10-3-2015 IV I COMPITO DI TCI

7 g di He a 300°C e 20 bar (A) vengono espansi isotermicamente fino a 2 bar (B). Il gas viene poi riportato al punto A con due Trasformazioni: isobara fino al punto C e poi adiabatica fino ad A. Calcolare i dati dei punti A, B, C. Calcolare il lavoro e ΔS nei vari step del ciclo e Totali.

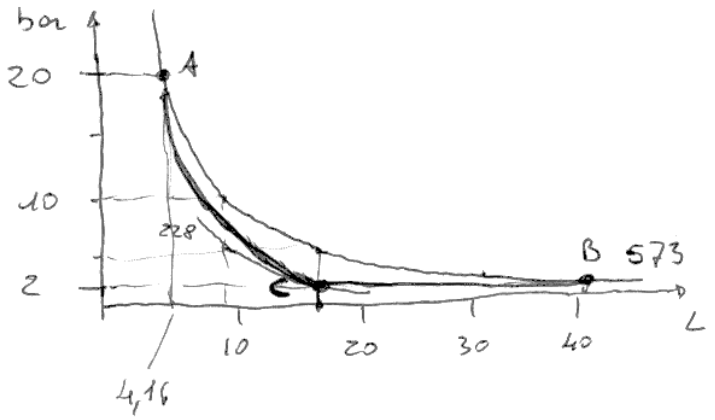
(A) moli di He $\frac{7g}{4\ g/mol} = \boxed{1.75\ mol}$ $V_A = \frac{nRT}{P} = \frac{1.75 \cdot 8.31 \cdot 573}{20 \cdot 10^5} = 416.6\ 10^{-2}\ L$

$\boxed{V_A = 4,166\ L}$

$T_A = 300 + 273 = \boxed{573\ K\ T_A}$ $\boxed{P_A = 20\ bar}$

(B) $\boxed{T_B = 573\ K}$ $\boxed{P_B = 2\ bar}$ $V_B = V_A \frac{P_A}{P_B}$ $4,166 \cdot \frac{20}{2} = \boxed{41,66\ L\ V_B}$

$\boxed{41.7\ L\ V_B}$



(C) $P_C V_C^\gamma = P_A V_A^\gamma$ $\gamma = \frac{c_p}{c_v} = \frac{5}{3}$

$V_C^\gamma = \frac{P_A}{P_C} V_A^\gamma$ $\boxed{V_C = \left(\frac{P_A}{P_C}\right)^{\frac{1}{\gamma}} V_A}$

$\frac{1}{\gamma} = \frac{3}{5} = 0.6$ $V_C = \left(\frac{20}{2}\right)^{0.6} 4.166$

$\boxed{V_C = 16.6\ L}$

$\boxed{V_C = 16.59\ L}$ $T_C = \frac{PV}{nR} = \frac{2\ 10^5 \cdot 16.59 \cdot 10^{-3}}{1.75 \cdot 8.31}$

$\boxed{T_C = 228\ K}$

$\Delta U = Q - L$ $\Delta U = 0$ $Q - L = 0$ $Q = L$

$L_{AB} = Q_{AB}$ $L_{AB} = P\Delta V = \int_A^B P\,dV = \int_A^B \frac{nRT}{V}\,dV$

$L_{AB} = nRT \ln \frac{V_B}{V_A} = 1.75 \cdot 8.31 \ln \frac{41.66}{4.166} \cdot 573 = \boxed{19187\ J\ L_{AB}}$

$L_{BC} = P\Delta V = 2 \cdot 10^5 \cdot (16.59 - 41.66) \cdot 10^{-3} = \boxed{-5014\ J\ L_{BC}}$

$L_{CA} = ?$ $\Delta U = Q - L$ $(Q = 0)$ $\boxed{L = -\Delta U}$ $L_{CA} = -nC_v\Delta T = -1.75 \cdot \frac{3}{2} \cdot 8.1 (T_A - T_C)$

$L_{CA} = -1.75 \cdot \frac{3}{2} \cdot 8.31 (573 - 228) = \boxed{7525,7\ J\ L_{CA}}$ $L_{TOT} = 19187 - 5014 - 7526$

$L_{TOT} = 6647\ J$ $\boxed{L_{TOT} = 6647\ J}$

$$\Delta S_{AB} = \frac{Q_{AB}}{T} = \frac{L_{AB}}{T} = \frac{19187}{573} \simeq 33,485 \text{ J/K} \qquad \boxed{\Delta S_{AB} = 33,49 \text{ J/k}}$$

$$\Delta S_{BC} = \frac{Q_{BC}}{T} = n C_p \frac{\Delta T}{T} = n C_p \int_B^C \frac{dT}{T} = n C_p \ln \frac{T_C}{T_B} = 1,75 \cdot \frac{5}{2} \cdot 8,31 \ln \frac{228}{573}$$

$$\boxed{\Delta S_{BC} = -33,50 \text{ J/k}}$$

$\Delta S_{CA} = 0$ (ADIABATICA $Q = 0$)

$$\Delta S_{TOT} = \Delta S_{AB} + \Delta S_{BC} + \Delta S_{CA}$$
$$= 33,48,5 - 33,50$$
$$= 0$$