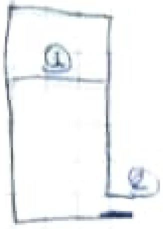
1) $\frac{P_1}{\rho g} + \cancel{\frac{V_1^2}{2g}}^{\,0} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + \cancel{z_2}^{\,0}$



$$V_2 = \sqrt{\frac{2(P_1 - P_2)}{\rho} + 2 g z_1}$$

$$= \sqrt{\frac{2(250-100)\times 10^3}{1000} + 2 . 9{,}81\, 2{,}5}$$

$$= \sqrt{\frac{2(250-100)\times 1000}{1000} + 49{,}05}$$

$$V_2 = 18{,}68\ m/s$$

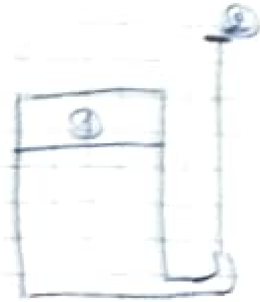
$$\dot{V} = A V = \frac{\pi D^2}{4} V = \frac{\pi (0{,}1)^2}{4} . 18{,}68$$

$$\boxed{\dot{V} = 0{,}146\ m^3/s}$$

TRANE

2) 1 atm = 100 kPa

$$\frac{P_1}{\rho g} + \overset{0}{\cancel{\frac{V_1^2}{2g}}} + z_1 = \frac{\overset{P_{atm}}{P_2}}{\rho g} + \overset{0}{\cancel{\frac{V_2^2}{2g}}} + z_2$$



$$z_2 = \frac{P_1 - P_2}{\rho g} + z_1 = \frac{P_1 - P_{atm}}{\rho g} + z_2$$

$$P_{1,\text{efektif}} = P_1 - P_{atm} = 200\,kPa$$

$$\frac{200 \times 1000}{1000 \times 9{,}81} + 20$$

$$\boxed{z_2 = 40{,}39\,m}$$

TRANE

5) $$\frac{P_1}{\rho g} + \cancel{\alpha_1 \frac{V_1^2}{2g}} + \cancel{z_1} + \cancel{h_{pompa}} = \frac{P_2}{\rho g} + \cancel{\alpha_2 \frac{V_2^2}{2g}} + \cancel{z_2} + \cancel{h_{turbin}} + h_L$$

$V_1 = V_2$ $z_1 = z_2$ 0 $V_1 = V_2$ $z_1 = z_2$ 0

$z_1 = z_2$

$V_1 = V_2$

$$h_L = \frac{P_1 - P_2}{\rho g} = \frac{\Delta P}{\rho g}$$

$$h_L = \frac{2 \times 1000}{1000 \times 9{,}81} = 0{,}204 \text{ m}$$

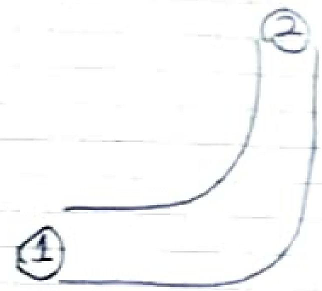
$$W_{pompa} = m g h_L = \rho v g h_L$$

$$= \underset{\rho}{1000} \cdot \underset{g}{9{,}81} \cdot \underset{v}{20 \times 10^{-3}} \cdot \underset{h_L}{0{,}204}$$

$$\boxed{W_{pompa} = 40 \text{ W}}$$

b)

$$\frac{P_1}{\rho g} + \cancel{\frac{V_1^2}{2g}} + \cancel{z_1}^{0} = \frac{P_2}{\rho g} + \cancel{\frac{V_2^2}{2g}} + z_2 \qquad V_1 = V_2$$



