GABARITO P2 FÍSICA 3 2/2015

1 - A velocidade de propagação do pulso em uma corda vale $v_c = \sqrt{\frac{T}{\mu}}$, de forma que se

$$T \rightarrow 2T \rightarrow v = \sqrt{\frac{2T}{\mu}} = \sqrt{2}\sqrt{T/\mu} = \sqrt{2}\, v_c.$$

$$T \rightarrow 4T \rightarrow v = \ldots = 2 v_c.$$

2- Tendo em vista que a potência de uma onda forma ce justamente a taxa de energia/s e que

$$P_0 = \text{Área} \times \text{Intensidade} \propto |\text{Amplitude}|^2,$$

basta multiplicar a Amplitude por $\sqrt{2}$ que

$$P = |\sqrt{2}\ \text{Amplitude}|^2 = 2|\text{Amplitude}|^2 = 2P_0.$$

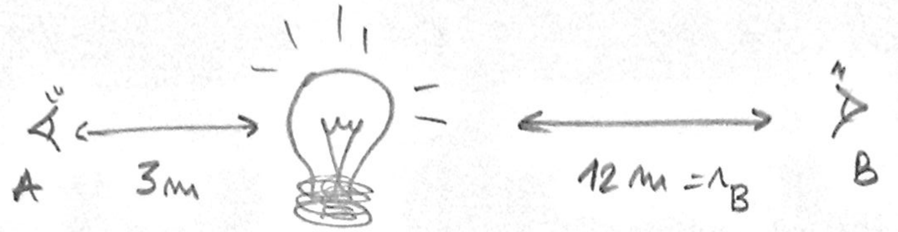
3 - CONCEITUAL

4- Do gráfico histórico obtemos $T = 4s \rightarrow f = 0{,}25\,Hz$

Do gráfico Instantâneo obtemos $\lambda = 3m$

Como $v = \lambda f \rightarrow v = 3 \cdot 0{,}25 = 0{,}75\ m/s$.

5-



$$I = \frac{P}{\text{Área}} = \frac{P}{4\pi r^2}$$

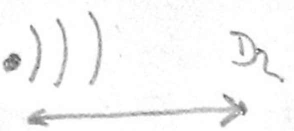
$$I_B = \frac{P}{4\pi r_B^2} \quad \therefore \quad I_A = \frac{P}{4\pi r_A^2} \Rightarrow \frac{P}{4\pi} = I_A r_A^2 = I_B r_B^2$$

A) $\quad I_A = I_B \left(\frac{r_B}{r_A}\right)^2 = I_B \left(\frac{12}{3}\right)^2 = 16 I_B$

B) $\quad$ ou $I_A = \dots = I_B \left(\frac{12}{2}\right)^2 = 36 I_B$

c) $\quad$ ou $I_A = \dots = I_B \left(\frac{9}{3}\right) = 9 I_B$

6-



$$I = 8 \times 10^{-8} \frac{W}{m^2}$$

$$\beta = (10\,dB) \log \left(\frac{8 \times 10^{-8}}{1{,}0 \times 10^{-12}} \right)$$

$$= (10\,dB) \left[\underbrace{\log 8}_{0{,}90} + \underbrace{\log 10^4}_{4} \right] = 49\,dB$$

Dn

$$\beta = (10\,dB) \log \left(\frac{5 \cdot 8 \times 10^{-8}}{10^{-12}} \right)$$

$$= 10\,dB \left[\underbrace{\log 40}_{1{,}6} + \underbrace{\log 10^4}_{4} \right] = 56\,dB$$

7 – $K_c = \dfrac{T_F}{T_Q - T_F} = \dfrac{273}{373-273} = \dfrac{273}{100} = 2{,}73.$

se T_F for $T_{ambiente} \sim 300K \rightarrow K_c = \dfrac{300}{373-300} \Rightarrow 4{,}1$

se T_Q ——— $K_c = 273/(300-273) = 10$

8 – $W^{útil} = W^{ciclo} = Q^{ciclo} = Q^{ent} - Q^{sai}$

$$= mc_v(T_3 - T_2) - mc_v(T_4 - T_1)$$

$$= mc_v(T_1 - T_2 - T_4 + T_3)$$

Mas $c_p - c_v = R \rightarrow c_v = c_p - R$ e $\gamma = \dfrac{c_p}{c_v}$.

