

Clase 40 10 Noviembre 2020

Título de la nota

04/11/2020

Proceso adiabático reversible 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 adiabático	
p_1 (atm)	2.000	→	γ	1.2884
V_1 (L)	32.800	→	V_2 (L)	16.400
T_1 (K)	400.000	→	T_2 (K)	488.531
n_1 (mol)	2.000	→	n_2 (mol)	2.000
Calculando T_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	2.000	→	γ	1.2884
V_1 (L)	32.800	→	V_2 (L)	16.400
T_1 (K)	400.000	→	T_2 (K)	488.531
n_1 (mol)	2.000	→	n_2 (mol)	2.000
Calculando p_1		proceso	Calculando p_2 adiabática	
p_1 (atm)	2.000	→	p_2 (atm)	4.88531
V_1 (L)	32.800	→	V_2 (L)	16.400
T_1 (K)	400.000	→	γ	1.2884
n_1 (mol)	2.000	→	n_2 (mol)	2.000
Calculando n_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	2.000	→	p_2 (atm)	4.88531
V_1 (L)	32.800	→	γ	1.2884
T_1 (K)	400.000	→	T_2 (K)	488.531
n_1 (mol)	2.000	→	n_2 (mol)	2.000
	R (atmL/molK)	0.0820	Cp (cal/molK)	8.8827
			Cv (cal/molK)	6.8941



Proceso adiabático Irreversible 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 adiabático	
p_1 (atm)	2.000	→	γ	1.2884
V_1 (L)	32.800	→	V_2 (L)	16.4000
T_1 (K)	400.000	→	T_2 (K)	562.153
n_1 (mol)	2.000	→	n_2 (mol)	2.000
Calculando T_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	2.000	→	γ	1.2884
V_1 (L)	32.800	→	V_2 (L)	16.400
T_1 (K)	400.000	→	T_2 (K)	562.153
n_1 (mol)	2.000	→	n_2 (mol)	2.000
Calculando p_1		proceso	Calculando p_2 adiabática	
p_1 (atm)	2.000	→	p_2 (atm)	5.62153
V_1 (L)	32.800	→	V_2 (L)	16.400
T_1 (K)	400.000	→	γ	1.2884
n_1 (mol)	2.000	→	n_2 (mol)	2.000
Calculando n_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	2.000	→	p_2 (atm)	5.62153
V_1 (L)	32.800	→	γ	1.2884
T_1 (K)	400.000	→	T_2 (K)	562.153
n_1 (mol)	2.000	→	n_2 (mol)	2.000
	R (atmL/molK)	0.0820	C_p (cal/molK)	8.8827
			C_v (cal/mol/K)	6.8941



o Modelo perfecto Reversible (simulador)

Gas	a	b	c	d	e	m (g)	n (mol)	M (g/mol)
Anhidrido carbónico	8.9487e+0	0.00e+0	0.00e+0	0.00e+0		88.2000	2.0000	44.1000

T ₁ (K)	T ₂ (K)	p ₁ (atm)	p ₂ (atm)	R (cal/mol K)
400.00	487.60	2.0000	4.8760	1.9886

V ₁ (L)	V ₂ (L)
32.80	16.4

ΔH (cal)	1567.8122
ΔU (cal)	1219.4095
ΔS p cte (cal/K)	3.5442
q p cte (cal)	1567.8122
w p cte (cal)	348.4027
q isotérmico (cal)	-1417.7573

Cp (cal/molK)	8.9487
Cv (cal/molK)	6.9601
ΔS V cte (cal/K)	2.7566
q V cte (cal)	1219.4095
w V cte (cal)	0
w isotérmico (cal)	-1102.7140



γ	1.2857
w adiabático (cal)	-1219.4095
ΔS isotérmico (cal/K)	-3.5444
ΔS adiabático (cal/K)	0
q adiabático (cal)	0

Se cumple la segunda ley de la Termodinámica

○ Modelo perfecto Irreversible (simulador)

Gas	a	b	c	d	e	m (g)	n (mol)	M (g/mol)
Anhíbrido carbónico	8.9487e+0	0.00e+0	0.00e+0	0.00e+0		88.2000	2.0000	44.1000

T_1 (K)	T_2 (K)	p_1 (atm)	p_2 (atm)	R (cal/mol K)
400.00	559.99	2.0000	5.5999	1.9886

V_1 (L)	V_2 (L)
32.80	16.4

ΔH (cal)	2863.4050
ΔU (cal)	2227.0928
ΔS p cte (cal/K)	6.0217
q p cte (cal)	2863.4050
w p cte (cal)	636.3122
q isotérmico (cal)	-2223.0105

C_p (cal/molK)	8.9487
C_v (cal/molK)	6.9601
ΔS V cte (cal/K)	4.6835
q V cte (cal)	2227.0928
w V cte (cal)	0
w isotérmico (cal)	-2223.0105



γ	1.2857
w adiabático (cal)	-2227.0928
ΔS isotérmico (cal/K)	-5.5575
ΔS adiabático (cal/K)	1.92673
q adiabático (cal)	0
Se cumple la segunda ley de la Termodinámica	

○ Modelo ideal Reversible (Simulador):

Gas	a	b	c	d	e	m (g)	n (mol)	M (g/mol)
Anhidrido carbónico	4.7280e+0	1.75e-2	-1.34e-5	4.10e-9		88.2000	2.0000	44.1000

T_1 (K)	T_2 (K)	p_1 (atm)	p_2 (atm)	R (cal/mol K)
400.00	487.60	2.0000	4.8760	1.9886
V_1 (L)	V_2 (L)			
32.80	16.4			

ΔH (cal)	1788.5398
ΔU (cal)	1440.1370
ΔS p cte (cal/K)	4.0386
q p cte (cal)	1788.5398
w p cte (cal)	348.4027
q isotérmico (cal)	-1417.7573

C_p (cal/molK)	9.8464
C_v (cal/molK)	7.8578
ΔS V cte (cal/K)	3.2510
q V cte (cal)	1440.1370
w V cte (cal)	0
w isotérmico (cal)	-1102.7140

γ	1.2531
w adiabático (cal)	-1440.1370
ΔS isotérmico (cal/K)	-3.5444
ΔS adiabático (cal/K)	0
q adiabático (cal)	0
Se cumple la segunda ley de la Termodinámica	