$V_1 = V_2$

$$\frac{P_1 - P_2}{\rho g} = z_2$$

$$P_1 - P_2 = \rho g z_2$$

$$= 1000 \times 9{,}81 \times 0{,}5$$

$$P_1 - P_2 = 4{,}9 \text{ kPa}$$

$$\boxed{P_{1,etkin} = 4{,}9 \text{ kPa}}$$

$$P_1 - P_2 = P_1 - P_{atm} = P_{1,etkin}$$

$$\Sigma F = \sum_{çıkış} \beta \dot{m} V - \sum_{giriş} \beta \dot{m} V$$

$$F_{Rx} + P_{1,etkin} A = 0 - \beta \dot{m} V$$

$$F_{Ry} = \beta \dot{m} V - 0$$

$$V_1 = V_2 = V = \frac{\dot{m}}{\rho A} = \frac{\dot{m}}{\rho \pi D^2 / 4}$$

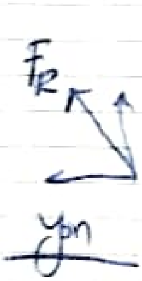
$$F_{Rx} = -\beta \dot{m} V - P_{1,etkin} \cdot A$$

$$F_{Rx} = -1{,}03 \times 40 \times 5{,}09 - 4{,}9 \times 1000 \times \left(\frac{\pi (0{,}1)^2}{4}\right)$$

$$V = \frac{40}{1000 \pi (0{,}1)^2 / 4} = 5{,}09 \text{ m/s}$$

$$F_{Rx} = -209{,}7 - 38{,}465$$

$$F_{Rx} = -248{,}16 \text{ N} \leftarrow$$



$$F_{Ry} = \beta \dot{m} V$$

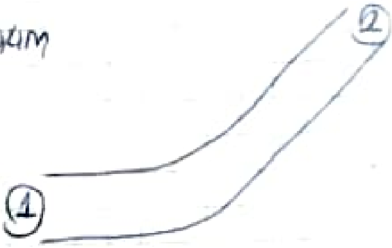
$$F_{Ry} = 1{,}03 \times 40 \times 5{,}09$$

$$F_{Ry} = 209{,}7 \text{ N} \uparrow$$

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} = \sqrt{248{,}16^2 + 209{,}7^2}$$

$$F_R = 324{,}9 \text{ N}$$

7) $$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + \cancel{z_1}^{\,0} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2 \quad \text{atm}$$



$$V_1 = \frac{\dot m}{\rho A_1} = \frac{30}{1000 \times 150 \times 10^{-4}} = 2 \text{ m/s}$$

$$V_2 = \frac{\dot m}{\rho A_2} = \frac{30}{1000 \times 25 \times 10^{-4}} = 12 \text{ m/s}$$

$$\underbrace{P_1 - P_2}_{P_1 - P_{atm}} = \rho g \left(\frac{V_2^2 - V_1^2}{2g} + z_2 \right)$$

$$P_{1,etkin} = 1000 \times 9{,}81 \left(\frac{12^2 - 2^2}{2 \times 9{,}81} + 0{,}4 \right)$$

$$P_{1,etkin} = 73{,}9 \text{ kPa}$$

$$\Sigma F = \sum_{\text{çıkış}} \beta \dot m V - \sum_{\text{giriş}} \beta \dot m V$$

$$F_{R,x} + P_{1,etkin} \cdot A_1 = \beta \dot m V_2 \cos\theta - \beta \dot m V_1$$

$$F_{R,x} + 73{,}9 \times 10^3 \times 150 \times 10^{-4} = 1{,}03 \times 30 \times 12 \times \cos 45 - 1{,}03 \times 30 \times 2$$

$$F_{R,x} = -908 \text{ N} \leftarrow$$

$$F_{R,y} - W = \beta \dot m V_2 \cdot \sin\theta - 0$$

$$F_{R,y} - 50 \times 9{,}81 = 1{,}03 \times 30 \times 12 \times \sin 45$$

$$F_{R,y} = 753 \text{ N} \uparrow$$

$$F_R = \sqrt{F_{R_x}^2 + F_{R,y}^2} = \sqrt{908^2 + 753^2}$$

$$\boxed{F_R = 1180 \text{ N}}$$