

Clase 13 7 octubre 2020

Título de la nota

07/10/2020

$$dU = n \bar{C}_V dT = \text{extensivo}$$

$$d\bar{U} = \bar{C}_V dT = \text{intensivo}$$

$$\left(\frac{J}{\text{mol}}\right) = \frac{J}{\text{mol} \cdot K} \cdot K$$



$$\Delta U \propto \Delta T$$

$$\begin{aligned} \bar{\Delta U} &= \bar{C}_V \Delta T \\ \Delta U &= n \bar{C}_V \Delta T \end{aligned}$$

$$\Delta U = q - w$$

$$q = w$$

$$\Delta U = 0$$

Calcular funciones de estado y trayectoria en la compresión isotérmica de 2 moles de N_2 que se encuentran a una presión de 1.5 atm a una temperatura de 300 K. La compresión se llevará a cabo a la mitad del volumen inicial. Agregar las gráficas p vs V , T vs V , T vs p , S vs T . Discutir los resultados y comparar el proceso de forma Reversible e Irreversible.

compresión

$$P_1 \rightarrow P_2 \quad P_2 > P_1$$

$$V_1 \rightarrow V_2 \quad V_2 < V_1 \quad V_2 = \frac{1}{2} V_1$$

$$n_1 \rightarrow n_2 \quad n_1 = n_2 = \text{cerrado}$$

$$T_1 \rightarrow T_2 \quad T_1 = T_2 \text{ isotérmico}$$

Rev

$$W_R = -$$

$$q_R = -$$

$$\Delta S_R = -$$

$$\Delta H = 0$$

$$\Delta U = 0$$

$$W_{\text{rev}} = -$$

$$q_{\text{rev}} = -$$

$$\Delta S_{\text{rev}} = -$$

$W_R < W_{\text{rev}}$
 $\Delta S_R < \Delta S_{\text{rev}}$

$$V_1 = \frac{n_1 R T_1}{P_1}$$


$$V_1 = \frac{(2 \text{ mol}) (0.082 \text{ atm L/mol K}) (300 \text{ K})}{1.5 \text{ atm}}$$

$$V_1 = 32.8 \text{ L}$$

$$V_2 = \frac{1}{2} V_1 = \frac{32.8 \text{ L}}{2} = 16.4 \text{ L}$$

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{(1.5 \text{ atm}) (32.8 \text{ L})}{(16.4 \text{ L})} = 3 \text{ atm}$$

	p (atm)	V (L)	T (K)
1	1.5	32.8	300
2	3	16.4	300


Isotérmico

	ΔU (J)	ΔH (J)	ΔS J/K	q (J)	w (J)
Rev	0	0			
Irrev	0	0			

	presión	aumenta
compresión		
	Volumen	disminuye

Reversible	
ΔH (J)	0
ΔU (J)	0
ΔS_{Rev} (J/K)	-11.526
q_{Rev} (J)	-3457.695
w_{Rev} (J)	-3457.695



Irreversible	
ΔH (J)	0
ΔU (J)	0
ΔS_{Irrev} (J/K)	-16.617
q_{Irrev} (J)	-4985.190
w_{Irrev} (J)	-4985.190

q_{Rev}	<	q_{Irrev}
w_{Rev}	<	w_{Irrev}
ΔS_{Rev}	<	ΔS_{Irrev}

Reversible

$$W_R = nRT \ln \frac{V_2}{V_1}$$

$$= (2 \text{ mol}) (8.314 \text{ J/mol K}) (300 \text{ K}) \ln \left(\frac{16.4 \text{ L}}{32.8 \text{ L}} \right)$$

$$= -3457.69 \text{ J}$$

$$q_R = -3457.69 \text{ J} \quad W_R = q_R$$

$$\Delta S_R = \frac{q_R}{T} = \frac{-3457.69 \text{ J}}{300 \text{ K}} = -11.52 \text{ J/K}$$

$$\int_1^2 ds = \int_1^2 \frac{dq}{T} \quad \checkmark$$

$$\underline{\Delta S} = \left(\frac{q}{T} \right) \quad T = \text{cte}$$

|_{rev}

$$\begin{aligned} W_{\text{rev}} &= p_2 (v_2 - v_1) = 3 \text{ atm} (16.4 - 32.8) \text{ L} \\ &= (-49.2 \text{ atm}) \left(\frac{1.01325 \times 10^5 \text{ N/m}^2}{\text{atm}} \right) \left(\frac{\text{L}}{10^{-3}} \right) \\ &= -4985.19 \text{ J} = \frac{\text{N}}{\text{m}^2} \text{ m}^3 = \text{N} \cdot \text{m} = \text{J} \end{aligned}$$