○ Modelo ideal Irreversible (simulador):

Gas	a	b	c	d	e	m (g)	n (mol)	M (g/mol)
Anhídrido carbónico	4.7280e+0	1.75e-2	-1.34e-5	4.10e-9		88.2000	2.0000	44.1000

T_1 (K)	T_2 (K)	p_1 (atm)	p_2 (atm)	R (cal/mol K)
400.00	559.99	2.0000	5.5999	1.9886

V_1 (L)	V_2 (L)
32.80	16.4

ΔH (cal)	3352.7633
ΔU (cal)	2716.4511
ΔS p cte (cal/K)	7.0281
q p cte (cal)	3352.7633
w p cte (cal)	636.3122
q isotérmico (cal)	-2223.0105

C_p (cal/molK)	9.8464
C_v (cal/molK)	7.8578
ΔS V cte (cal/K)	5.6900
q V cte (cal)	2716.4511
w V cte (cal)	0
w isotérmico (cal)	-2223.0105



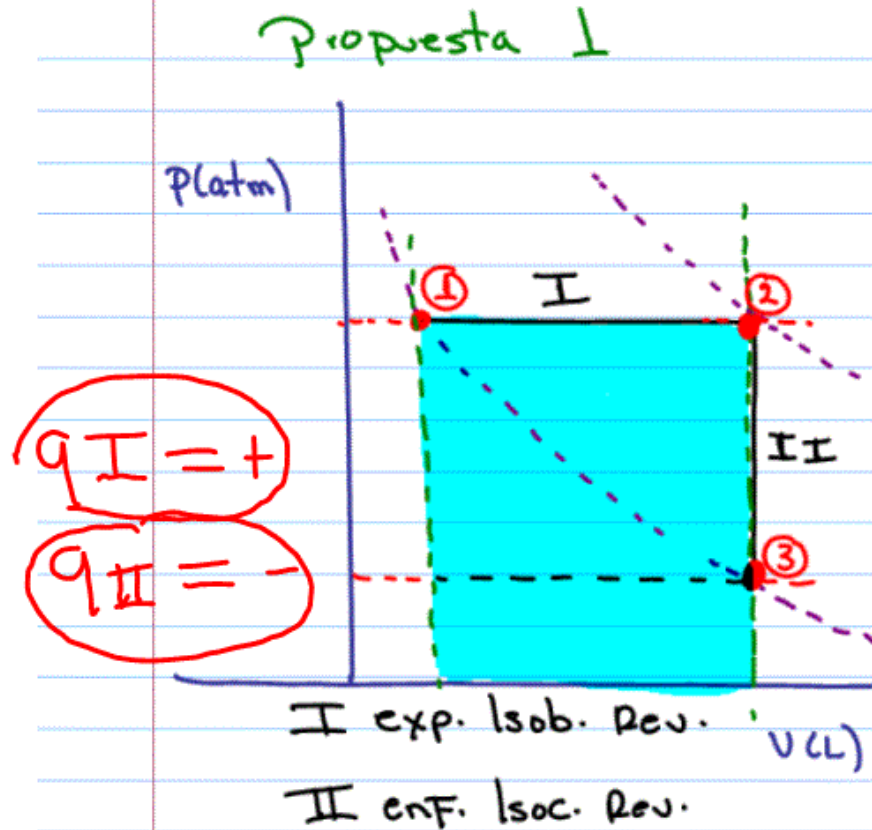
γ	1.2531
w adiabático (cal)	-2716.4511
ΔS isotérmico (cal/K)	-5.5575
ΔS adiabático (cal/K)	2.93320
q adiabático (cal)	0
Se cumple la segunda ley de la Termodinámica	

Secuencias
Termodinámicas

2 o más procesos que no regresan al origen

ΔS_{sec}
 $\Delta H_{\text{sec}} \neq 0$
 ΔU_{sec}

$q_{\text{sec}} \neq 0$
 w_{sec}



$$p_1 = p_2 > p_3$$

$$v_1 < v_2 = v_3$$

$$T_1 = T_3 < T_2$$

$$W_{\text{sec}} = W_I + W_{II}$$

$$= \oplus + \ominus$$

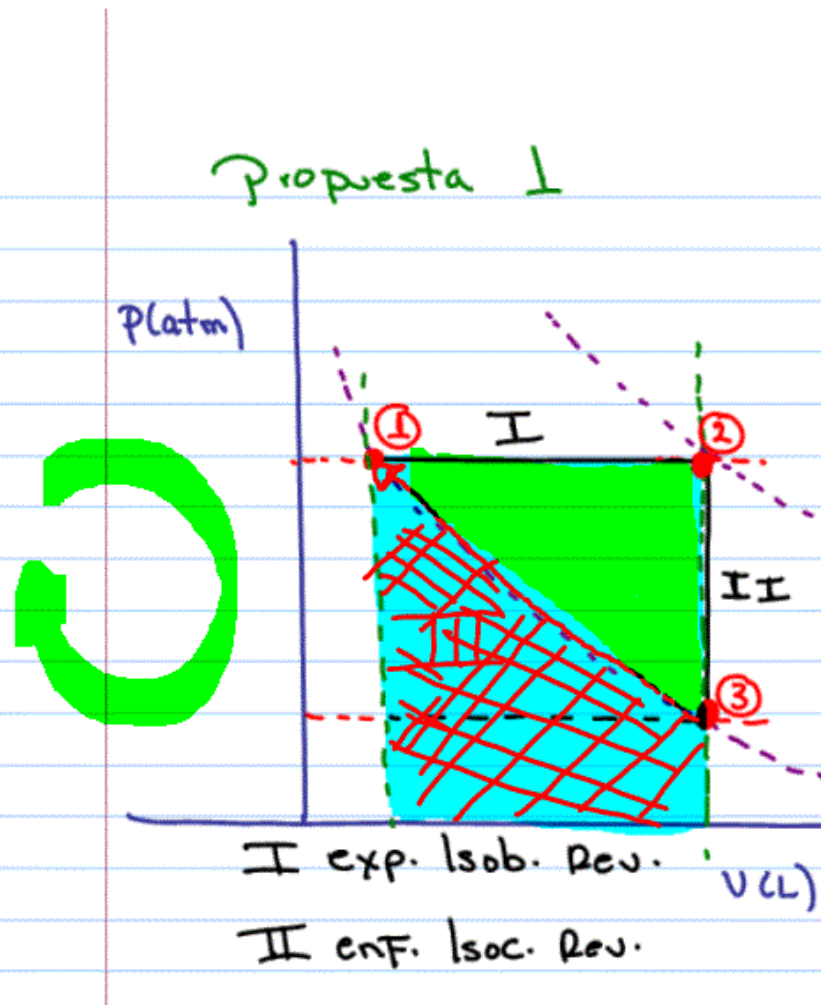
$$W_{\text{sec}} = + \text{ favorable}$$