De forma que $c_v = \gamma c_v - R$

$$R = (\gamma - 1)c_v$$

$$c_v = \frac{R}{\gamma - 1}.$$

$$\Rightarrow W^{útil} = \frac{mR}{\gamma-1}(T_1 - T_2 - T_4 + T_3)$$

$$= \frac{mR}{1-\gamma}(T_2 - T_1 + T_4 - T_3)$$

9- $\eta = \dfrac{W^{útil}}{Q^{q}} = \dfrac{\cancel{mc_V}(T_3 - T_2 - T_4 + T_1)}{\cancel{mc_V}(T_3 - T_2)}$

$$= \frac{T_3 - T_2}{T_3 - T_2} - \frac{T_4 - T_1}{T_3 - T_2}$$

$$= 1 - \frac{T_4 - T_1}{T_3 - T_2}$$

Mas $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1} \longrightarrow T_2 = \left(\dfrac{V_1}{V_2}\right)^{\gamma-1} T_1 = \left(\dfrac{V_{MÁX}}{V_{MÍN}}\right)^{\gamma-1} T_1$

$T_3 V_3^{\gamma-1} = T_4 V_4^{\gamma-1} \longrightarrow T_3 = \left(\dfrac{V_4}{V_3}\right)^{\gamma-1} T_4 = \left(\dfrac{V_{MÁX}}{V_{MÍN}}\right)^{\gamma-1} T_4$

$$\Downarrow$$

$$T_2 = r^{\gamma-1} T_1$$

$$T_3 = r^{\gamma-1} T_4$$

Assim, $\eta = 1 - \dfrac{\cancel{T_4 - T_1}}{r^{\gamma-1}\cancel{(T_4 - T_1)}} = 1 - \dfrac{1}{r^{\gamma-1}}$.

10- Verificamos que no ciclo de Otto, representado na figura, o gás admite calor apenas no processo $2 \to 3$, de forma que

$$T_Q \geq T_3 .$$

Da mesma forma, o gás rejeita calor apenas no processo $4 \to 1$, de forma que

$$T_F \leq T_1 .$$

11 - $$E^{term\,(He)}_{inicial} = n c_V T$$
$$= n \frac{3}{2} R T$$

Mas, $M_M^{He} = 4 g/mol \rightarrow n_{He} = 0{,}5\, mol$

$$= 0{,}5 \cdot \frac{3}{2} \cdot 8{,}314 \cdot 300 = 1871\, J$$

Analogamente, $M_M^{Ar} = 40\, g/mol \longrightarrow n_{Ar} = 0{,}125\, mol$

$$E^{térm\,(Ar)}_{inicial} = 0{,}125 \cdot \frac{3}{2} 8{,}314 \cdot 600 = 935\, J$$

Mas, para gases ideais em eq. térmico,

$$\bar{\epsilon} = \frac{E^{TOTAL}}{N_{He} + N_{Ar}} = \frac{E_f^{He}}{N_{He}} = \frac{E_f^{Ar}}{N_{Ar}}$$

nº de Avogadro

$$E_f^{He} = \frac{\overbrace{N_{He}}^{n_{He}}}{N_{He}+N_{Ar}} E^{total} \qquad \frac{N_A}{N_A}$$

$$= \frac{n_{He}}{n_{He}+n_{Ar}} E^{total}$$

$$= \frac{0,5}{0,5+0,125} \cdot 2806 = 2244 \text{ J}$$

ou $E_f^{Ar} = \frac{0,125}{0,625} 2806 = 561 \text{ J}$

$$\Delta E^{térm}_{He} = n c_v \Delta T_{He} \rightarrow \frac{2244-1871}{0,5 \cdot \frac{3}{2} \cdot R} = 60 \text{K}$$

$$\downarrow$$

$$T_f^{He} = 360 \text{K}$$

ou

$$\Delta E^{térm}_{Ar} = n c_v \Delta T_{Ar} \rightarrow \frac{561-935}{0,125 \cdot \frac{3}{2} R} = -240 \text{K}$$

$$\downarrow$$

$$T_f^{Ar} = 360 \text{K}$$

13- Rendimento máximo (Carnot):