$$q_{\text{irrev}} = W_{\text{irrev}} = -4985.19 \text{ J}$$

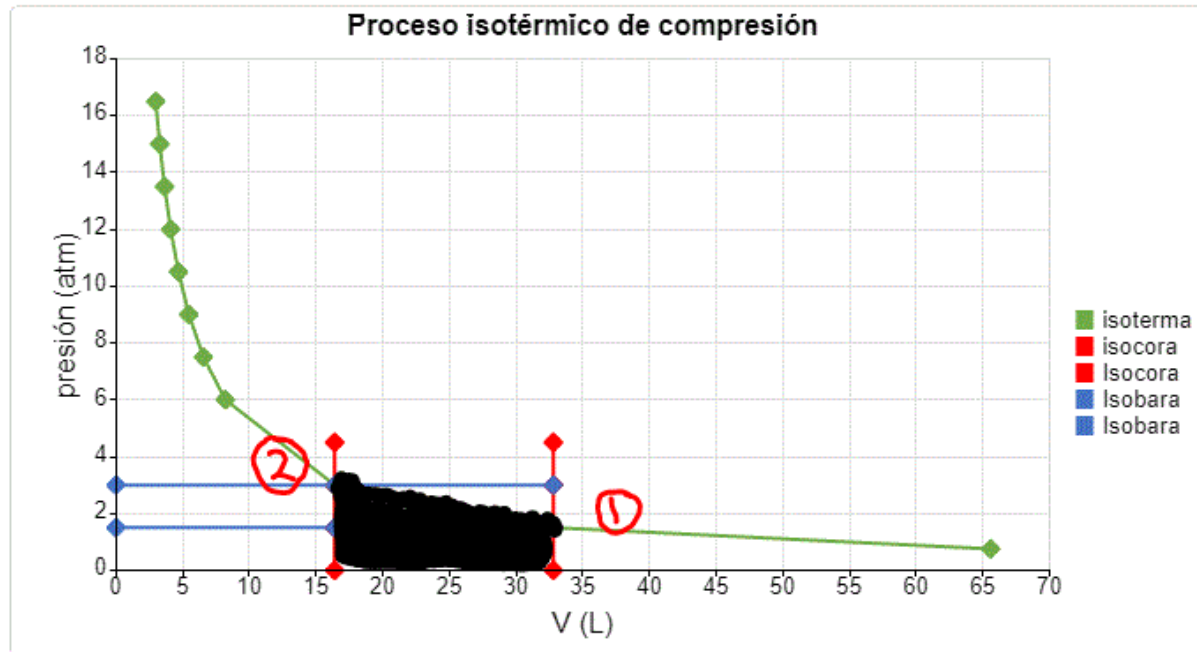
exotérmico

$$\Delta S_{\text{irrev}} = \frac{q_{\text{irrev}}}{T}$$
$$= \frac{-4985.19 \text{ J}}{300 \text{ K}} = -\frac{16.61 \text{ J}}{\text{K}}$$

