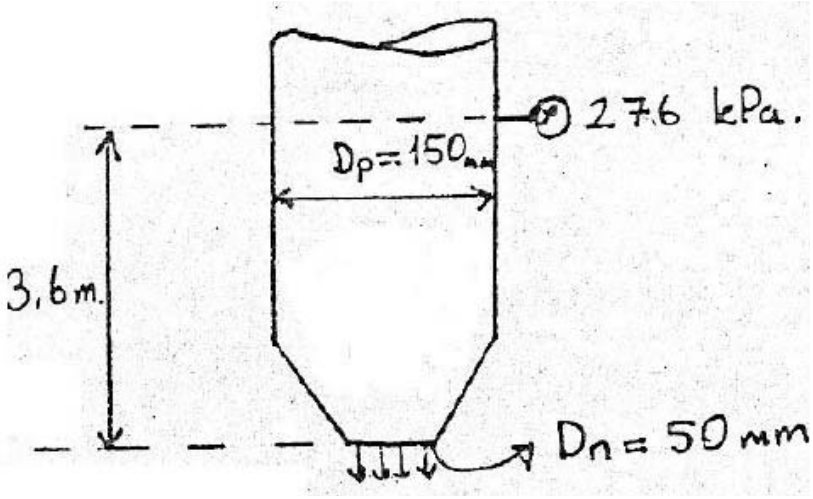
PROBLEM SET-1

Important Note: This problem set is for your own studies and it will not be collected.

In all problems below you can use $\nu_{water} = 1\times10^{-6}$ m^2/s and $\nu_{oil} = 5\times10^{-5}$ m^2/s

1) A 50 mm diameter nozzle terminates a vertical 150 mm pipeline in which water flows downward. At a point on the pipeline a pressure gage reads 276 kPa. If this point is 3.60 m above the nozzle tip and the headloss between the point and tip, is 1.50 m, calculate the flowrate.

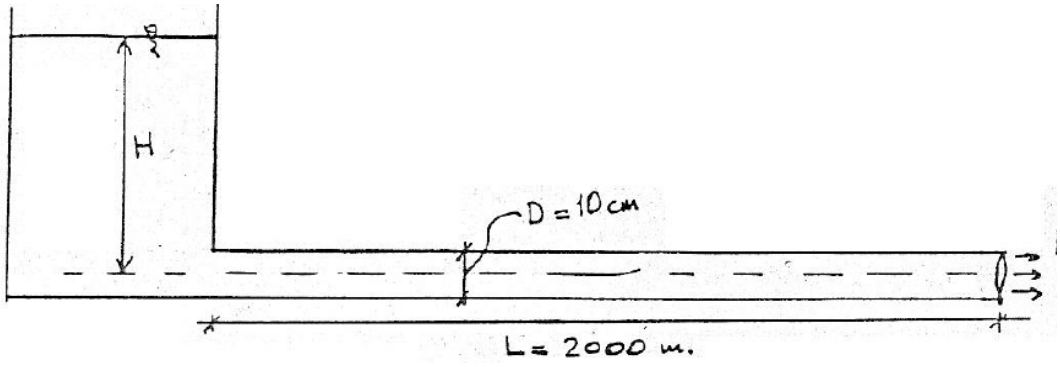


2) The velocity distribution for fully-developed laminar flow in a pipe is given by

$$V_x = -\frac{R^2}{4\mu}\frac{dh}{dx}\left[1-\left(\frac{r}{R}\right)^2\right] \quad \text{where } h = \left(\frac{P}{\gamma}+z\right)$$

Determine the radial distance from the pipe axis at which the velocity equals the average velocity

3) A reservoir is discharged into atmosphere through a pipe of 10 cm diameter and 2000 m length. The discharge is 1.50 lt/sec. The kinematic viscosity and the specific weight of the liquid are 0.12 cm^2/sec and 0.8 t/m^3. Determine the state of the flow and depth in the reservoir (Neglect the entrance loss).



