UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2005/2006 Academic Session

November 2005

EAH 221/3 – Fluid Mechanic for Civil Engineer

Duration: 3 hours

Instructions to Candidates:

1. Ensure that this paper contains **FIVE (5)** printed pages before you start your examination.

2. This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions only. Marks will be given to the **FIRST FIVE (5)** questions put in order on the answer script and **NOT** the **BEST FIVE (5).**

3. Each question carry equal marks.

4. All questions **MUST BE** answered in English

5. Each question **MUST BE** answered on a new sheet.

6. Write the answered question numbers on the cover sheet of the answer script.

1. (a) A cubical block of 20 cm edge and weight 20 kg is allowed to slide down a plane inclined at 20° to the horizontal on which there is thin film of oil of viscosity 0.22×10^{-3} kg-s/m^2. What terminal velocity will be attained by the block if the fill thickness is estimated to be 0.025 mm.

(8 marks)

(b) Carbon-tetra chloride has a mass density of 1594 kg/m^3. Calculate its specific weight and specific volume in the metric gravitational system of units. Also calculate its specific gravity.

(4 marks)

(c) In measuring the unit surface energy of a mineral oil (sp. gr. 0.85) by the bubble method, air is forced to form a bubble at the lower end of a tube of internal diameter 1.5mm immersed at a depth of 1.25 cm in the oil. Calculate the unit surface energy if the maximum bubble pressure is 15 kg/m^2.

(8 marks)

2. (a) Explain the terms:
   i. intensity of pressure
   ii. pressure head

(4 marks)

(b) Prove that the pressure is the same in all directions at a point in a static fluid.

(4 marks)

(c) In the accompanying figure (Figure 1), fluid A is water, fluid B is oil of specific gravity 0.85, Z = 0.7m, and y = 1.5m. Compute pressure difference between the points ‘m’ and ‘n’.

(6 marks)

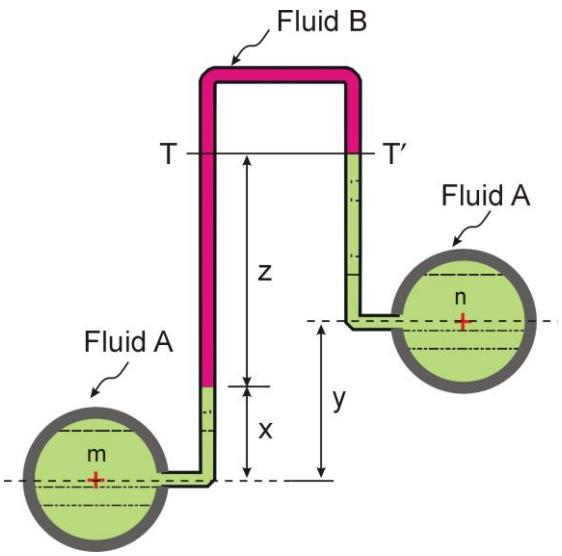

Figure 1

2. (d) Petrol of specific gravity 0.8 flows upwards through a vertical pipe shown in Figure 2. A and B are two points in the pipe, B being 0.3m higher than A. Connections are led from A and B to a U-Tube containing mercury. If the difference of pressure between A and B is 0.18 kg/cm^2, find the reading shown by the differential mercury manometer gage.

(6 marks)

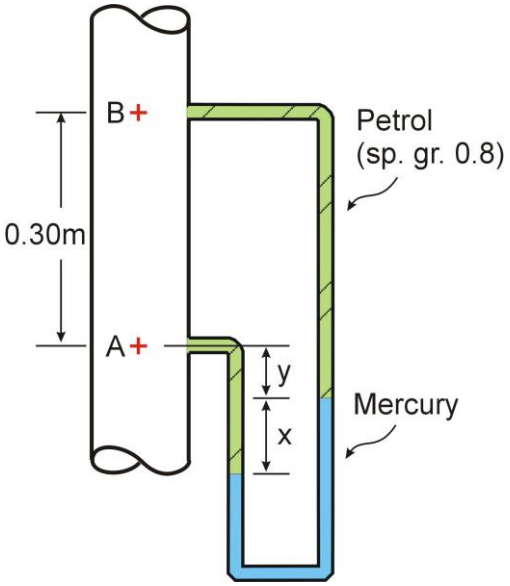

Figure 2

3. (a) Explain the terms:
   i. Total pressure and centre of pressure
   ii. Buoyant force and centre of buoyancy

