GABARITO – PROVA OFICIAL – T.B – 2 2014. (1)

1ª Q)

$\rho_R = \frac{\rho_{GN}}{\rho_{padrão}} = 0,65$

$\rho_{padrão} = \rho_{ar}$ < 15°C, 10^5 Pa (abs)

$\rho_{ar} = \frac{10^5}{287 \times (273+15)} \Rightarrow \boxed{\rho_{ar} \cong 1,21 \frac{kg}{m^3}}$ → (0,5)

$\boxed{\rho_{GN} = 0,65 \times 1,21 = 0,7865 \frac{kg}{m^3}}$ (0,5) $\Rightarrow \gamma_{GN} = \rho_{GN} \times g$

$\gamma_{GN} = 0,7865 \times 9,8 \Rightarrow \boxed{\gamma_{GN} \cong 7,71 \frac{N}{m^3}}$ → (0,5)

$0,7865 = \frac{10^5}{R_{GN} \times 288} \Rightarrow \boxed{R_{GN} \cong 441,5 \frac{m^2}{s^2 K}}$ → (0,5)

2ª Q)

$p_m + 0,12 \times 1000 \times 9,8 + 0,36 \times 13600 \times 9,8 - 936 \times 1000 \times 9,8 + 0,2 \times 13600 \times 9,8$

$- 0,2 \times 1000 \times 9,8 = 95000$

$p_m + 1176 + 47980,8 - 3528 + 26656 - 1960 = 95000$

$\boxed{p_m = 24675,2 \text{ Pa}} \Rightarrow (1,5)$

$H_1 = H_2 + H_{p_1-2}$

(2)

$$z_1 + \frac{p_1}{\gamma} + \frac{v_1^2}{2g} = z_2 + \frac{p_2}{\gamma} + \frac{v_2^2}{2g} + H_{p_{1-2}}$$

$z_1 = z_2 = 0$ PHR

$v_1 = v_2 \Rightarrow$ mesmo diâmetro

$$\therefore \frac{p_1}{\gamma} = \frac{p_2}{\gamma} + H_{p_{1-2}} \Rightarrow H_{p_{1-2}} = \frac{p_1 - p_2}{1000 \times 9{,}8} = \frac{p_1 - p_2}{9800}$$

$$p_1 + 0{,}36 \times 1000 \times 9{,}8 - 0{,}36 \times 13600 \times 9{,}8 = p_2$$

$$p_1 - p_2 = 0{,}36 \times 9{,}8 \times (13600 - 1000) \therefore \boxed{p_1 - p_2 = 44452{,}8\ Pa}$$

↳ (0,5)

$$H_{p_{1-2}} = \frac{44452{,}8}{9800} \Rightarrow \boxed{H_{p_{1-2}} \simeq 4{,}536\ m \simeq 4{,}54\ m}$$

↳ (1,0)

3ª Q | a) $H_2 = 10\ m = z_2 + \frac{p_2}{\gamma} + \frac{v_2^2}{2g}$

$$10 = 0 + 2{,}03 + \frac{v_2^2}{19{,}6} \Rightarrow \boxed{v_2 \simeq 12{,}5\ m/s} \Rightarrow (0{,}25)$$

$$v_2 \times \frac{\pi \times D_2^2}{4} = v_1 \times \frac{\pi \times D_1^2}{4} \Rightarrow 12{,}5 \times 5^2 = v_1 \times 6^2 \Rightarrow \boxed{v_1 \simeq 8{,}7\ m/s}$$

↳ (0,25)

$H_1 + H_M = H_2 \Rightarrow H_{p_{1-2}}$ → já considerada no rendimento da máquina

$$z_1 + \frac{p_1}{\gamma} + \frac{v_1^2}{2g} + H_M = z_2 + \frac{p_2}{\gamma} + \frac{v_2^2}{2g}$$

$z_1 = z_2$.

$p_1 - p_2 = 3{,}6 \times (133280 - 9800) \Rightarrow$ **$p_1 - p_2 = 444528\ Pa$** $\Rightarrow$ (0,5)

$\frac{444528}{9800} + \frac{8{,}7^2}{19{,}6} + H_M = \frac{12{,}5^2}{19{,}6}$ ∴ **$H_M \simeq -41{,}25m \simeq -41{,}3m$**

∴ H_M < 0 é TURBINA (0,5)

$N_T = \gamma \times Q \times H_T \times \eta_T = 9800 \times 12{,}5 \times \frac{\pi \times 0{,}05^2}{4} \times 41{,}3 \times 98$

∴ **$N_T \simeq 7947{,}1W$** (0,5)

b) $H_0 = H_1 + H_{p_{0-1}}$

$z_0 + \frac{p_0}{\gamma} + \frac{v_0^2}{2g} = z_1 + \frac{p_1}{\gamma} + \frac{v_1^2}{2g} + H_{p_{0-1}}$.

$58 + 0 + 0 = 0 + \frac{p_1}{9800} + \frac{8{,}7^2}{19{,}6} + H_{p_{0-1}}$.

$p_1 - 2{,}03 \times 9800 = 444528 \Rightarrow$ **$p_1 = 464422\ Pa$** (0,25)

$58 = \frac{464422}{9800} + \frac{8{,}7^2}{19{,}6} + H_{p_{0-1}} \Rightarrow$ **$H_{p_{0-1}} \simeq 6{,}75m$** (0,25)

c) $H_2 = H_3 + H_{p_{2-3}}$

$z_2 + \frac{p_2}{\gamma} + \frac{v_2^2}{2g} = z_3 + \frac{p_3}{\gamma} + \frac{v_3^2}{2g} + H_{p_{2-3}}$.

$0 + 2{,}03 + \frac{12{,}5^2}{19{,}6} = -9 + 0 + 0 + H_{p_{2-3}}$

$H_{p_{2-3}} \simeq 19m$ (0,5)

(4)

4-a) $Q_{m3} = \rho_3 \times Q_3 \Rightarrow 66 = 998 \times Q_3$

$Q_3 \simeq 0,0661 \frac{m^3}{s} \simeq 66,1\ l/s \Rightarrow (0,25)$

$Q_3 = Q_1 + Q_2$

$Q_1 = v_1 \times \frac{\pi D_1^2}{4} = 5 \times \frac{\pi \times 0,04^2}{4} \Rightarrow$ (0,25)

$Q_1 \simeq 6,28 \times 10^{-3} \frac{m^3}{s}$ ou $Q_1 \simeq 6,28\ l/s$

$\therefore Q_2 = Q_3 - Q_1 = 66,1 - 6,28 \Rightarrow$ (0,5)

$Q_2 \simeq 59,82\ l/s$

$59,82 \times 10^{-3} = v_2 \times \frac{\pi \times 0,06^2}{4} \Rightarrow$

$v_2 \simeq 21,2\ m/s \Rightarrow (0,5)$

$Re_2 = \frac{v_2 \times D_2}{\nu} = \frac{21,2 \times 60 \times 10^{-3}}{10^{-6}} \Rightarrow$

$Re_2 \simeq 1\,272.000 \Rightarrow (0,25)$

L, ∴ TURBULENTO

$v_2 = \frac{49}{60} \times v_{max_2} \Rightarrow v_{max_2} = \frac{21,2 \times 60}{49}$

$v_{max_2} \simeq 26\ m/s \Rightarrow (0,25)$