1. Travail :

$\delta W = -P_{ext} \cdot dV$: travail élémentaire.

$W = \int \delta W = -\int P_{ext} \cdot dV$. : P_{ext} pression extérieur.

$W = -\int P \, dV$ P : Pression du fluide

2. Quantité de chaleur :

$$\begin{cases} \delta Q = C_P \, dT + \ell \, dP \\ \delta Q = C_V \, dT + h \, dV \\ \delta Q = \lambda \, dP + \nu \, dV \end{cases}$$

$Q = \int \delta Q$

3. Variation de l'énergie interne :

$dU = \delta W + \delta Q$ (1er principe) $\int dU = \Delta U = U_f - U_i$

$\Delta U = W + Q$. [J] $\int \delta U = U$.

Bilan énergétique.

4. Transformation d'un gaz parfait : (réversible).

4.1 : Transformation isochore : ($V = cte$)

$W = -\int P_{ext} \cdot dV$ $(dV = 0)$

$\boxed{W = 0}$.

$\delta Q = C_V \cdot dT + \ell \cdot dV$

$\boxed{\delta Q = C_V \cdot dT}$.

4.2 Transf. isobare : ($P = cte$)

$W = -P \int_{V_i}^{V_f} dV$ $(P_{ext} = P = cte)$

$dP = 0$.

$\boxed{W = -P \cdot (V_f - V_i)}$.

$\delta Q = C_P \cdot dT + \ell \cdot dP$

$\boxed{\delta Q = C_P \cdot dT}$.

4.3. Transf. isotherme : ($T = cte$) (GP)

$W = -\int P \cdot dV$.

$= -\int n \frac{RT}{V} \cdot dV$

$W = -nRT \cdot \int_{V_i}^{V_f} \frac{dV}{V}$

$W = -nRT \cdot \ln \frac{V_f}{V_i}$

$\boxed{W = nRT \ln \left(\frac{V_i}{V_f} \right)}$.

- $dU = C_V \cdot dT$

$\Delta U = C_V \cdot \Delta T = W + Q$.

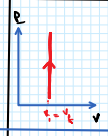
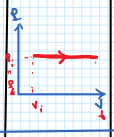
$\boxed{Q = -W = -nRT \cdot \ln \frac{V_i}{V_f}}$.

4.4. Transf. adiabatique : $Q = 0$.

$\Delta U = W + Q = W$.

$\boxed{W = C_V \cdot \Delta T}$.

(G.P)

Transformat°	$P = f(V)$	$\Delta S = 0$	W	Q	ΔU
$V = cte$		$\frac{P}{T} = cte$	$W = 0$	$Q = C_V (T_f - T_i)$	$\Delta U = C_V \cdot \Delta T$
$P = cte$		$\frac{V}{T} = cte$	$W = -P(V_f - V_i)$	$Q = C_P (T_f - T_i)$	$\Delta U = C_V (T_f - T_i)$
$T = cte$		$PV = cte$	$W = nRT \ln \frac{V_f}{V_i}$	$Q = -W$	$\Delta U = 0$
$Q = 0$		$PV^\gamma = cte$ $TV^{\gamma-1} = cte$ $TP^{\frac{1-\gamma}{\gamma}} = cte$	$W = C_V (T_f - T_i)$	$Q = 0$	$\Delta U = C_V (T_f - T_i)$

I. Enthalpie : (chaleur interne, fonction thermique) :

$H = U + P.V$ ($H = cte$: isenthalpique)

$dH = dU + d(P.V)$

$= dU + V dP + P.dV$.

$= \delta Q + \delta W + V dP + P.dV$

$dH = \delta Q + V.dP$. $\qquad \delta Q = C_P.dT + h.dP$

$dH = C_P.dT + (h + V) dP$ . . (i)

$dH = \left(\frac{\partial H}{\partial T}\right)_P dT + \left(\frac{\partial H}{\partial P}\right)_T dP$

$C_P = \left(\frac{\partial H}{\partial T}\right)_P$ et $h + V = \left(\frac{\partial H}{\partial P}\right)_T$

* isobare. ($P = cte$) $\therefore$ (i) : $dP = 0$.

$\boxed{dH = C_P.dT}$ 2ème loi de Joule. $H = H(T)$

$U = U(T)$ 1ère loi de Joule. $U = U(T)$.