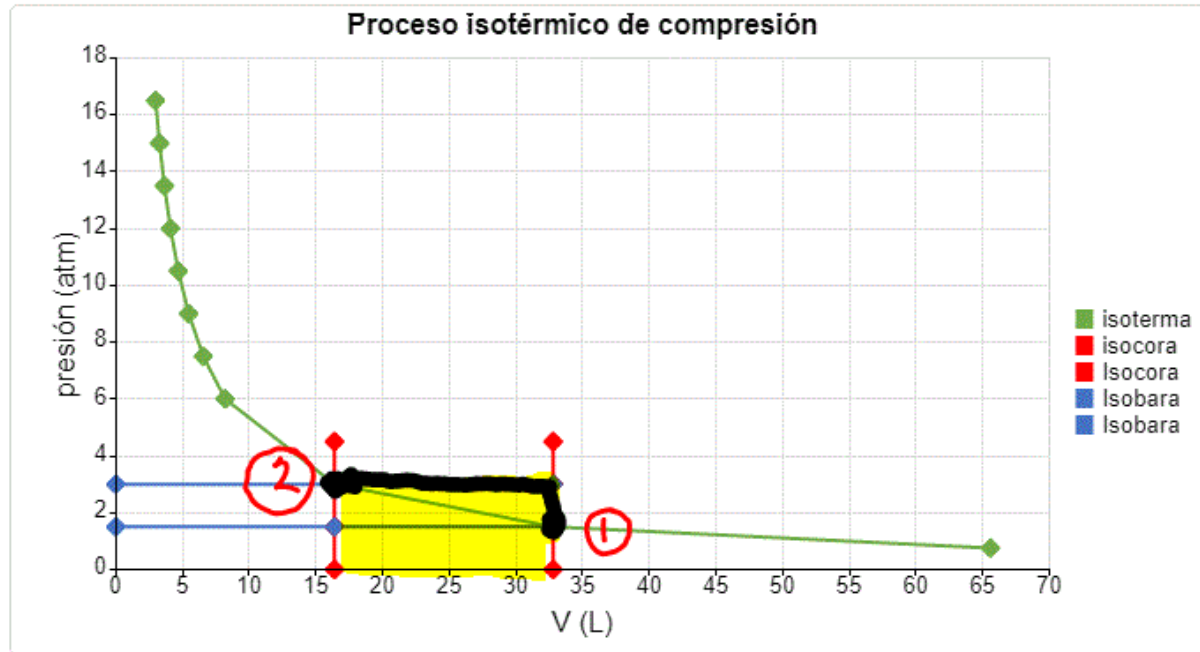
$$W_R < W_{\text{irrev}}$$

$$q_R < q_{\text{irrev}}$$

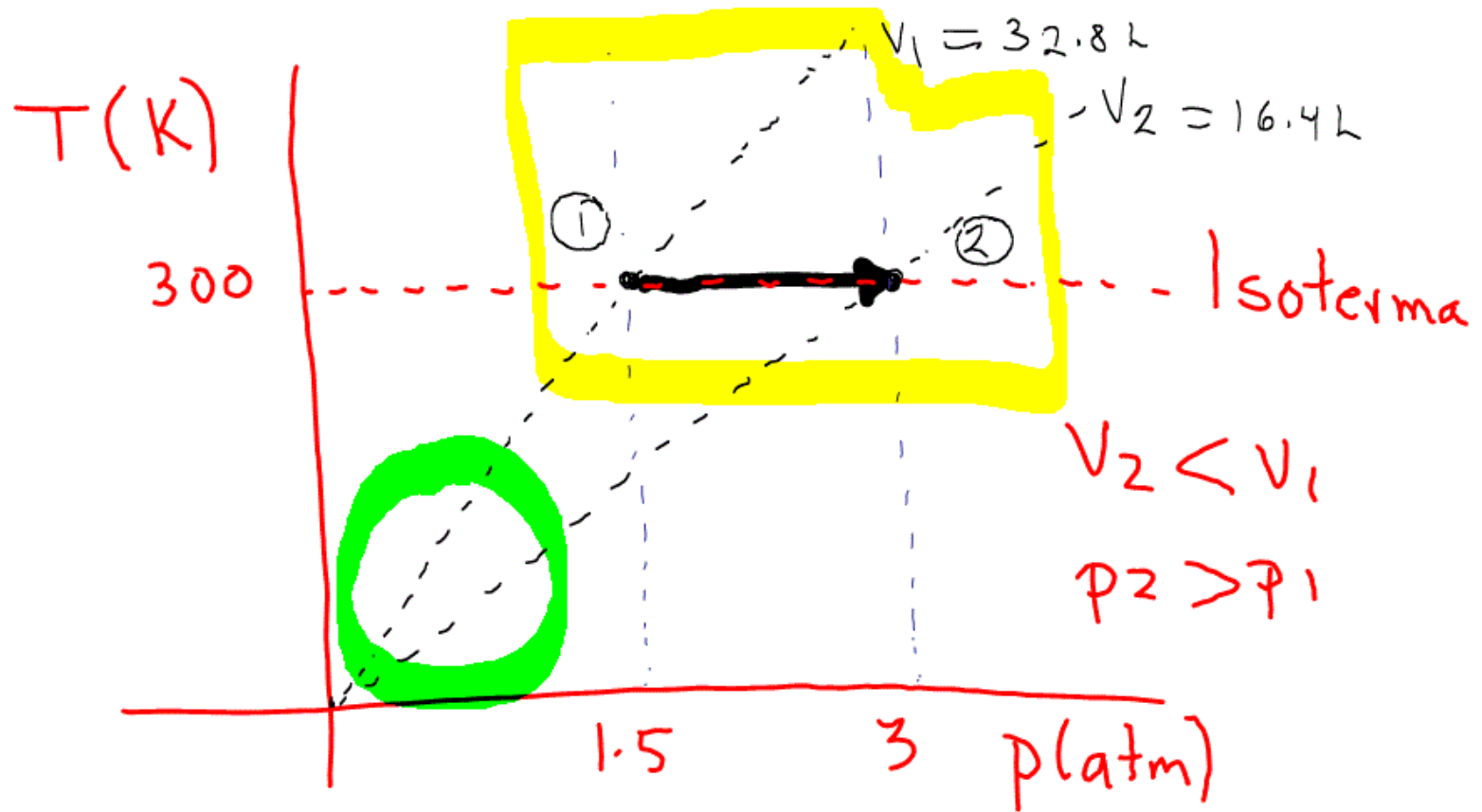
$$\Delta S_R < \Delta S_{\text{irrev}} \quad \text{Disminución de entropía}$$

