UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2000/2001 Academic Session

SEPTEMBER / OCTOBER 2000

EAH221/3 – Fluids Mechanic For Engineering

Time : [3 hours]

Instruction to candidates:-

1. This paper consists of **SEVEN (7)** questions. Answer **FIVE (5)** questions only.
2. Answers **MUST BE** written in Bahasa Malaysia.

1. (a) Explain briefly on the following items:-

    (i) viscosity

    (ii) surface tension

(6 marks)

(b) A diving bell is lowered into the sea at a depth which has a pressure of $2.5MN/m^2$ and a density of $1026.114kg/m^3$. The density of air in the diving bell is $30kg/m^3$. On the surface of the sea the pressure is $100kN/m^2$ and the density of sea water is $1025kg/m^3$. Calculate the bulk modulus of the sea water and the density of air when the diving bell was initially lowered.

(6 marks)

(c) At a depth of 8km below the ocean, the pressure is 83MPa. Calculate the specific weight of the sea water at that depth if the density on the surface is $1025kg/m^3$ and the average bulk modulus is 2.4GPa. Assume the gravity is not varied with depth.

(8 marks)

2. (a) Based on Figure 1 below, calculate the difference in pressure between A and B.

Oil, S.G = 0.8

Mercury, S.G = 13.6

Figure 1

(4 marks)

(b) A rectangular tank with a dimension of 3m length, 2m wide and χm depth. If the weight of the tank is 40kN and the draft in fresh water is 0.68, calculate the height of meta centre. Density of water is $1000kg/m^3$.

(6 marks)

2. (c) A sewage tank of a sewage treatment plant discharged its effluent into the sea through a horizontal rectangular culvert 1.5m depth and 1m wide. The face of the discharge end of the culvert is at 40^o to the vertical and the storage level is controlled by a flap-gate weighing 5kN. The gate which is used to close the culvert has a hinge on the top. When the sea water stands to the hinge level, calculate the height of sewage above the hinge in the storage tank to enable it to be disposed into the sea. The density sewage is $1000 kg/m^3$ and the density of sea water is $1025 kg/m^3$.

(10 marks)

3. (a) Explain briefly on the following items and if necessary sketch the appropriate diagrams to help your explaination:

(i) Bourdon gauge
(ii) Stream tube

(6 marks)

(b) Figure 2 shows an annulus in a vertical position in a fresh water with a density of $1000 kg/m^3$. Calculate the force exerted by the water on the side of annulus and the depth of the centre of pressure from the surface.

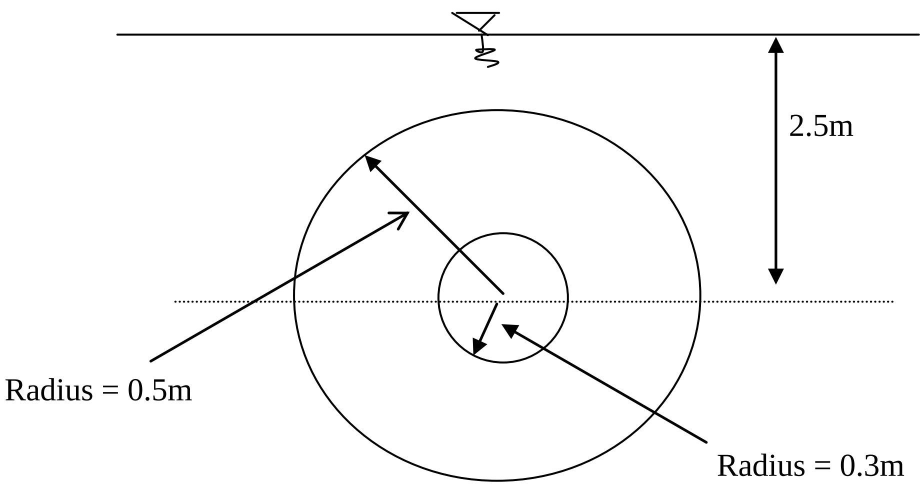

Figure 2

(4 marks)

3. (c) Figure 3 shows a siphon is connected from a large reservoir with an exit at point 3. The diameter of siphon is 400mm and the atmospheric pressure is $100kN/m^2$. The allowable absolute pressure at point 2 is $50kN/m^2$ with a flowrate of $2m^3/s$. By neglecting frictional and minor head losses, calculate Z_2 and Z_3.

