Problem 7.1: A horizontal pipeline has a diameter of 0.1 m. Water is pumped through this pipeline with a mean velocity V=1.35 m/sec. Kinematic viscosity index of water $\nu=10^{-7}$ m^2/sec. Roughness of the boundary a=1.5 10^{-4} m.

a) What difference in head can be read from two manometers that are connected to the pipe and of which the distance between the points of connection equals to 100 m.

b) Same question for a liquid with a viscosity index. $\nu=10^{-5}$ m^2/s

c) Same question for a liquid with a viscosity index. $\nu=10^{-4}$ m^2/s

Problem 7.2: In a welded steel oil line (diameter 0.6m), pumps are spaced 10 km apart. The pumps are working a difference in pressure head of 25 m oil column. Calculate the discharge. Density of the oil is $\rho=800$ kg/m^3, kinematic viscosity is $\nu=10^{-4}$ m^2/s, boundary roughness is $a=5\times10^{-5}$ m. In the course of time, the roughness of the pipe (expressed in terms of roughness length will grow 3×10^2 times the original value. Will the discharge be influenced by this? If so, how much (in %) will the reduction (approximate) be?

Problem 7.3: Find the discharge of the pipe system shown in Figure 7.3 and if the diameter of the system is converted into ϕ150 mm find the length of the pipe of the system.

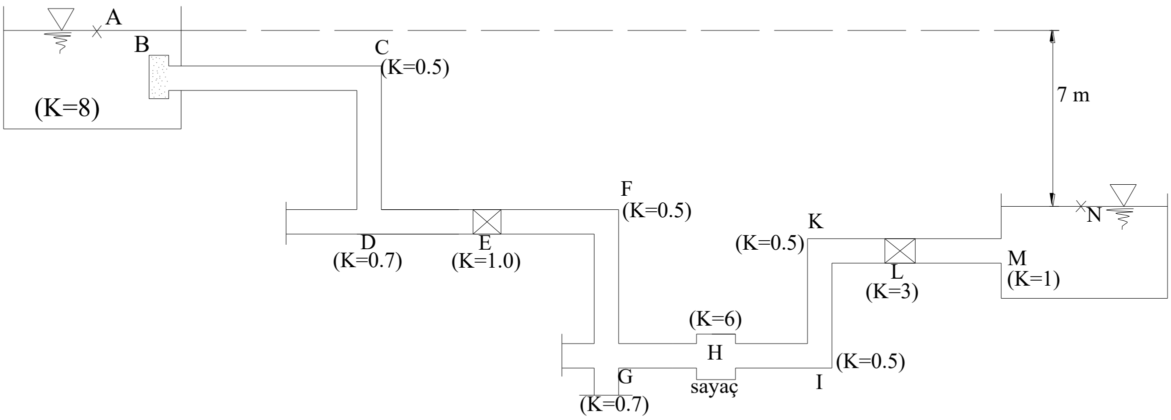

Figure 7.3

Problem 7.4: Determine the discharge for system as given in Figure and calculate the pressures at Points A, B, C, D. Head loss per unit length and head loss at the nozzle may be calculated with using equations of $\left(\frac{0.1\,V^2}{2g}\right)$ and $\left(\frac{3V^2}{2g}\right)$, respectively. Neglect the head losses at elbows and entrance.