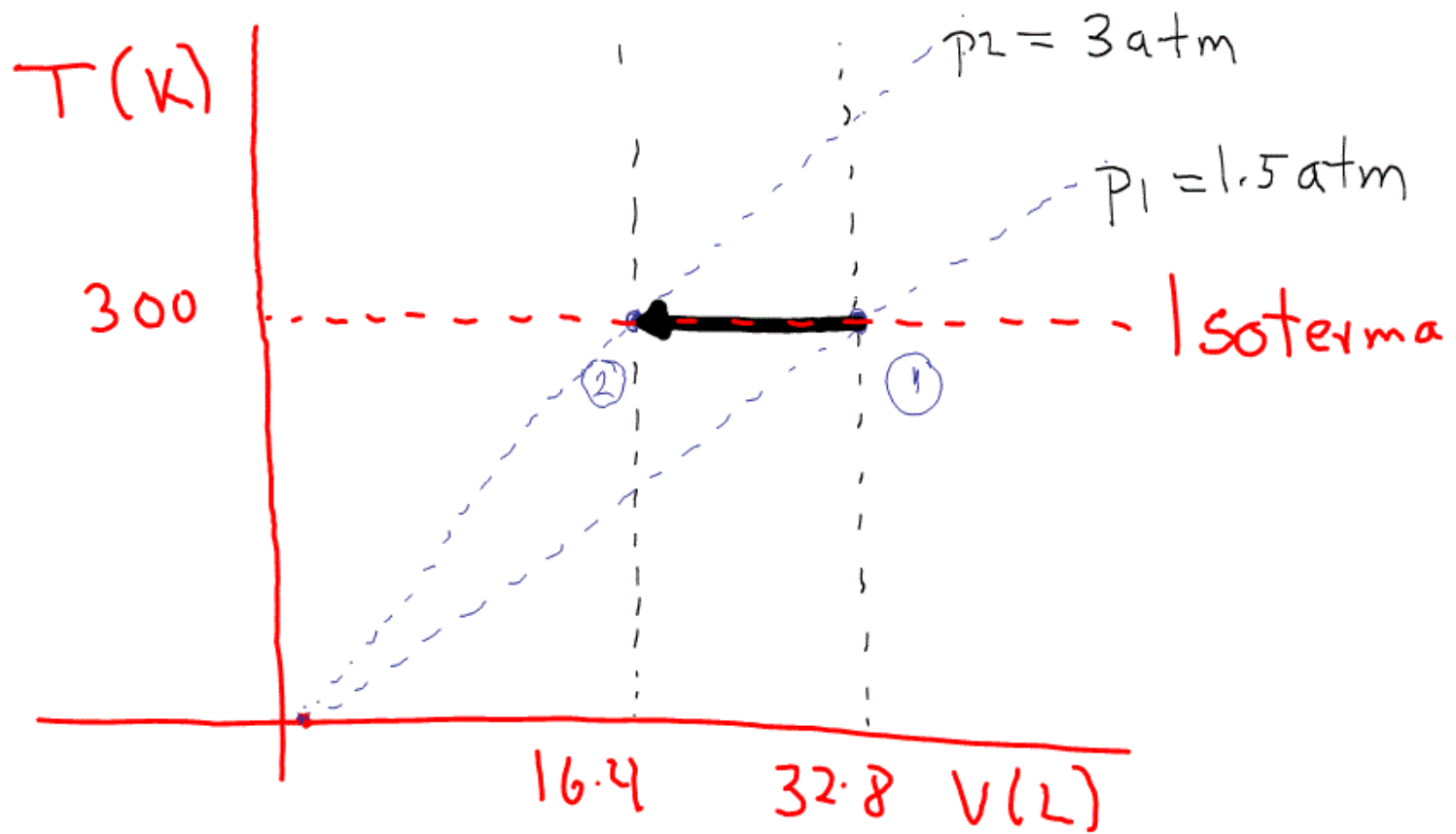


