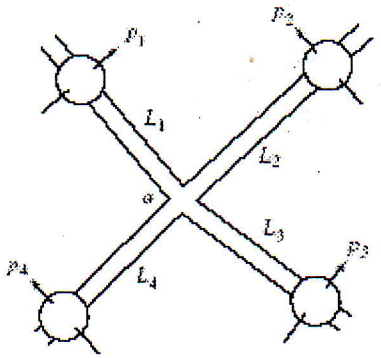
Menoufiya University Faculty of Engineering Shebin El-Kom Final Exam Academic Year: 2013-2014	Minufiya University	Post Graduate: Diploma Department: Mechanical power Engineering Subject: Pipe Network system Time Allowed: 3hrs Date: 10/6/2014

Note: Assume any data required, state your assumption clearly.

Question (1) (25 Marks)

1.a) A pipeline 10 km long, 300 mm diameter and with roughness 0.03 mm, conveys water from a reservoir (top water level 850 m) to a water treatment plant (elevation 700 m). Assuming that the reservoir remains full, and neglecting minor losses, estimate the quantity of flow. Take (μ= 1.307× 10^{-3} Pa.s, ρ =1000 kg/m^3)

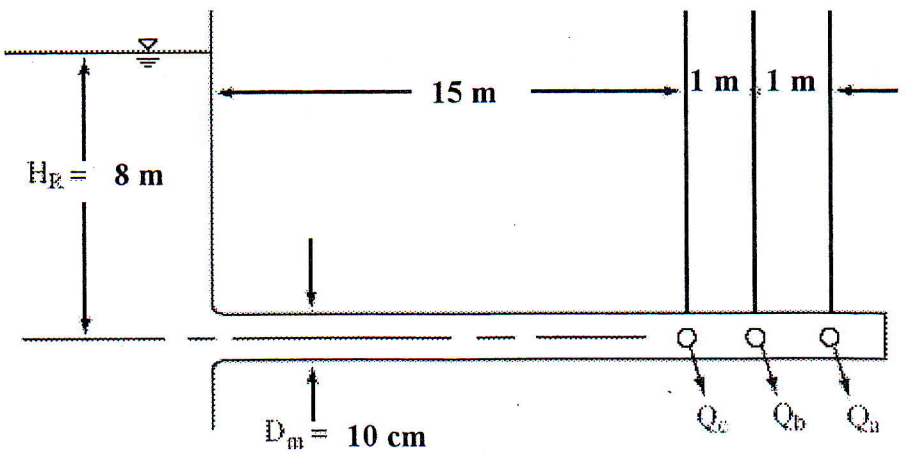
1.b) In the figure below all four horizontal cast-iron (f = 0.02) pipes are 45 m long and 8 cm in diameter and meet at junction a, delivering water at 20°C(μ= 1.307× 10^{-3} Pa.s, ρ =1000 kg/m^3). The pressures are known at four points as shown: p_1 = 950 kPa, p_2 = 350 kPa, p_3 = 675 kPa, p_4 = 100 kPa. Neglecting minor losses, determine the flow rate and direction in each pipe.



Question (2) (25 Marks)

2.a) Dive an expression for head rise coefficient due to lateral outlet and discuss how it changes with Q_3/Q_1.

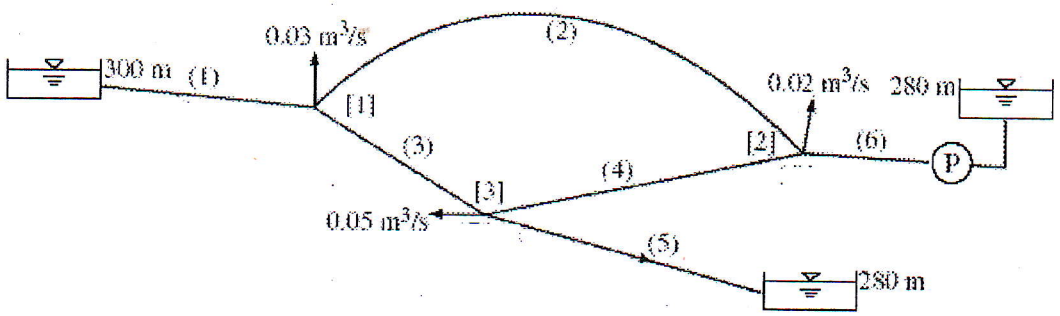
b) The 3-port manifold shown in the next diagram has a port-to-main diameter ratio D_3/D_1 = 0.6, a friction factor f = 0.02 in the main and all laterals, and L_3/D_3 = 5 for each lateral. Considering fluid friction in the main and laterals and junction losses, compute the port discharges Q_a, Q_b, and Q_c. The downstream end of the main is closed off by a blank plate.



