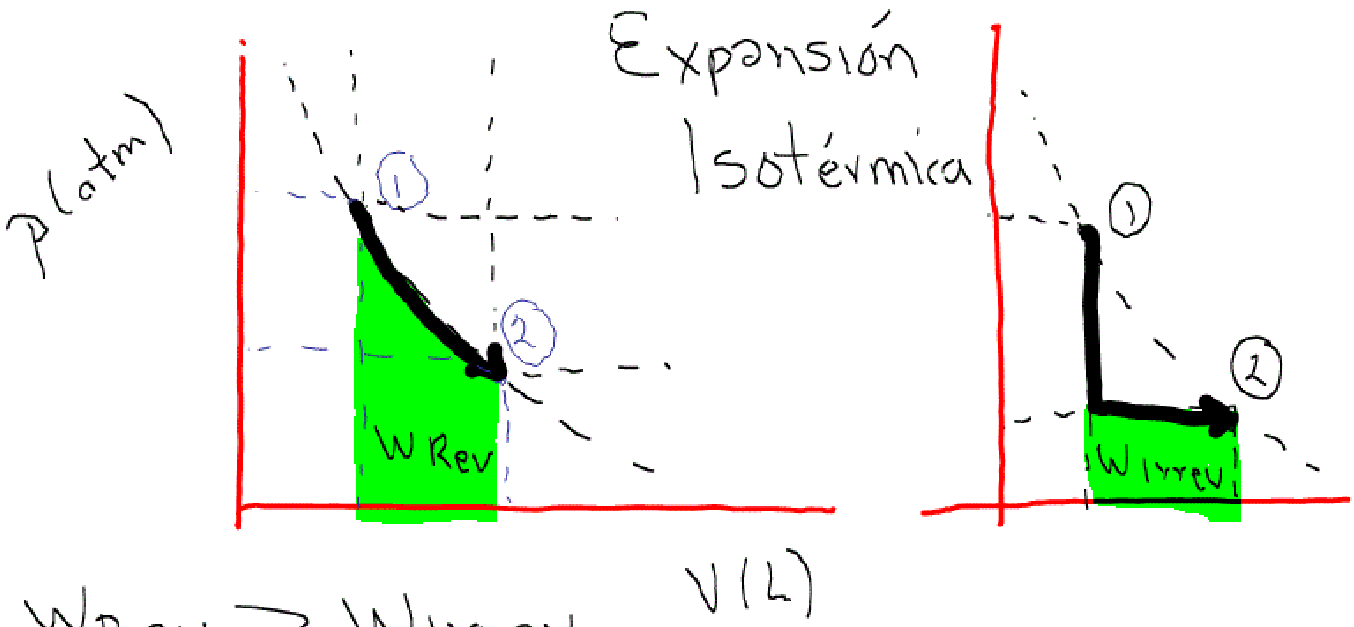
