Resolução - Termodinâmica

01)

Transformação A → B

$\boxed{\frac{PV}{T} = \frac{P'V'}{T'}} \Rightarrow \frac{1.10^5}{227+273} = \frac{2.10^5}{T_B} \Rightarrow$

$T_B = 1.000K$

$\boxed{\Delta U = nC_v \Delta T}$

$\Delta U = 5 . \frac{3}{2} . \cancel{8}^{4} . (1.000 - 500)$

$\Delta U = 3.10^4 J$

$\tau = 0 \ (\Delta V = 0)$

$\boxed{Q = \tau + \Delta U}$

$Q = 3.10^4 J$

Transformação B → C

$\boxed{\frac{PV}{T} = \frac{P'V'}{T'}} \Rightarrow \frac{0,2}{1.000} = \frac{0,4}{T_C}$

$T_C = 2.000K$

$\boxed{\Delta U = n . C_v . \Delta T}$

$\Delta U = 5 . \frac{3}{2} . 8 . 1000$

$\Delta U = 6.10^4 J$

$\boxed{\tau = p . \Delta V} \Rightarrow \tau = 2.10^5 . 0,2$

$\tau = 4.10^4 J$

$\boxed{Q = \tau + \Delta U}$

$Q = 10.10^4 J$

Trabalho no ciclo

$\boxed{\tau \overset{N}{=} \text{Área}}$

$\tau = 0,2 . 1.10^5 = 2.10^4 J$

Rendimento

$\boxed{\eta = \frac{\tau_{ciclo}}{Q_{recebido}}}$

$\eta = \frac{2.10^4}{3.10^4 + 10.10^4}$

$\therefore \eta \cong 15\%$

Alternativa B

---

02)

Transformação A → B

$\boxed{\Delta U = \frac{3}{2}(p'V' - pV)}$ (monoatômico)

$\Delta U = \frac{3}{2}(4.10^5 . 3,2.10^{-2} - 2.10^5 . 2,4.10^{-2})$

$\Delta U = 12.10^3 J$

$\boxed{\tau \overset{N}{=} \text{Área}}$

$\tau = \frac{(B+b)h}{2} = (4.10^5 + 2.10^5) . 0,8.10^{-2}$

$\tau = 4,8.10^3 J$

$\boxed{Q = \tau + \Delta U} \Rightarrow Q = 16.8.10^3 J$

Transformação B → C

$\boxed{\Delta U = \frac{3}{2} p \Delta V} \rightarrow \Delta U = \frac{3}{2} . 4.10^5 . 1,6.10^{-2} = 9,6.10^3 J$

$\boxed{\tau = p . \Delta V} \Rightarrow \tau = 4.10^5 . 1,6.10^{-2} = 6,4.10^3 J$

$\boxed{Q = \tau + \Delta U} \Rightarrow Q = 9,6.10^3 + 6,4.10^3 = 16.10^3 J$

Trabalho no ciclo

$\boxed{\tau \overset{N}{=} \text{Área}} \Rightarrow \tau = \frac{(B+b)h}{2} = \frac{(2,4+1,6)10^{-2} . 2.10^5}{2}$

$= 4.10^3 J$

Rendimento

$\boxed{\eta = \frac{\tau_{ciclo}}{Q_{recebido}}} \rightarrow \eta = \frac{4.10^3}{32,8.10^3} \cong 12\%$

Alternativa C

Einsteinmania

Prof. Douglas Almeida

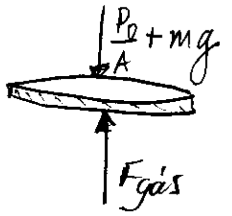
03)

$\boxed{Q = \tau + \Delta U}$

$185 = \tau + 80$

$\tau = 105\,J$

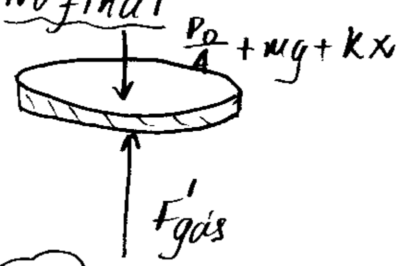
No inicio



$F_{gás} = \frac{10^5}{10 \cdot 10^4} + 10$

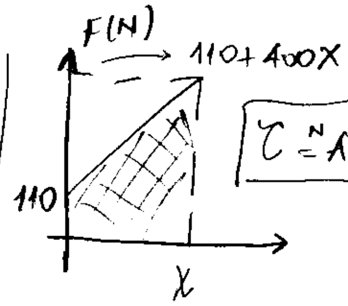
$F_{gás} = 110\,N$

No final



$F'_{gás} = 100 + 10 + 400x$

Fazendo o gráfico da força que o gás exerce no êmbolo x o deslocamento deste, temos:



$\boxed{\tau \overset{N}{=} \text{Área}}$

$105 = \frac{(110 + 110 + 400x)x}{2} \Rightarrow$

$40x^2 + 22x - 21 = 0 \Rightarrow$

$x \left\langle \begin{array}{l} -\cancel{\frac{84}{80}} \\ \frac{40}{80} = 0{,}5\,m \text{ ou } 50\,cm \end{array} \right.$

Alternativa C

04)

Na expansão, há o aumento do volume. Além disto, quanto maior a área formada pelo gráfico e o eixo do volume, maior o trabalho.

