

Clase 18 13 octubre 2020

Título de la nota

09/10/2020

Proceso isotérmico en gases de comportamiento perfecto e ideal en sistemas cerrados					
Instrucción: Insertar en las celdas de color amarillo los valores correspondientes					
Calculando V_1		proceso	Calculando V_2		
p_1 (atm)	1.050	→	p_2 (atm)	0.350	expansión
V_1 (L)	50.000	→	V_2 (L)	150.000	
T_1 (K)	320.120	→	T_2 (K)	320.120	
n_1 (mol)	2.000	→	n_2 (mol)	2.000	
	R (J/molK)	8.314			
			presión	disminuye	
expansión					
			Volumen	aumenta	

Reversible	
ΔH (J)	0
ΔU (J)	0
ΔS_{Rev} (J/K)	18.268
Q_{Rev} (J)	5847.864
W_{Rev} (J)	5847.864



Irreversible	
ΔH (J)	0
ΔU (J)	0
ΔS_{Irrev} (J/K)	11.078
Q_{Irrev} (J)	3546.375
W_{Irrev} (J)	3546.375

Q_{Rev}	>	Q_{Irrev}
W_{Rev}	>	W_{Irrev}
ΔS_{Rev}	>	ΔS_{Irrev}

Proceso isotérmico en gases de comportamiento perfecto e ideal en sistemas cerrados					
Instrucción: Insertar en las celdas de color amarillo los valores correspondientes					
Calculando V_1		proceso	Calculando V_2		
p_1 (atm)	0.350	→	p_2 (atm)	1.050	compresión
V_1 (L)	150.000	→	V_2 (L)	49.990	
T_1 (K)	320.120	→	T_2 (K)	320.120	
n_1 (mol)	2.000	→	n_2 (mol)	2.000	
	R (J/molK)	8.314			
			presión	aumenta	
			compresión		
			Volumen	disminuye	

Reversible	
ΔH (J)	0
ΔU (J)	0
ΔS_{Rev} (J/K)	-18.271
q_{Rev} (J)	-5848.929
w_{Rev} (J)	-5848.929



Irreversible	
ΔH (J)	0
ΔU (J)	0
ΔS_{Irrev} (J/K)	-33.238
q_{Irrev} (J)	-10640.189
w_{Irrev} (J)	-10640.189



	$\Delta H (J)$	$\Delta U (J)$	$\Delta S (J/K)$	$q (J)$	$w (J)$
I	0	0	18.268	5847.86	5847.86
II	0	0	-18.268	-5847.86	-5847.86
total	0	0	0	0	0

$$q_{\text{ciclo}} = w_{\text{ciclo}}$$

Ciclo 1

I Exp. Isot. Rev.

II Comp. Isot. Rev.