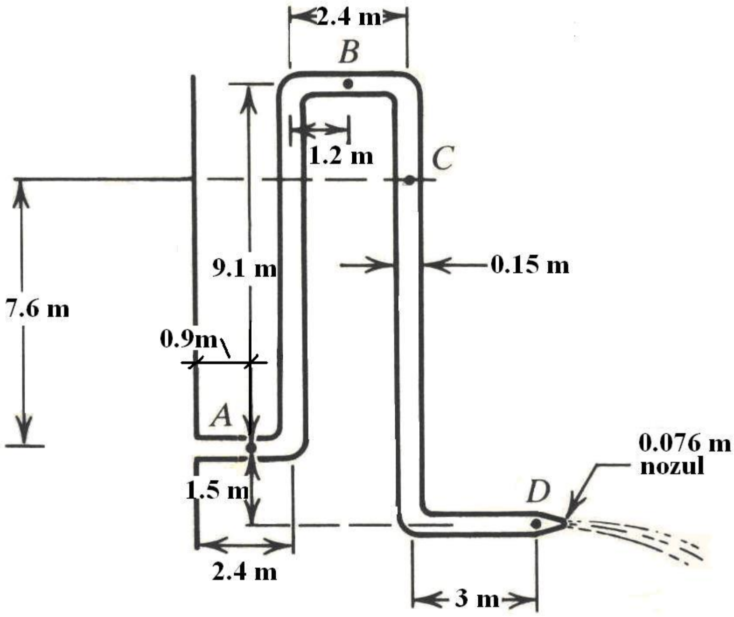

Figure 7.4

Problem 7.5: A fluid with a kinematic viscosity $\nu=15\times10^{-7}$ m^2/s flows in the pipe system in Figure 7.5. The roughness of the pipe is k=0.001 m and the minor head loss coefficients of the system are known as $K_{contraction.}=0.21$ $K_{entrsnce}=0.05$. Find the discharge of the system by using Moody diagram.

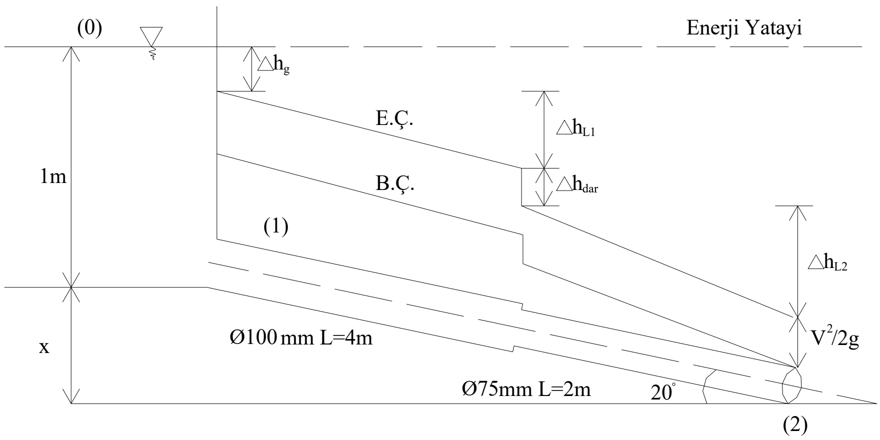

Figure 7.5

Problem 7.6: Water flows from the reservoir A to reservoir B in the Figure 7.6. The elevation difference between the reservoirs is $\Delta h=5.00$ m. Find the discharge. Draw the energy and hydraulic grade line. ($g=10$ m/s^2, $\nu=10^{-6}$ m^2/s)

