Clase 8 30 Septiembre 2020

Título de la nota 30/09/2020

W

q

Funciones de trayectoria < Rev. ✓ / Irrev. ✓

W { energía $= \text{Joule} = N \cdot m$

mecánico $= P(V_2 - V_1)$ $\frac{N}{m^2} m^3$

desplazamiento $= F \times d = N \cdot m = \text{Joule}$

equivalente mecánico del calor (q)

$$1\ \text{cal} = 4.186\ \text{J}$$

q y w

- Funciones trayectoria ✓
- diferenciales inexactas
- $đq$ ó $đw$
- δq ó δw
- dq ó dw ✗ Δq ó Δw ✗

Funciones de estado

$1 \rightarrow 2$
proceso

Helmholtz

$U, H, S, A, G \rightarrow$ Gibbs

diferenciales exactas

dU, dH, dS, dA, dG

$\Delta U, \Delta H, \Delta S, \Delta A, \Delta G$

Estado Estado

sistema 1 → 2

evolución

- proceso
- intercambio de energía
- trayectoria
  - Rev
  - IRev

$V \propto \frac{1}{P}$ Ley Boyle

$V \propto T$ Ley Charles

$V \propto n$ Ley Avogadro

$V = f(p, T, n)$

$$dV = \left(\frac{\partial V}{\partial P}\right)_{T,n} dP + \left(\frac{\partial V}{\partial T}\right)_{P,n} dT + \left(\frac{\partial V}{\partial n}\right)_{T,P} dn$$

$$V = \frac{k_1}{P} \qquad V = k_2 T \qquad V = k_3 n$$

$$\frac{\partial V}{\partial P} = -\frac{k_1}{P^2} \qquad \frac{\partial V}{\partial T} = k_2 \qquad \frac{\partial V}{\partial n} = k_3$$

$$dv = \left(\frac{\partial v}{\partial p}\right)_{T,n} dp + \left(\frac{\partial v}{\partial T}\right)_{p,n} dT + \left(\frac{\partial v}{\partial n}\right)_{T,p} dn$$

$$dv = \left(\frac{-k_1}{p^2}\right) dp + k_2\, dT + k_3\, dn$$

$$\left[dv = -\frac{\not{p}v}{p^{\not{2}}} dp + \frac{v}{T} dT + \frac{v}{n} dn\right]\frac{1}{v}$$

$$\int \frac{dv}{v} = -\int \frac{dp}{p} + \int \frac{dT}{T} + \int \frac{dn}{n}$$

$$\ln v = -\ln p + \ln T + \ln n + \ln k$$

$$e^{\ln v} = e^{\ln\left(\frac{nkT}{p}\right)} \quad \therefore \quad \boxed{v = \frac{nRT}{p}}$$

$pV = nRT$ { intensivas T, p
extensivas V, n

$$P\frac{V}{n} = RT$$

$$P\bar{V} = RT$$

$\bar{V}$ { intensivo

{ 3 dimensiones → 2 dimensiones

Procesos termodinámicos

- Isotérmicos $T = cte$
- Isobáricos $p = cte$
- Isocóricos $V = cte$
- adiabaticos $q = 0$
- politrópicos $q \neq 0$

(adiabaticos y politrópicos: V, T, P cambian)