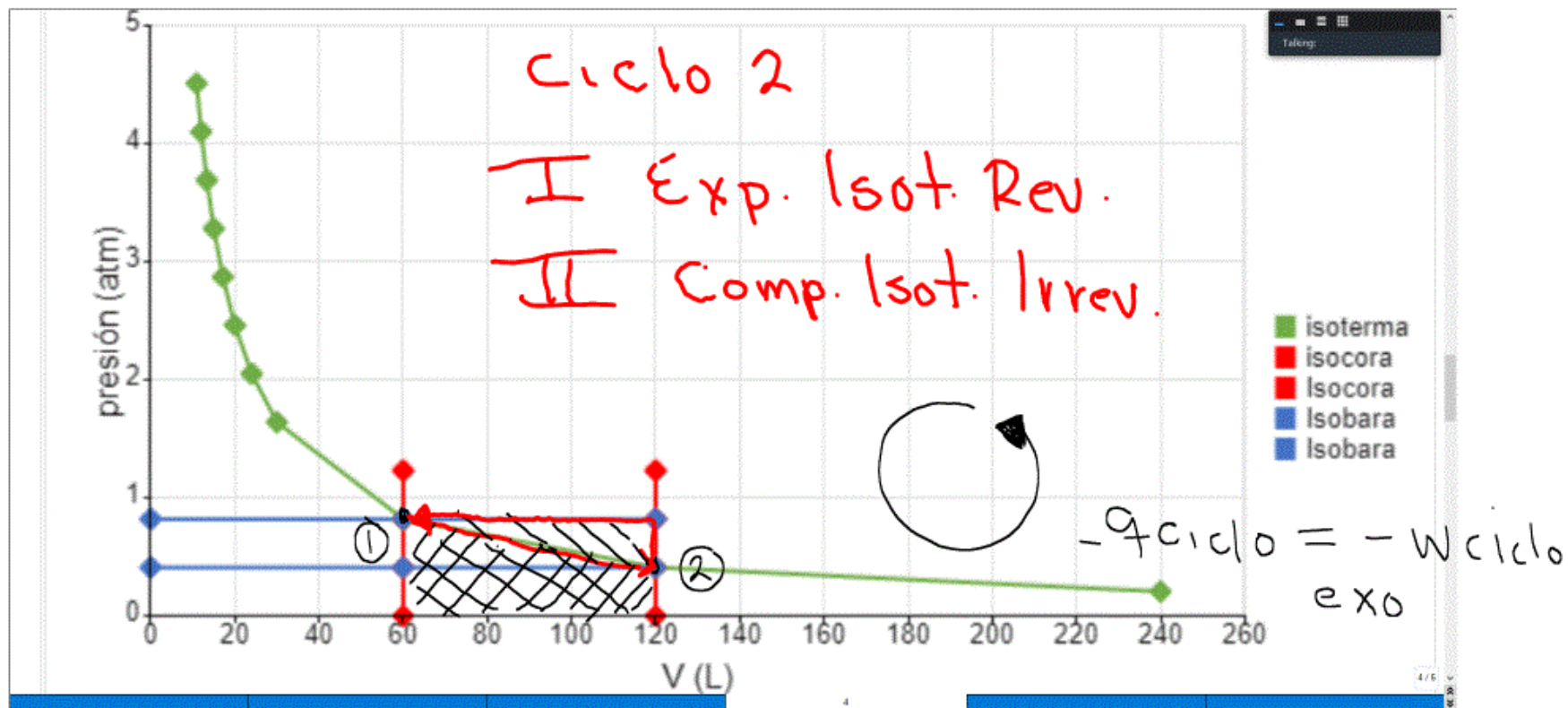
	$\Delta H (J)$	$\Delta U (J)$	$\Delta S (J/K)$	$q (J)$	$w (J)$
I	0	0	18.268	5847.86	5847.86
II	0	0	-33.238	-10640.13	-10640.13
total	0	0	-14.973	-4792.2	-4792.27

$$q_{\text{ciclo}} = w_{\text{ciclo}}$$

Ciclo 2

I Exp. Isot. Rev.

II Comp. Isot. Irrev.