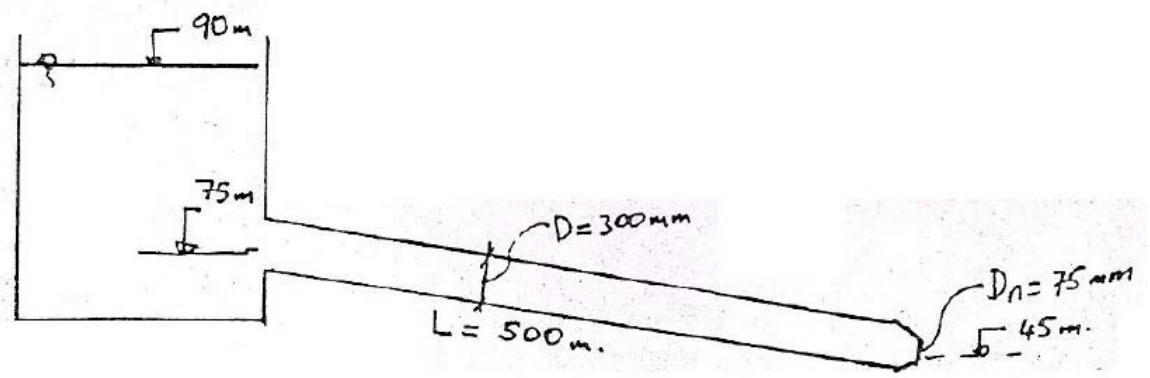
4) If the headloss in a smooth pipe, which has a length and diameter of 150 m and 75 mm respectively, is 21 m when the flowrate is 8.5 lt/sec. Is the flow laminar or turbulent ?

5) The same fluid (problem 4) flows through 300 m-length and 75 mm diameter and 300 m-length and 100 mm diameter smooth pipes. The two flows are adjusted so that their Reynolds numbers are the same. What is the ratio between their head losses?

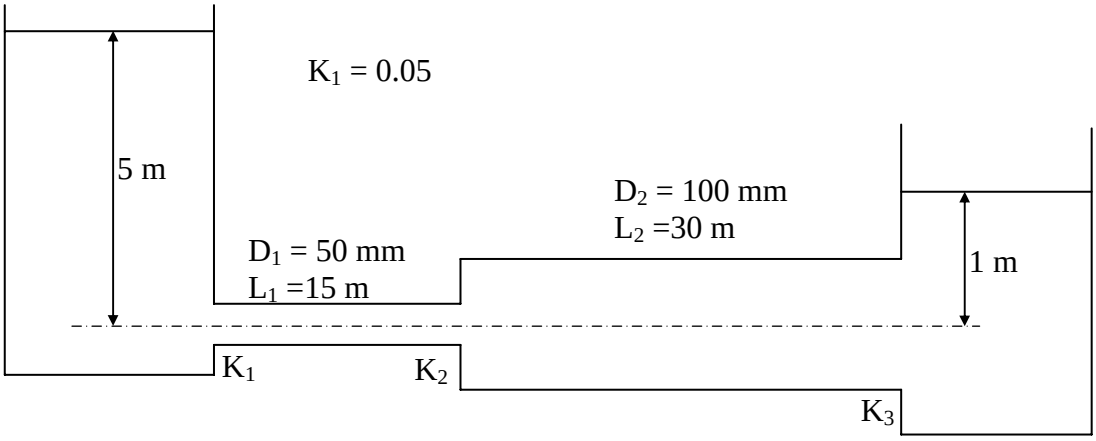
6) In a laminar flow of 0.007 m^3/s in a 75 mm- diameter pipeline the shearing stress at the pipe wall is known to be 47.9 kPa. Calculate the viscosity of the fluid

7) Water flows through a diameter of 300 mm inclined pipeline 300 m long running from elevation 90 m to 75 m. A pressure gage at elevation 90 m reads 275 kPa and one at elevation 75 m reads 345 kPa. Calculate head loss, direction of flow, and shear stress at the pipe wall and 75 mm from the pipe wall.

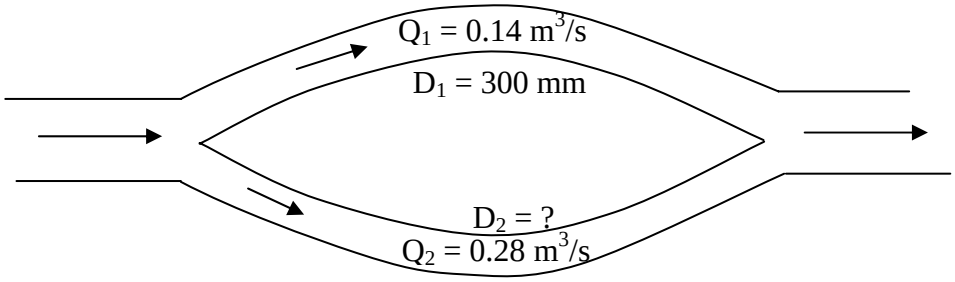
8) A diameter of 300 mm pipe leaves a reservoir with a surface elevation of 90 m at elevation 75 m and drops to elevation 45 m, where it terminates in a 75 mm –diameter nozzle. If the total head loss through the line and nozzle is 9 m, calculate the flow rate.



