

## GUÍA 12 - PRIMER PRINCIPIO

3) RECIPIENTE → 8g DE HELIO

$$T_0 = 27^\circ\text{C} = 300\text{K}$$

EMBOLLO MOVIL → PRESIÓN CTE A 1 ATM

$$V_F = 2V_i$$

INICIALMENTE) GAS IDEAL (He) 1 MOL — 4,00 g

$$\times \text{ — } 8\text{g}$$

$$PV = nRT$$

$$1,04 \text{ moles}$$

$$1 \text{ ATM} \cdot V_i = 1,04 \cdot 0,082 \cdot 300\text{K}$$

$$V_i = 25,6 \text{ L}$$

$$V_F = 51,2 \text{ L}$$

FINAL)  $PV = nRT$

$$1 \text{ ATM} \cdot 51,2 \text{ m}^3 = 1,04 \text{ mol} \cdot 0,082 \cdot T$$

$$T_F = 600 \text{ K}$$

$$\Delta U = Q - W$$

COMO ES  $P = \text{cte}$

$$Q = nC_p (T_F - T_i)$$

$$W = P_F \cdot (V_F - V_i)$$

$$W = 1 \text{ ATM} (25,6 \text{ L})$$

$$W = 25,6 \text{ J}$$

$$Q = 1,04 \cdot \frac{5}{2} R (300\text{K})$$

$$Q = 64 \text{ J}$$

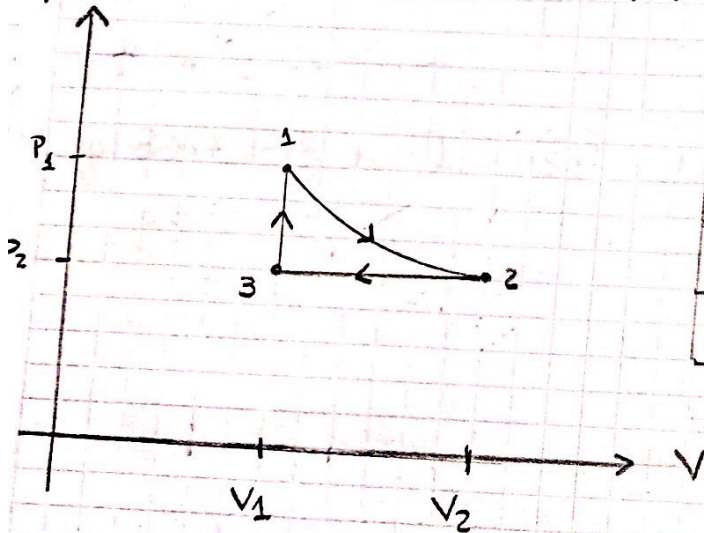
$$\Delta U = 38,4 \text{ J}$$

5

CICLO  
 ① GAS EXPANDIENDO VOL ( $V_1$  A  $2V_1$ )  
 CON  $T = CTE$   
 ② GAS SE ACHICA A  $P = CTE$  HASTA  $V_1$   
 ③  
 VUELVE A ① A  $V = CTE$

GRAFICO P-V

$PV = NRT$



	①	②	③
T	$T_1$	$T_1$	$\frac{1}{2} \frac{P_1 V_1}{NR}$
P	$\frac{NR T_1}{V_1}$	$\frac{1}{2} P_1$	$\frac{1}{2} P_1$
V	$V_1$	$2V_1$	$V_1$

TRAYECTO (1-2) → COMO ES CON  $T = CTE$  ISOTERMA

$\Delta U = 0 \rightarrow \Delta U = Q - W \quad (T_1 = T_2)$

$0 = Q - W$

$Q = W$

$W = \int_{SIST} P_{SIST} dV = \int \frac{NRT}{V} dV \rightarrow NRT \ln \left( \frac{V_2}{V_1} \right)$

(X SER REVERSIBLE)

COMO  $T = CTE$   
 $NRT = CTE$

$W = NRT \ln \left( \frac{2V_1}{V_1} \right)$

$W = NRT \ln(2) = Q$

(2)