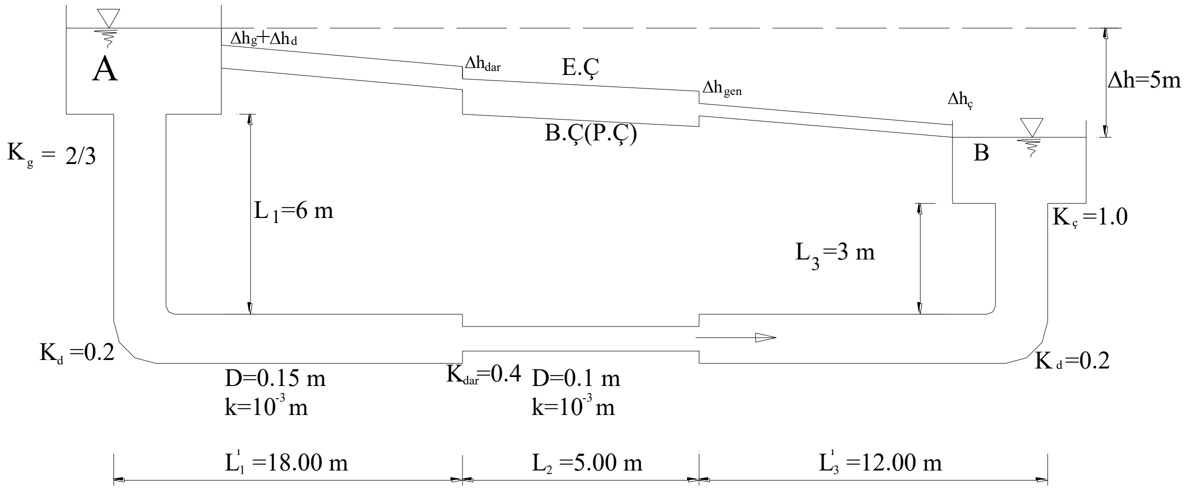

Figure 7.6

Problem 7.7: A fluid is pumped from a pressurized tank with a pump that is placed 4.5 m higher elevation from the fluid surface of the pressurized tank to an open tank 3 m below the fluid surface of the pressurized tank. If the pump adds 1.5 kW to the system determine the discharge and the pressure at point A. If the vaporization pressure of the fluid is 3 N/cm^2 (absolute pressure), show if the fluid evaporate or not at this point.

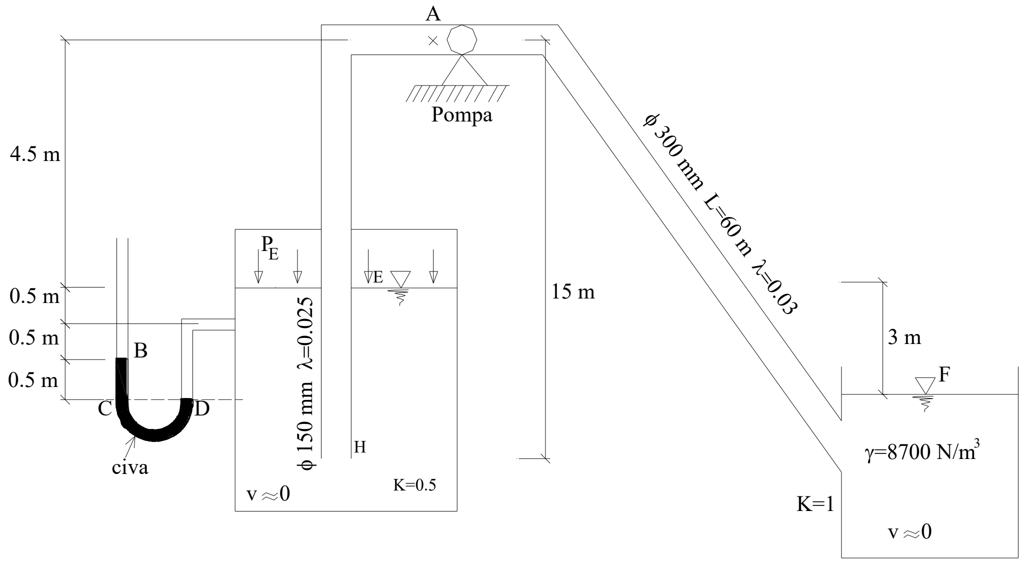

Figure 7.7

Problem 7.8: The discharge from the reservoir A to reservoir C is 400 lt/s in Figure 7.8. The pressure at the outlet of the turbine DE is –5 mwc. Find the power which could be obtained from the turbine and draw the energy grade line of the system.

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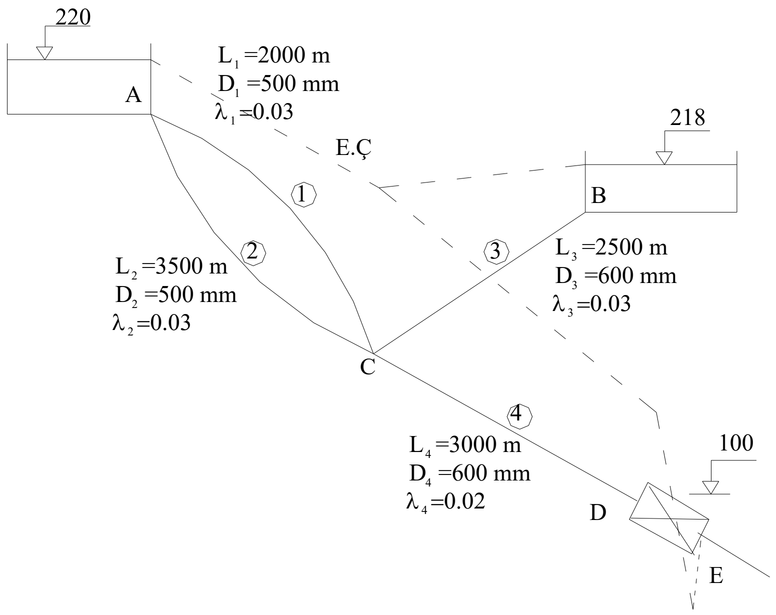

