EXERCISES

1) Two water reservoirs are connected by a pipe 610m of 0.3m diameter, f'=0.038 and the flow produced by the difference in water surface elevations equals 0.17cumecs, if a new pipe of 0.3m diameter and length 460m is laid from the highest reservoir parallel to the old line and connected to the old line 460m from its inlet. Determine the total discharge for the improved system, f'=0.019 for the new pipe. Neglect secondary losses.
2) One of the advantages of parallel connections in water pipe network distribution is to enhance discharge. Demonstrate this fact with this question. A straight 300mm diameter pipeline 5km long is laid between two reservoirs of surface elevations150m and 100m. The pipeline enters these reservoirs 10m below their water surface levels. To increase the capacity of the line a 300mm diameter line 2.5km long is laid parallel to and from the original lines mid-point to the lower reservoir. What increase in flow rate is gained by installing the new line? Assume the friction factor is 0.02 for all the pipes and neglect minor losses.
3) A three pipe system is such that the total pressure drop is 1.5bar and the elevation drop is 5m. The length L, diameter d and friction factorf' for the three pipes are given in the table below.

Pipe	Length L (m)	Diameter D (m)	f'
1	150	10.0	0.0275
2	200	7.5	0.0245

3	75	5.0	0.0315

Calculate the ratio of the total flow rates for the case in which the pipes are connected in series compare to the case in which the pipes are in parallel. The density of water can be taken as 1000kg/m^3.

4) Two long pipes are used to convey water between two reservoirs whose water surfaces are at different elevations. One pipe has a diameter twice that of the other. If both pipes have the same value of friction factor and if minor losses are neglected, what is the ratio of the flow rates through the two pipes

5) A 2.0m diameter concrete pipe of length 1560m for which ε=1.5mm conveys 12^{0}C water between two reservoirs at a rate of 8.0m^3/s. What must be the difference in water surface elevation between the two reservoirs?

6) For the diagram below and the information in the table below.

Pipe No	Diameter (mm)	Length (m)	f’
1	200	300	0.021
2	300	300	0.0185
3	450	300	0.0165
4	300	600	0.0185
5	300	700	0.0185

Find the equivalent length of a 300mm diameter clean cast iron pipe to replace the above system. For H=10m, ε=0.25mm, what is Q?

7) (a) For laminar flow in pipes $f' = \frac{64}{\mathrm{Re}}$. Using this information, develop the expression for the velocity in terms of lost head due to friction, diameter and other pertinent items.

(b) How much power is lost per meter of pipe length when oil with a viscosity of 0.20N.s/m^2 flows in a 20cm diameter pipe at 0.5L/s. The oil has a density of 840kg/m^3.

(c) Oil of absolute viscosity 0.1Pa.s and relative density 0.85 flows through 3048m of 305mm cast iron pipe at the rate of 44.4x$10^{-3}m^3$/s. What is the lost head in the pipe?

8) Water is pumped 15Km, from a reservoir at elevation 30m to second reservoir 64m. The pipeline connecting the reservoirs is 1.5m in diameter. It is concrete and has an absolute roughness of 0.9mm. If the flow is 109L/s and pumping station efficiency is 80%, what will be the monthly power bill if electricity costs 30kobo per kilowatt hour? (f'=0.0175).

9) It is necessary to pump 0.38m^3/s of water from reservoir at an elevation of 270m to a tank whose bottom is at an elevation of 330m. The pumping unit is located at elevation 270m. The suction pipe is 0.6m in diameter and very short so head losses may be neglected. The pipeline from the pump to the upper tank is 123m long and is 0.5m in diameter. Consider the minor losses in the line to equal 0.75m if water. Find the maximum lift of the pump and the power required for pumping if the pump efficiency is 76%. The maximum depth of water in the tank is 11.4m and the supply lines are cast iron, f'=0.017.