Kafrelsheikh University
Faculty of Engineering
Dept. Mech. Engineering
Year: 2nd Year Mechanical
Subject: Fluid mechanics (MPE2005)

Semester: 1st Semester
Final Examination
Date: 15/3/2021
Time allowed: 3 hours
Full Mark: 60

Answer the following questions and assume any missing dada

Important note: Use suitable illustrations (drawing) as much as you can.

Question (1) [15 Marks]

A. Define "fluid mechanics" and mention three of its application, specific weight, specific gravity, kinematic viscosity (state units and dimension).

B. The differential mercury manometer of **Fig. 1** 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.

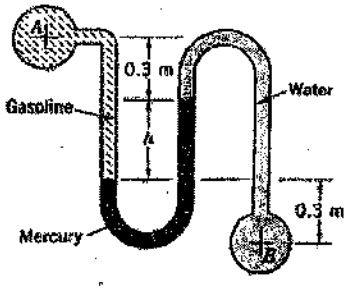

Fig. 1

C. A quart of a liquid at 20 °C has a mass of 0.84 kg and volume of 1.2 m^3. Calculate the oil's specific weight, mass density, and specific gravity.

Question (2) [15 Marks]

A. The pressure within a bubble of soapy water of 0.05 cm diameter is 5.75 gm/cm^2 greater than that of the atmosphere. Calculate the surface tension in the soapy water in S.I. units.

B. For the rectangular gate (1.5 m × 2 m) shown in **Fig. 2** that is hinged at the upper edge:

(i)- Sketch the pressure distribution on both sides of the gate.

(ii)- Sketch the FBD (free body diagram) of the gate, showing the location of force on each side.

(iii)- Calculate the force on the stop.

(iv)- At what level of oil above the hinge, y, the gate will start opening.

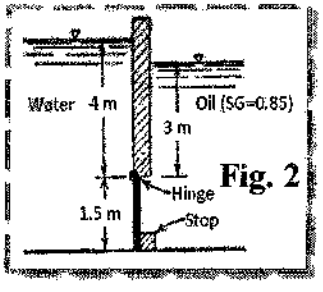

Fig. 2

C. When a liquid rotates at a constant angular velocity about a vertical axis as a rigid body, the pressure intensity varies.

a) Linearly with radial distance
b) As the square of the radial distance
c) Inversely as the square of the radial distance
d) Inversely as the radial distance

With my best wishes

Dr. Swellam W. Sharshir

Question (3) [15 Marks]

A. A tank containing water moves horizontally at (a = 3.5 m/s^2). The tank is 2.5 m long, 2.5 m high and depth of water (at rest) is 2 m **calculate:**

(i) The angle of the water surface to the horizontal, and

(ii) The remaining water volume when the acceleration is increased by 25 %.

B. **Show that** the head loss in the inlet section of a venturimeter is $H_L = (1 - C_d^2)\Delta h$ where Cd is the coefficient of discharge of the meter and Δh is the piezometric head difference between the inlet and the throat.

C. A 30 cm *15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. **Calculate**

(i) The discharge of oil.

(ii) The pressure difference between the entrance section and the throat section. Take the co-efficient of meter as 0.98 and specific gravity of mercury as 13.6.

Question (4) [15 Marks]

A. What are the losses in pipelines, Explain minor losses and major losses?

B. On the same **Fig. 3** shown below, draw the total energy and hydraulic gradient lines (TEL&HGL).

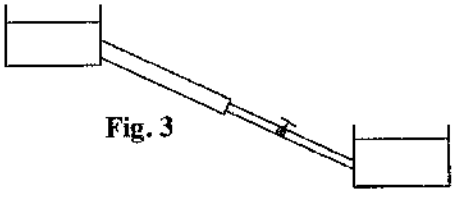

Fig. 3

C. Water flows through a pipe **AB** as shown in **Fig. 4** of diameter d_1 = 50 mm which is in sense with a pipe **BC** of diameter d_2 = 5 mm in which the mean velocity V_2 = 2m s^{-1}. At C the pipe of forks and one branch **CD** is of diameter d_3 such that the mean velocity V_3 is 1.5 m s^{-1}. The other branch **CE** is of diameter d_4 = 30 mm and conditions are such that the discharge Q_2 from BC divides so that Q_4 = 1/2 Q_3. Calculate the values of Q_1, V_1, Q_2, Q_3, d_3, Q_4 and V_4.

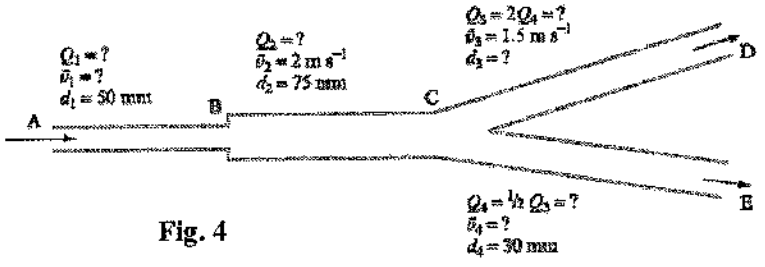

Fig. 4