Question (3) **(25 Marks)**

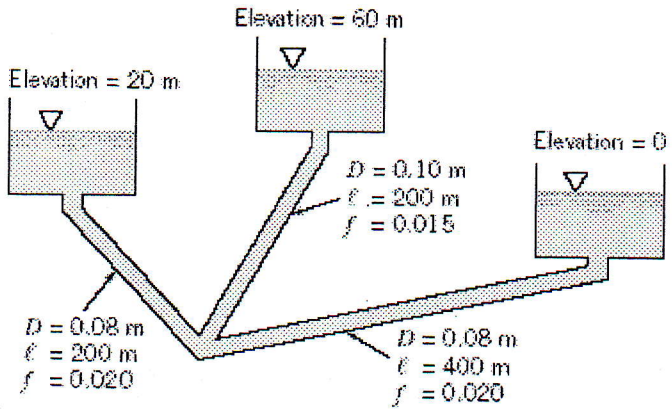
In the sketch the network consists of 6 pipes and 3 nodes. A source pump and one reservoir supply the network, and the lower reservoir receives water. Do the following tasks: (a) write the system of Q-equations; (b) write the system of ΔQ-equations; (c) using the Newton method, describe the solution of the system of ΔQ-equations; (d) if the discharge in pipe 5 is $Q_5 = 0.026$ m^3/s into the reservoir, and the discharge in pipe 6 is $Q_6 = 0.112$ m^3/s from the reservoir, what are discharges at other pipes? Take the friction factor to be 0.02 and $h_p = 35\text{-}600Q^2$.

Pipe	Dia. m	Length m
1	0.30	1000
2	0.20	2500
3	0.20	1000
4	0.30	1500
5	0.15	1000
6	0.35	800



Question (4) **(25 Marks)**

The three water-filled tanks shown in the figure are connected by pipes as indicated. If minor losses are neglected, determine the flow rate in each pipe. If a pump is introduced in the pipe connected to the highest reservoir to duplicate the flow rate into the lowest one, find the head generated by the pump.