$$PV^{x} = cte$$

x = pendiente

$$x = 0$$

$$PV^{0} = cte \qquad P = cte$$

Isobárico

$pV^x = cte \qquad x = 1$

$pV = cte \qquad T = cte$

Isotérmico

$pV^x = cte \qquad x = \infty$

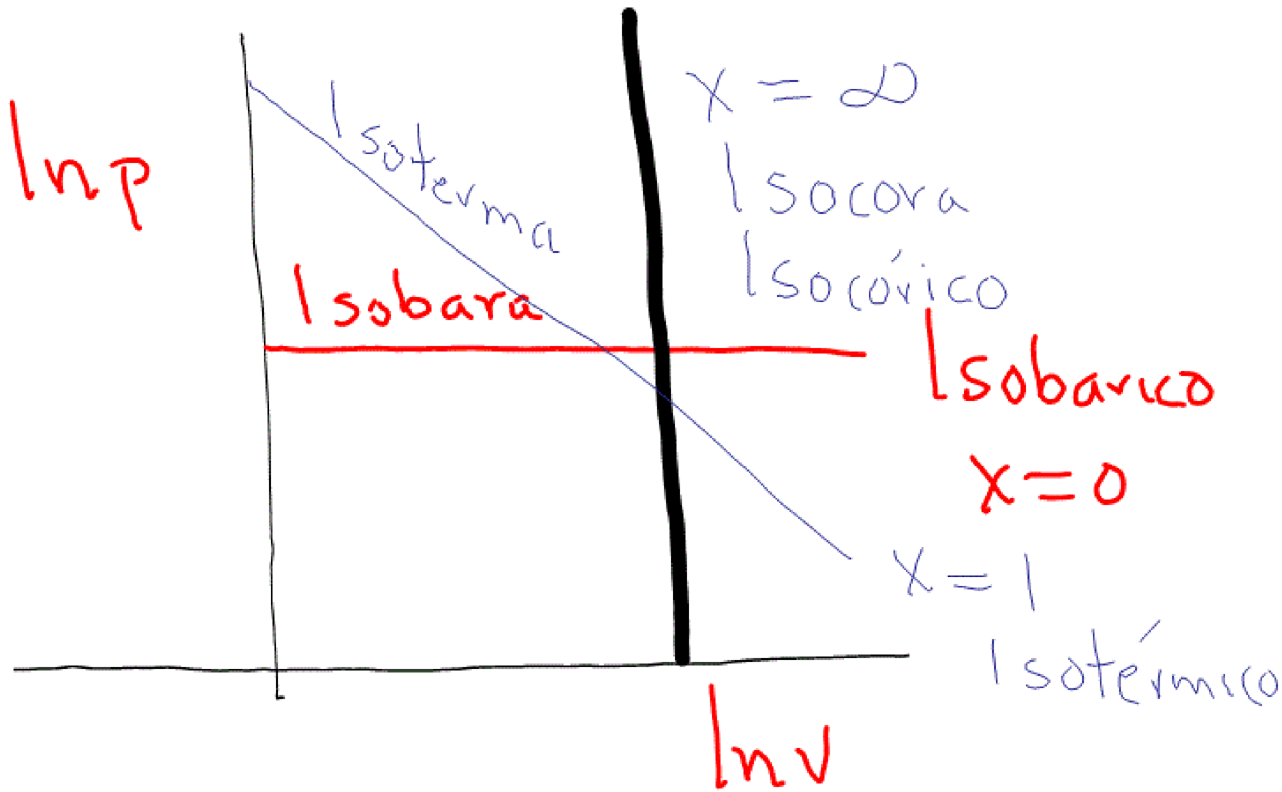
$V = cte$

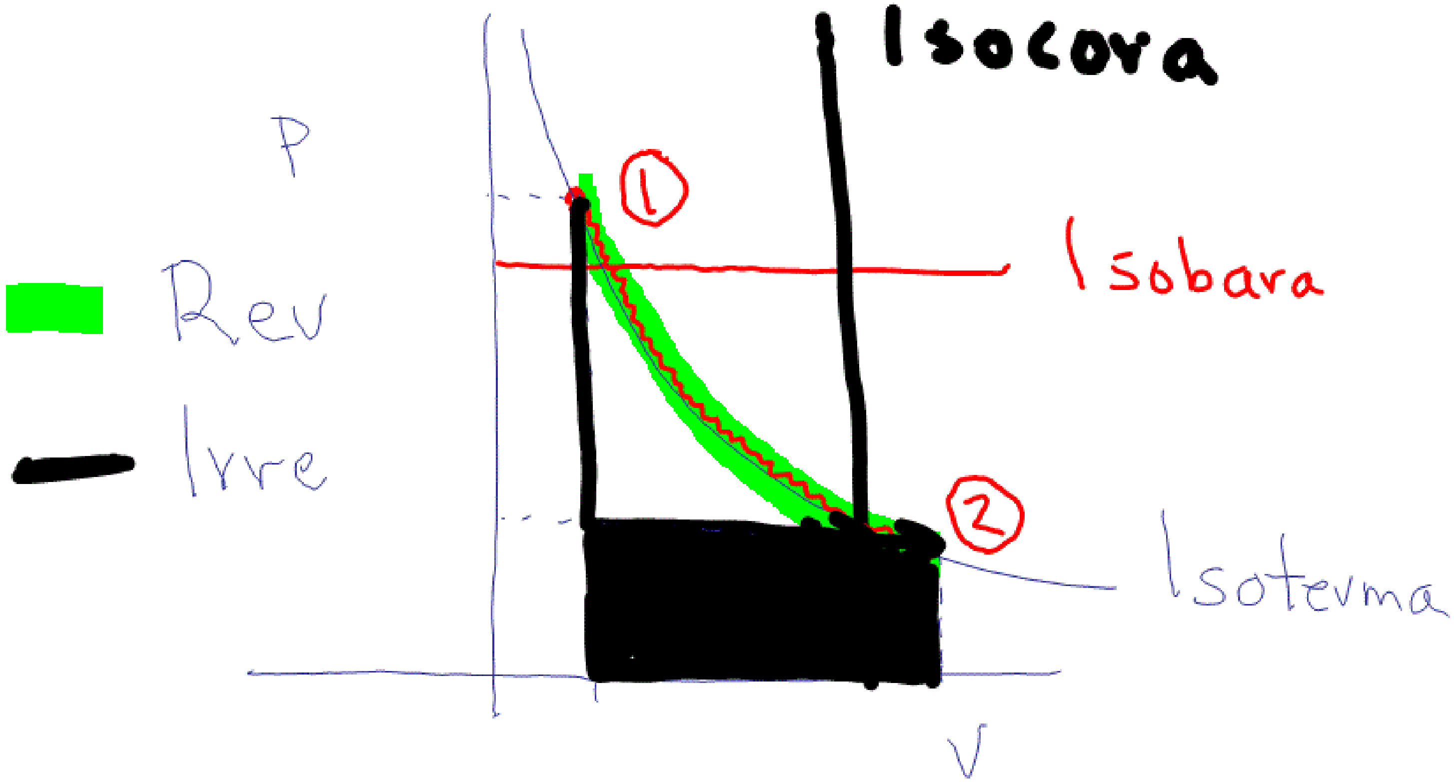