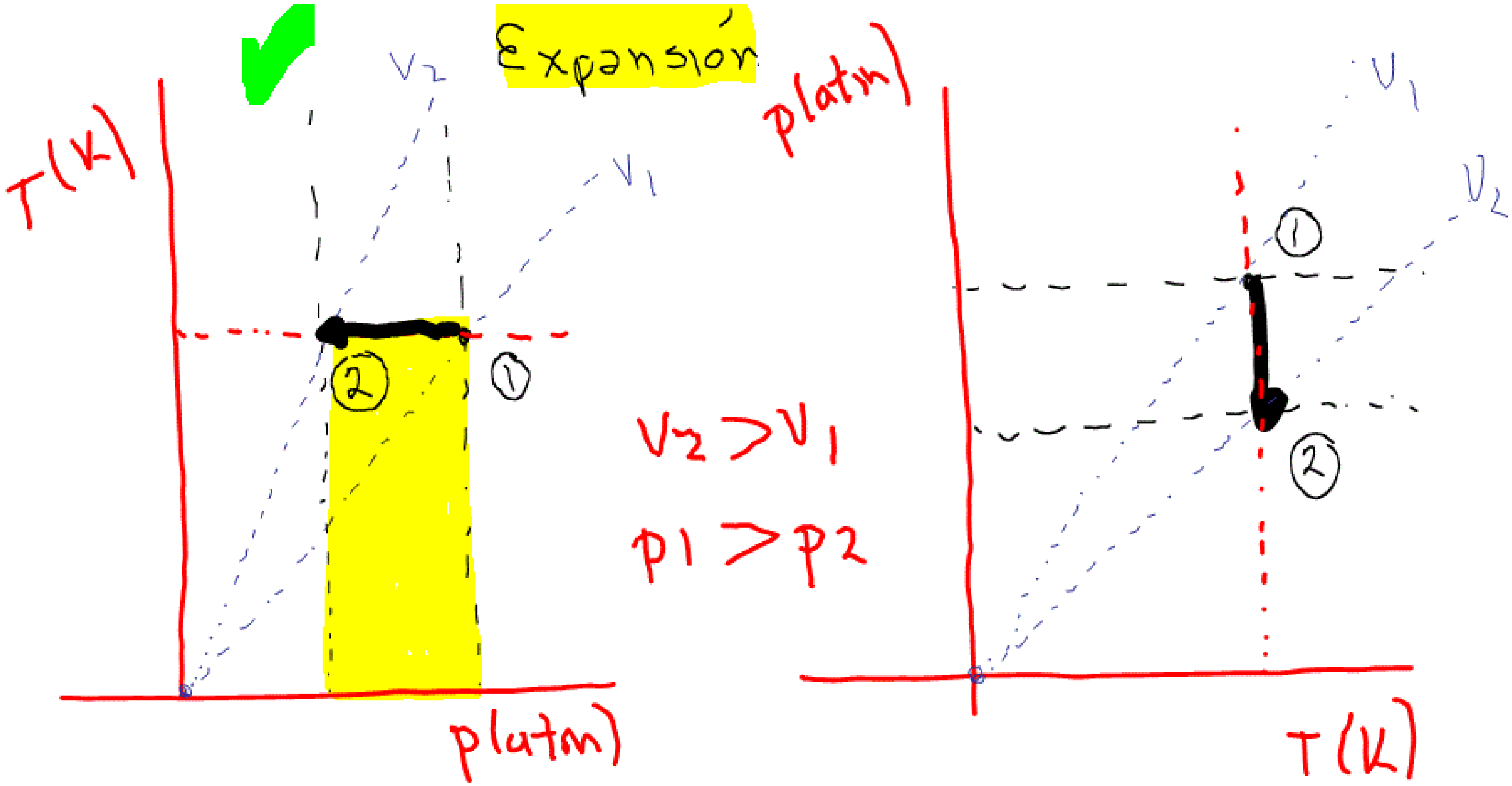
Clase 12 6 octubre 2020

