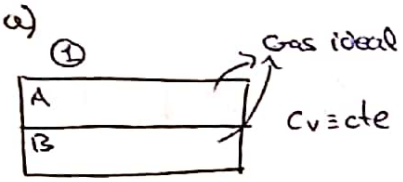
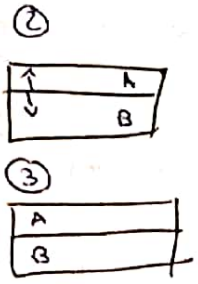
Entregable grupal 3.

1. a)



$V_{Ai} = V_{Bi} = 5\,l$ $\quad P_{Ai} = 3\cdot10^5\,Pa$

$T_{Ai} = T_{Bi} = 293\,K$ $\quad P_{Bi} = 2\cdot10^5\,Pa$



a) ¿T_{Af}, T_{Bf}? ¿P_{Af}, P_{Bf}? ¿V_{Af}, V_{Bf}?

El sistema es un depósito adiabático cuyo volumen no cambia $\Rightarrow Q = 0$; $dV = 0$

$\Downarrow$

$dV = 0 \Rightarrow W = 0 \Rightarrow \Delta U = Q + W = 0 + 0 \Rightarrow \Delta U = 0 \Rightarrow \Delta U = n\underbrace{C_{v,m}}_{cte}\Delta T = 0 \Rightarrow \Delta T = 0$

Es un proceso isotermo $\Rightarrow \Delta T_A = \Delta T_B = 0$

Por tanto $\Rightarrow$ $\boxed{T_{Af} = T_{Ai} = T_{Bf} = T_{Bi} = 293\,K}$

Cuando el émbolo alcanza el equilibrio $\Rightarrow P_{Af} = P_{Bf}$

$PV = nRT \Rightarrow P_{Af} = \frac{n_A R T_{Af}}{V_{Af}}$; $P_{Bf} = \frac{n_B R T_{Bf}}{V_{Bf}} \Rightarrow \frac{n_A R T_{Af}}{V_{Af}} = \frac{n_B R T_{Bf}}{V_{Bf}} \Rightarrow n_A \frac{T_{Af}}{V_{Af}} = n_B \frac{T_{Bf}}{V_{Bf}}$

$\frac{n_A}{V_{Af}} = \frac{n_B}{V_{Bf}} \Rightarrow n_{Af} = n_{Ai} = n_A$ y $n_{Bf} = n_{Bi} = n_B$ porque la masa se conserva.

$n_A = \frac{P_{Af} V_{Af}}{R T_{Af}} = \frac{P_{Ai} V_{Ai}}{R T_{Ai}} = 0'0158\ mol$; $n_B = \frac{P_{Bf} V_{Bf}}{R T_{Bf}} = \frac{P_{Bi} V_{Bi}}{R T_{Bi}} = 0'4105\ mol$

$\frac{n_A}{V_{Af}} = \frac{n_B}{V_{Bf}} \Rightarrow V_A = \frac{n_A}{n_B} V_{Bf} \Rightarrow$ El volumen del depósito no varía: $V_{Af} + V_{Bf} = 10\,l$

$V_{Af} = 0'01 - V_{Bf} = \frac{n_A}{n_B} V_{Bf} \Rightarrow V_{Bf}\left(\frac{n_A}{n_B} + 1\right) = 0'01 \Rightarrow \boxed{V_{Bf} = 0'004\ m^3} \Rightarrow \boxed{V_{Ai} = 0'006\ m^3}$

$P_{Af} = \frac{n_A R T_{Af}}{V_{Af}} = 2'5\cdot10^5\,Pa = P_{Bf} \Rightarrow \boxed{P_{Af} = P_{Bf} = 2'5\cdot10^5\,Pa}$

b) $\Delta S = \frac{Q}{T} = 0$ por ser adiabático (el sistema).

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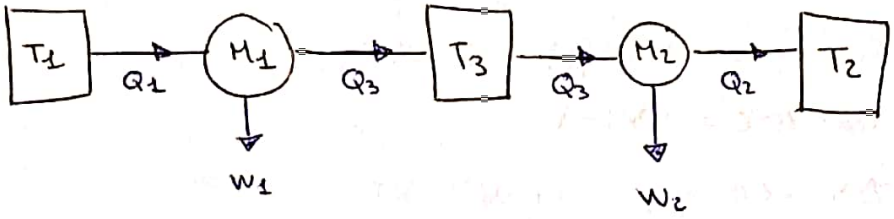

$T_1 = 490\ K$

$T_2 = 250\ K$

$\eta_1 = \eta_2$

¿T_3? ¿W_1, W_2? ¿Q_2? $Q_1 = 147\ kJ$

Máquina 1: absorbe energía (Q_1) y la cede (W_1, Q_3) $\Rightarrow |Q_1| - |W_1| = |Q_3|$

$|W_1| = |Q_1| - |Q_3|$

Máquina 2: absorbe energía (Q_3) y la cede (Q_2, W_2) $\Rightarrow |Q_3| - |W_2| = |Q_2|$

$|W_2| = |Q_3| - |Q_2|$

Rendimiento de un ciclo $\equiv \eta = \frac{Q_3}{W_1} = \frac{Q_3}{Q_1 - Q_3}$; $\eta_2 = \frac{Q_2}{W_2} = \frac{Q_2}{Q_3 - Q_2}$

$\eta_1 = \eta_2 \Rightarrow \frac{Q_3}{Q_1 - Q_3} = \frac{Q_2}{Q_3 - Q_2} \Rightarrow Q_3(Q_3 - Q_2) = Q_2(Q_1 - Q_3) \Rightarrow Q_3^2 - Q_3Q_2 + Q_3Q_2 = Q_2Q_1$

$Q_3^2 = Q_2Q_1$

$\Delta S = \frac{Q}{T} \equiv cte$ en un ciclo $\Rightarrow \frac{Q_1}{T_1} = \frac{Q_3}{T_3} = \frac{Q_2}{T_2} \Rightarrow$ $Q_3 = Q_1 \frac{T_3}{T_1}$

$Q_2 = Q_1 \frac{T_2}{T_1} = 147 \cdot 10^3 \frac{250}{490}$

$Q_2 = 75\ kJ \Rightarrow Q_3^2 = Q_2Q_1 \Rightarrow Q_3 = 105\ kJ$

$T_3 = Q_3 \frac{T_1}{Q_1} = 105 \cdot 10^3 \frac{490}{147 \cdot 10^3} \Rightarrow T_3 = 350\ K$

$W_1 = Q_1 - Q_3 = 147 - 105$

$W_2 = Q_3 - Q_2 = 105 - 75$

$\Rightarrow W_1 = 42\ kJ$, $W_2 = 30\ kJ$