Ex1:

1- $Re = \frac{\rho V D}{\mu} = \frac{VD}{\nu} = \frac{\frac{Q_v}{S} \times D}{\nu} = \frac{\frac{4 \times 19 \times 10^{-3}}{\pi (20 \times 10^{-2})^2} \times 20 \times 10^{-2}}{118 \times 10^{-6}}$

$Re = 1016$

$V = \frac{Q_v}{S} = 0,6$

The flow is laminar

$\Delta h_L = \frac{\lambda L v^2}{2Dg} = \frac{64}{Re} \times \frac{1 \times 10^3 \times (0,6)^2}{2 \times 9,81 \times 20 \times 10^{-2}}$

$\boxed{\Delta h_L = 5,5 m}$

2- $Re = \frac{\rho V D}{\mu} = \frac{1000 \times 2 \times 0,3}{10^{-3}}$

$Re = 6 \times 10^5$

The flow is turbulent

$\Delta h_L = \lambda \frac{L v^2}{2gD}$

$\lambda = 0,79 \sqrt{\frac{\varepsilon}{d}} = 0,79 \sqrt{\frac{2 \times 10^{-3}}{0,3}}$

$\lambda = 0.065$

$\Delta h_L = 0,065 \times \frac{10^3 (2)^2}{2 \times 9,81 \times 0,3} = 40,77 m$

Ex2:

EBG

$P_A + \frac{1}{2}\rho v_A^2 + \rho g z_A = P_2 + \frac{1}{2}\rho v_2^2 + \rho g z_2 + \Sigma \Delta P_L + \Sigma \Delta P_S$

$P_A = P_2 + \frac{\rho}{2}(v_2^2 - v_A^2) + \rho g z_2 + \Sigma \Delta P_L + \Sigma \Delta P_S$

$\Delta P_S = k_c \frac{\rho v_m^2}{2} = 0,5 \times \frac{1000 \times 1,5^2}{2}$

$\Delta P_S = 3062 Pa$

$\Sigma \Delta P_L = \Delta P_1 + \Delta P_2 = \lambda \frac{L v_1^2}{2 D_1} \rho + \frac{\lambda L v_2^2}{2 D_2} \rho$

$Re_1 = \frac{v D_1}{\nu} = \frac{1,75 \times (30 \times 10^{-2})}{1,3 \times 10^{-6}}$

$Re_1 = 4.038 \times 10^5$

$Re_2 = \frac{v_2 D_2}{\nu} = \frac{3,5 \times (10 \times 10^{-2})}{1,3 \times 10^{-6}}$

$Re_2 = 2,69 \times 10^5$

The regime is turbulent.

$\lambda_1 = 0,79 \sqrt{\frac{\varepsilon}{d}} = 0,79 \sqrt{\frac{0,3 \times 10^{-3}}{30 \times 10^{-2}}}$

$\lambda_1 = 0,02$

$\lambda_2 = 0,79 \sqrt{\frac{\varepsilon}{d}} = 0,79 \sqrt{\frac{0,3 \times 10^{-3}}{10 \times 10^{-2}}}$

$\lambda_2 = 0,04$

$\Sigma \Delta P_L = 0,02 \times \frac{4 \times 1,75^2}{2(30 \times 10^{-2})} 1000 + 0,04 \frac{3 \times 3,5^2}{2 \times (10 \times 10^{-2})} \times 1000$

$= 7758,33 Pa$

$P_A = 10^5 + \frac{1000}{2}(3,5^2 - 1,75^2) + 1000 \times 9,81 \times 3 + 7758,33 + 3062,5 = 144844,58 Pa$

Ex3:

1- $Q_v = SV \Rightarrow V = \frac{Q_v}{S} = \frac{4 Q_v}{\pi d^2}$

$= \frac{4 \times 2,51 \times 10^{-3}}{\pi \times (100 \times 10^{-3})^2} = 0,319 m/s$

2- $Re = \frac{\rho V D}{\mu} = \frac{0,896 \times 1000 \times 0,319 \times 100 \times 10^{-3}}{0,7}$

$Re = 40,7$

3- Laminar

4- $\lambda = \frac{64}{40,7} = 1,57$

5- $\Delta P_L = \Sigma \Delta P_L = \rho (L_{AB} + L_{CD} + L_{EF} + L_{HG} + L_{IJ} + L_{KL} + L_{MN}) \frac{0,319}{2 \times 10^{-2}} \times \frac{v^2}{2}$

$= 0,896 \times 1000 (6 + 12 + 5 + 4 + 7 + 7) \frac{0,319}{2 \times 10^{-2}} \times \frac{v^2}{2}$

$\Delta P_L = 2,35 \times 10^6$ Pa

6. $\Delta P_s = \sum \Delta P_s$

$= f \left(2k_{bend\,45} + 2k_{bend\,90} + k_{bend\,180} \right) \frac{v^2}{2}$

$= 1000 \times 0,896 \,(1,4) \times \frac{0,318}{2}$

$\Delta P_s = 63,42$ Pa

7. EB

$$P_1 + \frac{\rho v_1^2}{2} + \rho g z_1 = P_2 + \frac{\rho v_2^2}{2} + \rho g z_2 + \sum \Delta P_s + \sum \Delta P_L$$

$$P_L = P_2 = P_1 + \rho g (z_1 - z_2) - \sum \Delta P_s - \sum \Delta P_L$$