

Clase 36 20 octubre 2021

Título de la nota

20/10/2021

Exp. Adiab. R.

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

$$T_1 \rightarrow T_2 \quad T_1 > T_2$$

$$V_1 \rightarrow V_2 \quad V_2 > V_1$$

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

$$\Delta S = 0 \quad q = 0$$

$$\Delta U = n C_V \Delta T \quad \Delta H = n C_P \Delta T$$

$$\Delta U = -W$$

$$\Delta H = - \text{enfriamiento}$$

$$\Delta U = -$$

$$W = + \text{expansión}$$

$$\Delta U = -W$$

Comp. Adiab. R.

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

$$T_1 \rightarrow T_2 \quad T_2 > T_1$$

$$V_1 \rightarrow V_2 \quad V_2 < V_1$$

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

$$\Delta H = + \quad \Delta U = +$$

$$\Delta S = 0 \quad q = 0$$

$$W = -$$

$$\Delta U = q - w$$

$$du = \delta q - \delta w$$

$$\delta q = du - \delta w$$

$$\frac{\delta q}{T} = \frac{n C_v dT - p dv}{T}$$

$$ds = n C_v \frac{dT}{T} - \frac{p}{T} dv$$

$$\frac{P}{T} = \frac{nR}{V}$$

$$PV = nRT$$

$$\frac{P}{T} = \frac{nR}{V}$$

$$\int_1^2 ds = nC_v \int_{T_1}^{T_2} \frac{dT}{T} - nR \int_{V_1}^{V_2} \frac{dV}{V}$$

$$\Delta S = nC_v \ln \frac{T_2}{T_1} - nR \ln \frac{V_2}{V_1}$$

W R Adiab.

$$pV^\gamma = \text{cte}$$

$$W = p \, dv \quad p = \frac{\text{cte}}{V^\gamma}$$

$$W = \text{cte} \int_{V_1}^{V_2} \frac{dv}{V^\gamma}$$

$$W = \text{cte} \int_{V_1}^{V_2} V^{-\gamma} \, dv$$

$$W = cte \quad \frac{V^{-\gamma+1}}{-\gamma+1} \quad \Big|_{V_1}^{V_2}$$

$$W = \frac{p V^\gamma V^{-\gamma+1}}{1-\gamma} \quad \Big|_{V_1}^{V_2}$$

$$W = \frac{p V}{1-\gamma} \Big|_{V_1}^{V_2} = \frac{p_2 V_2 - p_1 V_1}{\gamma-1}$$

$$\Delta \phi V = nR \Delta T$$

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

$$W_R = \frac{nR(T_2 - T_1)}{1-\gamma}$$

$$= \frac{\cancel{\text{mol J}}}{\cancel{\text{mol K}}} (\cancel{K}) = J$$

I deal. $\overline{C_p} = a + bT + cT^2$

$$\overline{C_v} = (a - R) + bT + cT^2$$

$$\Delta S = n \int_{T_1}^{T_2} \left[\frac{(a - R) + bT + cT^2}{T} \right] dT - nR \ln \frac{V_2}{V_1}$$