Isocórico

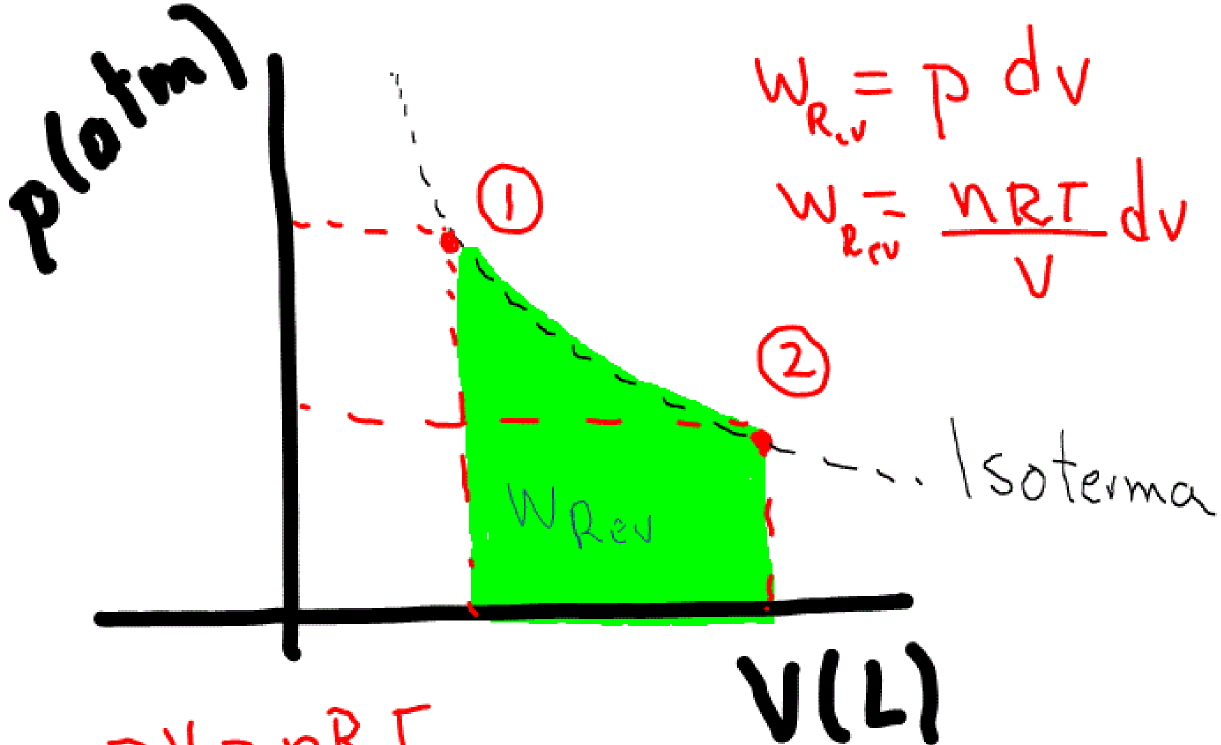
$$\left[pv^{x} = cte \right] \ln$$

$$\ln p + x \ln v = \ln cte$$

$$\boxed{\ln p = \ln cte - x \ln v}$$


lnp
Isoterma
Isobara
$X = \infty$
Isocora
Isocórico
Isobarico
$X = 0$
$X = 1$
Isotérmico
lnv


