Menoufiya University
Faculty of Engineering
Shebin El-Kom
Final Examination (100 Marks)
Academic Year: 2017-2018

Year: First year
Department: Mechanical Power
Subject: ***Fluid Mechanics (I) MPE121***
Time Allowed: 180 minutes
Date: 20/05/2018

Allowed Tables and Charts: None

Answer all the following Questions

Question (1) ***(25 Marks)***

(a) The *rotating-cylinder viscometer* in Figure 1 shears the fluid in a narrow clearance, Δr, as shown. Assume a linear velocity distribution in the gaps. If the driving torque M is measured, find an expression for the dynamic viscosity μ by (a) neglecting, and (b) including the bottom friction. **(7 Marks)**

(b) The differential mercury manometer of Fig. 2 is connected to pipe A containing gasoline (SG=0.65) and to pipe B containing water. Determine the differential reading h corresponding to a pressure in A of 20 kPa and a vacuum of 150 mm Hg in B. **(8 Marks)**

(c) You are floating around a pool drinking a bottle of Cola. If you accidently drop the bottle into the water (with the lid on), how much of the Cola would you have had to have drunk for the bottle to float back up to you? Given that: The mass of empty glass bottle is 370 gm and the density of glass is 2500 kg/m^3. The full (new bottle) contains 350 cm^3 of liquid of specific gravity of 1.15 and a small amount of air on the top of volume 14 cm^3. Take the density of air as 1.2 kg/m^3 **(10 Marks)**

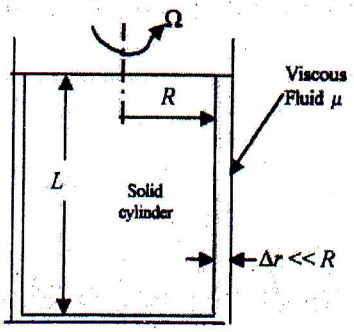

Figure 1

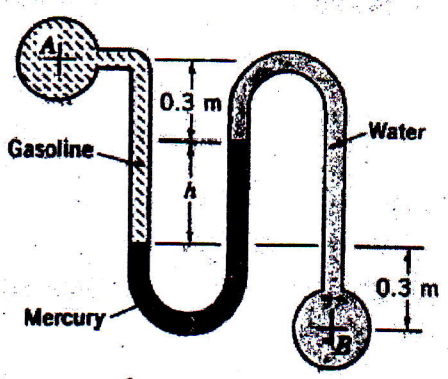

Figure 2

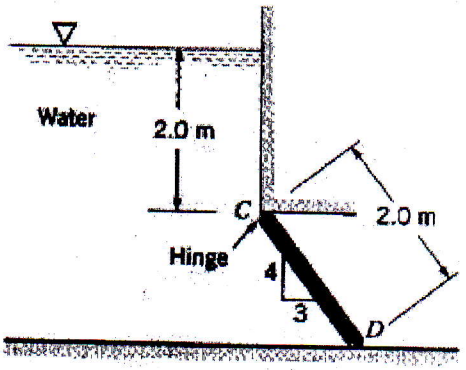

Figure 3

Question (2) ***(25 Marks)***

(a) Derive an expression for the force acting on an inclined immersed surface and its location. **(7 Marks)**

(b) Starting from first principles, prove that $h_f = \frac{flQ^2}{12d^5}$ **(7 Marks)**

(c) The rectangular gate CD of Figure 3 is 1.8 m wide and 2 m long. Assuming the material of the gate to be homogeneous and neglecting friction at the hinge C. Determine the weight of the gate necessary to keep it shut until the water level rises to 2 m above the hinge. **(11 Marks)**

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

(a) Derive an expression for measuring the flow rate in a gasoline pipeline using Venturimeter. **(5 Marks)**

(b) A venture meter is introduced in a 75 mm diameter pipe. The area of the pipe is 6 times the area of the throat. The U-tube manometer connected to the venture reads a difference in oil level of 4 cm oil. The specific gravity of oil is given as S=0.8 and the discharge coefficient is also known to be Cd=0.98. Find the discharge of water through the pipe for the following cases:

(i) Horizontal pipe **(5 Marks)** (ii) Vertical pipe **(5 Marks)**

(c) A 90° elbow is used to direct water flow at a rate of 25 kg/s in a horizontal pipe, see Figure 4. The diameter of the entire elbow is 10cm. The elbow discharges water into the atmosphere, and thus the pressure at the exit is the local atmospheric pressure. The elevation difference between the centers of the exit and the inlet of the elbow is 35 cm. The weight of the elbow and the water in it is considered to be negligible. Take the momentum-flux correction factor to be 1.03. Determine

(a) the gage pressure at the center of the inlet of the elbow and (b) the anchoring force needed to hold the elbow in place. **(10 Marks).**