$$\Delta S_{\text{sec}} = \Delta S_I + \Delta S_{II}$$

$$= \oplus + \ominus$$

sera favorable porque

$$\Delta S_I \text{ es mayor}$$



$$P_1 = P_2 > P_3$$

$$V_1 < V_2 = V_3$$

$$T_1 = T_3 < T_2$$

$$W_{sec} = W_I + W_{II}$$

$$= \oplus + \ominus$$

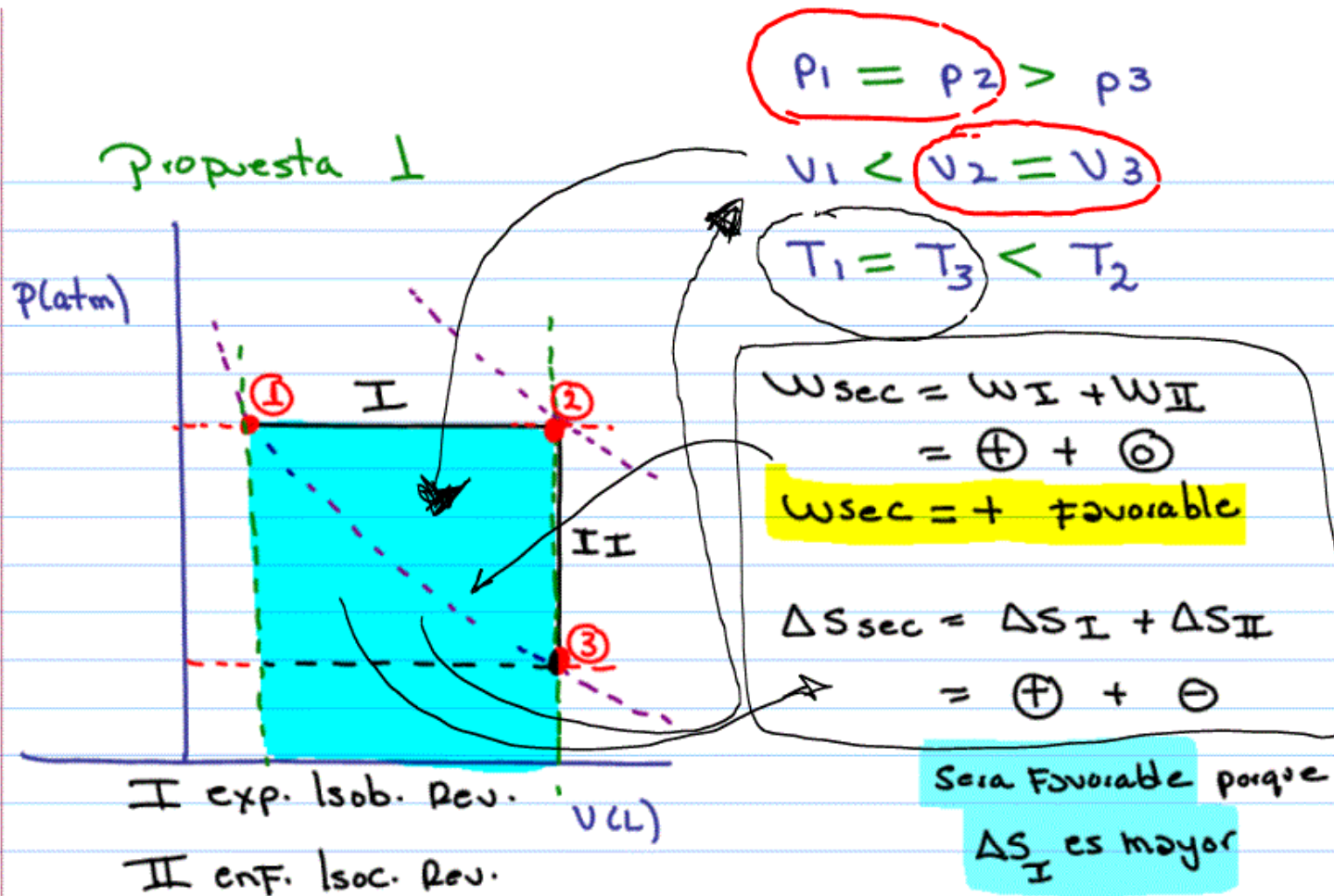
$$W_{sec} = + \text{ favorable}$$

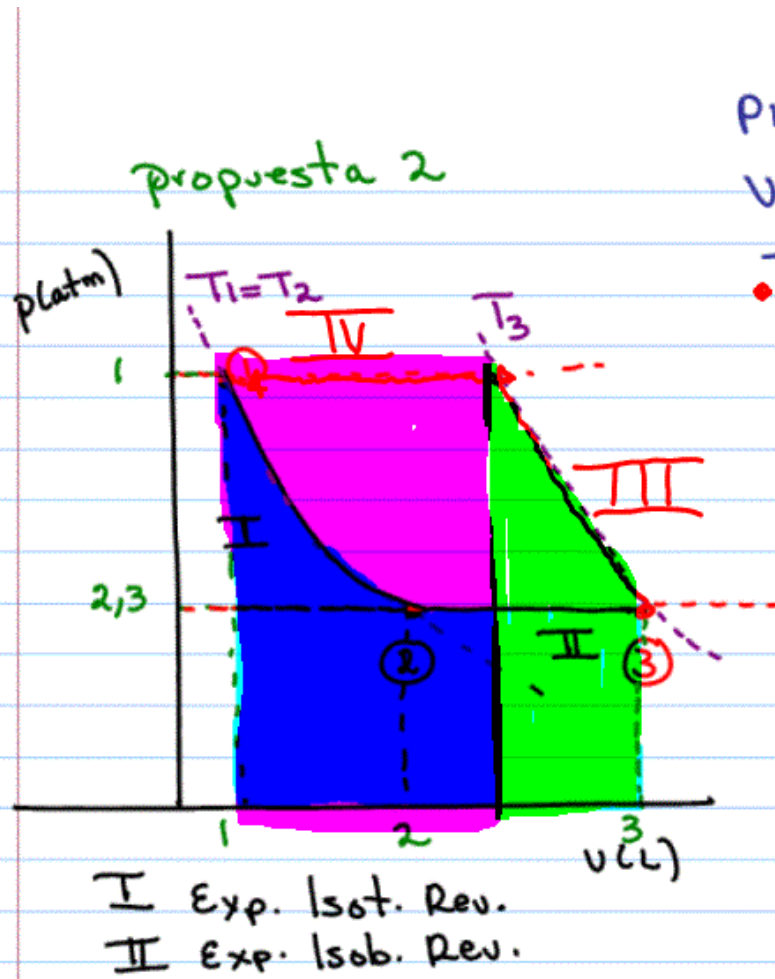
$$\Delta S_{sec} = \Delta S_I + \Delta S_{II}$$

$$= \oplus + \ominus$$

Sera Favorable porque

ΔS_I es mayor





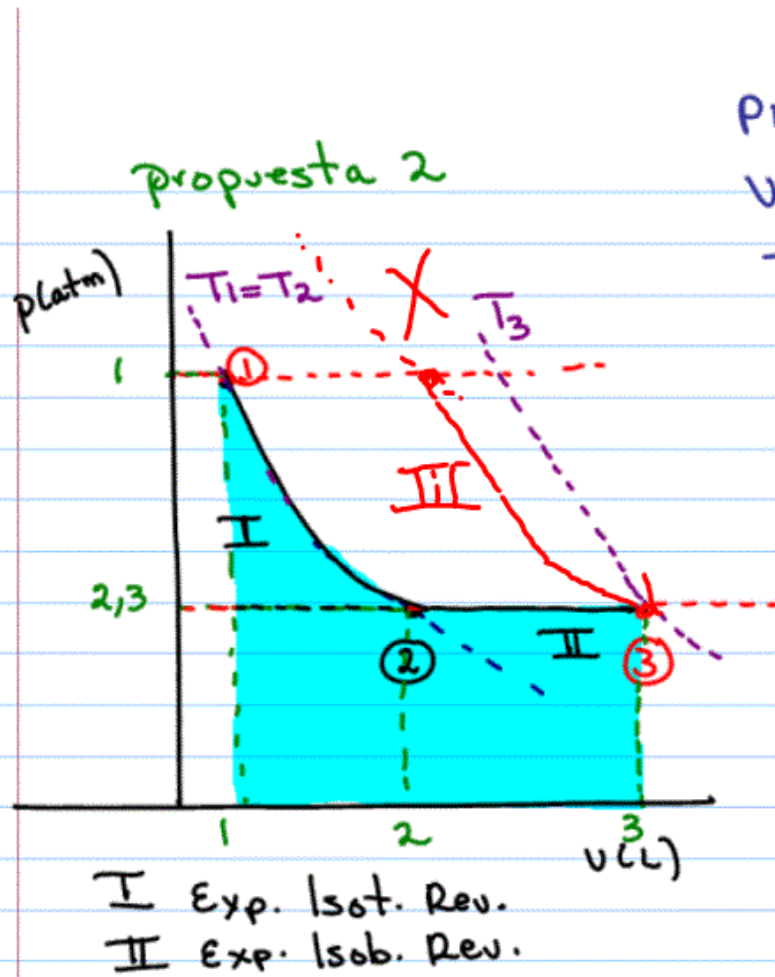
$$p_1 > p_2 = p_3$$

