a) La capacidad calórica bajo la condición x cte es la razón entre el calor transferido al sistema y el consecuente cambio de temperatura bajo condición x cte.

$$C_x = \left.\frac{\delta Q}{dT}\right|_x \Rightarrow$$ no es una derivada, ya que δQ no es un diferencial exacto.

b) Como $dU = \delta Q - P dV$, $\delta Q = dU + P dV = \left.\frac{\partial U}{\partial T}\right|_V dT + \left.\frac{\partial U}{\partial V}\right|_T dV + P dV$

$dV = 0 \Rightarrow \boxed{\left.\frac{\delta Q}{dT}\right|_V = \left.\frac{\partial U}{\partial T}\right|_V = C_V}$

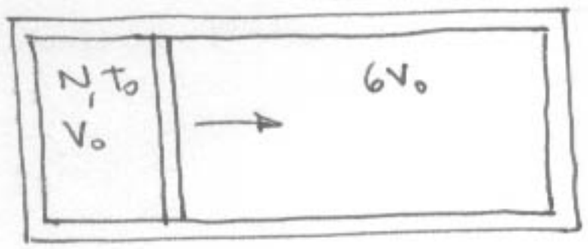
c) Ahora $\delta Q = dU + P dV = \left(\left.\frac{\partial U}{\partial T}\right|_P\right) dT + \left(\left.\frac{\partial U}{\partial P}\right|_T\right) dP + P\left(\left.\frac{\partial V}{\partial T}\right|_P dT + \left.\frac{\partial V}{\partial P}\right|_T dP\right)$

$\Rightarrow \boxed{C_P = \left.\frac{\delta Q}{dT}\right|_P = \left.\frac{\partial U}{\partial T}\right|_P + P\left.\frac{\partial V}{\partial T}\right|_P}$

d) En un gas ideal $U = \frac{3}{2} N k_b T \quad PV = N k_b T$

$\Rightarrow \left.\frac{\partial U}{\partial T}\right|_V = \left.\frac{\partial U}{\partial T}\right|_P = \frac{3 N k_b}{2}$ y $\left.\frac{\partial V}{\partial T}\right|_P = \frac{N k_b}{P}$

$\Rightarrow \boxed{C_V = \frac{3 N k_b}{2}, \quad C_P = C_V + N k_b}$



$dU = \delta Q - PdV$

$W = \int PdV$

$Q = \Delta U + W$

T_f

a) $T = cte$

b) $P = cte$

c) $\delta Q = 0$

a) δ: $T = cte$ $\quad \Delta U = 0$ y $P = \frac{NkT_0}{V}$ $\Rightarrow$ $\boxed{W = \int_{V_0}^{7V_0} \frac{NkT_0}{V} dV = NkT_0 \ln(7)}$

$\Rightarrow \boxed{Q = W}$ y $\boxed{T_f = T_0}$

b) δ: $P = cte$ $\quad \boxed{W = P_0 \Delta V = 6P_0V_0}$ $\quad \boxed{\Delta U = \frac{3}{2} P_0 \Delta V = 9P_0V_0 = 9NkT_0}$

y $\boxed{Q = 15 P_0V_0 = 15NkT_0}$ $\quad P_0V_f = NkT_f \Rightarrow \boxed{T_f = \frac{7P_0V_0}{Nk} = 7T_0}$

c) δ: $\delta Q = 0$, $Q = 0$ y $dU = \frac{3}{2}(PdV + VdP) = -PdV$ $\Rightarrow$ $5PdV + 3VdP = 0$ $\quad / \cdot \frac{1}{3PV}$

$\Rightarrow \boxed{PV^{5/3} = cte}$

$\Rightarrow U = \frac{3}{2} PV = \frac{3}{2} P_0V_0^{5/3} \left(\frac{V}{V^{5/3}}\right) = \frac{3}{2} P_0V_0 \left(\frac{V_0}{V}\right)^{2/3}$

$\Rightarrow \boxed{\Delta U = \frac{3}{2} P_0V_0 \left(\left(\frac{1}{7}\right)^{2/3} - 1\right)}$ $\quad \Rightarrow \boxed{W = -\Delta U}$

$\boxed{\Delta U = \frac{3}{2} NkT_0 \left(\left(\frac{1}{7}\right)^{2/3} - 1\right)}$