Figure 7.8

Problem 7.9: The fluid flows from reservoirs (1) and (2) to valve at M. The Manning roughness coefficient for the pipes are n=0.014.

a) The piezometer height at M is 112 m,

b) And when the valve is opened at M determine the discharge.

c) Draw the energy grade line for both cases.

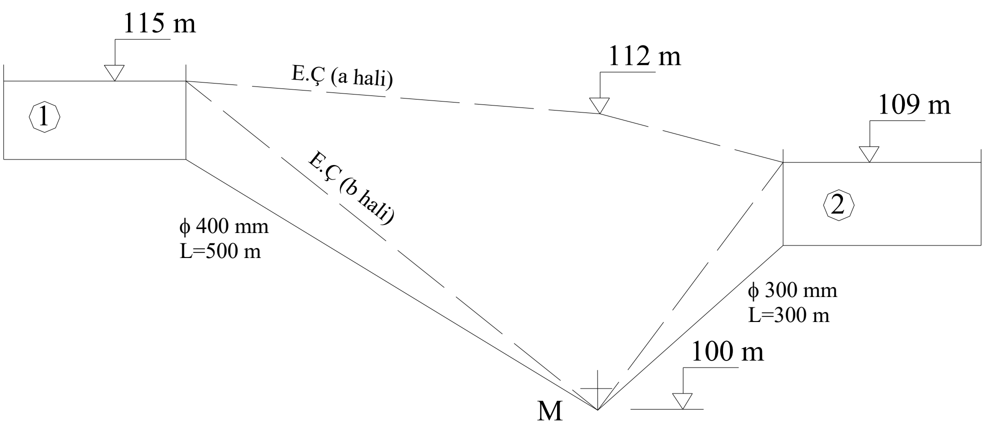

Figure 7.9

Problem 7.10: Determine the discharge at each pipe when the friction head loss in the pipe AD is 14 m in Fig 7.10 and find the elevation of the reservoir E, draw the energy grade line of the system.

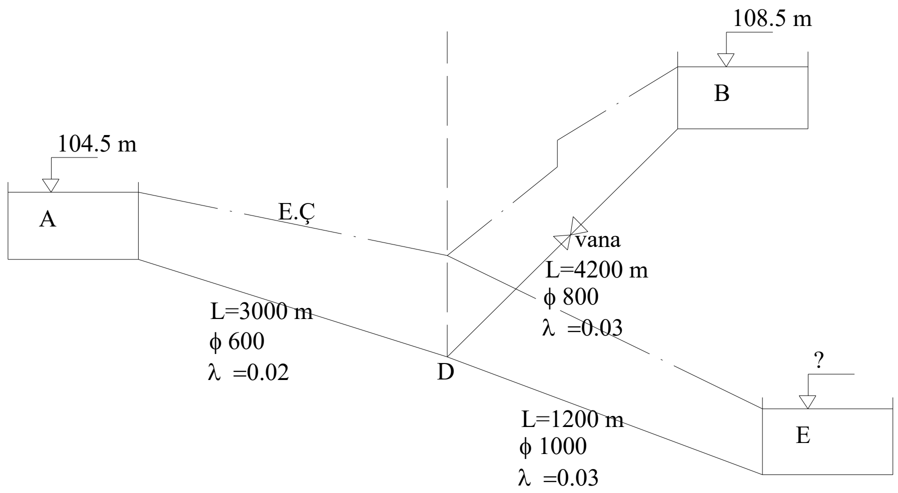

Figure 7.10

Problem 7.11: Reservoir A and B are feeding reservoir C by a pump located at point D. The discharges from Reservoir A and B to Reservoir C have same discharges as 100 lt/sec. If the efficiency of the pump is η = 0.70, what will be required power of this pump. Determine the elevation of Reservoir B. Draw the energy grade line of the system. (λ=0.02, η=0.70, L_1=500m, ϕ_1=400mm, L_2=1000m, ϕ_2=300mm, L_3=1500m, ϕ_3=500mm.)