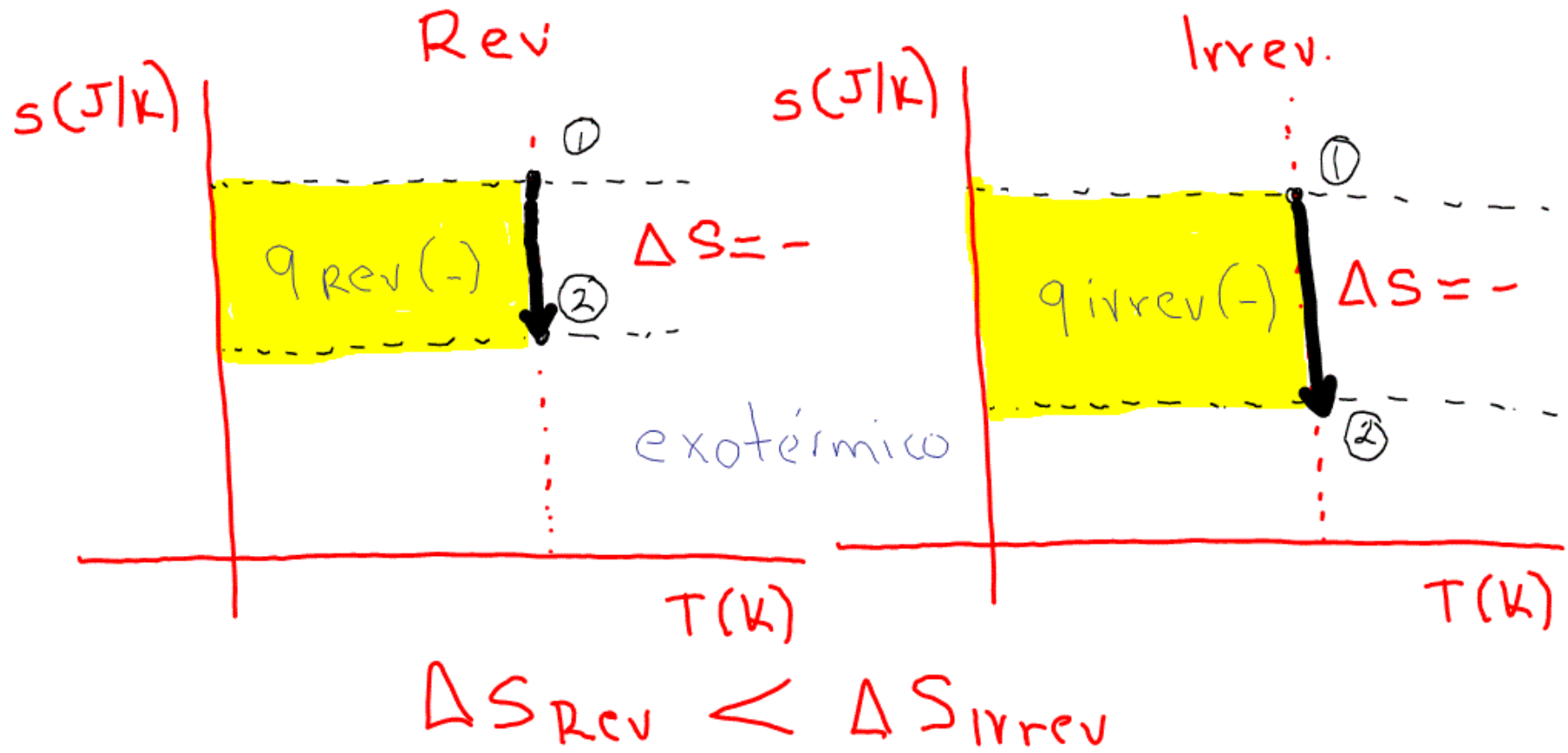
Comp. Isot. Rev.

