El-Mansoura University
Faculty of Engineering
Dept. of Irrigation &Hydraulics
Second Year Civil Engineering

Final Exam
Hydraulics (I)
January 2, 2013
Time Allowed: 3 Hours

Total marks: 90

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Answer the following questions as you can. Illustrate your answers with neat sketches. Any missing data can be reasonably assumed. Final result values should be correctly obtained.

Question (I) (20 marks)

(a) Define the following fluid properties:
- Density
- Specific Weight
- Specific gravity
- Viscosity
- Surface tension

(b) A central plate of area 6.0 m^2, Figure (1), being pulled with a force of 160.0 N. If the dynamic viscosities of the two oils are in the ratio of 1:3 and the viscosity of the top oil is 0.12 N.sec/m^2. Determine the velocity at which the central plate will move.

(c) For the system shown in Figure (2), Find ($P_A - P_B$). (*Take* $\gamma_{water} = 62.4\ lb/ft^3$)

Question (II) (20 marks)

(a) What is the difference between absolute pressure and vacuum pressure?

(b) Determine the weight (W) per meter width to stabilize the gate with 45° angle as shown in Figure (3). Weight of gate is equal to 100 tons per meter width.

(c) Explain different cases of floating bodies, then determine the case of floating wooden cylinder of specific gravity equal to 0.61, Figure (4), if placed vertically in oil of specific gravity equal to 0.85.

Question (III) (20 marks)

(a) Define the following terms:
- Trajectory
- Stream line
- Stream tube

(b) A siphon shown in Figure (5) has a uniform circular bore of 3.0 in diameter and consists of a bend pipe with its crest at 6.0 ft above water level discharging into atmosphere at level 12.0 ft below water level. Find the velocity of flow, the discharge and the absolute pressure at crest level if the atmospheric pressure is equivalent to 33 ft of water. (Assume head losses from point A to point B equals 1.5 ft and from point B to point C equals 3 ft)

(c) Determine the required time to empty the tank shown in Figure (6). The area of orifice in the bottom of tank is equal to 13 cm^2. (Take Cd equal to 0.62)

Question (IV) (20 marks)

(a) Deduce an expression for the discharge through large rectangular orifice, then determine the discharge if the dimensions of the orifice are 1.0 m wide and 1.5 m deep, the top of the of the orifice is at 0.8 m below the water level in the reservoir. Also, determine the percentage error if the orifice is treated as small. (Take Cd = 0.6)

(b) Deduce an expression for the discharge through triangular weir, then find the discharge if the head over the weir is 0.4 m and apex angle is equal to 90°. (Take Cd = 0.64)

(c) The pipe bend shown in Figure (7) is in horizontal plan. Oil with a specific gravity of 0.86 enters the reducing bend at section (1) with a velocity of 3.2 m/sec and a pressure of 150 Kpa. Determine the force required to hold the bend in place. (Neglect any energy losses in the bend)

Question (V) (20 marks)

(a) Make the manual hydraulic analysis for the simple system shown in Figure (8) using the method given by El-Ghandour (2010). Values of pipe flows can be assumed in the first trial equal to 0.2485 m^3/sec and 0.1235 m^3/sec through pipe [1] and pipe [2] respectively. Take Kinematic viscosity equal to $1.575*10^{-6}$ m^2/sec. Trials should be continued until the tolerance less than or equal to 0.01. (Neglecting minor losses and use Moody Diagram)

(b) For the system shown in Figure (9): (Take C_{HW} = 150)
(i) What is the elevation of the water level in lower tank?
(ii) What is the diameter of equivalent pipe required to connect the two tanks?

