## Exo 1

$$\frac{P_1}{\rho} + \frac{1}{2}v_1^2 + g z_1 = \frac{P_2}{\rho} + \frac{1}{2}v_2^2 + g z_2$$

$$S_1 v_1 = S_2 v_2 \Rightarrow v_2 = \frac{S_1 v_1}{S_2}$$

$$\left(\frac{P_1}{\rho} + \frac{1}{2}(v_1^2 - v_2^2)\right) = P_2$$

$$P_2 = P_1 + \frac{\rho}{2}\left(v_1^2 - \left(\frac{S_1 v_1}{S_2}\right)^2\right)$$

$$P_2 = P_1 + \frac{\rho}{2} v_1^2 \left(1 - \left(\frac{S_1}{S_2}\right)^2\right)$$

$$P_2 = 1,5 \times 1,013\times10^5 + \frac{1000}{2}(5,7)^2 \left(1 - \left[\frac{\frac{\pi d_1^2}{4}}{\frac{\pi d_2^2}{4}}\right]^2\right)$$

$$P_2 = 1,027 \times 10^5 \text{ Pa}$$

## Exo 2

ERs ① et ②

$$P_1 = P_2 + \rho g R$$

$$R = \frac{P_1 - P_2}{\rho g} \quad -①$$

ERs ② et ③ ; ① et ④

$$P_2 = P_3 + \rho g x \qquad P_1 = P_4 + \rho g y$$

$$P_1 - P_2 = P_4 + \rho g y - P_3 - \rho g x$$

$$P_1 - P_2 = P_4 - P_3 + \rho g (y - x)$$

$$P_1 - P_2 = P_4 - P_3 + \rho g R \quad -②$$

EB ③ et ④

$$P_3 + \frac{\rho}{2} v_3^2 + \rho g z_3 = P_4 + \frac{\rho}{2} v_4^2 + \rho g z_4$$

$$P_4 - P_3 = \frac{\rho}{2}(v_3^2 - v_4^2) \quad -③$$

$$S_3 v_3 = S_4 v_4$$

$$v_3 = \frac{S_4 v_4}{S_3} = \frac{\pi d^2}{4} v$$

$$Q_4 = S_4 v_4 \Rightarrow v_4 = \frac{Q_4}{S_4}$$

③ dans ②

$$P_1 - P_2 = \frac{\rho}{2}(v_3^2 - v_4^2) + \rho g R \quad -④$$

④ dans ①

$$R = \frac{\frac{\rho}{2}(v_3^2 - v_4^2) + \rho_a g R}{\rho_w g}$$

$$R\rho_w g - \rho_a g R = \frac{\rho_a}{2}(v_3^2 - v_4^2)$$

$$R(\rho_w g - \rho_a g) = \frac{\rho_a}{2}(v_3^2 - v_4^2)$$

$$R = \frac{\rho_a\left(\frac{Q^2}{S_3^2} - \frac{Q^2}{S_4^2}\right)}{2(\rho_w g - \rho_a g)}$$

$$R = \frac{1,225 \times \left(\frac{0,2^2}{(7,77\times10^{-3})^2} - \frac{6,2^2}{(0,63)^2}\right)}{2(1000\times9,81 - 1,225\times9,81)}$$

$$R = 0,037 \text{ m}$$

## Exo 3

$$Q_{V_1} = Q_{V_2} + Q_{V_3}$$

$$\text{EB} : P_4 + \frac{\rho}{2} v_4^2 + \rho g z_4 = P_1 + \frac{\rho}{2} v_1^2 + \rho g z_1$$

$$P_1 = P_4 + \rho g (z_4 - z_1) - \frac{\rho}{2} v_1^2$$

$$S_1 v_1 = S_2 v_2 + S_3 v_3$$

$$v_1 = \frac{S_2 v_2 + S_3 v_3}{S_1}$$

EB : ② et ④

$$P_2 + \frac{\rho}{2} v_2^2 + \rho g z_2 = P_4 + \frac{\rho}{2} v_4^2 + \rho g z_4$$

$$v_2^2 = \frac{2\rho}{\rho} g (z_4 - z_2)$$

$$v_2 = \sqrt{2g(z_4 - z_2)} = 11,71 \text{ m/s}$$

EB entre ③ et ④

$P_4 + \frac{\rho}{2} v_4^2 + \rho g z_4 = P_3 + \frac{\rho}{2} v_3^2 + \rho g z_3$

$v_3 = \sqrt{2g(z_4 - z_3)} = \sqrt{2 \times 9,81 \times 4}$

$= 8,85$ m/s

$v_1 = \frac{11,71 \times \left(\frac{\pi (0,03)^2}{4}\right) + 8,89 \cdot \left(\frac{\pi (0,02)^2}{4}\right)}{\frac{\pi (0,03)^2}{4}}$

$v_1 = 5,07$ m/s

$P_1 = 10^5 + (1000 \times 9,81 \times 7) - \frac{1000}{2} (5,07)^2 = 15,18 \times 10^4$ Pa

Exo 4s

EB entre A et $A_1$

$P_{A_0} + \frac{\rho}{2} v_{A_0}^2 + \rho g z = P_{A_1} + \frac{\rho}{2} v_{A_1}^2 + \rho g z$