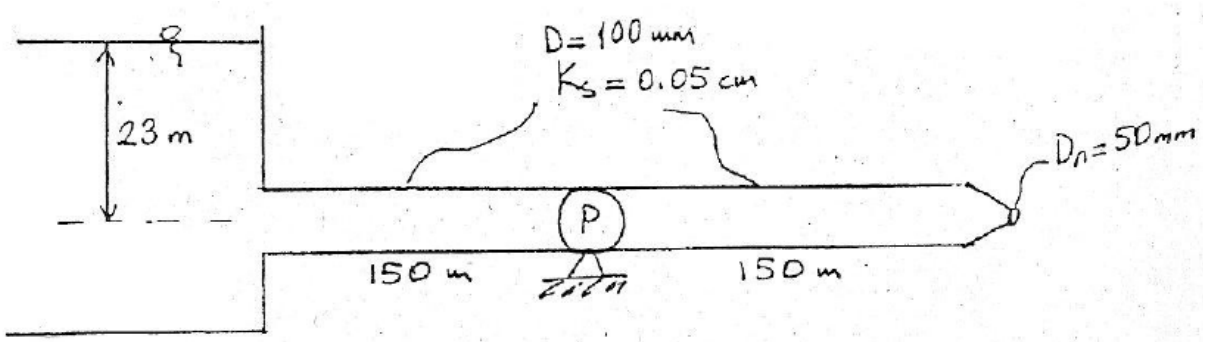
9) Calculate the flowrate of water through the cast iron pipeline shown in the figure below. Include all head losses.



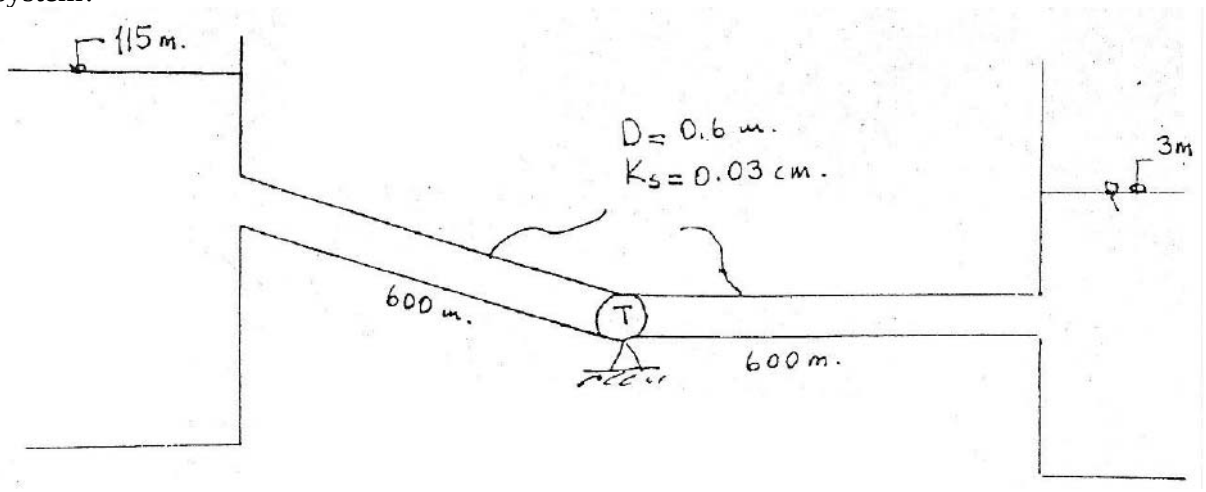
10) Water flows in the parallel pipeline system shown below. In the first pipe the discharge is 0.140 m^3/s and the diameter is 0.30 m. Both pipes are smooth and have equal lengths. Calculate the diameter of the second pipe which should carry 0.280 m^3/s.