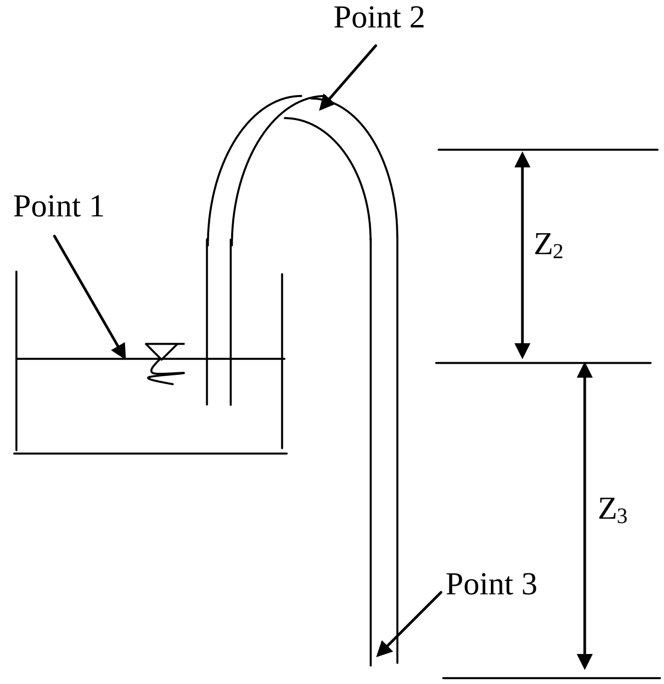

Figure 3

(10 marks)

4. (a) Explain briefly on the principle of pitot tube. Sketch a suitable diagram to help you in your explaination.

(4 marks)

(b) With the aid of a sketch diagram, explain on the concept of flow measurement using venturi meter and consequently derive an equation for an ideal flow rate condition. As a guidance, use point 1 for the pressure and velocity in the pipe and point 2 for the pressure and velocity at the throat.

(6 marks)

(c) Describe the difference between;

(i) Laminar flow and turbulent

(ii) Steady flow and unsteady flow.

(5 marks)

(d) If the volume flow rate in a pipe is doubled and the diameter of the pipe is doubled, what happen to the Reynolds number if the viscosity remains constant?

(5 marks)

5. (a) Water flows from section 1 to section 2 in the pipe shown in Figure 4. For the data given in the figure, determine the velocity of flow and the fluid pressure at section 2. Assume that the total head loss from section 1 to section 2 is 3.00 m.

Figure 4

(10 marks)

(b) The pipe shown in Figure 5 has a uniform diameter of 150mm. Assume the head loss between points 1 and 2 is 1.2m and between points 2 and 3 is 2.0m. Determine the discharge of water in the pipe and the pressure head at point 2.

Figure 5

(10 marks)

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6. (a) Assuming hydrostatic pressure distributions, uniform velocity profiles, and negligible viscous effects, fine the force on the sluice gate shown in Figure 6.

Figure 6

(10 marks)

(b) A 45^{o} reducing bend, 600mm diameter upstream, 300mm diameter downstream, has water flowing through it at the rate of 0.444m^3/s under a pressure of 145 kPa. Neglecting any loss in the bend, calculate the force exerted by the water on the reducing bend.

Figure 7

(10 marks)

7. (a) Determine the discharge through the system shown in Figure 8. Assume that the head loss in the pipe is given by $4V_1^2/2g$ and the head loss in the nozzle is given by $3V_2^2/2g$, where V_1 and V_2 are the velocities in the pipe and the nozzle respectively.

Figure 8

(10 marks)

(b) A 25mm diameter sphere of lead, weighing 111 kN/m^3, is moving downward in an oil at a constant velocity of 0.357 m/s. Calculate the absolute viscosity of the oil if the specific gravity is 0.93.

(10 marks)

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