$$v_1 < v_2 < v_3$$

$$T_1 = T_2 < T_3$$

$$\begin{aligned} W_{\text{sec}} &= W_{\text{I}} + W_{\text{II}} \\ &= \oplus + \oplus \\ &= + \text{Favorable} \end{aligned}$$

$$\begin{aligned} \Delta S_{\text{sec}} &= \Delta S_{\text{I}} + \Delta S_{\text{II}} \\ &= \oplus + \oplus \\ &= \oplus \text{Favorable} \end{aligned}$$



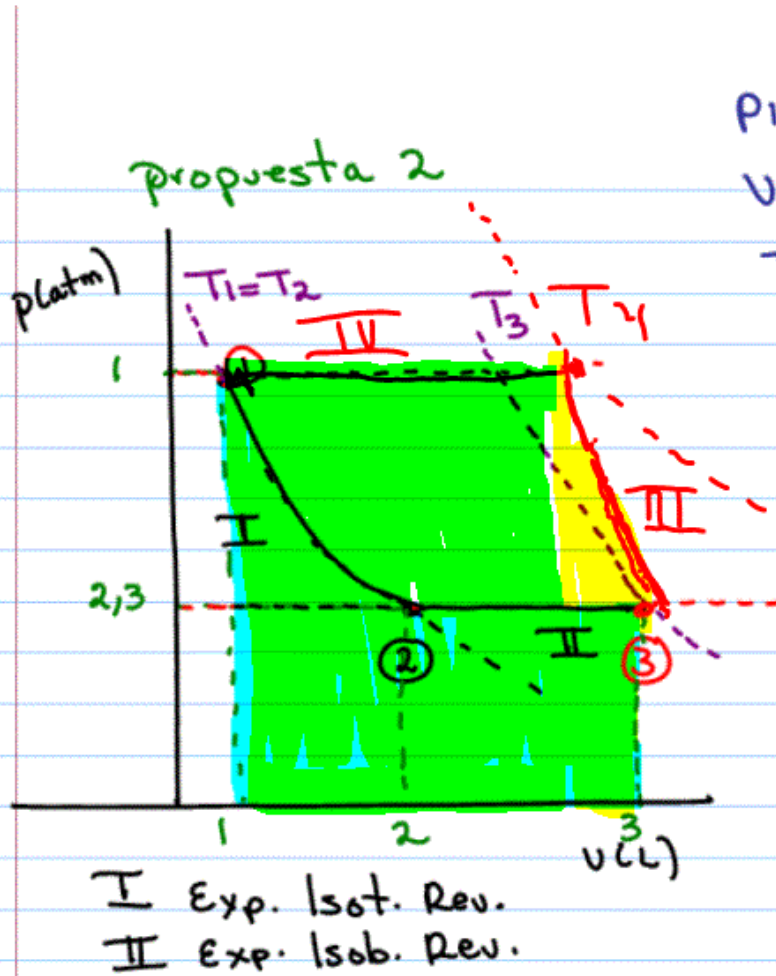
$$p_1 > p_2 = p_3$$

$$v_1 < v_2 < v_3$$

$$T_1 = T_2 < T_3$$

$$\begin{aligned} W_{\text{sec}} &= W_{\text{I}} + W_{\text{II}} \\ &= \oplus + \oplus \\ &= \oplus \text{ Favorable} \end{aligned}$$