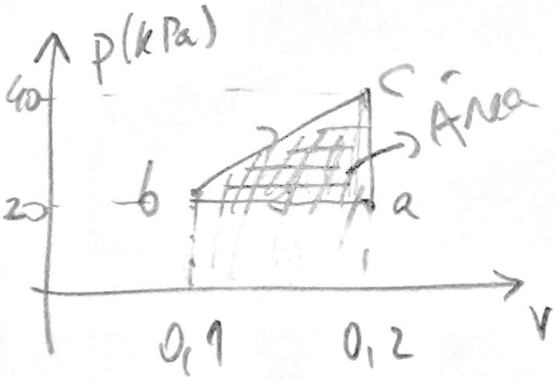
$$\eta_{MAX} = 1 - \frac{T_F}{T_Q} = 1 - \frac{300}{600} = 0,5 = 50\%$$

O rendimento c/ os dados da figura é:

$$\eta = \frac{W_{ciclo}}{Q_Q} = \frac{60}{100} = 0,6 = 60\% > \eta_{MAX} \Rightarrow$$

$\Rightarrow$ não é possível construir essa máquina.

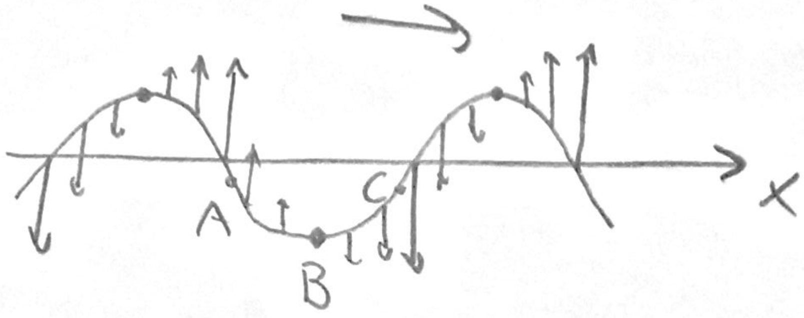
14- $W_{ciclo} = \text{Área} = \dfrac{\text{base} \times \text{altura}}{2}$



$$\text{Área} = \frac{(0,2 - 0,1) \cdot (40000 - 20000)}{2} = 1000\ J$$

$$\eta = \frac{W_{ciclo}}{Q_Q} = \frac{1000}{4000} = 0,25$$

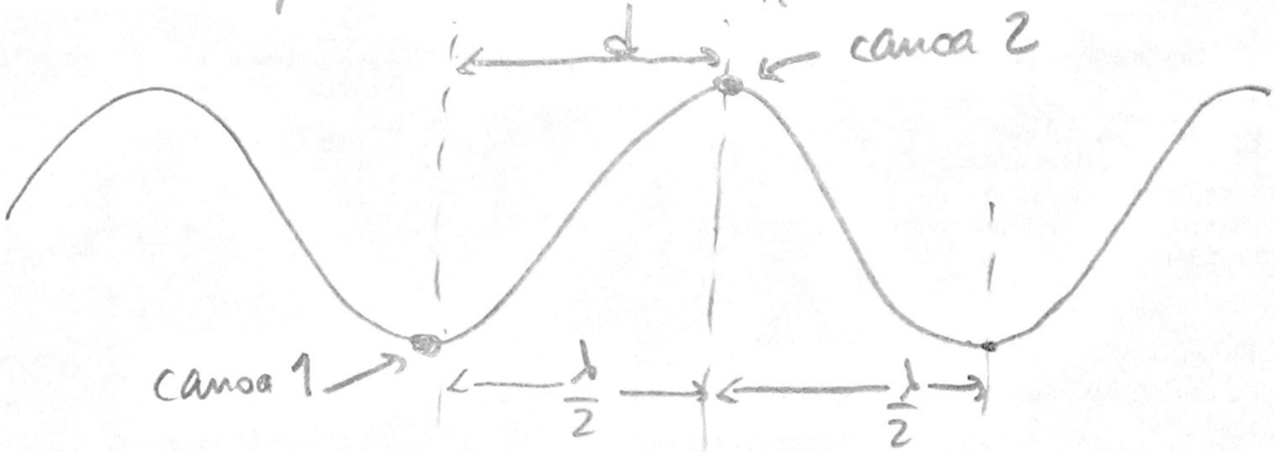
15 - Referência: figura 20.16 do Livro



entre A e B : ↑

entre B e C : ↓

16 -



$d = 10\ m$ (separação das canoas)