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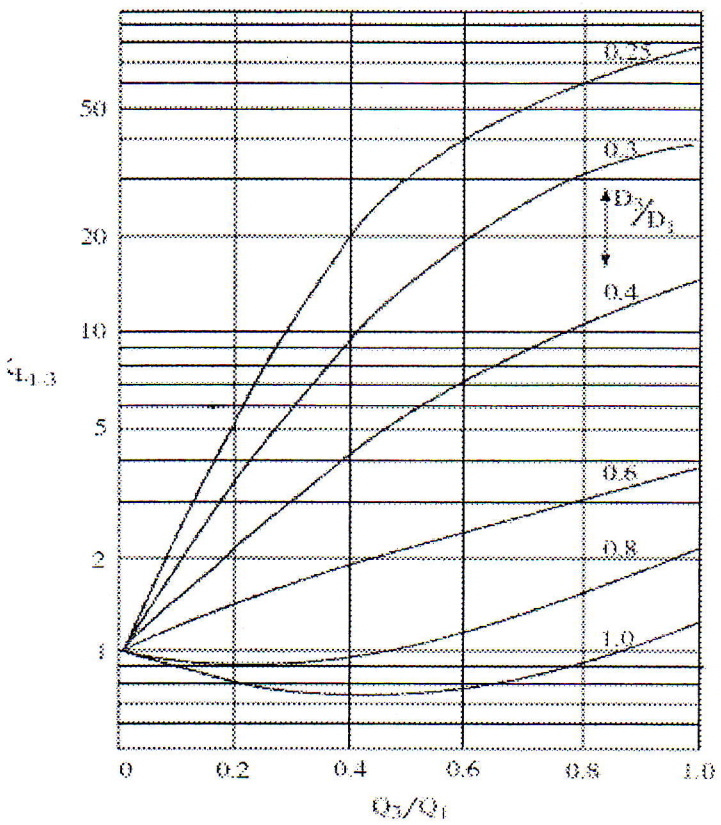
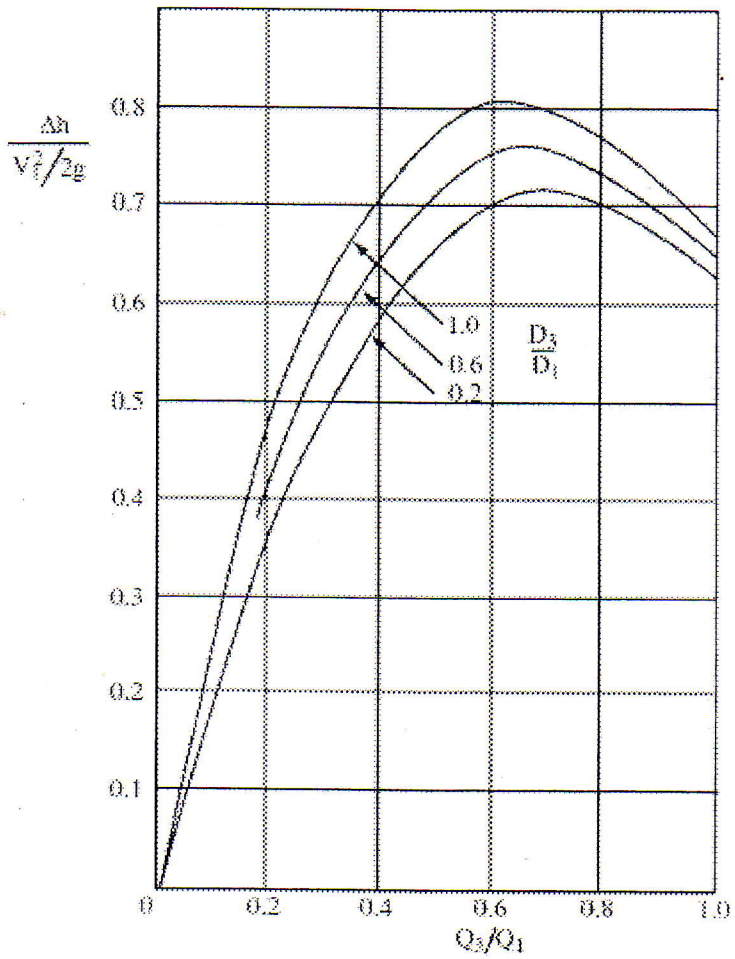
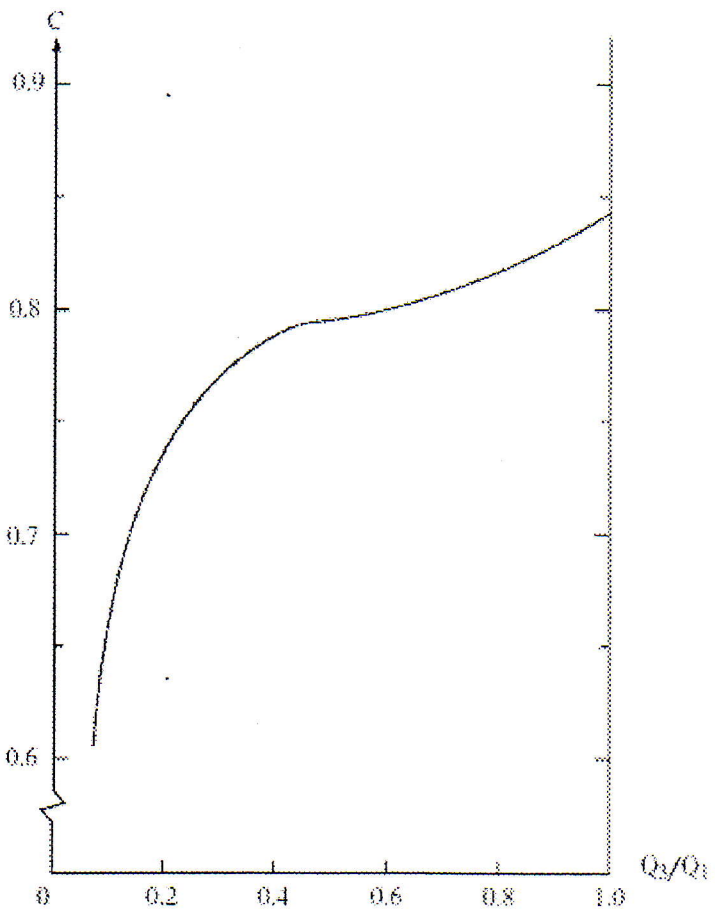
Dr. Samy M. El-Behery