$$\begin{aligned} \Delta S_{\text{sec}} &= \Delta S_{\text{I}} + \Delta S_{\text{II}} \\ &= \oplus + \oplus \\ &= \oplus \text{ Favorable} \end{aligned}$$



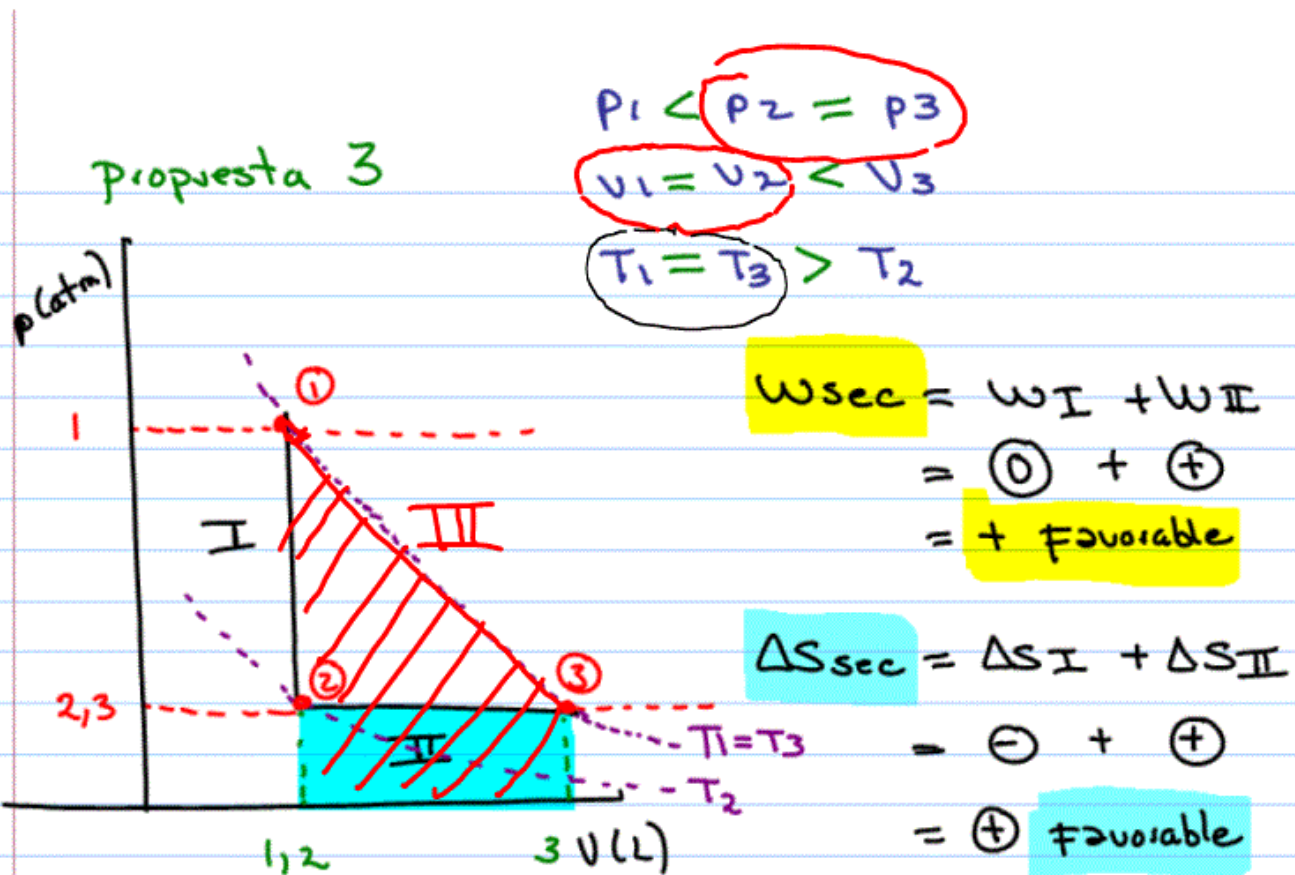
$$p_1 > p_2 = p_3$$

$$v_1 < v_2 < v_3$$

$$T_1 = T_2 < T_3$$

$$\begin{aligned}
 W_{\text{sec}} &= W_{\text{I}} + W_{\text{II}} \\
 &= \oplus + \oplus \\
 &= \oplus \text{ Favorable}
 \end{aligned}$$

$$\begin{aligned}
 \Delta S_{\text{sec}} &= \Delta S_{\text{I}} + \Delta S_{\text{II}} \\
 &= \oplus + \oplus \\
 &= \oplus \text{ Favorable}
 \end{aligned}$$