$v_1 = \sqrt{(P_{A_1} - P_{A_0}) \frac{2}{\rho}}$

EHS :

$P_{A_1} = P_{atm} + \rho g H$

$P_{A_0} = P_{atm} + \rho g (H - h_1)$

$P_{A_1} - P_{A_0} = \rho g h_1$

$v_1 = \sqrt{\rho g h_1 \frac{2}{\rho}} = \sqrt{2 g h_1}$

$v_1 = \sqrt{2 \cdot 9,81 \times 9 \cdot 10^{-2}} = 4,2$ m/s

$Q_V = S v_1 = (300 \cdot 10^{-4}) \cdot 4,2$

$Q_V = 0,126$ m³/s

EB entre $A_1$ et A

$P_{A_1} + \frac{\rho}{2} v_{A_1}^2 + \rho g z = P_A + \frac{\rho}{2} v_1^2 + \rho g z$

$P_{A_1} = P_A + \frac{\rho}{2} v_1^2$

$P_{atm} + \rho g H = P_A + \frac{\rho}{2} v_1^2$

$H = \frac{1,3 \times 10^5 - 10^5 + \frac{1000}{2} (4,2)^2}{1000 \times 9,81}$

$H = 3,95$ m

3) EHS : ① et ②

$P_1 = P_2 + \rho_{Hg} g h_2 \Rightarrow h_2 = \frac{P_1 - P_2}{\rho_{Hg} g}$

EHS : ② et ④

$P_2 = P_4 - \rho_w g h_{4-2}$

EHS ③ et ①

$P_1 = P_3 - \rho_w g h_{3-1}$

EB : $P_1 - P_2 = P_3 - P_4 + \rho_w g (h_{4-2} - h_{3-1})$

$P_1 - P_2 = P_3 - P_4 + \rho_w g h_2$

EB ③ et ④

$P_3 + \frac{\rho}{2} v_3^2 + \rho g z_3 = P_4 + \frac{\rho}{2} v_4^2 + \rho g z_4$

$P_3 - P_4 = \frac{\rho_w}{2} (v_4^2 - v_3^2)$

$P_1 - P_2 = \frac{\rho_w}{2} (v_4^2 - v_3^2) + \rho_w g h_2$

$h_2 = \frac{\frac{\rho_w}{2} (v_4^2 - v_3^2) + \rho_w g h_2}{\rho_{Hg} \cdot g}$

$h_2 \rho_{Hg} g - \rho_w g h_2 = \frac{\rho_w}{2} (v_4^2 - v_3^2)$

$h_2 = \frac{\frac{\rho_w}{2} (v_4^2 - v_3^2)}{2(\rho_{Hg} g - \rho_w g)} = \frac{\rho_w \left(\frac{Q_V^2}{S_4^2} - \frac{Q_V^2}{S_3^2}\right)}{2(\rho_{Hg} g - \rho_w g)}$

$h_2 = 1000 \left(\frac{0,126^2}{(100 \times 10^{-4})^2} - \frac{0,126^2}{(800 \cdot 10^{-4})^2}\right) \frac{}{2(13600 \cdot 9,81 - 1000 \cdot 9,81)}$

$h_2 = 0,64$ m

Suite

Exo 1 :

cas de pompe :

$$\frac{P_2 - P_1}{\rho} + \frac{v_2^2 - v_1^2}{2} + g(z_2 - z_1) = \frac{P_{méc}}{Q_m}$$

case d'une turbine :

$$\frac{P_2 - P_1}{\rho} + \frac{v_2^2 - v_1^2}{2} + g(z_2 - z_1) = \frac{-P_{éle}}{Q_m}$$

1 $Q_m = \rho Q_v = 1000 \times \frac{2772 \cdot 10^{-3}}{3600}$

$Q_m = 0,77 \text{ kg/s}$

2 $Q_m = \rho S v$

$$v = \frac{Q_m}{\rho S} = \frac{0,77}{1000 \times \pi \frac{[31,6 \cdot 10^{-2}]^2}{4}}$$

$= 1,02 \text{ m/s}$

3 - EB entre (A) et (B)

$$\frac{P_B - P_A}{\rho} + \frac{v_B^2 - v_A^2}{2} + g(z_B - z_A) = \frac{P_{méc}}{Q_m}$$

$$P_{méc} = 0,77 \times \left[\frac{[1 \times 10^5 - 2 \times 10^5]}{1000} + g(30 + 26)\right] = 346 \text{ watt}$$

4 - $\eta = \frac{P_{méc}}{P_{élec}} \Rightarrow P_{éle} = \frac{P_{méc}}{0,8}$

$P_{éle} = 432,5 \text{ watt}$

Exo 2 :

$$\frac{P_2 - P_1}{\rho} + \frac{v_2^2 - v_1^2}{2} + g(z_2 - z_1) = \frac{-P_{éle}}{Q_m}$$

$$P_{éle} = -Q_m \left(\frac{P_2 - P_1}{\rho} + \frac{v_2^2 - v_1^2}{2} + gh\right)$$

$P_{éle} = -175(-9,81 \times 30)$

$= -60086 \text{ watt}$

$\eta = \frac{P_{éle}}{P_m} \Rightarrow P_m = \frac{P_{éle}}{\eta} = -85837,5 \text{ watt}$