$$\Delta S_{\text{ciclo}} = - \text{No Favorable}$$

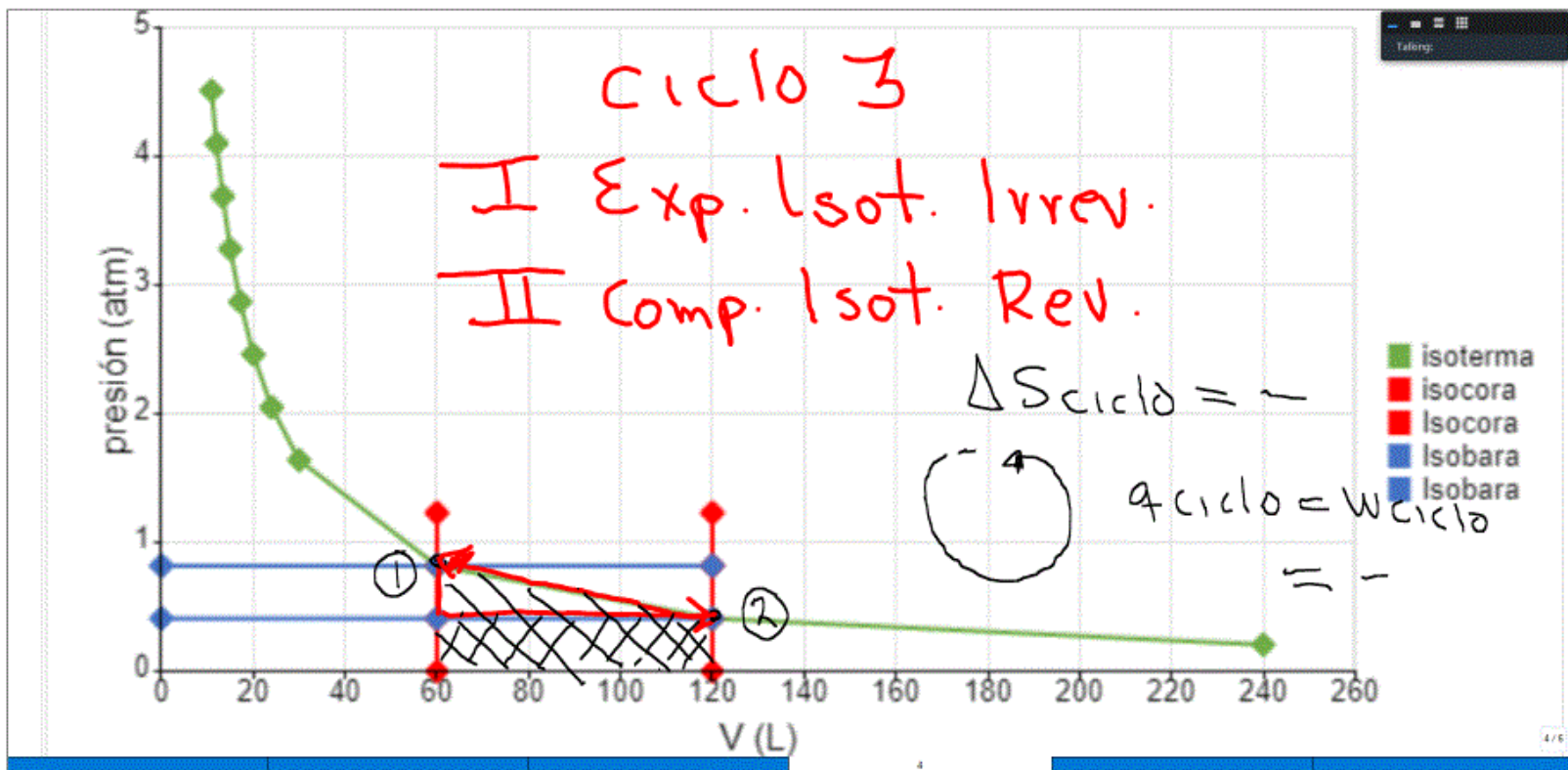
	$\Delta H (J)$	$\Delta U (J)$	$\Delta S (J/K)$	$q (J)$	$w (J)$
I	0	0	11.078	3546.37	3546.37
II	0	0	-18.271	-5848.92	-5848.92
total	0	0	-7.193	-2302.55	-2302.55

$$q_{\text{ciclo}} = w_{\text{ciclo}}$$

Ciclo 3

I Exp. Isot. Irrev.

II Comp. Isot. Rev.



	$\Delta H (J)$	$\Delta U (J)$	$\Delta S (J/K)$	$q (J)$	$w (J)$
I	0	0	11.078	3546.37	3546.37
II	0	0	-33.238	-10640.13	-10640.13
total	0	0	-22.16	-7093.76	-7093.76

$$q_{\text{ciclo}} = w_{\text{ciclo}}$$

Ciclo 4

I Exp. Isot. Irrev.

II Comp. Isot. Irrev.