Adiabático IR

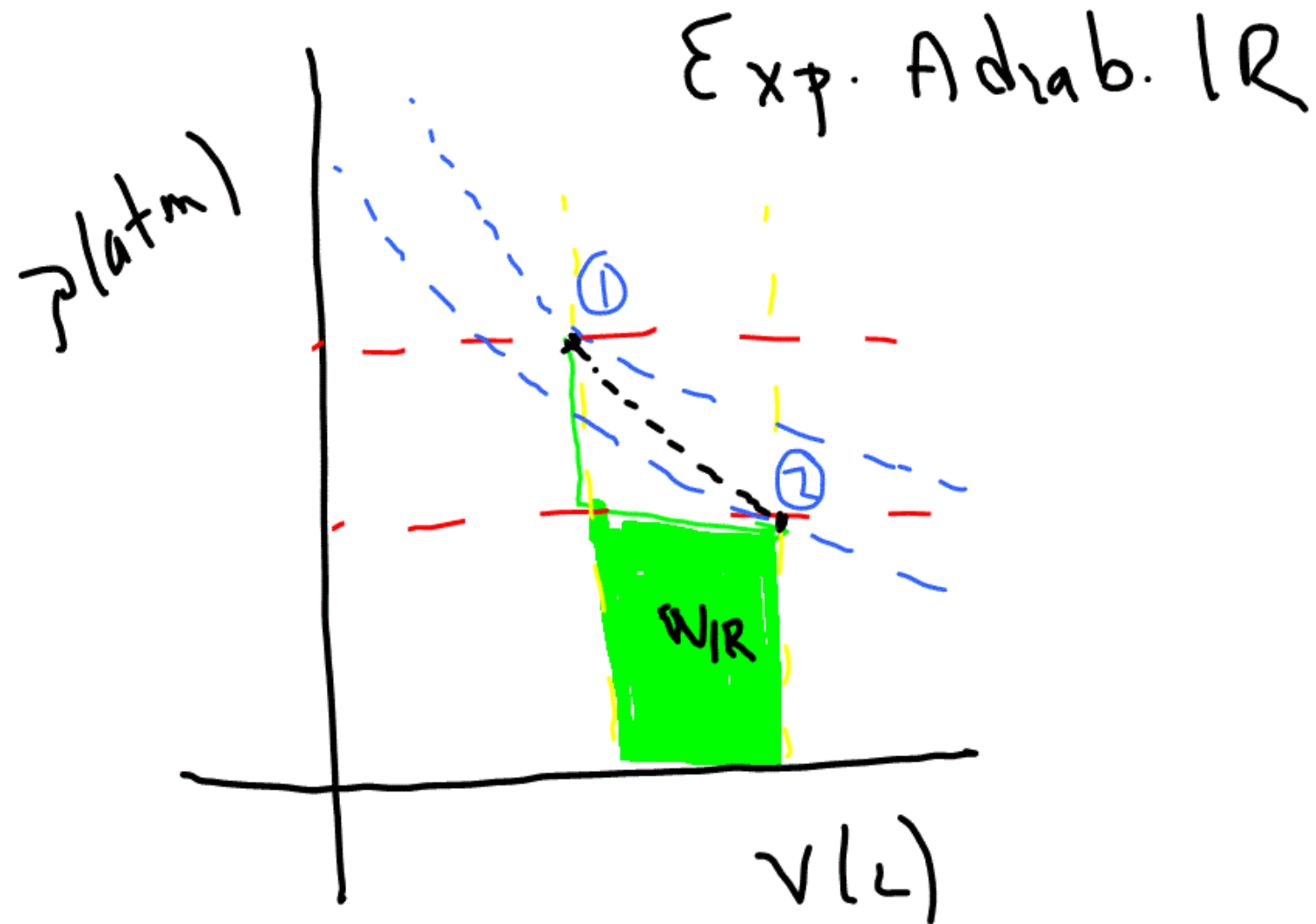
$$\Delta U = q - w$$

$$q = 0$$

$$\Delta U = -w$$

$$dU = -\delta w$$

$$nC_V dT = -p_2 dV$$



$$n \bar{C}_V dT = -p_2 dv$$

$$n \bar{C}_V (T_2 - T_1) = -p_2 (v_2 - v_1)$$

$$\cancel{n} \bar{C}_V (T_2 - T_1) = -p_2 \left[\frac{\cancel{n_2} R T_2}{p_2} - \frac{\cancel{n_1} R T_1}{p_1} \right]$$

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

$$\cancel{n} \bar{C}_V (T_2 - T_1) = - \left[T_2 + \frac{T_1 P_2}{P_1} \right] R$$

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

$$\cancel{n} \bar{C}_V (T_2 - T_1) = R \left[\frac{T_1 P_2}{P_1} - T_2 \right]$$

$$\cancel{n} \bar{C}_V (T_2 - T_1) = \bar{C}_P - \bar{C}_V \left[\frac{T_1 P_2}{P_1} - T_2 \right]$$

$$(T_2 - T_1) = \frac{\bar{C}_p - \bar{C}_v}{\bar{C}_v} \left[\frac{p_2 T_1}{p_1} - T_2 \right]$$