TRAYECTO (2-3) → CON P = CTE ISOBADA

$$P_2 = P_3$$

$$PV = NRT$$

$$P_2 = \frac{NRT_1}{2V_1} \rightarrow P_2 = \frac{1}{2} P_1$$

$$PV = NRT \rightarrow T = \frac{PV}{NR} = \frac{0,5 P_1 V_1}{NR} = T_3$$

$$Q = N C_p (T_3 - T_2)$$

$$Q = C_p \left( \frac{0,5 P_1 V_1}{NR} - T_1 \right)$$

$$\Delta U = Q - W$$

$$W = \frac{1}{2} P_1 (V_1 - 2V_1)$$

$$W = -\frac{1}{2} P_1 V_1$$

TRAYECTO (3-1) → A V = CTE ISOCORA

$$W = 0$$

$$W_{\text{ciclo}} = W_{12} + W_{23} + W_{31}$$

$$W_{\text{ciclo}} = NRT_1 \ln(2) - \frac{1}{2} P_1 V_1$$

$$W_c = NRT_1 (\ln(2) - \frac{1}{2})$$

$$W_c = 0,016 T_1$$

6

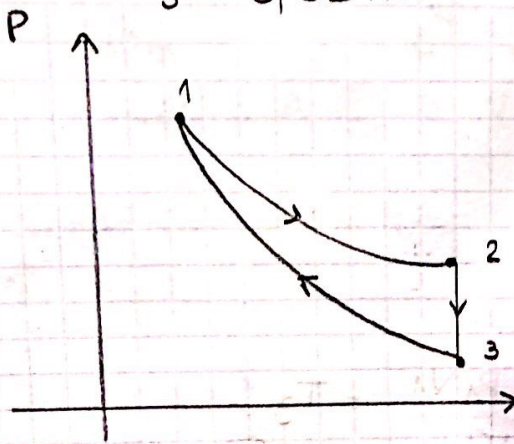
$$P_1 = 0,7 \text{ MPa}$$

$$V_1 = 1,5 \times 10^{-3} \text{ m}^3$$

$$V_3 = 0,01 \text{ m}^3$$

$$M_{N_2} = 11,95 \text{ g}$$

↓ DIÁTÓMICO



	①	②	③
P	0,7 MPa	0,1 MP	0,05
V	$1,5 \times 10^3$	0,01	0,01
T	305	305	143

TRAYECTO (1-2) → ISOTERMA (T = CTE)

$$T_1 = T_2$$

$$N \rightarrow 14 \text{ g}$$

$$N_2 \rightarrow 28 \text{ g}$$

ENTONCES

$$\text{si } 28 \text{ g } N_2 \text{ — } 1 \text{ MOL}$$

$$\text{— } X$$

$$11,95 \text{ g} \text{ — } X$$

$$N = 0,43 \text{ MOLES DE } N_2$$

$$PV = NRT$$

$$R = 8,314$$

(X R USO Pa)

$$700\,000 \cdot 1,5 \times 10^{-3} = 0,43 \cdot 8,314 \cdot T$$

$$T = 305 \text{ K}$$

COMO ES ISOTERMA  $\Delta U = 0$

ENTONCES  $Q = W$

$$W = \int P dV = NRT \ln\left(\frac{V_2}{V_1}\right) = 2020,5 \text{ J}$$

$$Q = 2020,5 \text{ J}$$

$$\Delta U = 0$$

3

TRAYECTO (2-3) → ISOCORA  $V = \text{cte}$

$$V_2 = V_3$$

$$V_2 = 0,01 \text{ m}^3$$

$$PV = nRT \rightarrow P_2 \cdot 0,01 = 0,42 \cdot 8,314 \cdot 305$$

$$P_2 = 106502,3 \text{ Pa} =$$

$$P_2 = 0,1 \text{ MPa}$$

COMO ES ISOCORA →  $W = 0$

$$\text{ENTONCES } \Delta U = Q$$

$$\text{CALCULO } \Delta U = n C_v (T_3 - T_2)$$

$$C_v \rightarrow \text{CON } V = \text{cte} \rightarrow \text{DIATOMICO } C_v = \frac{5}{2} R$$

