



a) $Q_1 = 90.9 \text{ l/s} = 0.0909 \frac{\text{m}^3}{\text{s}} = Q_2 = Q = A_3 \cdot V_3 \quad V_3 = \frac{0.0909}{0.071} = 1.29 \frac{\text{m}}{\text{s}} \quad A_3 = \frac{0.3^2 \cdot 3.14}{4} = 0.071 \text{ m}^2$
 $\Pi_A = 2.53 \text{ m}$

$$\Pi_0 + \frac{V_0^2}{2g} = \Pi_A + \frac{V_A^2}{2g} + \Delta E_{0-A}$$

$$\Pi_0 = 2.53 + \zeta_{ul} \cdot \frac{V_3^2}{2g} + \frac{\lambda_3 \cdot L_3 \cdot V_3^2}{D_3 \cdot 2g} + \zeta_{kor} \cdot \frac{V_3^2}{2g} + \zeta_{zat} \cdot \frac{V_3^2}{2g} + \zeta_{kor} \cdot \frac{V_3^2}{2g} + \zeta_{ul} \cdot \frac{V_3^2}{2g}$$

$$\Pi_0 = 2.53 + 0.5 \cdot \frac{1.29^2}{19.62} + \frac{0.025 \cdot 800 \cdot 1.29^2}{0.3 \cdot 19.62} + 0.2 \cdot \frac{1.29^2}{19.62} + \zeta_{zat} \cdot \frac{1.29^2}{19.62} + 0.2 \cdot \frac{1.29^2}{19.62} + \frac{1.29^2}{19.62}$$

$$\Pi_0 = 2.53 + 0.042 + 5.68 + 0.017 + \zeta_{zat} \cdot 0.085 + 0.017 + 0.085$$

$$25.3 = 8.371 + \zeta_{zat} \cdot 0.085 \quad 16.93 = \zeta_{zat} \cdot 0.085 \quad \boxed{\zeta_{zat} = 199.16}$$

b) $S = 2 \text{ d kW} = 2 \cdot 25.3 = 50.6 \text{ kW}$

$$H_p = E_2 - E_1$$

$$E_1 = \Pi_A - \zeta_{ul} \cdot \frac{V_1^2}{2g} - \frac{\lambda_1 \cdot L_1 \cdot V_1^2}{D_1 \cdot 2g}$$

$$E_1 = 2.53 - 0.5 \cdot \frac{0.46^2}{19.62} - \frac{0.015 \cdot 100 \cdot 0.46^2}{0.5 \cdot 19.62}$$

$$E_1 = 2.53 - 0.0054 - 0.032 \quad E_1 = 2.49 \text{ m}$$

$$E_2 = \Pi_0 + \frac{\lambda_2 \cdot L_2 \cdot V_2^2}{D_2 \cdot 2g} + \frac{V_2^2}{2g}$$

$$E_2 = 25.3 + \frac{0.025 \cdot 500 \cdot 1.28^2}{0.3 \cdot 19.62} + \frac{1.28^2}{19.62}$$

$$E_2 = 25.3 + 3.48 + 0.084 \quad E_2 = 28.86 \text{ m}$$

$$Q = A_1 V_1, \quad A_1 = \frac{0.5^2 \cdot 3.14}{4} = 0.196 \text{ m}^2$$

$$V_1 = \frac{0.0909}{0.1962} = 0.46 \frac{\text{m}}{\text{s}}$$

$$Q = A_2 V_2, \quad A_2 = \frac{0.3^2 \cdot 3.14}{4} = 0.071 \text{ m}^2$$

$$V_2 = \frac{0.0909}{0.071} = 1.28 \frac{\text{m}}{\text{s}}$$

$$H_p = E_2 - E_1 = 28.86 - 2.49$$

$$\boxed{H_p = 26.37 \text{ m}}$$

$$S = \frac{\rho \cdot g \cdot Q \cdot H_p}{\eta} \Rightarrow \eta = \frac{\rho \cdot g \cdot Q \cdot H_p}{S}$$

$$\eta = \frac{9.81 \cdot 0.0909 \cdot 26.37}{50.6} = 0.46$$