$d = \frac{\lambda}{2} \Rightarrow \lambda = 2d = 2 \cdot 10 = 20\ m$

canoa sobe e desce a cada 8s $\Rightarrow$ $\underline{T = 8s}$

Daí: $v = \frac{\lambda}{T} = \frac{20}{8} = \underline{2{,}5\ m/s}$

17 – $y(x,t) = \text{sen}\left[2\pi\left(\frac{x}{2} + \frac{t}{10}\right)\right]$

forma geral: $y(x,t) = A\,\text{sen}(kx + \omega t + \phi_0)$

Assim, comparando temos:

* $A = 1{,}0\,m$

* $k = \frac{2\pi}{2} = \pi\ m^{-1} = \frac{2\pi}{\lambda} \Rightarrow \lambda = 2{,}0\,m$

* $w = \frac{2\pi}{10} = \frac{\pi}{5}\ rad/s = 2\pi f \Rightarrow f = 0{,}1\,Hz$

no argumento, temos $+\omega t \rightarrow$ onda viaja no sentido negativo do eixo x

* $v = \lambda f = 2{,}0 \cdot 0{,}1 = 0{,}2\ m/s$

---

18 – onda de rádio $\Rightarrow$ onda eletromagnética $\Rightarrow$
$\Rightarrow$ viaja no vácuo $\Rightarrow$ $V = c = 3{,}0 \cdot 10^8\ m/s$

$\lambda = \frac{c}{f} = \frac{3{,}0 \cdot 10^8\ m/s}{2{,}0 \cdot 10^8\ Hz} = 1{,}5\,m$ //

$\Delta x = 800 \cdot 10^6\ Km = 8{,}0 \cdot 10^{11}\ m$

Daí: $\Delta t = \frac{\Delta x}{c} = \frac{8{,}0 \cdot 10^{11}}{3{,}0 \cdot 10^8} \cong 2667\,s \cong 45\ min$

$19 - \beta = 10 \log_{10}\left(\frac{I}{I_0}\right) \Rightarrow I = I_0 10^{\beta/10}$

$$I = \frac{P}{a} = \frac{1}{a}\left(\frac{E}{\Delta t}\right) = I_0 10^{\beta/10}$$

$$\therefore \Delta t = \frac{E}{a I_0 10^{\beta/10}} =$$

$$a = \frac{1}{2} \cdot (4\pi r^2) = 2\pi r^2$$

Daí: $\Delta t = \dfrac{0{,}10}{2\pi (0{,}08)^2 \cdot 10^{-12} \cdot 10^{9,3}} \cong 1246 s \cong$

$\cong 21 \text{ min}$

$20 - \quad T' = 2T$

$$\varepsilon_{med} = \frac{3}{2} k_B T \Rightarrow \varepsilon'_{med} = \frac{3}{2} k_B T' = \frac{3}{2} k_B \cdot (2T) =$$

$$= 2 \cdot \frac{3}{2} k_B T = \underline{\underline{2 \varepsilon_{med}}}$$

$$V_{rms} = \sqrt{\frac{3 k_B T}{m}} \Rightarrow V'_{rms} = \sqrt{\frac{3 k_B T'}{m}} = \sqrt{\frac{3 k_B \cdot (2T)}{m}} =$$

$$= \sqrt{2} \cdot \sqrt{\frac{3 k_B T}{m}} = \underline{\underline{\sqrt{2}\, V_{rms}}}$$

$\lambda = \dfrac{1}{4\sqrt{2}\pi (N/V) r^2} \Rightarrow$ não depende de T