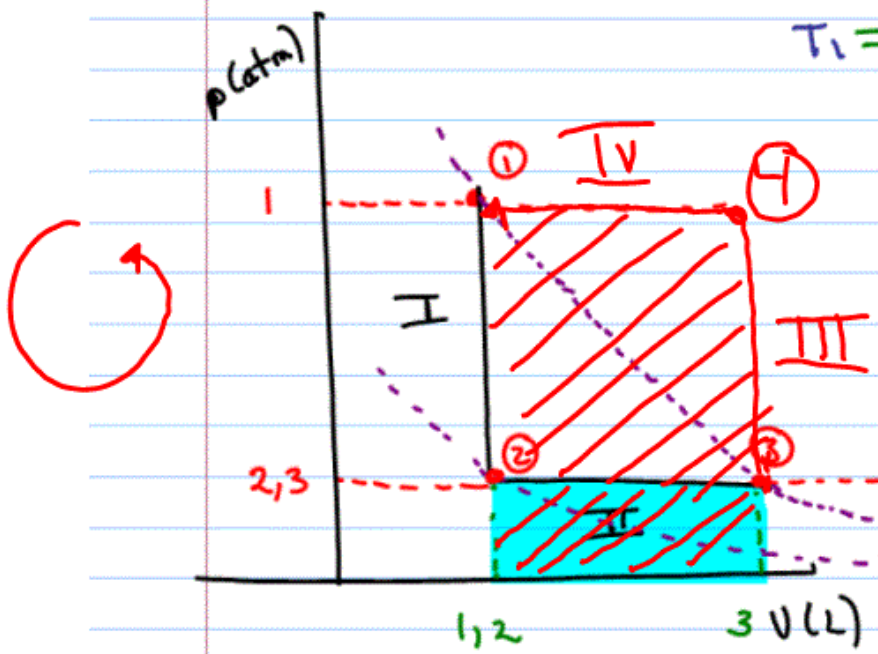


propuesta 3

$$P_1 < P_2 = P_3$$

$$V_1 = V_2 < V_3$$

$$T_1 = T_3 > T_2$$



$$W_{sec} = W_I + W_{II}$$

$$= \ominus + \oplus$$

$$= + \text{ favorable}$$

$$\Delta S_{sec} = \Delta S_I + \Delta S_{II}$$

$$= \ominus + \oplus$$

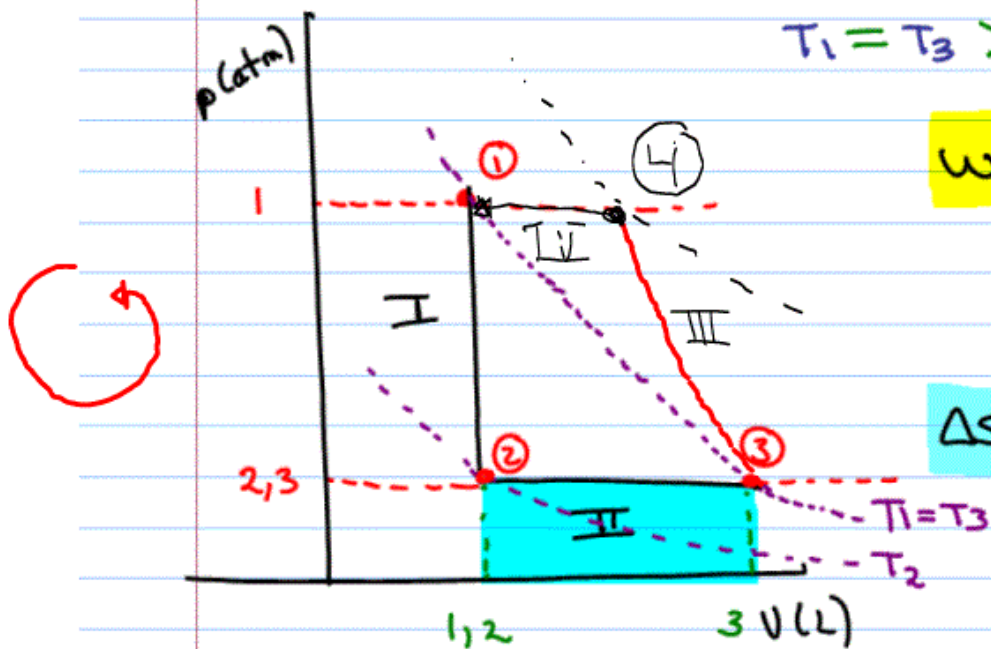
$$= \oplus \text{ favorable}$$

propuesta 3

$$P_1 < P_2 = P_3$$

$$V_1 = V_2 < V_3$$

$$T_1 = T_3 > T_2$$



$$W_{sec} = W_I + W_{II}$$

$$= \ominus + \oplus$$

$$= + \text{ favorable}$$

$$\Delta S_{sec} = \Delta S_I + \Delta S_{II}$$

$$= \ominus + \oplus$$

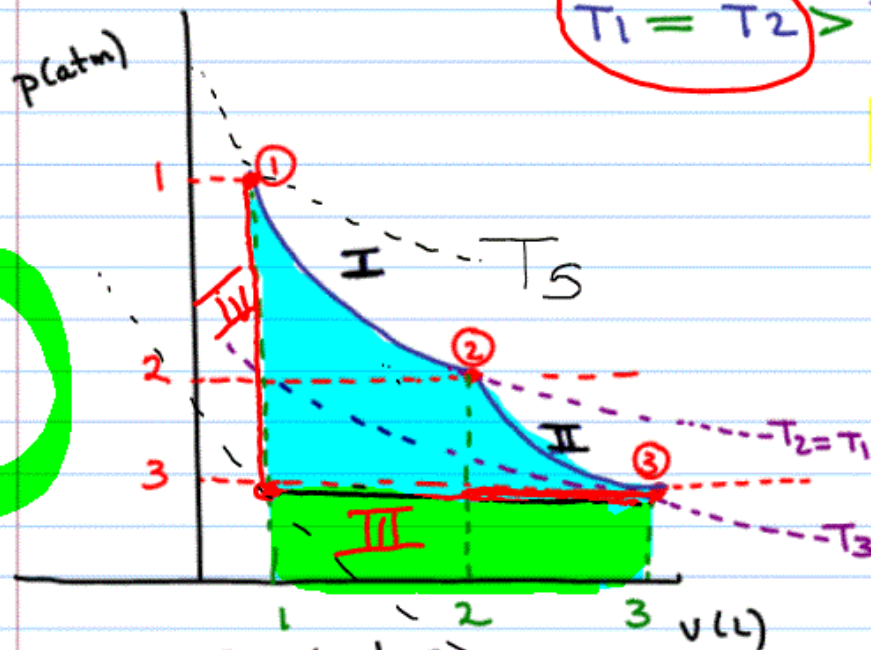
$$= \oplus \text{ favorable}$$

Propuesta 4

$$p_1 > p_2 > p_3$$

$$V_1 < V_2 < V_3$$

$$T_1 = T_2 > T_3$$



$$\begin{aligned} W_{\text{sec}} &= W_{\text{I}} + W_{\text{II}} \\ &= \oplus + \oplus \\ &= + \text{Favorable} \end{aligned}$$

$$\begin{aligned} \Delta S_{\text{sec}} &= \Delta S_{\text{I}} + \Delta S_{\text{II}} \\ &= \oplus + \ominus \\ &= \oplus \text{ Favorable} \end{aligned}$$

I Exp. Isot. Rev.