Favorecimiento

Ciclo 1 > ciclo 3 > ciclo 2 > ciclo 4

I Rev.
II

I Irrev.
II

—
tempo

Ciclo 1 > ciclo 3 > ciclo 2 > ciclo 4

Lento Rápido

Proceso Isobárico $p = \text{cte}$

$$p_1 \rightarrow p_2 = \text{cte}$$

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

Sistema
elástico

$$\left. \begin{array}{l} V_1 \rightarrow V_2 \\ T_1 \rightarrow T_2 \end{array} \right\} \begin{array}{l} V_2 > V_1 \quad T_2 > T_1 \text{ exp.} \\ V_1 > V_2 \quad T_1 > T_2 \text{ comp.} \end{array}$$

$$p_1 = \frac{n_1 R T_1}{V_1} \quad p_2 = \frac{n_2 R T_2}{V_2}$$

$$p_1 = p_2$$

$$\frac{\cancel{n_1} R T_1}{V_1} = \frac{\cancel{n_2} R T_2}{V_2}$$

$$\frac{T_1}{V_1} = \frac{T_2}{V_2}$$

$$T_2 = \frac{T_1 V_2}{V_1}$$

$$V_2 = \frac{T_2 V_1}{T_1}$$

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

$$\int_1^2 dH = n \bar{C}_p \int_{T_1}^{T_2} dT = q_p \text{ extensivo}$$

$$\Delta H = n \bar{C}_p (T_2 - T_1)$$

comportamiento
perfecto

$\bar{C}_p =$ Independiente de T

$$\bar{C}_p = f(T) = a + bT + cT^2 + dT^3$$

$a, b, c, d =$ ctes polinómicas

$$\int_1^2 dH = n \left[a + bT + cT^2 + dT^3 \right] \int dT$$

$$\Delta H = n \left[a \int_{T_1}^{T_2} dT + b \int_{T_1}^{T_2} T dT + c \int_{T_1}^{T_2} T^2 dT + d \int_{T_1}^{T_2} T^3 dT \right]$$

Comportamiento ideal.

$$\Delta H = n \left[a (T_2 - T_1) + \frac{b}{2} (T_2^2 - T_1^2) + \frac{c}{3} (T_2^3 - T_1^3) + \frac{d}{4} (T_2^4 - T_1^4) \right]$$

$$\bar{C}_p = f(T) = \frac{\text{cal}}{\text{molK}} \quad \text{ó} \quad \frac{\text{J}}{\text{molK}}$$

	perfecto	
gas	\bar{C}_p	\bar{C}_v
monoatómico	$\frac{5}{2} R$	$\frac{3}{2} R$
diatómico	$\frac{7}{2} R$	$\frac{5}{2} R$
Triatómico	$\frac{9}{2} R$	$\frac{7}{2} R$

$$R = \frac{\text{cal}}{\text{mol K}}$$

$$R = \frac{\text{J}}{\text{mol K}}$$

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

$$du = n \bar{C}_v dT$$

$$\bar{C}_p = \bar{C}_v + R$$

$$\bar{C}_v = \bar{C}_p - R$$

Teorema
Mayer

$\bar{C}_v =$ Independiente de T comp. perfecto

$\bar{C}_v = f(T)$ comp. ideal.

$$dU = n \left[\right.$$

$$\bar{C}_V = \bar{C}_P - R$$

$$\bar{C}_V = a + bT + cT^2 + dT^3 - R$$

$$\bar{C}_V = (a - R) + bT + cT^2 + dT^3$$

$$a + bT + cT^2 + dT^3 = \text{cal/molK}$$

$$a = \frac{\text{cal}}{\text{mol K}}$$

$$b \ T = \frac{\text{cal}}{\text{mol K}^2} \text{ K} = \frac{\text{cal}}{\text{mol K}}$$

$$c \ T^2 = \frac{\text{cal}}{\text{mol K}^3} \text{ K}^2 = \frac{\text{cal}}{\text{mol K}}$$

$$d \ T^3 = \frac{\text{cal}}{\text{mol K}^4} \text{ K}^3 = \frac{\text{cal}}{\text{mol K}}$$

$$ds = \frac{dq}{T}$$

$$\int_1^2 ds = \int_{T_1}^{T_2} \frac{n \bar{C}_p dT}{T} = n \bar{C}_p \int_{T_1}^{T_2} \frac{dT}{T}$$

$$\Delta S = n \bar{C}_p \ln \frac{T_2}{T_1}$$

$$\Delta S = \frac{J}{K} = (\text{mol}) \left(\frac{\text{cal}}{\text{mol K}} \right)$$

$$= \frac{\text{cal}}{K} \quad \frac{4.186 J}{\text{cal}}$$