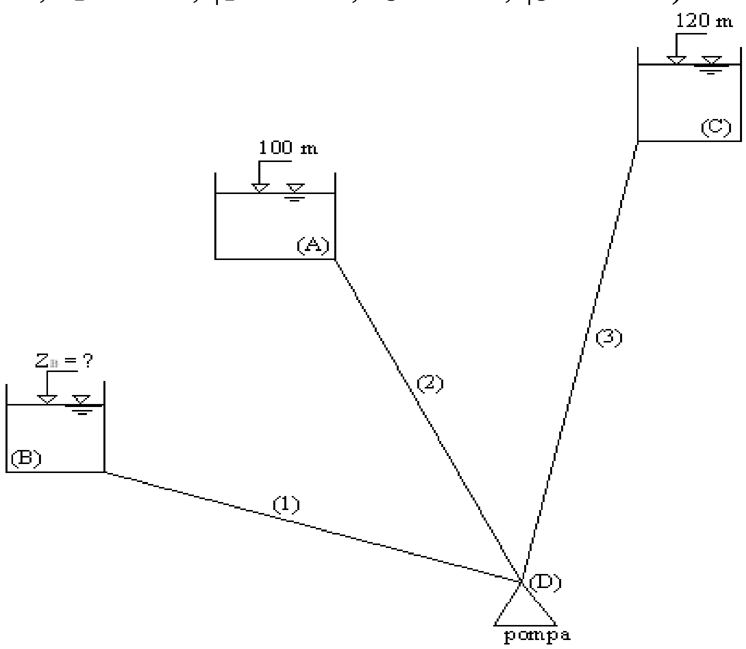

Figure 7.11

Problem 7.12: Draw the energy grade lines of the systems below since the flow directions are known.

Solution: The energy grade lines have shown on the systems with dotted lines.