Alternativa D

05)

Admitindo que para o oxigênio (O_2 – diatômico), $\gamma = \frac{7}{5}$, temos:

$\boxed{p_i V_i^{\gamma} = p_f V_f^{\gamma}} \Rightarrow p_i V_i^{\frac{7}{5}} = p_f \left(\frac{V_i}{2}\right)^{\frac{7}{5}} \Rightarrow p_f = 2^{\frac{7}{5}} p_i \Rightarrow p_f = 2^{1,4} p_i$

$\boxed{\tau = \frac{p_f V_f - p_i V_i}{1 - \gamma}} \Rightarrow \tau = \frac{2^{1,4} p_i \cdot \frac{V_i}{2} - p_i V_i}{1 - \frac{7}{5}} = \frac{p_i V_i (2^{0,4} - 1)}{-\frac{2}{5}}$

$= -\frac{5}{2} p_i V_i (2^{0,4} - 1)$ (trabalho do gás) $\Rightarrow \frac{5}{2} p_i V_i (2^{0,4} - 1)$ (trabalho do agente externo). Alternativa C

06)

$\Delta U_{AB} = 0$ (Temperatura constante)
$\Delta U_{BC} = -40J$
$\tau_{BC} = 0$
$\tau_{CA} = -40J$

$\tau_{ciclo} = 30J$

$\tau_{ciclo} = \tau_{AB} + \tau_{BC} + \tau_{CA}$
$30 = Q - \cancel{\Delta U_{AB}}^{0} + 0 + (-40)$
$Q = 70J$

"

07)

$\Delta U = \Delta M c^2$

$\dfrac{\Delta S}{\Delta M} = \dfrac{8\pi G M k_B}{\hbar c}$

$\Delta S = \dfrac{Q}{T}$ (temperatura constante)

$Q = \cancel{\tau}^{0} + \Delta U$

$\Delta S = \dfrac{\Delta U}{T}$

$\Delta S = \dfrac{\Delta M c^2}{T}$

$\dfrac{\Delta S}{\Delta M} = \dfrac{c^2}{T}$

$\dfrac{8\pi G M k_B}{\hbar c} = \dfrac{c^2}{T}$

$\therefore T = \dfrac{\hbar c^3}{8\pi G M k_B}$

"

08)

A) Um ciclo de Carnot corresponde a duas transformações isotérmicas e duas adiabáticas. Não é o caso. Errada

B) O gás converte (parcialmente) calor em trabalho. Errada.

C) Em CD, o gás perde calor. ($Q = \tau + \cancel{\Delta U}^{0} \Rightarrow \tau < 0 \therefore Q < 0$). Errada.

D) Em AB, $\Delta U = 0$. Errada.

E) $Q = \cancel{\tau}^{0} + \Delta U \Rightarrow Q = \Delta U$. $T_A > T_D \Rightarrow U_A > U_D$. $\Delta U > 0$. Correto.

"

09)

$m_e v_e = m_c v_c \Rightarrow v_e = \dfrac{m_c v_c}{m_e}$

$\cancel{Q}^{0} = \tau + \Delta U \Rightarrow \Delta U = -\tau \Rightarrow$

$\Delta U = -\left(\dfrac{m_e v_e^2}{2} + \dfrac{m_c v_c^2}{2}\right)$

$\Delta U = -\left[\dfrac{m_e}{2} \cdot \left(\dfrac{m_c v_c}{m_e}\right)^2 + \dfrac{m_c v_c^2}{2}\right]$

$\therefore \Delta U = -\dfrac{m_c(m_e + m_c) v_c^2}{2 m_e}$

Alternativa $\underline{\underline{C}}$

---

10)

$\cancel{Q}^{0} = \tau + \Delta U$

$\tau = -\Delta U$

$\Delta U = n C_v \Delta T$

$\tau = -n C_v \Delta T$

$\tau = -n C_v \left(\dfrac{P_f V_f}{nR} - \dfrac{P_i V_i}{nR}\right)$

$\tau = -\dfrac{C_v}{R}(P_f V_f - P_i V_i)$

$\boxed{R = C_p - C_v}$

$\tau = -\dfrac{C_v}{C_p - C_v}(P_f V_f - P_i V_i) \div (C_v)$

$\tau = -\dfrac{(P_f V_f - P_i V_i)}{\dfrac{C_p}{C_v} - 1}$; $\boxed{\gamma = \dfrac{C_p}{C_v}}$

$\tau = -\dfrac{(P_f V_f - P_i V_i)}{\gamma - 1}$ ou $\dfrac{(P_f V_f - P_i V_i)}{1 - \gamma}$