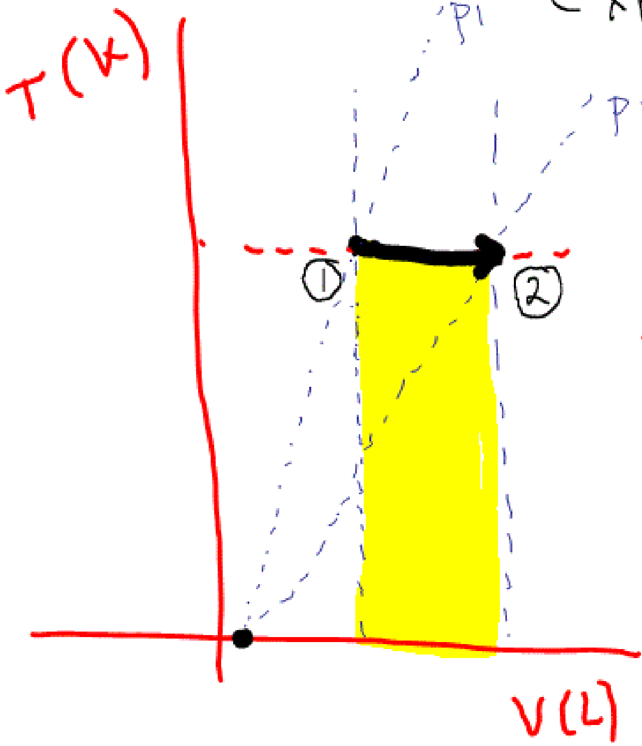
Título de la nota 06/10/2020



$W_{Rev} > W_{irrev}$

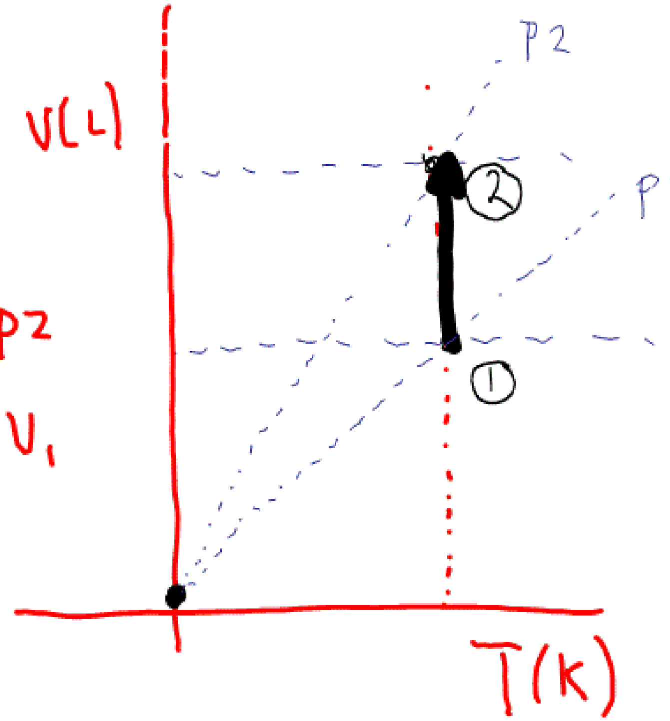

Expansión
T(K)
p(atm)
V2
V1
2
1
V2 > V1
p1 > p2
p(atm)
T(K)
V1
V2
1
2

Expansión



$P_1 > P_2$

$V_2 > V_1$



sistemas cerrados, estáticos

$$\Delta U = q - w$$

Isotérmico

$$\Delta U = 0$$

q { + endo ; − exo }

w { + exp. ; − comp. }

$$\Delta U = n\bar{C}_v \Delta T \qquad \Delta T = 0$$

$$\Delta U = 0 \qquad q = w$$

$$\Delta U = q - w = 0$$

Entalpía (ΔH)

$$\Delta H = \Delta U + \Delta pV$$

$$\Delta pV = \Delta nRT$$

$$\Delta H = \Delta U + \Delta nRT$$

$$dH = dU + nRdT$$

$$dH = n\bar{C}_v dT + nRdT$$

$$dH = n\,dT(\bar{C}_v + R)$$

$$dH = n\bar{C}_p dT$$

$$\bar{C}_v = \frac{J}{mol\,K}$$

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

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

Teorema Mayer

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

$\bar{C}_v$ y $\bar{C}_p$ son intensivas

Isotérmico $\Delta T = 0$

$\Delta H = 0$

$\Delta U = 0$

$q_{Rev} = W_{Rev}$

$q_{Irrev} = W_{irrev}$

Rev

$$W_{Rev} = nRT \ln \frac{V_2}{V_1}$$

$$= nRT \ln \frac{P_1}{P_2}$$

$$\Delta S_{Rev} = nR \ln \frac{V_2}{V_1}$$

$$= nR \ln \frac{P_1}{P_2}$$

Irrev

$$W_{Irrev} = P_2 (V_2 - V_1)$$

$$\Delta S_{Irrev} = \frac{q_{Irre}}{T}$$

ΔS

entropía

ΔS
- Función estado
- Ley 2 Termodinámica
- Desigualdad de Clausius
  - $dS \geq 0$
    - $dS > 0$ Irrev
    - $dS = 0$ Rev

    (Sist aislado)
  - $dS \geq \frac{dq}{T}$
- $\Delta S_U = \Delta S_{sis} + \Delta S_{Alr}$