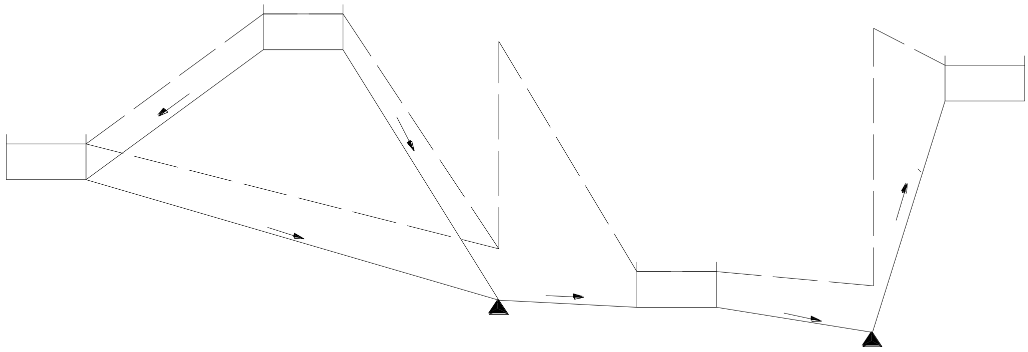

Figure 7.12a

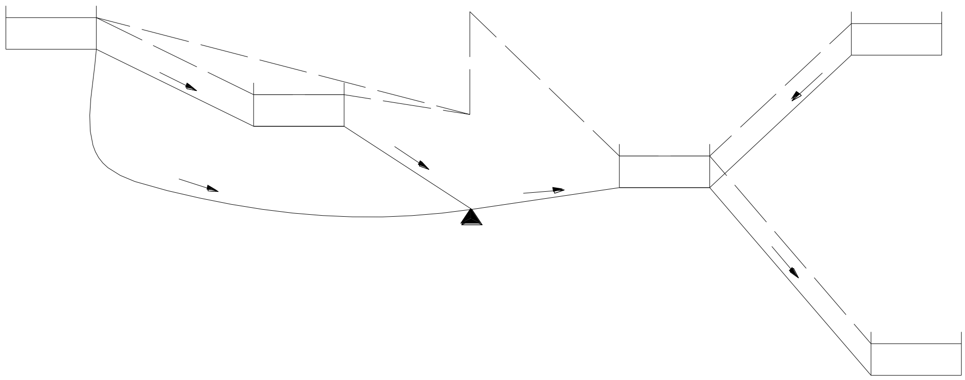

Figure 7.12b

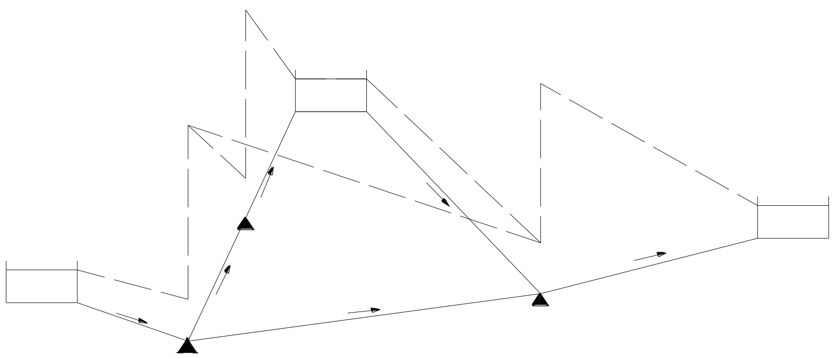

Figure 7.12c

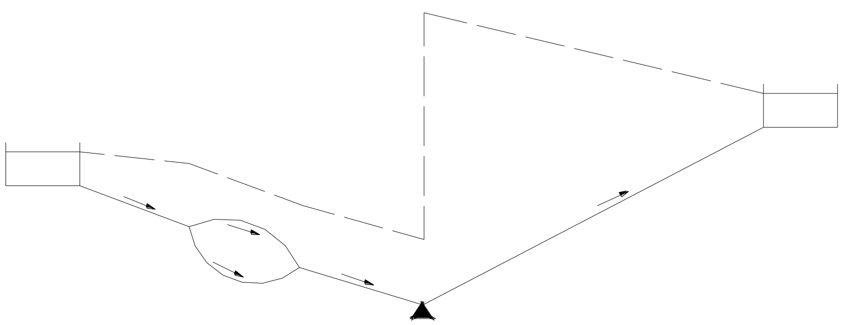

Figure 7.12d

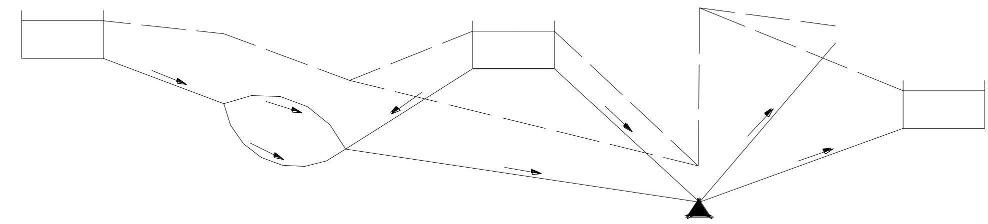

Figure 7.12e

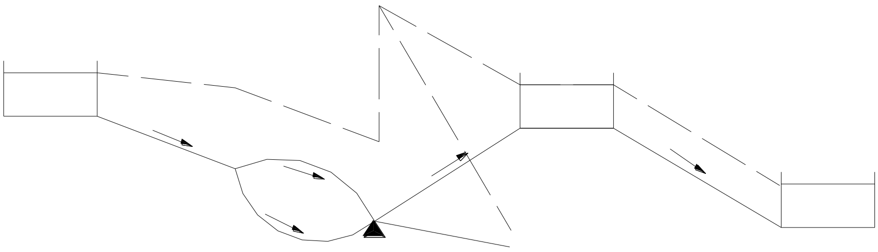

Figure 7.12f

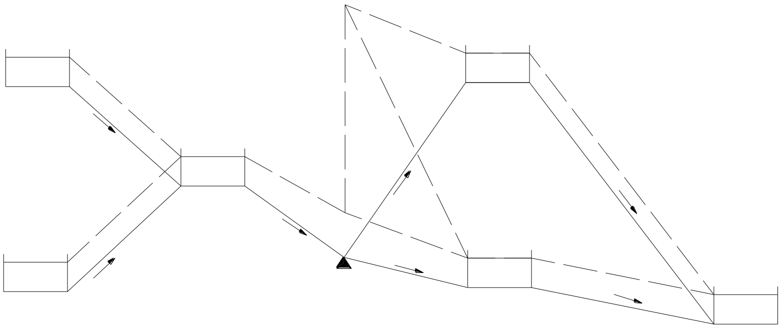

Figure 7.12g

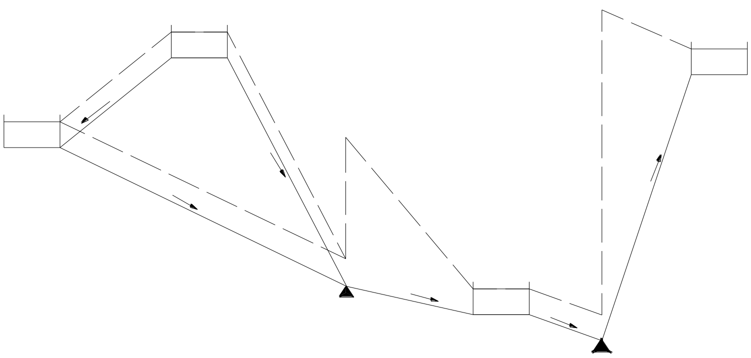

Figure 7.12h

Problem 7.13: Water flows through the pipe system as seen in Figure below. If the manometric height of the turbine is 116 m, determine the discharge in the pipe system. (Neglect head loss at the exit of the tank). ($\nu=10^{-6}$ m^2/s)