$$\Delta U = 0,42 \cdot \frac{5}{2} \cdot 8,314 \cdot (143 - 305)$$

$$\Delta U = -1414,2 \text{ J}$$

$$Q = -1414,2 \text{ J}$$

$$W = 0 \text{ J}$$

TRAYECTO (3-1) ADIABATICA

QUE SEA ADIABATICA

$$PV^n = \text{cte}$$

$$P_1 V_1^n = P_3 V_3^n$$

$$n = \frac{C_p}{C_v} = \frac{7}{5} \text{ ATOMO DIATOMICO}$$

$$P_3 = 0,05 \text{ MPa}$$

$$PV = nRT$$

$$50000 \cdot 0,01 = 0,42 \cdot 8,314 \cdot T_3$$

$$T_3 = 143 \text{ K}$$

COMO ES ADIABATICA (  $Q=0$  )

$$\Delta U = -W$$

$$\Delta U = N C_V (T_1 - T_3)$$

$$\Delta U = 0,42 \cdot (305 - 143)$$

$$\Delta U = 1416 \text{ J} \rightarrow W = -1416 \text{ J}$$

⑦

N MOLES, MONOATOMICO,  $V_A$  A  $2V_A$  CON  $T_A$

A - CON  $P = \text{CTE}$

$$PV = NRT$$

$$Q = N C_P \left( \frac{P_F 2V_A}{NR} - T_A \right)$$

$$W = \frac{NR T_A}{V_A} (2V_A - V_A)$$

$$\Delta U = N C_V \left( \frac{P_F 2V_A}{NR} - T_A \right)$$

INICIALMENTE

$$P_i = \frac{NR T_A}{V_A}$$

$$V_i = V_A$$

$$T_i = T_A$$

FINAL

$$P_F = \frac{NR T_A}{V_A}$$

$$V_F = 2V_A$$

$$T_F = \frac{P_F \cdot 2V_A}{NR}$$

8

UN MOL DE HELIO i)  $0^{\circ}\text{C} = 273\text{ K}$

$0,1\text{ MPA}$

SE COMPRIME ADIABATICAMENTE HASTA  $0,51\text{ MPA}$

EL VOL SE ACHICA

$$PV = NRT$$

$$0,1 \times 10^6 \text{ Pa} \cdot V_1 = 1 \cdot 8,314 \cdot 273 \text{ K}$$

$$V_1 = 0,022$$

COMPRI ME ADIABATICAMENTE  $\rightarrow PV^{\gamma} = \text{CTE}$

$$P_1 V_1^{\gamma} = P_2 V_2^{\gamma}$$

$$0,1 \times 10^6 \text{ Pa} \cdot (0,022)^{\gamma} = 0,51 \times 10^6 \cdot V_2^{\gamma}$$

$$V_2^{\gamma} = 9,4 \times 10^{-4}$$

$$\gamma \rightarrow \frac{C_p}{C_v} = 7/5$$

$$V_2 = 6,8 \times 10^{-3} = 0,0068$$

$$PV = NRT$$

$$0,51 \times 10^6 \cdot 0,0068 = 1 \cdot 8,314 \cdot T$$

$$T_F = 417 \text{ K}$$

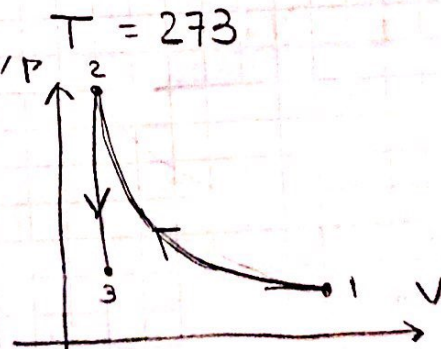
VOLUMEN CTE  $\rightarrow$  SE ENFRIA ( $V_2 = V_3$ )

