$C_v = \frac{3R}{2}$; $\gamma = \frac{5}{3}$; $n = 1\,mol$

$$W_{AB} = \int_A^B p\,dV = nRT_A \ln\left(\frac{V_B}{V_A}\right) = \boxed{nRT_A \ln(2)}$$

$$W_{BC} = \int_B^C p\,dV = \int_B^C p_B V_B^{\gamma} \frac{1}{V^{\gamma}}\,dV = \frac{p_B V_B^{\gamma}}{-\gamma+1} \left.\frac{1}{V^{\gamma-1}}\right|_B^C = \frac{nRT_A\,(2V_A)^{\gamma}}{V_A(-\gamma+1)}\left[\frac{1}{V_C^{\gamma-1}} - \frac{1}{(2V_A)^{\gamma-1}}\right]$$

$$P_C V_C^{\gamma} = P_B V_B^{\gamma}$$

$$\frac{nRT_C}{V_C} V_C^{\gamma} = P_B V_B^{\gamma}$$

$$\frac{nRT_A}{2} V_C^{\gamma-1} = P_B V_B^{\gamma}$$

$$\frac{1}{V_C^{\gamma-1}} = \frac{nRT_A}{2}\frac{1}{P_B V_B^{\gamma}} = \frac{nRT_A}{2} \cdot \frac{V_B}{nRT_A} \cdot \frac{1}{V_B^{\gamma}} = \frac{1}{2V_B^{\gamma-1}} =$$

$$= \frac{1}{2(2V_A)^{\gamma-1}}$$

$$W_{BC} = \frac{nRT_A}{1-\gamma}\frac{(2V_A)^{\gamma}}{V_A}\left[\frac{1}{2(2V_A)^{\gamma-1}} - \frac{1}{(2V_A)^{\gamma-1}}\right] = \boxed{\frac{nRT_A\,2V_A}{V_A(1-\gamma)}\left(-\frac{1}{2}\right) = \frac{nRT_A V_A}{(\gamma-1)V_A}}$$

$$W_{CD} = n R \frac{T_A}{2} \ln\left(\frac{V_D}{V_C}\right)$$

$$P_D = \frac{nRT_D}{V_D} = \frac{nRT_A}{V_A} \Rightarrow \frac{T_D}{V_D} = \frac{T_A}{V_A} \Rightarrow \frac{V_D}{V_A} = \frac{T_D}{T_A} = \frac{1}{2} \Rightarrow \boxed{V_D = \frac{1}{2}V_A}$$

$$\boxed{W_{CD} = -nR\frac{T_A}{2}\ln 2}$$

$$W_{DA} = \int_D^A p\,dV = P_A \cdot (V_A - V_D) = \frac{nRT_A}{V_A}\left(V_A - \frac{1}{2}V_A\right) = \boxed{\frac{nRT_A}{2}}$$

$$W_{Total} = nRT_A \ln 2 + \frac{nRT_A}{\gamma-1} - \frac{nRT_A}{2}\ln 2 + \frac{nRT_A}{2} =$$

$$= nRT_A\left[\ln 2 + \frac{1}{\gamma-1} - \frac{1}{2}\ln 2 + \frac{1}{2}\right] = nRT_A\left[\frac{1}{2}\ln 2 + \frac{1}{2} + \frac{1}{\gamma-1}\right] > 0$$

maq térmica

$\Delta U + W = Q$

$\Delta U_{AB} = 0 \Rightarrow Q_{AB} = nRT_A \ln 2$

$Q_{BC} = 0 \Rightarrow \Delta U_{BC} = -\frac{nRT_A}{\gamma - 1}$

$\Delta U_{CD} = 0 \Rightarrow Q_{CD} = -\frac{nRT_A}{2} \ln 2$

$\Delta U_{DA} = -0 + \frac{nRT_A}{\gamma-1} - 0 = \frac{nRT_A}{\gamma-1} \Rightarrow Q_{DA} = \frac{nRT_A}{\gamma-1} + \frac{nRT_A}{2}$

b) $\boxed{\Delta S_{AB} = \int_A^B p\frac{dV}{T} = nR \ln\left(\frac{V_B}{V_A}\right) = nR \ln 2} = -\Delta S_{AB}^{\frac{1}{2}}$ $\qquad \Delta S_{AB}^{U} = 0$

$\boxed{\Delta S_{BC} = 0} = \Delta S_{BC}^{\frac{1}{2}}$ $\qquad \Delta S_{BC}^{U} = 0$

$\Delta S_{CD} = -nR \ln\left(\frac{V_D}{V_C}\right) = nR \ln 2^{(3-\gamma)} = \boxed{(3-\gamma) nR \ln 2} = -\Delta S_{CD}^{\frac{1}{2}}$ $\qquad \Delta S_{CD}^{U} = 0$

$V_D = \frac{1}{2} V_A$ $\qquad \frac{V_D}{V_C} = \frac{1}{2} \frac{V_A}{2^{1-\gamma}\, 2V_A} = \frac{1}{2^{3-\gamma}}$

$V_C^{\gamma-1} = 2\,(2V_A)^{\gamma-1}$

$V_C = 2^{1-\gamma}\,(2V_A)$

$\boxed{\Delta S_{DA} = -nR\ln 2 - (3-\gamma) nR \ln 2} = -\Delta S_{DA}^{\frac{1}{2}}$ $\qquad \Delta S_{DA}^{U} = 0$

c) $\varepsilon = \frac{W}{Q_{abs}} = \frac{nRT_A\left[\frac{1}{2}\ln 2 + \frac{1}{2} + \frac{1}{\gamma-1}\right]}{nRT_A\left[\ln 2 + \frac{1}{\gamma-1} + \frac{1}{2}\right]} =$

$= \frac{1}{2}\frac{\left[\ln 2 + 1 + \frac{2}{\gamma-1}\right]}{\ln 2 + \frac{1}{\gamma-1} + \frac{1}{2}} = \frac{1}{2}\frac{\left[\ln 2 + 1 + 3\right]}{\ln 2 + \frac{3}{2} + \frac{1}{2}} \simeq \frac{1}{2}\cdot\frac{4,69}{2,69} = \boxed{0,87}$

Revisar creo que hay un error de cuenta