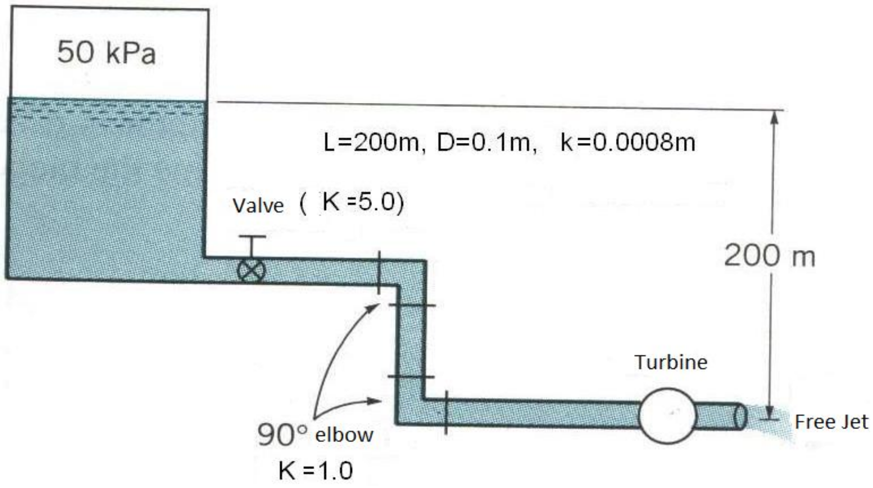

Figure 7.13

Problem 7.14: Determine the discharges in the parallel pipes and the pressure at A if the pressure at point B is 8 N/cm^2 and at C the pipe is open to the atmosphere in Fig. 7.14. For all pipes the Manning's roughness coefficient will be n=0.016.

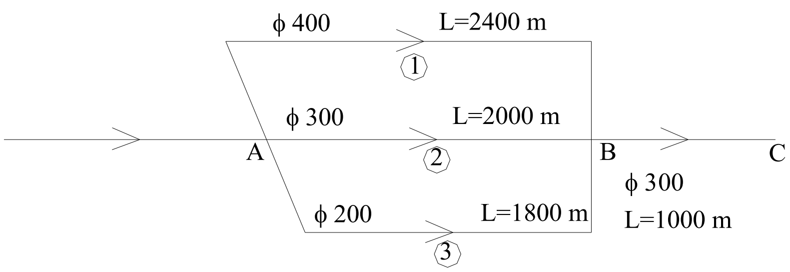

Figure 7.14

Problem 7.15: In the system shown in Fig.7.15 water is pumped from A to reservoir B, find the power of the pump and draw the energy grade line of the system. The pipe length, discharge pumped from the pump, diameters of the pipes, and Kutter numbers were given in the figure.