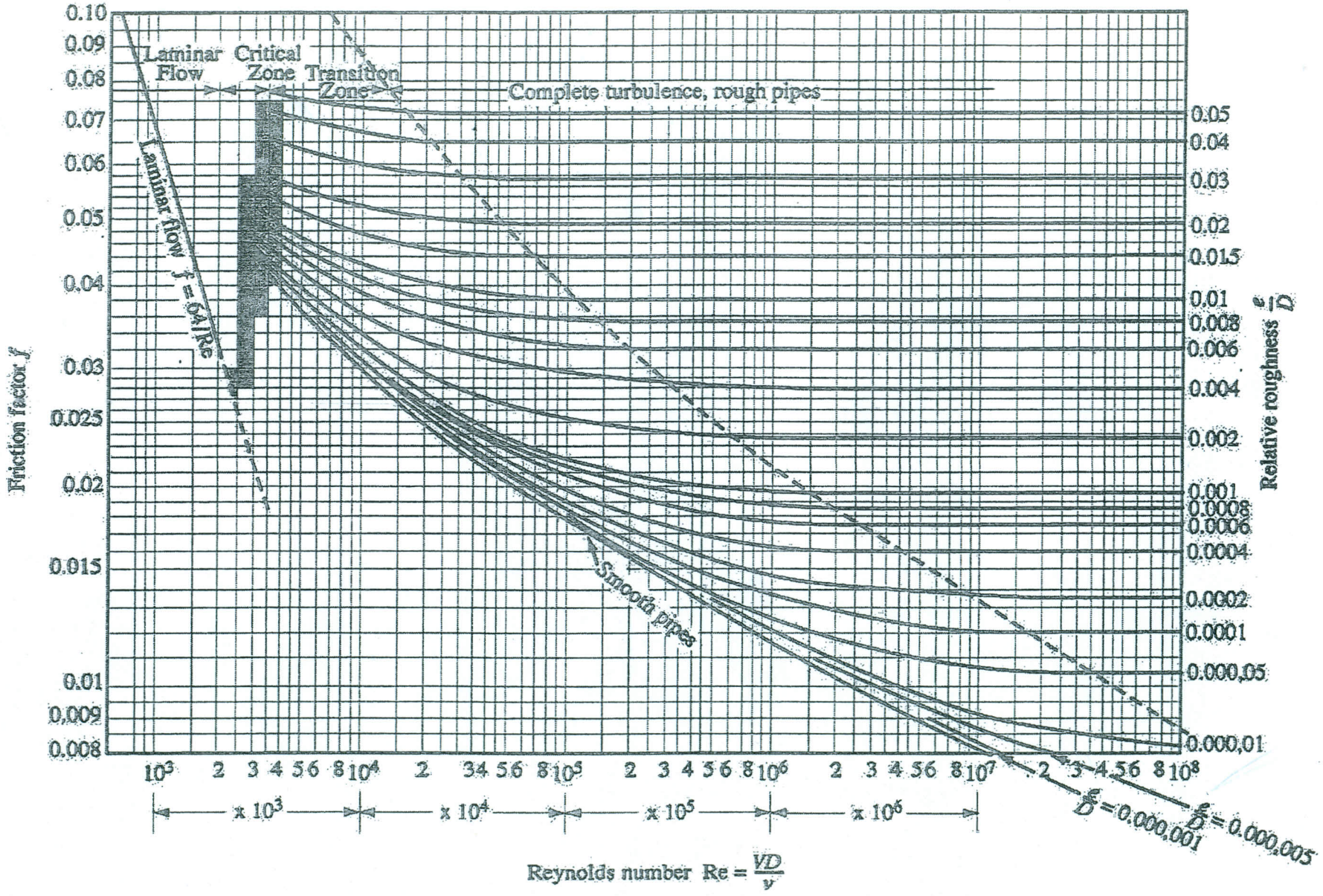
(c) A horizontal pipe 24 in. in diameter and 10000 ft long leaves a reservoir 100 ft below the surface and terminates in a valve. The steady state friction factor is 0.018 and it is assumed remain constant during the acceleration process. If the valve opens suddenly, calculate the required time to reach the steady flow. (Take minor losses into consideration)

Best Wishes

Examiners:

Prof. Dr/ Kassem El-Alfy

Dr/ Hamdy El-Ghandour


Laminar Flow
Critical Zone
Transition Zone
Complete turbulence, rough pipes
Laminar flow f = 64/Re
Smooth pipes
Friction factor f
Relative roughness ε/D
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.025
0.02
0.015
0.01
0,009
0.008
0.05
0.04
0.03
0.02
0.015
0.01
0.008
0.006
0.004
0.002
0.001
0.0008
0.0006
0.0004
0.0002
0.0001
0.000,05
0.000,01
10³ 2 3 4 5 6 8 10⁴ 2 3 4 5 6 8 10⁵ 2 3 4 5 6 8 10⁶ 2 3 4 5 6 8 10⁷ 2 3 4 5 6 8 10⁸
x 10³
x 10⁴
x 10⁵
x 10⁶
ε/D = 0.000,001
ε/D = 0.000,005
Reynolds number Re = VD/ν

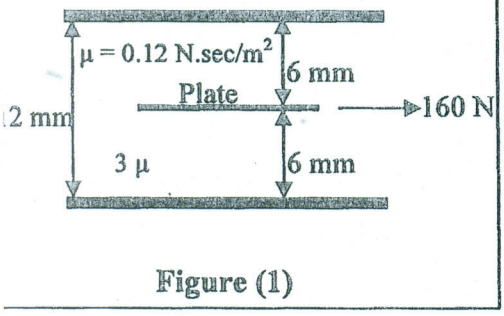


Figure (1)

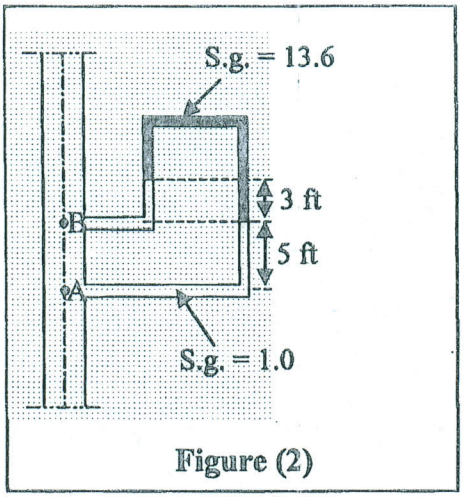


Figure (2)