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

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

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

$$\cancel{T_2} + T_2 \gamma - \cancel{T_2} = T_1 \left[(\gamma - 1) \frac{P_2}{P_1} + 1 \right]$$

$$T_2 \gamma = T_1 \left[(\gamma - 1) \frac{P_2}{P_1} + 1 \right]$$

$$T_2 = \frac{T_1}{\gamma} \left[(\gamma - 1) \frac{P_2}{P_1} + 1 \right]$$

$$T_2 = \frac{T_1}{X} \left[(X-1) \frac{P_2}{P_1} + 1 \right]$$

$$X = 1 \quad \text{Isot.}$$

$$T_2 = \frac{T_1}{1} \left[(1-1) \frac{P_2}{P_1} + 1 \right]$$

$$T_2 = T_1$$

IR

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

R

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

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

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

$$\frac{p_2 v_2 / nR}{p_1 v_1 / nR} = \frac{1}{\gamma} \left[(\gamma - 1) \frac{p_2}{p_1} + 1 \right]$$

$$P_2 V_2 = \frac{P_1 V_1}{\gamma} \left[(\gamma - 1) \frac{P_2}{P_1} + 1 \right]$$

$$P_2 V_2 = \left[\frac{\cancel{P_1} V_1}{\gamma} (\gamma - 1) \frac{P_2}{\cancel{P_1}} + \frac{P_1 V_1}{\gamma} \right]$$

$$P_2 V_2 = \left[\frac{V_1}{\gamma} (\gamma - 1) P_2 + \frac{P_1 V_1}{\gamma} \right]$$

$$\frac{p_2 v_2}{p_2} = \frac{v_1}{\gamma} \left[\frac{(\gamma-1)p_2}{p_2} + \frac{p_1}{p_2} \right]$$

$$v_2 = \frac{v_1}{\gamma} \left[(\gamma-1) + \frac{p_1}{p_2} \right] \quad R$$

$$v_2 \gamma = \frac{p_1 v_1 \gamma}{p_2} \quad R$$

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

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

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

$$p_2 \left[v_2 - \frac{v_1}{\gamma} (\gamma - 1) \right] = \frac{v_1 p_1}{\gamma}$$

$$p_2 = \frac{v_1 p_1 / \gamma}{\left[v_2 - \frac{v_1}{\gamma} (\gamma - 1) \right]}$$

IR

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)	5.000	→	γ	1.6667
V_1 (L)	40.000	→	V_2 (L)	49.923
T_1 (K)	2439.000	→	T_2 (K)	2104.000
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando T_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	5.000	→	γ	1.6667
V_1 (L)	40.000	→	V_2 (L)	49.923
T_1 (K)	2439.024	→	T_2 (K)	2104.038
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando p_1		proceso	Calculando p_2 adiabática	
p_1 (atm)	5.000	→	p_2 (atm)	3.45591
V_1 (L)	40.000	→	V_2 (L)	49.923
T_1 (K)	2439.000	→	γ	1.6667
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando n_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	5.000	→	p_2 (atm)	3.45590
V_1 (L)	40.000	→	γ	1.6667
T_1 (K)	2439.000	→	T_2 (K)	2104.006
n_1 (mol)	1.000	→	n_2 (mol)	1.000
R (atmL/molK)	0.0820		C_p (cal/molK)	4.9654
			C_v (cal/molK)	2.9792

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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)	5.000	→	γ	1.6667
V_1 (L)	40.000	→	V_2 (L)	49.9232
T_1 (K)	2439.000	→	T_2 (K)	2153.600
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando T_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	5.000	→	γ	1.6667
V_1 (L)	40.000	→	V_2 (L)	49.923
T_1 (K)	2439.024	→	T_2 (K)	2153.635
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando p_1		proceso	Calculando p_2 adiabática	
p_1 (atm)	5.000	→	p_2 (atm)	3.53737
V_1 (L)	40.000	→	V_2 (L)	49.923
T_1 (K)	2439.000	→	γ	1.6667
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando n_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	5.000	→	p_2 (atm)	3.53737
V_1 (L)	40.000	→	γ	1.6667
T_1 (K)	2439.000	→	T_2 (K)	2153.606
n_1 (mol)	1.000	→	n_2 (mol)	1.000
R (atmL/molK)	0.0820		C_p (cal/molK)	4.9654
			C_v (cal/molK)	2.9792