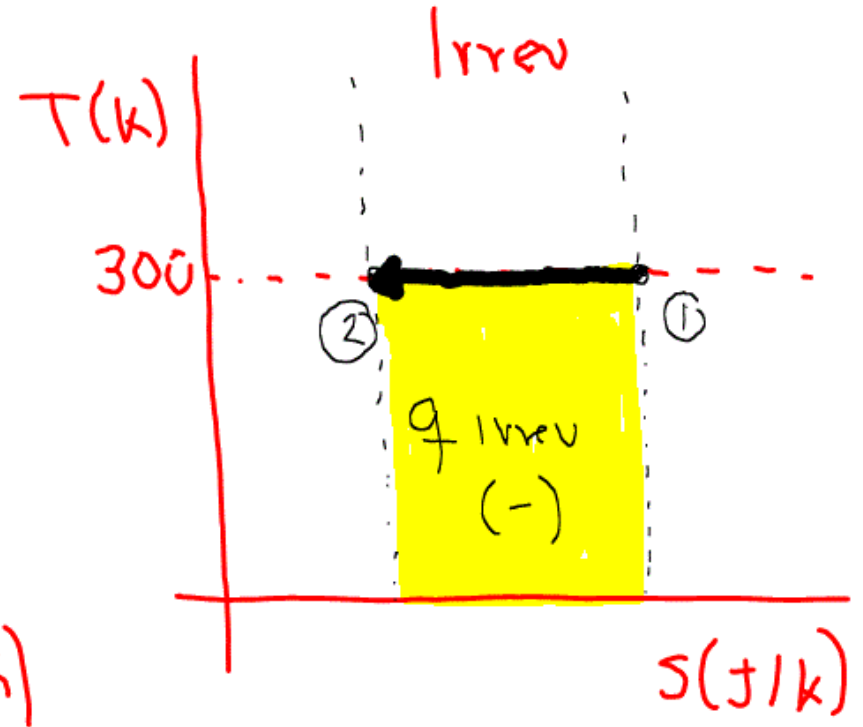
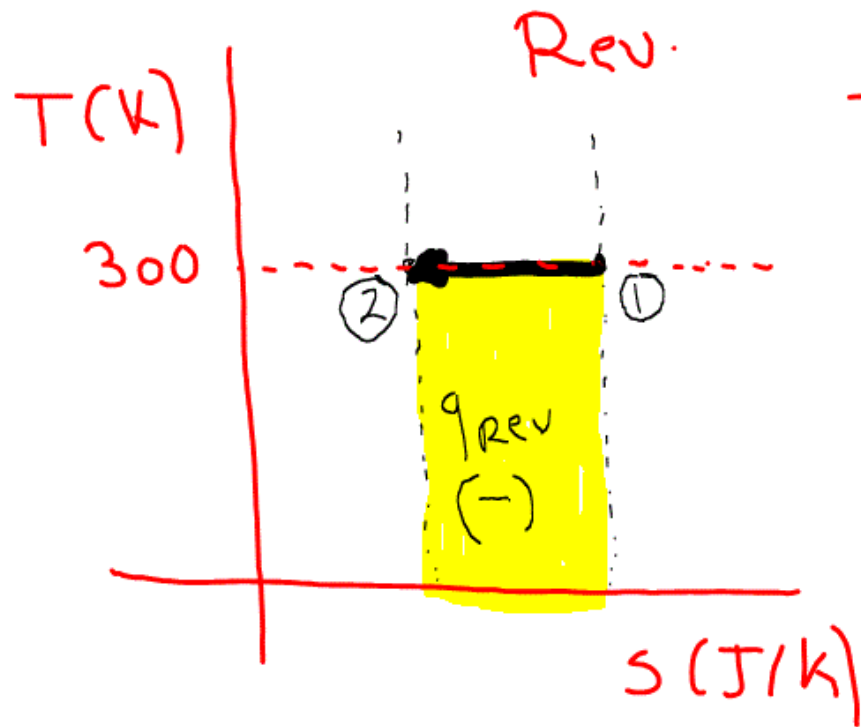


Comp. Isot. Irrev.









Referencia para gases

Comportamiento perfecto $\left\{ \begin{array}{l} \bar{C}_v, \bar{C}_p \\ \text{ctes} \end{array} \right.$

Comportamiento ideal $\left\{ \begin{array}{l} \bar{C}_v \text{ y } \bar{C}_p \\ \text{función de } T \end{array} \right.$

$$PV = nRT$$

gases	\bar{C}_p	\bar{C}_v
He Ar, Kr, Xe, Rn	$5/2 R$	$3/2 R$
O ₂ , N ₂ , H ₂ , CO Cl ₂	$7/2 R$	$5/2 R$
H ₂ O, CO ₂ , O ₃	$9/2 R$	$7/2 R$
NH ₃	$11/2 R$	$9/2 R$

perfecto