$\Delta S_U > 0$ Irreversible

procesos naturales

$$W_{Rev} = nRT \ln \frac{V2}{V1}$$

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

$$\frac{q_{Rev}}{T} = \frac{nRT \ln \frac{V2}{V1}}{T}$$

$$\Delta S_{Rev} = nR \ln \frac{V2}{V1}$$

$$= nR \ln \frac{P1}{P2}$$

$$\Delta S = \frac{q_{Rev}}{T}$$

$$q_{Rev} = W_{rev}.$$

$$\Delta S_{Rev} = mol \frac{J}{mol K}$$

$$= \frac{J}{K} \quad \text{UES}$$

$$\Delta S_{Irrev} = \frac{q_{Irrev}}{T}$$

$$\text{UES} = \frac{J}{K}$$

Calcular las Funciones de estado y trayectoria cuando 1 mol O_2 se expande Isotérmicamente a 298.15 K al doble de su volumen inicial cuando la presión es de 1 atm.

Agregar las gráficas básicas y discutir resultados. (de Forma Rev y de Forma Irrev). sist cerrado.

$p_1 \longrightarrow p_2 \downarrow \qquad p_2 < p_1$

$V_1 \longrightarrow V_2 \uparrow \qquad V_2 > V_1$

$T_1 \rightarrow T_2 \quad = cte$

$n_1 \rightarrow n_2 \quad = cte$

Cálculos

$$V_1 = \frac{nRT_1}{P_1} = \frac{(1\,mol)\left(0.082\,\frac{atm\,L}{mol\,K}\right)(298.15\,K)}{1\,atm}$$

$$= 24.44\ L$$

$$V_2 = 2V_1 = 48.88\ L$$

$$T_1 = \frac{P_1V_1}{n_1R} \qquad T_1 = T_2 \qquad T_2 = \frac{P_2V_2}{n_2R}$$

$$\frac{p_1 V_1}{n_1 R} = \frac{p_2 V_2}{n_2 R} \qquad n_1 = n_2$$

$$p_1 V_1 = p_2 V_2 \qquad \therefore V_2 = \frac{p_1 V_1}{p_2}$$

$$p_2 = \frac{p_1 V_1}{V_2}$$

$$p_2 = \frac{(1\ atm)(24.44\ L)}{(48.88\ L)} = 0.5\ atm$$

I

	p (atm)	V (L)	T (K)
1	1	24.44	298.15
2	0.5	48.38	298.15

isotérmico

predicciones Reversible $q_{Rev} = W_{Rev}$

$\Delta H, \Delta U = 0$

$q_{Rev} = +$ endo $W_{rev} = +$ expansión

$\Delta S_{Rev} = +$ expansión aumenta volumen

Irreversible

predicciones

$q_{irrev} = W_{irrev}$

$\Delta H, \Delta U = 0$

$q_{irrev} = +$ endo

$W_{irrev} = +$ expansión

$\Delta S = +$ expansión aumenta volumen

$W_{Rev} > W_{irrev}$

$\Delta S_{Rev} > \Delta S_{irrev}$

$q_{Rev} > q_{irrev}$

	ΔU (J)	ΔH (J)	ΔS (J/K)	q (J)	w (J)
Rev	0	0	5.76	1718.2	1718.2
Irrev	0	0	4.15	1238.2	1238.2

Rev

$$W_{Rev} = nRT \ln \frac{V_2}{V_1} = (1\,mol)\left(\frac{8.314\,J}{mol\,K}\right)\left(\ln \frac{48.88\,L}{24.44\,L}\right)(298.15\,K)$$

$$= 1718.2\ J$$

$$\Delta S_{Rev} = \frac{q_{Rev}}{T} = \frac{1718.2\,J}{298.15\,K}$$

$$= 5.76\ \frac{J}{K}$$

Irrev.

