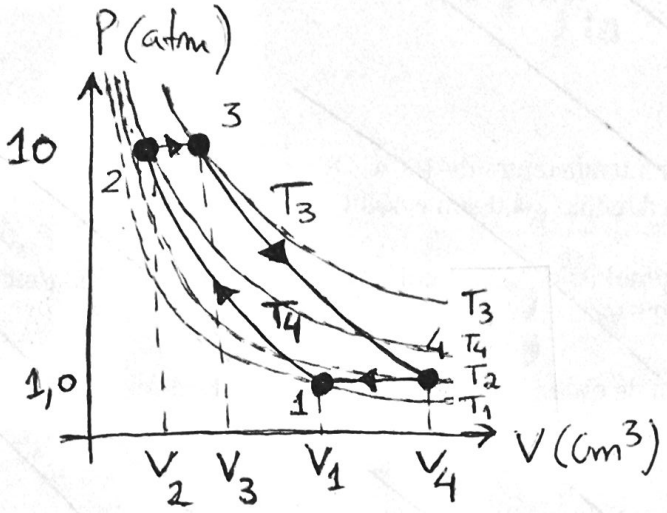
Ciclo de Brayton

Exercício ((Ciclo de Brayton))



$m = ?$

$\Rightarrow PV = nRT \Rightarrow m = \frac{PV}{RT}$

$= \frac{1{,}013 \times 10^5 \cdot 200 \cdot 10^{-6}}{8{,}314 \cdot 400}$

$= 0{,}0061\ mol$

	P(atm)	V(cm³)	T(K)
1	1	200	400
2	10	39	769
3	10	50	997
4	1	258	517

$\Rightarrow P_1 V_1^{\gamma} = P_2 V_2^{\gamma} \rightarrow V_2 = \sqrt[\gamma]{\frac{P_1}{P_2}}\ V_1$

$= \sqrt[1{,}4]{1/10} \cdot 200$

$= 39\ cm^3$

$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1} \rightarrow T_2 = T_1 \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

$= 400 \cdot \left(\frac{200}{39}\right)^{0,4}$

$= 769\ K$

$\Downarrow$

$Q_{2\to3} = nc_p \Delta T$

$= n \frac{7}{2} R \Delta T \Rightarrow \Delta T = \frac{2 \cdot Q_{2\to3}}{7nR}$

$\Delta T = \frac{2 \cdot 40{,}4}{7 \cdot 0{,}0061 \cdot 8{,}314}$

$\Delta T = 228\ K$

$T_3 = T_2 + 228 = 997\ K$

$P_3 V_3 = nRT_3$

$V_3 = \frac{nRT_3}{P_3}$

$= \frac{0{,}0061 \cdot 8{,}314 \cdot 997}{10 \cdot 1{,}013 \times 10^5} = 5{,}0 \times 10^{-5}\ m^3 = 50\ cm^3$

$\Downarrow$

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$$P_3 V_3^{\gamma} = P_4 V_4^{\gamma} \rightarrow V_4 = \sqrt[\gamma]{\frac{P_3}{P_4}} V_3$$

$$= \sqrt[1,4]{10} \cdot 50 = 259\ cm^3$$

$$P_4 V_4 = nRT_4 \rightarrow T_4 = \frac{P_4 V_4}{nR} = 517\ K$$

→ $Q_{12} = Q_{34} = 0$

→ $Q_{23} = 40,4\ J$ (DSDO)

→ $Q_{41} = mC_p \Delta T = 0,0061 \cdot \frac{7}{2} R \cdot (400 - 517) = -29,8\ J$

→ $W^{ciclo} = \underbrace{Q^{ent}}_{|Q_{23}|} - \underbrace{Q^{sai}}_{|Q_{41}|} = \underbrace{40,4}_{entra} - \underbrace{20,8}_{sai} = 19,6\ J$ //

→ Trata-se de uma Máq. Térmica pois $W^{ciclo} > 0$ e $|Q_q| > |Q_F|$.

→ $\eta = \frac{W^{útil}}{Q_q} = \frac{19,6}{40,4} \sim 0,48\ \%$

→

$$\left.\begin{array}{l} T_Q \geq T_3 = 997\ K \\ T_F \leq T_1 = 400\ K \end{array}\right\} \eta_{carnot} = 1 - \frac{T_F}{T_Q}$$

$$= 1 - \frac{400}{997} \sim 0,6$$ //