(2 marks)

(b) The sector gate shown in Figure 3 consists of a cylindrical surface of which PN is the trace, supported by a structural frame hinged at M. The length of the gate perpendicular to the paper is 9m. Determine the amount and location of the horizontal and vertical components of the total hydrostatic pressure on the gate.

(8 marks)

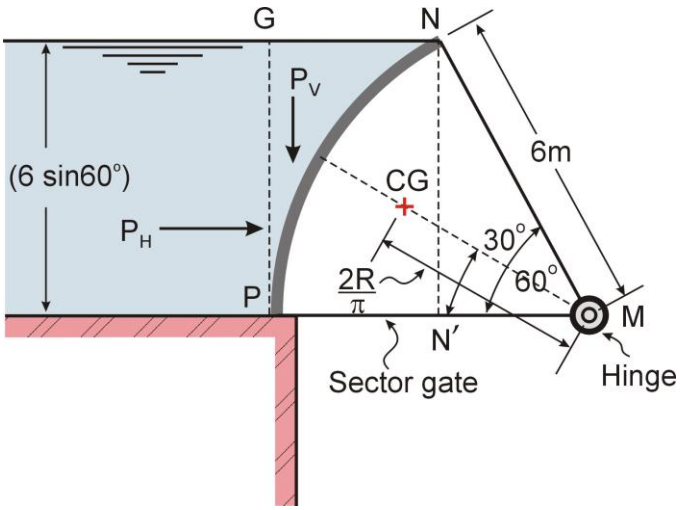

Figure 3

3. (c) Petrol of specific gravity 0.8 flows upwards through a vertical pipe shown in Figure 2. A and B are two points in the pipe, B being 0.3m higher than A. Connections are led from A and B to a U-Tube containing mercury. If the difference of pressure between A and B is 0.18 kg/cm^2, find the reading shown by the differential mercury manometer gage.

(10 marks)

4. (a) A 15 cm diameter pipe carries 0.072 m^3/s of water. The pipe branches into two pipes as shown in Figure 4. If the velocity in the 50 mm pipe is 12 m/s, what is the velocity in the 100 mm pipe?

(5 marks)

Figure 4

(b) Motor oil with a specific gravity of 9.3 enters the reducing bend shown in Figure 5 with a velocity of 3m/s and a pressure of 275kPa. Calculate the x and y forces required to hold the bend in place. Neglect energy losses and the bend is in a horizontal plane.

(15 marks)

Figure 5

5. (a) For the system in Figure 6, calculate

i) the flow rate of water from the nozzle (7 marks)
ii) the pressure at point A (7 marks)

Figure 6

5. (b) True or False (1 point each) and give explanation (1 point each).

1) T or F? The Energy Grade Line (EGL) can never rise in the direction of flow except at a pump.
2) T or F? Given the same flow rate of water, losses increase as the pressure in a pipe system increases.
3) T or F? Piezometric head increases with depth in a reservoir.

(6 marks)

6. (a) A nozzle jet hits a flat plate at the normal of its surface. If the diameter of the jet is 50mm and its velocity is 18 m/s, determine

i) force exerted on the static plate
ii) force exerted on the moving plate at 6m/s (toward the jet)

(14 marks)

(b) A fountain jet with 15 cm in diameter can reach maximum height of 20 meter. Determine its flow rate and jet diameter at the height of 12 m.

(6 marks)

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