II Exp. Adiab. Rev.

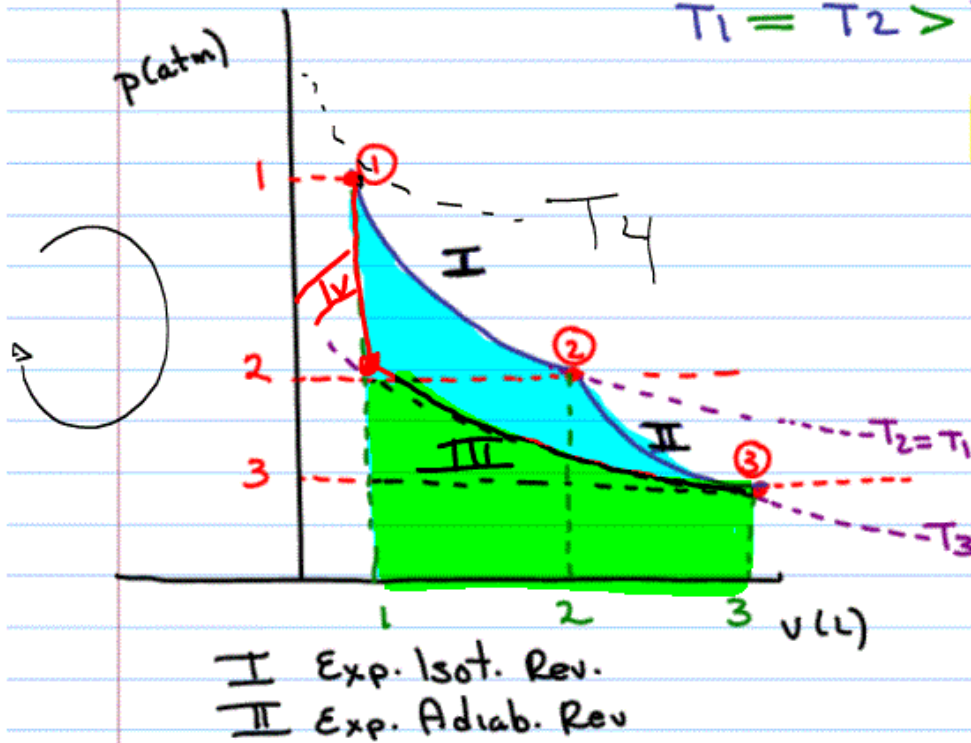
T₄

Propuesta 4

$$p_1 > p_2 > p_3$$

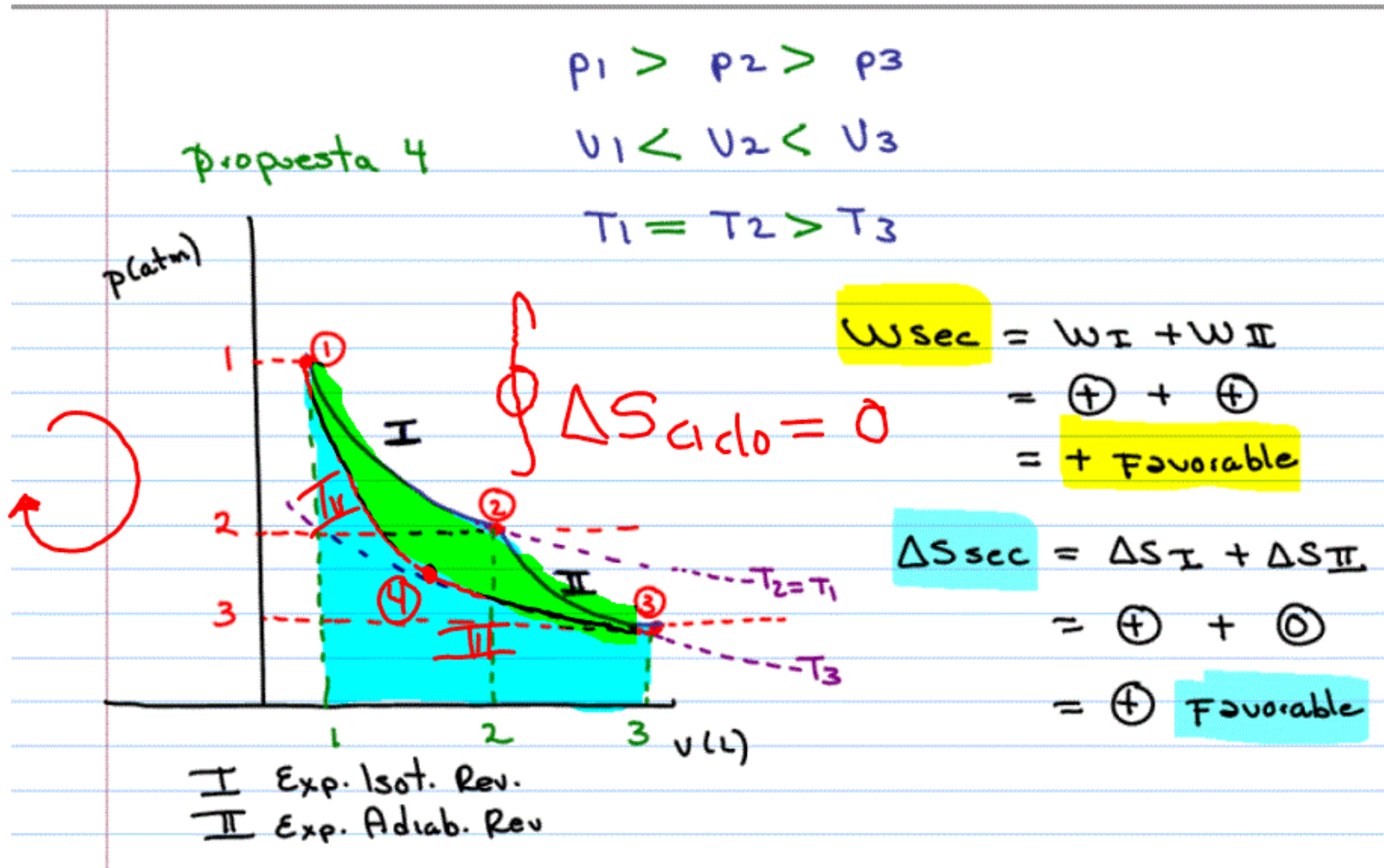
$$V_1 < V_2 < V_3$$

$$T_1 = T_2 > T_3$$



$$\begin{aligned}
 W_{\text{sec}} &= W_{\text{I}} + W_{\text{II}} \\
 &= \oplus + \oplus \\
 &= + \text{Favorable}
 \end{aligned}$$

$$\begin{aligned}
 \Delta S_{\text{sec}} &= \Delta S_{\text{I}} + \Delta S_{\text{II}} \\
 &= \oplus + \ominus \\
 &= \oplus \text{ Favorable}
 \end{aligned}$$



Ciclos Termodinámicos $\left\{ \begin{array}{l} \Delta H_{\text{ciclo}} = 0 \\ \Delta U_{\text{ciclo}} = 0 \end{array} \right. \quad q_{\text{ciclo}} = w_{\text{ciclo}}$

$$\oint ds = 0$$

solo si todos
los procesos
son reversibles

Los ciclos más favorecidos