$$V = 0,0068 \quad T = 273$$

$$PV = NRT$$

$$P \cdot 0,0068 = 8,314 \cdot 273$$

$$P = 0,33 \text{ MPA}$$

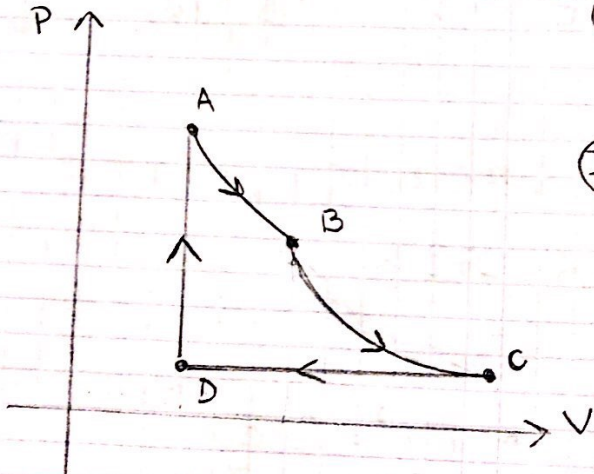


# GUIA 12 - EJ (11)

11 1 MOL DE GAS IDEAL MONOATÓMICO

$$(C_v = \frac{3}{2}R, \gamma = \frac{5}{3})$$

CICLO CERRADO



(I) AB - ISOTERMICA (T=cte)

$$V_B = 2V_A = 4 \times 10^{-3} \text{ m}^3$$

(II) BC - EXPANSIÓN ADIABÁTICA

$$T_c = T_B/2$$

(III) CD - ISOBARICA (P=cte)

$$V_D = V_A$$

(IV) DA - V=cte ISOCORICA

$$P_A = 1,64 \text{ MPA}$$

	A	B	C	D
P (MPa)	1,64	0,82	0,15	0,15
V (m <sup>3</sup> )	2 × 10 <sup>-3</sup>	4 × 10 <sup>-3</sup>	0,011	2 × 10 <sup>-3</sup>
T (K)	394	394	197	36

	AB	BC	CD	DA
ΔU (J)	0			
Q (J)		0		
W (J)				0



TRAYECTO AB - ISOTERMICA

$$\bullet T_A = T_B$$

$$P V = N R T \rightarrow 1,64 \times 10^6 \cdot 2 \times 10^{-3} = 1.8,314 \cdot T$$

$$T_A = 394 \text{ K}$$

$$T_B = 394 \text{ K}$$

$$P V = N R T \rightarrow P_B \cdot 4 \times 10^{-3} = 1.8,314 \cdot 394$$

$$P_B = 0,82 \text{ MPa}$$

TRAYECTO BC - ADIABATICA

$$\bullet T_C = \frac{T_B}{2}$$

$$T_C = 197 \text{ K}$$

$$P V = N R T$$

$$P_C \cdot 0,011 = 8,314 \cdot 197$$

$$P_C = 0,15 \text{ MPa}$$

$$P V^\gamma = \text{CTE}$$

$$P_B V_B^\gamma = P_C V_C^\gamma$$

PERO TMB

$$T_B V_B^{\gamma-1} = T_C V_C^{\gamma-1}$$

$$394 \cdot (4 \times 10^{-3})^{\frac{5}{3}-1} = 197 \cdot V_C^{\frac{5}{3}-1}$$

$$9,93 = 197 V_C^{2/3}$$

$$V_C = 0,05$$

$$V_C = 0,011 \text{ m}^3$$

PUEDO USAR  
ESTA FORMULA?

o COMO  
HAGO

TRAYECTO CD

$$\bullet V_D = V_A$$

$$\bullet P_C = P_D$$

$$P V = N R T$$

$$0,15 \times 10^6 \cdot 2 \times 10^{-3} = 8,314 \cdot T$$

$$T = 36 \text{ K}$$