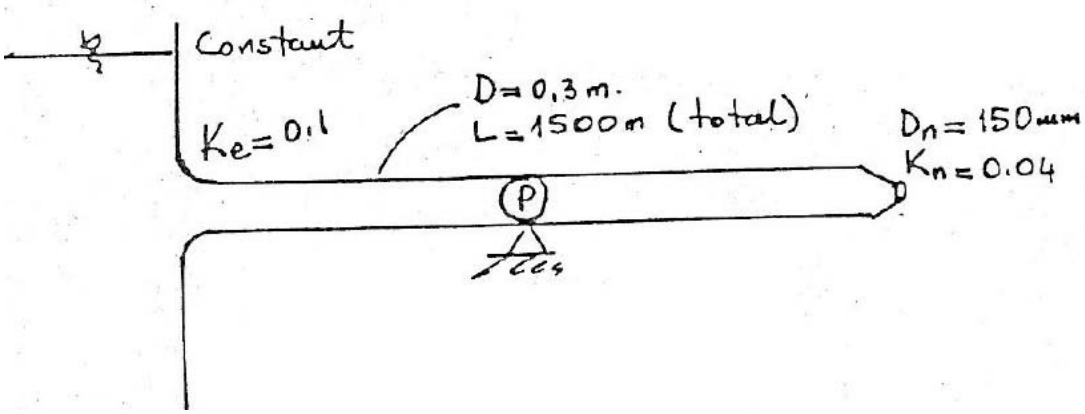
11) The pump is required to mantain the flowrate which would have occured without any friction. Calculate the required pump power by neglecting minor losses.



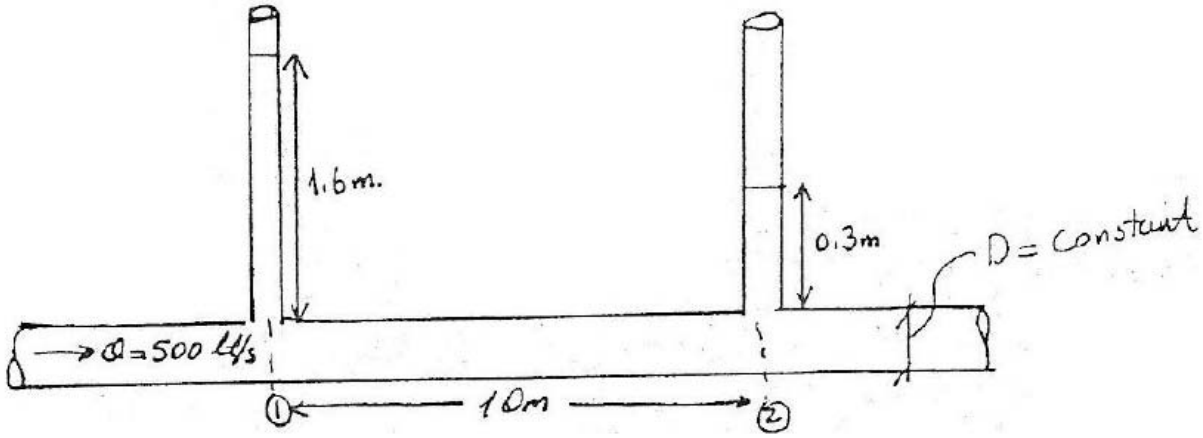
12) If the turbine extracts 400 kW from the flow, what flowrate must be passing through the system?



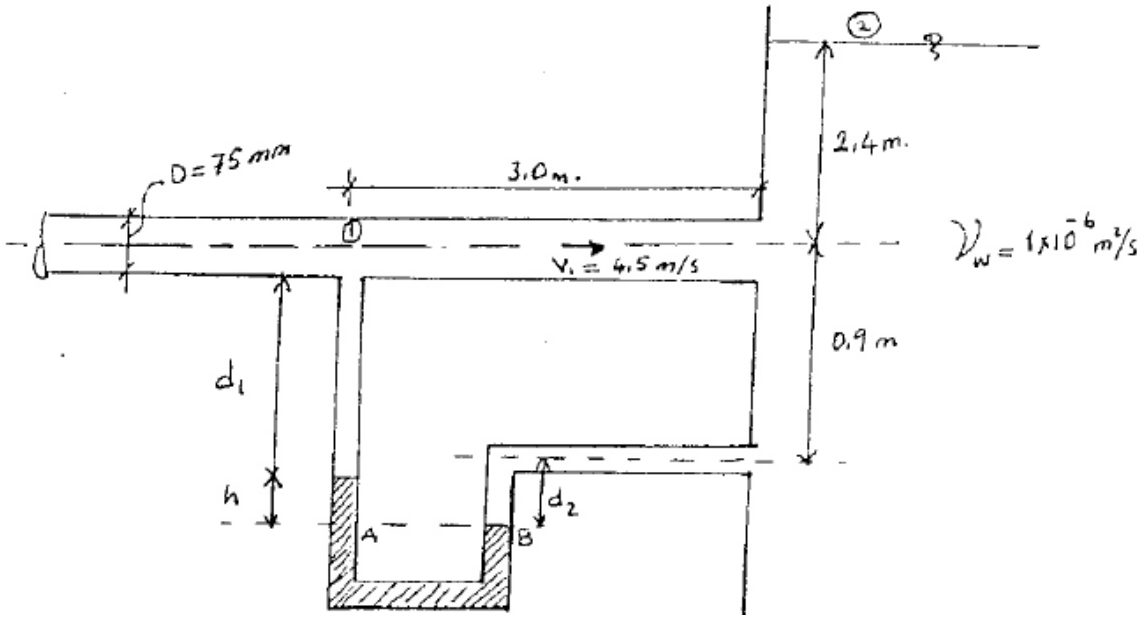
13) The flowrate through the following pipeline and nozzle system when there is no pump is 0.28 m^3/s. How much power must be supplied by the pump to produce the same flowrate with a 100 mm diameter nozzle at the end of the line? The pipe is galvanized iron.