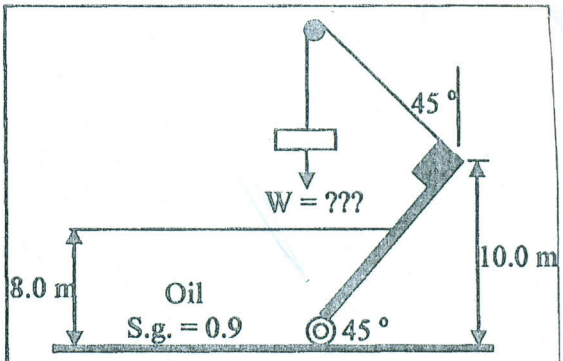


Figure (3)

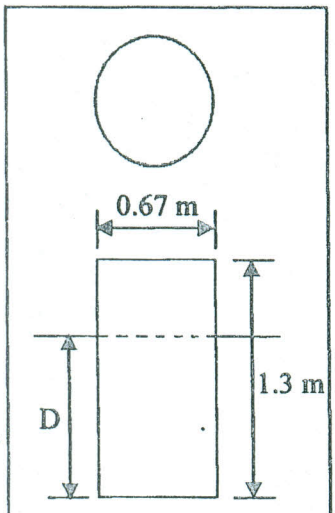


Figure (4)

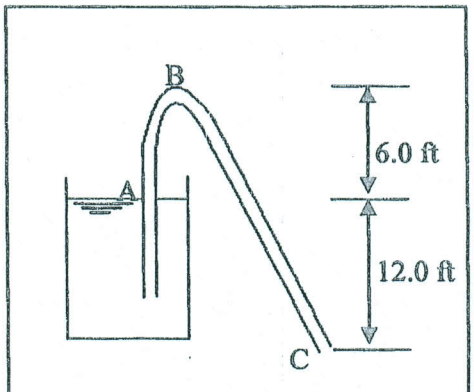


Figure (5)

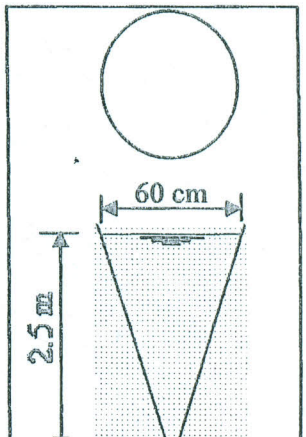


Figure (6)

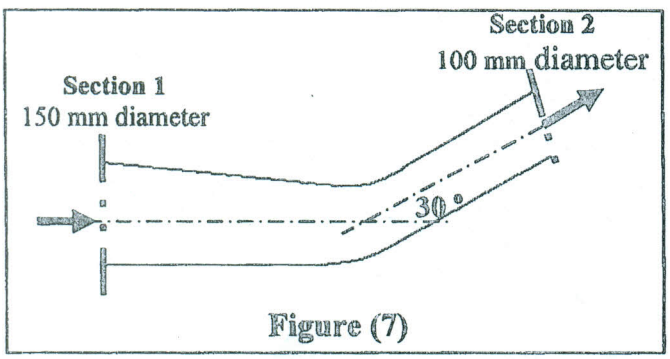


Figure (7)

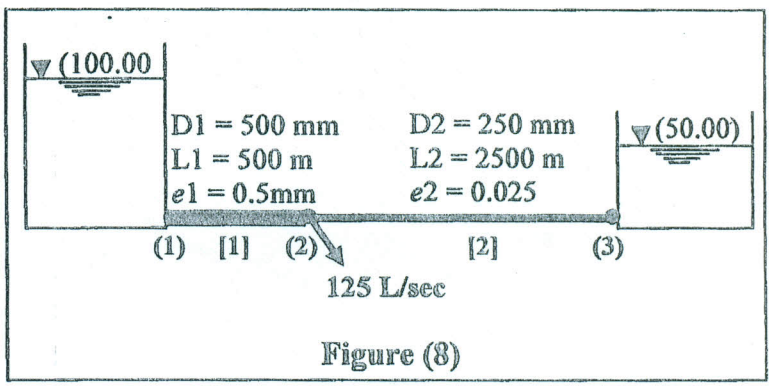


Figure (8)

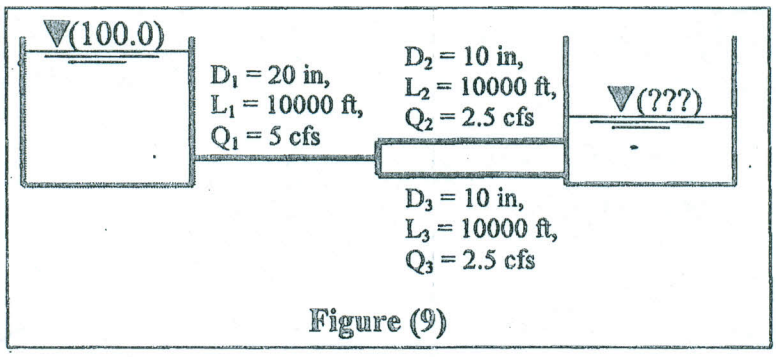


Figure (9)