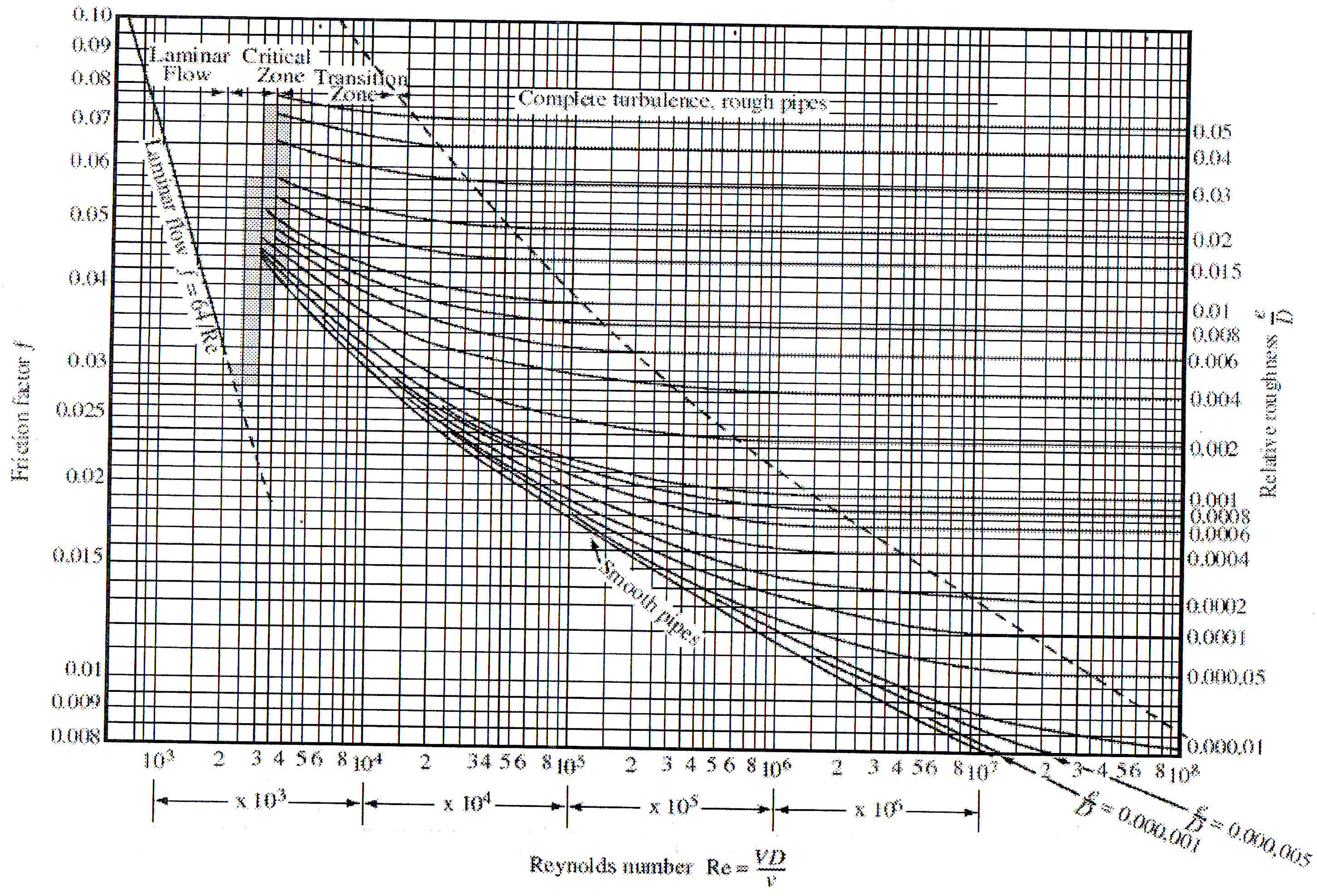


experimental data for the pressure rise coefficient.



An example of the behavior of the orifice coefficient C.

Orifice coefficent C based on f_3 =0.02 and L_3/D_3 =5



Laminar Flow
Critical Zone
Transition Zone
Complete turbulence, rough pipes
Laminar flow f = 64/Re
Smooth pipes
Friction factor f
Relative roughness ε/D
Reynolds number Re = VD/ν
ε/D = 0.000,001
ε/D = 0.000,005