14) Water is flowing with a flow rate of 500 lt/sec. Determine the diameter of the commercial steel pipe.



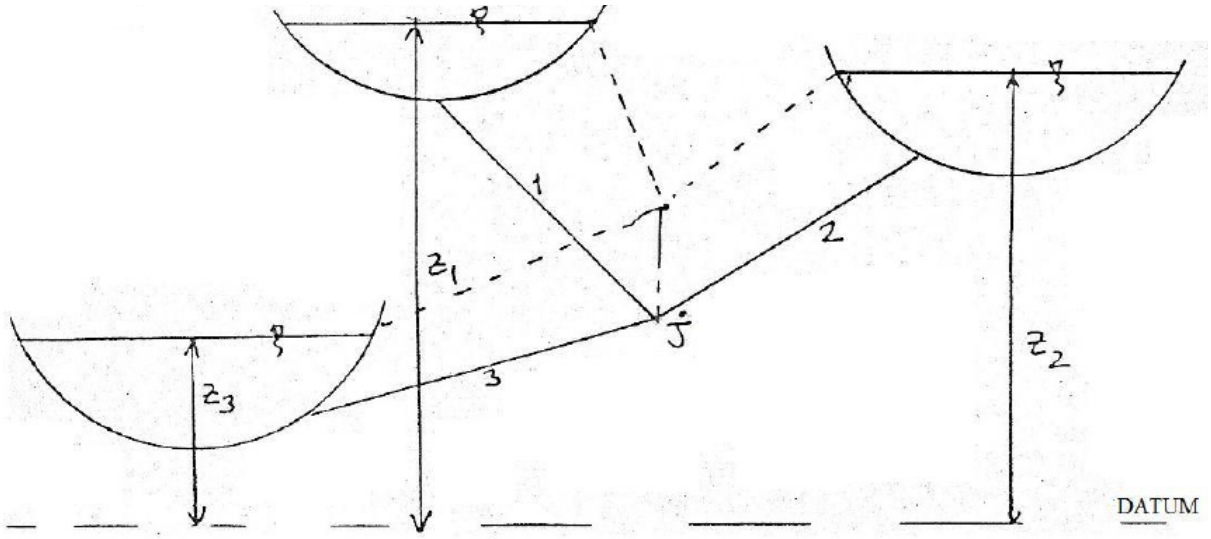
15) Calculate the magnitude and the direction of the manometer reading for the smooth pipe section given in the below figure.



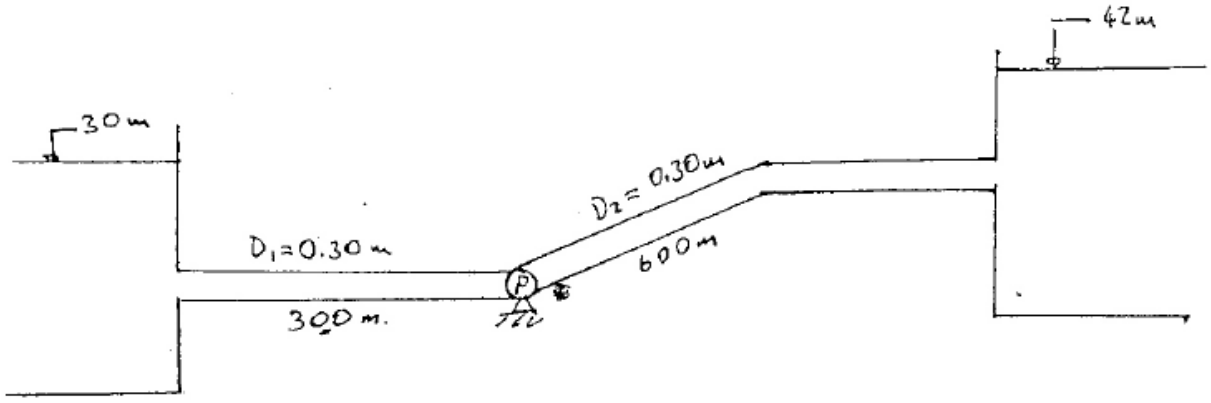
16) Water flows through a smooth pipe of 3 cm diameter with a pressure drop of 1.41 kgf/cm^2 along 70 m length. Calculate the flow rate.

