

$$T_2 = \frac{T_1}{\gamma}\left[(\gamma-1)\frac{p_2}{p_1} + 1\right]$$

$$K = K$$

$$T_2 = \frac{T_1}{x}\left[(x-1)\frac{p_2}{p_1} + 1\right]$$

$x = 1$ isot.

$$T_2 = \frac{T_1}{x}\left[(x-1)\frac{p_2}{p_1} + 1\right]$$

$$T_2 = \frac{T_1}{1}\left[(1-1)\frac{p_2}{p_1} + 1\right]$$

$$T_2 = T_1\left(0 + 1\right] = T_2 = T_1$$

obtener relación p, V

$$\frac{T_2}{T_1} = \frac{1}{\gamma}\left[(\gamma-1)\frac{p_2}{p_1}+1\right] \qquad T=\frac{pV}{nR}$$

$$\frac{p_2V_2/\cancel{n}R}{p_1V_1/\cancel{n}R} = \frac{1}{\gamma}\left[(\gamma-1)\frac{p_2}{p_1}+1\right]$$

$$p_2V_2 = \frac{p_1V_1}{\gamma}\left[(\gamma-1)\frac{p_2}{p_1}+1\right]$$

$$p_2V_2 = \left[\frac{\cancel{p_1}V_1}{\gamma}(\gamma-1)\frac{p_2}{\cancel{p_1}} + \frac{p_1V_1}{\gamma}\right]$$

$$p_2V_2 = \left[\frac{V_1}{\gamma}(\gamma-1)p_2 + \frac{p_1V_1}{\gamma}\right]$$

$$p_2V_2 = \frac{1}{\gamma}\left[V_1p_2(\gamma-1) + p_1V_1\right]$$

$$p_2V_2\gamma = \left[V_1p_2(\gamma-1) + p_1V_1\right]$$

$$\boxed{\left\{p_2V_2\gamma = V_1\left[p_2(\gamma-1) + p_1\right]\right\}\frac{1}{p_2}}$$

$$V_2\gamma = V_1\left[(\gamma-1) + \frac{p_1}{p_2}\right]$$

$$\boxed{V_2 = \frac{V_1}{\gamma}\left[(\gamma-1) + \frac{p_1}{p_2}\right]}$$

$$m^3 = m^3$$

$$p_2 V_2 \gamma = (\gamma - 1) V_1 p_2 + p_1 V_1$$

$$p_2 V_2 \gamma - (\gamma - 1) V_1 p_2 = p_1 V_1$$

$$p_2 \left[V_2 \gamma - (\gamma - 1) V_1 \right] = p_1 V_1$$

$$\boxed{p_2 = \frac{p_1 V_1}{\left[V_2 \gamma - (\gamma - 1) V_1 \right]}} \qquad \frac{(N/m^2)(\cancel{m^3})}{\cancel{m^3} - \cancel{m^3}}$$

$$V_2 = \frac{V_1}{x}\left[(x-1) + \frac{p_1}{p_2}\right]$$

$\boxed{x = 1 \text{ Isot.}}$

$$V_2 = \frac{V_1}{1}\left[(1-1) + \frac{p_1}{p_2}\right]$$

$$V_2 = \frac{V_1 p_1}{p_2}$$

$\boxed{p_2 V_2 = p_1 V_1}$

obtener relación T, V

$$T_2 = \frac{T_1}{\gamma}\left[(\gamma-1)\frac{p_2}{p_1} + 1\right]$$

$\boxed{p = \frac{nRT}{V}}$

$$T_2 = \frac{T_1}{\gamma}\left[(\gamma-1)\,\frac{\cancel{n}RT_2/V_2}{\cancel{n}RT_1/V_1} + 1\right]$$

$$T_2 = \frac{T_1}{\gamma}\left[(\gamma-1)\,\frac{T_2/V_2}{T_1/V_1} + 1\right]$$

$$T_2 = \frac{T_1}{\gamma}\left[(\gamma-1)\,\frac{T_2V_1}{T_1V_2} + 1\right]$$

$$\frac{T_2}{T_1}\gamma = (\gamma-1)\,\frac{T_2V_1}{T_1V_2} + 1$$

$$\frac{T_2\gamma}{T_1} - \left[(\gamma-1)\,\frac{T_2V_1}{T_1V_2}\right] = 1$$

$$\frac{T_2}{T_1}\left[\gamma - (\gamma-1)\frac{V_1}{V_2}\right] = 1$$

$$T_2 = \frac{T_1}{\left[\gamma - (\gamma-1)\frac{V_1}{V_2}\right]} \qquad K = K$$

$$T_2 = \frac{T_1}{\left[x - (x-1)\frac{V_1}{V_2}\right]} \qquad x = 1$$

Isot.

$$T_2 = \frac{T_1}{\left[1 - (1-1)\frac{V_1}{V_2}\right]} = \qquad T_2 = T_1$$

Adiabatico Irrev.

$$\Delta H = n\bar{C}_p \Delta T$$

$$dH = n\bar{C}_p\, dT \quad \text{ideal.}$$

$$\Delta U = n\bar{C}_v \Delta T \quad \text{perfecto}$$

$$dU = n\bar{C}_v\, dT$$

$$W_{IR} = p_2(V_2 - V_1) \qquad q_{IR} = 0$$

$$\Delta U_{IR} = q_{IR} - W_{IR}$$

$$q_{IR} = \Delta U_{IR} + W_{IR}$$

$$\frac{\delta q_{IR}}{T} = \frac{n\bar{C}_v\, dT + p\, dV}{T}$$

$$dS = \frac{\delta q}{T} \qquad \frac{P}{T} = \frac{nR}{V}$$

$$\int_1^2 dS_{IR} = n\bar{C}_v \int_{T_1}^{T_2} \frac{dT}{T} + \frac{P}{T}\, dV$$

$$\Delta S_{IR} = n\bar{C}_v \int_{T_1}^{T_2} \frac{dT}{T} + nR \int_{V_1}^{V_2} \frac{dV}{V}$$

$$\boxed{\Delta S_{IR} = n\bar{C}_v \ln \frac{T_2}{T_1} + nR \ln \frac{V_2}{V_1}} \qquad \Delta S_{IR} > 0$$