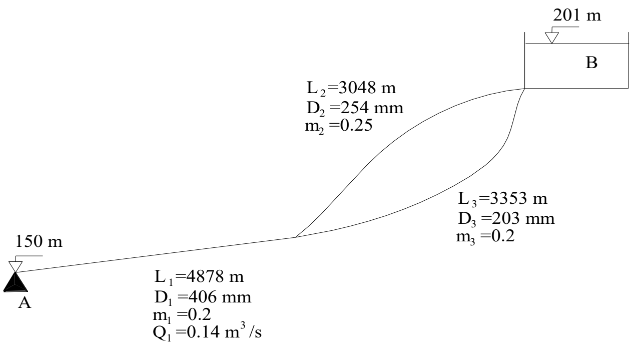

Figure 7.15

Problem 7.16: The discharge of the pipe DC is 300 lt/s and the pipe is open to atmosphere at C in the system shown in Fig. 7.16. If the outlet of the pipe is at 100m;

Find the elevation of the reservoir A and the discharges of pipes (1) and (2). Draw the energy grade line of the system.

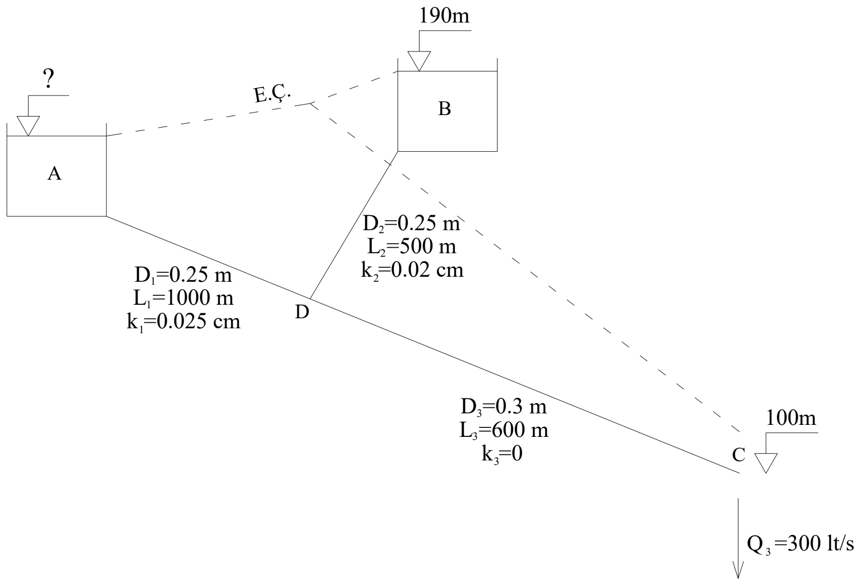

Figure 7.16

Problem 7.17: Determine the discharge for each pipe in the network below by using Hardy-cross method (Consider two iterations). (n=2).

$$r_i = \frac{16}{2g\pi^2}\lambda_i \frac{L_i}{D_i^5}$$

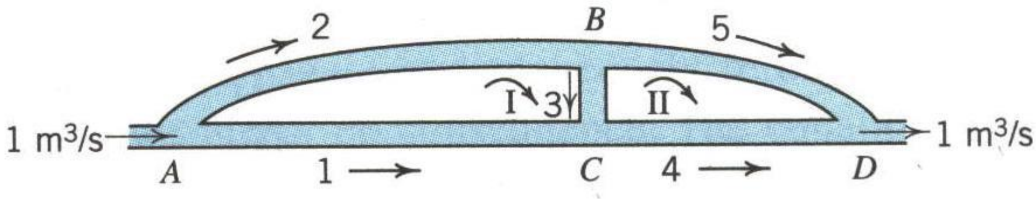

Figure 7.17