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

4-a) With the valve closed, water flows from tank A to tank B as shown in Fig. 5. What is the flow rate into tank B when the valve is opened to allow water to flow into tank C also? Neglect all minor losses and assume that the friction factor is 0.02 for all pipes. **(10 marks)**

4-b) Water is pumped from tank A to tank B through a pipeline as shown in Fig. 6 at a rate of 40 lit/s. The pipeline is 100 m long and 10 cm in diameter with friction coefficient f = 0.03. The pump head is H_p = 90 m and the kinematic viscosity of water is 10^{-6} m^2/s. Determine whether the flow is laminar or turbulent and the height of tank B. The local loss coefficient for various section is: sharp entrance = 0.5, open globe valve = 0.69, 90° bend =0.15, 90° elbow =0.95, half-closed gate valve =0.7 and sharp exit=1.0 **(15 marks)**

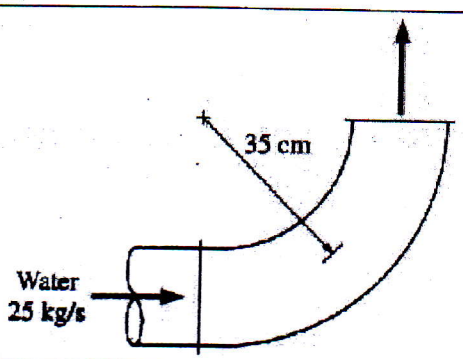

Figure 4

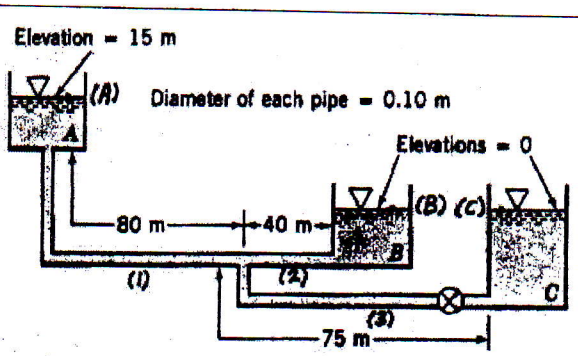

Figure 5

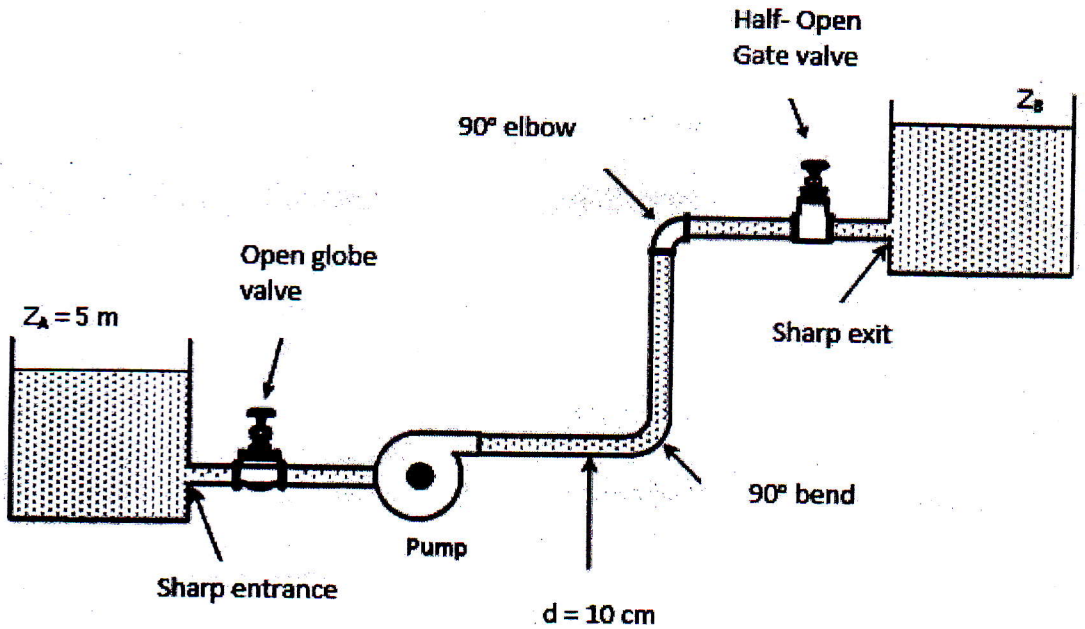

Figure 6

Question	1	2	3	4	Work & Oral Exam through a semester
ILOs	A8, A13,	B1, B2, C16	A8, B3 , C18	A8, B1, C1	A8, A13, B1, B2, B3, C1, C16,D9

Best Wishes