Menoufiya University
Faculty of Engineering
Shebin El-Kom
Final Examination
Academic Year: 2015-2016

Year: First year
Department: Mechanical Power
Subject: *Fluid Mechanics (I) MPE121*
Time Allowed: 180 minutes
Date: 29.05.2016

Allowed Tables and Charts: *(None)*

Answer all the following Questions *(Two Pages)* **[100 Marks for all]**

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

(a) A 10 *kg* block slides down a smooth inclined surface as shown in Fig. 1 with a velocity 0.22 *m/s*. The gap between the block and the surface is 0.1 *mm*. Assume the velocity distribution in the gap is linear and the area of the block in contact with oil is 0.2 m^2. The kinematic viscosity of oil is 4.2×10^{-4} m^2/s. Find for oil; **(8 Marks)**

i- The mass density
ii- The specific gravity
iii- The specific weight
iv- The shear stress

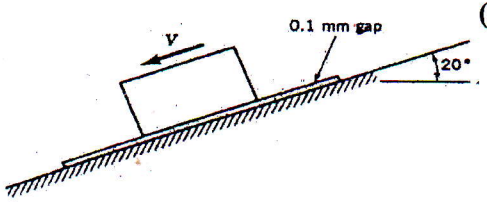

Figure 1

(b) The air pressure in the sealed tanks are (-22 *cm* Hg) column and 20 kN/m^2 in the left and right tanks, respectively, see Fig. 2. Determine the elevation of the manometer liquid in the right hand column at A **(8 Marks)**

(c) Long solid cylinder of radius 0.8 m hinged at point A is used as an automatic gate, as shown in Fig. 3. When the water level reaches 5 m, the gate opens by turning about the hinge at point A. Determine **(9 Marks)**

i- The hydrostatic force acting on the cylinder and its line of action when the gate opens.
ii- The weight of the cylinder per m length of the cylinder.

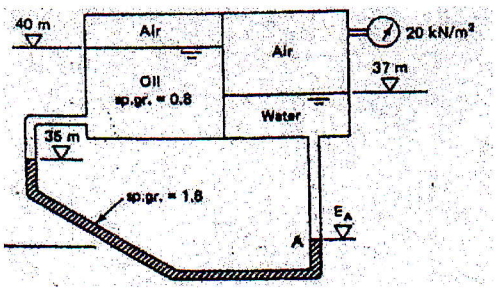

Figure 2

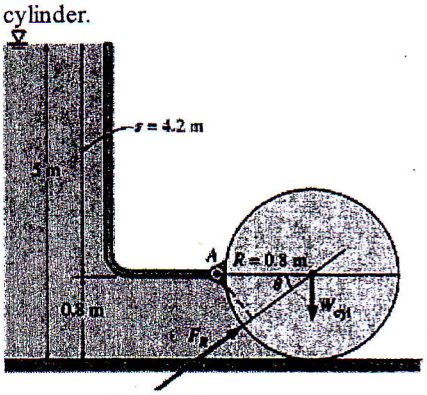

Figure 3

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

(a) For the condition of stability of floating bodies derive an expression for the metacentric height. **(9 Marks)**

(b) The tank of water in Fig. 4 is 12 cm wide into the paper. If the tank is accelerated to the right in rigid-body motion at 6 m/s^2, compute (a) the water depth at AB, and (b) the water force on panel AB. **(8 Marks)**

(c) A U-tube that contains water in its right arm and another liquid in its left arm is rotated about an axis closer to the left arm, see Fig. 5. For a known rotation rate (N=30 rev/min) at which the liquid levels in both arms are the same, the density of the fluid in the left arm is to be determined. **(8 Marks)**

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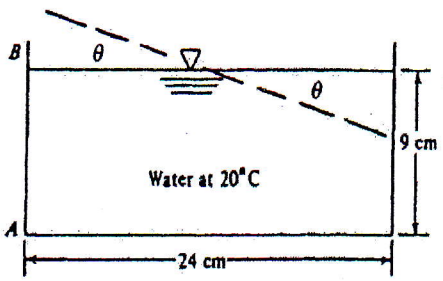

Figure 4

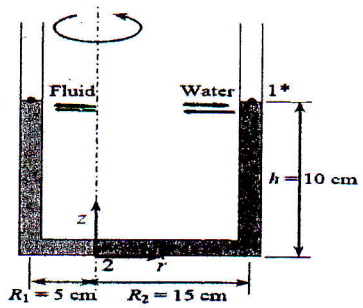

Figure 5

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

(a) For one-dimensional incompressible flows derive Bernolli's equation. **(8 Marks)**

(b) Develop an expression for the actual discharge using a pipeline orifice meter. **(8 Marks)**

(c) Kerosene (SG = 0.85) flows through the venture meter shown in Fig. 6 with flow rates ranging between 0.005 and 0.050 m^3/s. For steady ideal flow, determine the range in pressure difference (P1– P2) needed to measure these flow rates. **(9 Marks)**

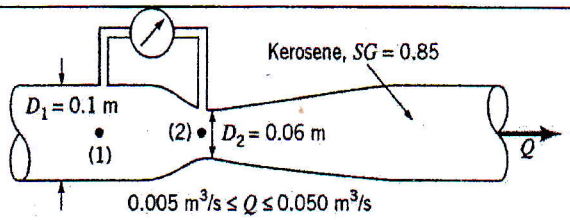

Figure 6

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

(a) In the hydraulic circuit shown in Fig. 7, find the pump power if the pump head is 55 m water. **(8Marks)**

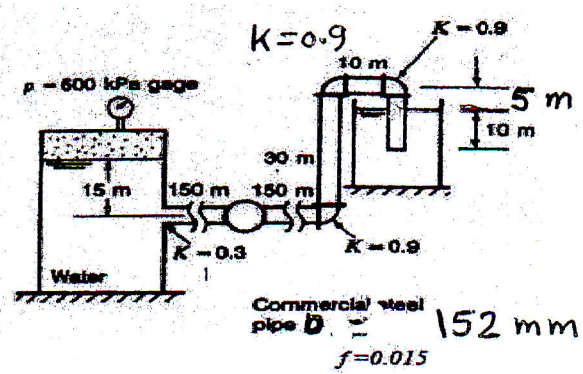

Figure 7

(b) Using the momentum theory, prove that the efficiency of propellers is a function of the approaching and far downstream velocities of the flowing fluid **(9 Marks)**

(c) Water accelerated by a nozzle strikes the back surface of a cart moving horizontally at a constant velocity as shown in Fig. 8. Determine the braking force and the power wasted by the brakes. **(8 Marks)**

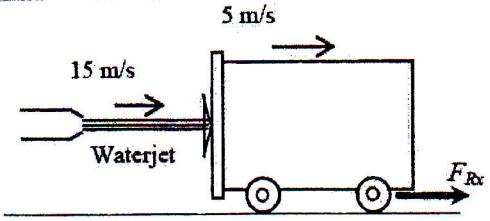

Figure 8

Best Wishes

Professor Kamal Ibrahim & Professor Wageeh A. El-Askary