son aquellos con
isotermas puros ✓

el ciclo de Carnot se compone de :

I Exp. Isot. Rev.

II Exp. Adiab. Rev. predecir las variables de estado

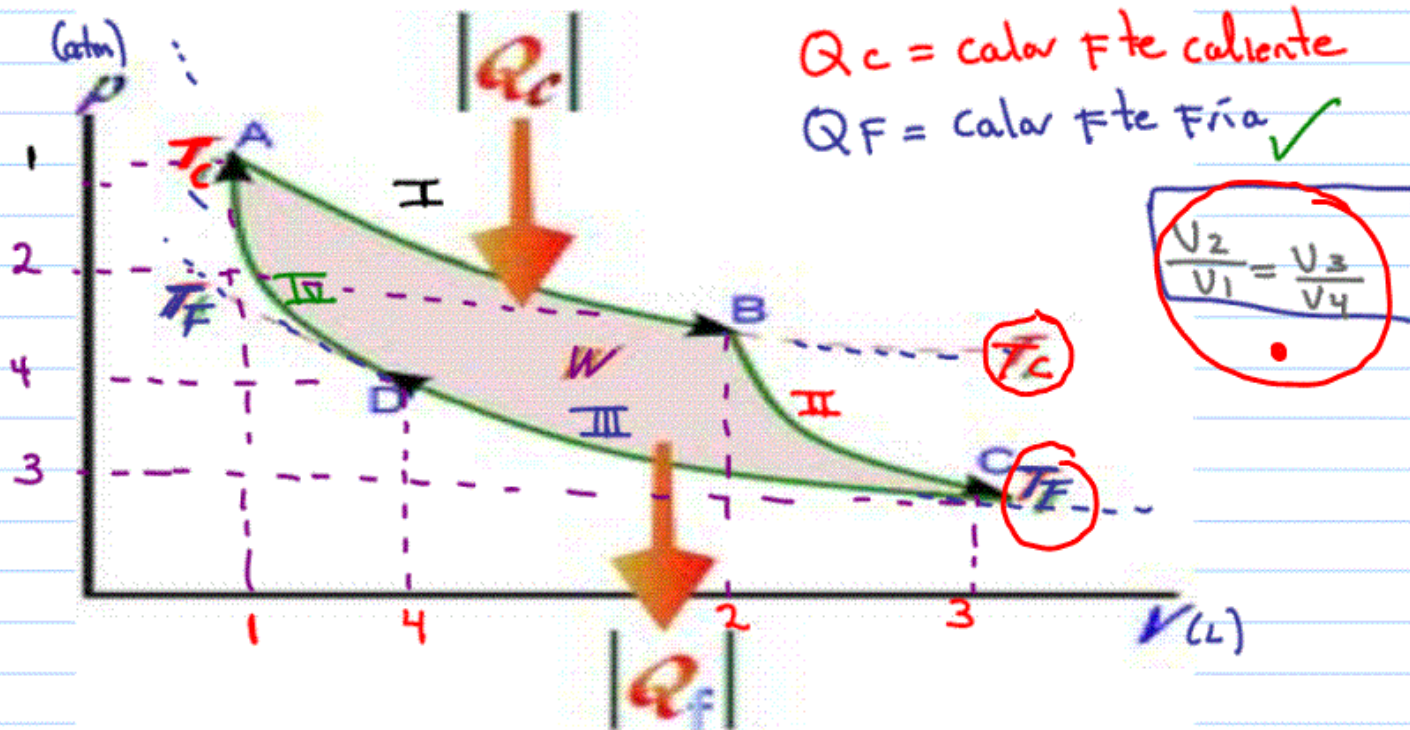
III Comp. Isot. Rev.

IV Comp. Adiab. Rev.

Título de la nota

Ciclo de Carnot

10/09/2015



Cálculo de Funciones termodinámicas

	q	W	ΔU	ΔH	ΔS
I	$nRT_c \ln \frac{V_2}{V_1}$ q caliente	q caliente	0	0	$nR \ln \frac{V_2}{V_1}$
II	0	$\frac{nR(T_F - T_c)}{1-\gamma}$ - ΔU	$n \int_{T_F}^{T_c} \bar{C}_V dT$	$n \int_{T_F}^{T_c} \bar{C}_P dT$	0
III	$nRT_F \ln \frac{V_4}{V_3}$ q fría	q fría	0	0	$nR \ln \frac{V_4}{V_3}$
IV	0	$\frac{nR(T_c - T_F)}{1-\gamma}$ - ΔU	$n \int_{T_c}^{T_F} \bar{C}_V dT$	$n \int_{T_c}^{T_F} \bar{C}_P dT$	0
Total	q ciclo =	w ciclo	0	0	0