17) In the figure below find the discharges for water with the following pipe data and reservoir elevations

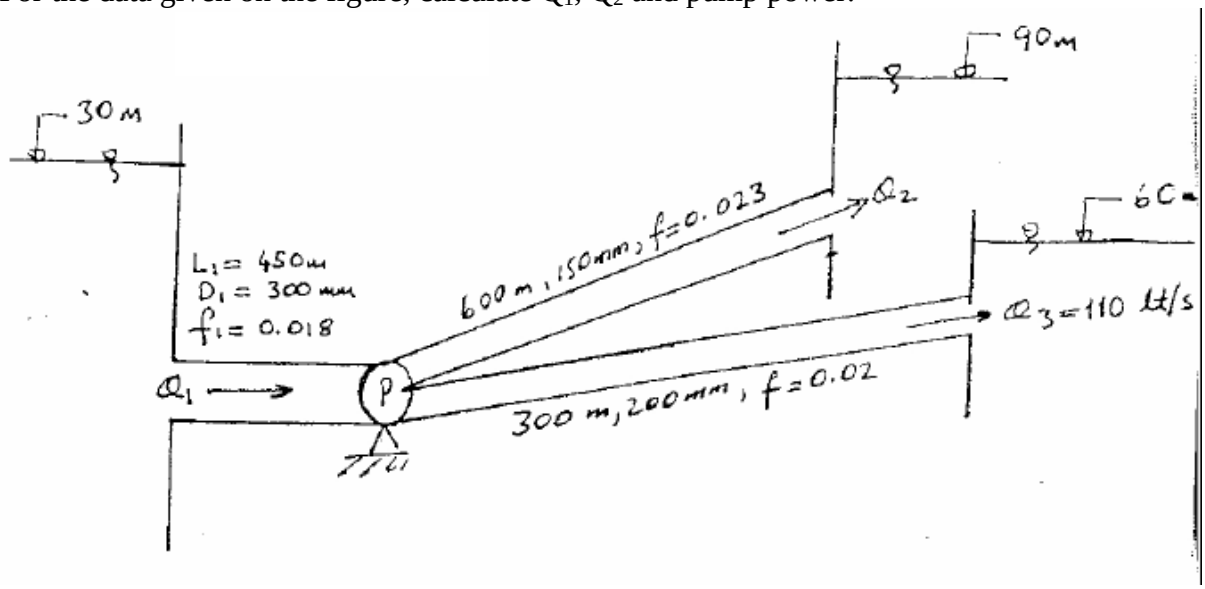
L_1 = 300 m	D_1 = 1 m	k_{s1}/D_1 = 0.0002
L_2 = 600 m	D_2 = 0.45 m	k_{s2}/D_2 = 0.002
L_3 = 1000 m	D_3 = 0.60 m	k_{s3}/D_3 = 0.001



18) If there is no pump, 0.14 m^3/s of water would flow through this pipe system. Calculate the pump power required to mantain the same flow rate in the opposite direction.



19) By the help of a pump, water is delivered from the main reservoir two service reservoirs. For the data given on the figure, calculate Q_1, Q_2 and pump power.



20) Considering the below system, calculate the flow rates and draw EGL

L_1 = 150 m	D_1 = 0.50 m	k_{s1} = 0.05 mm
L_2 = 150 m	D_2 = 0.25 m	f_2 = 0.015
L_3 = 300 m	D_3 = 0.40 m	f_3 = 0.015
L_4 = 400 m	D_4 = 0.20 m	f_4 = 0.015
L_5 = 200 m	D_5 = 0.50 m	f_5 = 0.015