Isocora
P
1
Isobara
Rev
Irre
2
Isoterma
V



$$W_{Rev} = p\,dV$$

$$W_{Rev} = \frac{nRT}{V}\,dV$$

$$pV = nRT$$

$$p = \frac{nRT}{V}$$

$$W_{Rev} = nRT \int_{V_1}^{V_2} \frac{dV}{V}$$

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

$$= nRT \ln \frac{V_2}{V_1} = (mol)\left(\frac{J}{mol\,K}\right)(K)$$

Isotérmica

$$= J$$

$pV = nRT$ balance energía ✓

$\left(\frac{N}{m^2}\right)\left(m^3\right) = pV = N \cdot m = J$

$nRT = (mol)\left(\frac{J}{mol\,K}\right)(K) = J$

$PV = nRT \quad R = ?$

condiciones normales

$T = 273.15\ K$

1 bar

1 mol

22.4 L

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

$$R = \frac{(1\ \text{bar})\left(\frac{1.01325\times10^{5}\ N/m^2}{1.01325\ \text{bar}}\right)(22.4\ L)\left(\frac{1\ m^3}{10^3\ L}\right)}{(1\ \text{mol})(273.15\ K)}$$

$$= \frac{(N/m^2)(m^3)}{(\text{mol})(K)} = \frac{J}{\text{mol}\ K}$$

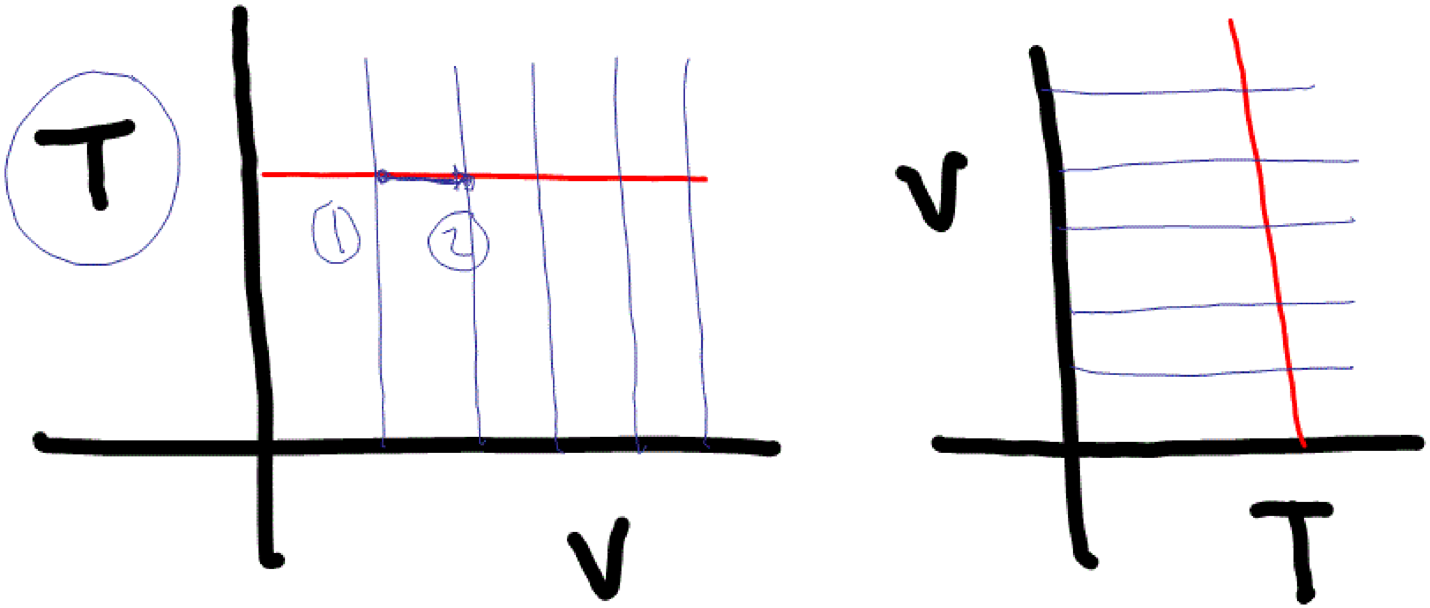
$$= 8.314\ \frac{J}{\text{mol}\ K}$$

$$R = \left(\frac{8.314\ J}{mol\ K}\right)\left(\frac{1\ cal}{4.186\ J}\right) = \frac{1.9861\ cal}{mol\ K}$$

$$R = \frac{(1\ \cancel{bar})\left(\frac{1\ atm}{1.01325\ \cancel{bar}}\right)(22.4\ L)}{(1\ mol)(273.15\ K)} = 0.082\ \frac{atm\ L}{mol\ K}\ \checkmark$$

Tarea
perfil
Isotérmico
de
expansión reversible

- p vs V
- T vs V
- V vs T
- p vs T
- T vs p


T
①
②
V
V
T