$$W_{irrev} = p_2 (V_2 - V_1)$$

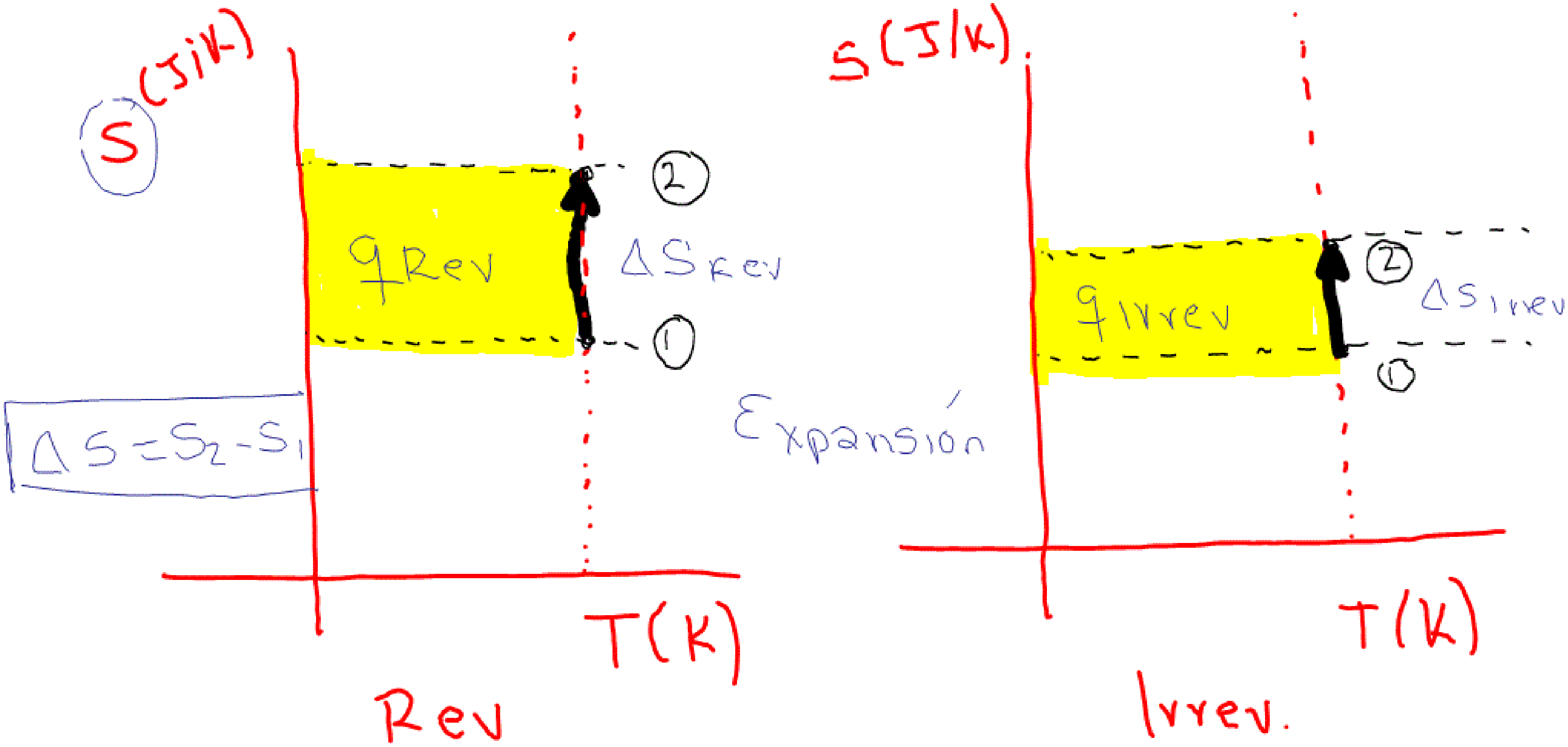
$$= 0.5\,atm\,(48.88\,L - 24.44\,L)$$

$$= (12.22\,atm\,L)\left(\frac{1.01325 \times 10^5\,N/m^2}{atm}\right)\left(\frac{1\,m^3}{10^3\,L}\right)$$

$$= 1238.2\,\frac{N}{m^2}\,m^3 = N \cdot m = J$$

$$\Delta S_{Irrev} = \frac{q_{Irrev}}{T}$$

$$= \frac{1238.2\,J}{298.15\,K} = 4.15\,\frac{J}{K}$$


S (J/K)
q_{Rev}
ΔS_{Rev}
2
1
$\Delta S = S_2 - S_1$
T(K)
Rev
Expansión
S (J/K)
q_{Irrev}
ΔS_{Irrev}
2
1
T(K)
Irrev.