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$$\Delta U = -W$$

$$\Delta U = n\bar{C}_V (T_2 - T_1)$$

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

$$\Delta T_R > \Delta T_{IR}$$

$$W_R > W_{IR}$$

$$T_{ZR} < T_{ZIR}$$

$$P_{ZR} < P_{ZIR}$$

$$V_{ZR} = V_{ZIR}$$

PROCESOS ISOCÓRICOS, ISOBÁRICOS, ADIABÁTICOS e ISOTÉRMICOS EN GASES

Modelo perfecto e ideal Reversibles

Insertar en las celdas de color amarillo los valores correspondientes

Resultados en las celdas de color verde

Constantes de Cp como función de T (cal/molK)

Gas	a	b	c	d	e	m (g)	n (mol)	M (g/mol)
Argón	4.9654e+000					28.0000	1.0000	28.0000

T_1 (K)	T_2 (K)	p_1 (atm)	p_2 (atm)	R (cal/mol K)
2439.00	2104.00	5.0000	3.4500	1.9886
V_1 (L)	V_2 (L)			
40.00	49.92			

W:	4174.38	4174.38	J
Q:	0	0	J
N _x :	4174.38	4174.38	J
W:	-4174.38	-4174.38	J
H:	-6960.17	-6960.17	J
S:	0	0	JK



ΔH (cal)	-1663.4090
ΔU (cal)	-997.2280
ΔS p cte (cal/K)	-0.7336
q p cte (cal)	-1663.4090
w p cte (cal)	-666.1810
q isotérmico (cal)	1799.7314

C_p (cal/molK)	4.9654
C_v (cal/molK)	2.9768
ΔS V cte (cal/K)	-0.4398
q V cte (cal)	-997.2280
w V cte (cal)	0
w isotérmico (cal)	1074.5233

γ	1.6680
w adiabático (cal)	997.2280
ΔS isotérmico (cal/K)	0.7379
ΔS adiabático (cal/K)	0
q adiabático (cal)	0
Se cumple la segunda ley de la Termodinámica	

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PROCESOS ISOCÓRICOS, ISOBÁRICOS, ADIABÁTICOS e ISOTÉRMICOS EN GASES

Modelo perfecto e ideal Irreversibles

Insertar en las celdas de color amarillo los valores correspondientes

Resultados en las celdas de color verde

Constantes de Cp como función de T (cal/molK)

Gas	a	b	c	d	e	m (g)	n (mol)	M (g/mol)
Argón	4.9654e+000					28.0000	1.0000	28.0000

T_1 (K)	T_2 (K)	p_1 (atm)	p_2 (atm)	R (cal/mol K)
2439.00	2153.60	5.4500	3.5370	1.9886
V_1 (L)	V_2 (L)			
40.00	49.92			



ΔH (cal)	-1417.1252
ΔU (cal)	-849.5787
ΔS p cte (cal/K)	-0.6179
q p cte (cal)	-1417.1252
w p cte (cal)	-567.5464
q isotérmico (cal)	849.3059

C_p (cal/molK)	4.9654
C_v (cal/molK)	2.9768
ΔS V cte (cal/K)	-0.3705
q V cte (cal)	-849.5787
w V cte (cal)	0
w isotérmico (cal)	849.3059

γ	1.6680
w adiabático (cal)	849.5787
ΔS isotérmico (cal/K)	0.3482
ΔS adiabático (cal/K)	0.07010
q adiabático (cal)	0
Se cumple la segunda ley de la Termodinámica	

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	Est.1	Est.2	
P	4.99987	3.45534	atm
v	40	49.923	ltr/mol
T	2437.29	2102.23	K
u	24133.4	19959	J/mol
h	44397.8	37437.7	J/mol
s	30.0261	30.0261	J/(mol·K)

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T_1 (K)	2439.000	→	γ	1.6667
n_1 (mol)	1.000	→	n_2 (mol)	1.000
Calculando n_1		proceso	Calculando T_2 adiabática	
p_1 (atm)	5.000	→	p_2 (atm)	3.45590
V_1 (L)	40.000	→	γ	1.6667
T_1 (K)	2439.000	→	T_2 (K)	2104.006
n_1 (mol)	1.000	→	n_2 (mol)	1.000
R (atmL/molK)	0.0820		C_p (cal/molK)	4.9654
			C_v (cal/molK)	2.9792



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