Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	FLUID MECHANICS 1
COURSE CODE	:	BDA 20603
PROGRAMME	:	BDD
EXAMINATION DATE	:	DECEMBER 2016 / JANUARY 2017
DURATION	:	3 HOUR
INSTRUCTION	:	**PART A:** ANSWER **THREE (3)** QUESTIONS ONLY OUT OF **FOUR (4)** QUESTIONS **PART B:** ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A: ANSWER **THREE (3)** QUESTIONS ONLY OUT OF **FOUR (4)** QUESTIONS

Q1 (a) The manometer in **Figure Q1 (a)** contains carbon tetrachloride ($SG = 1.59$). Initially the pressure differential between pipes A and B, which contain a brine ($SG = 1.1$) is zero. It is desired that the manometer give a differential reading of 30.5 cm (measured along the inclined tube) for a pressure differential of 0.7 kPa.

(i) Illustrate the rise of the manometer fluid by using a clear sketch; and

(ii) Determine the required angle of inclination θ.

(6 marks)

(b) The gate ABC as shown in **Figure Q1 (b)** located in reservoir contains water and has a width of 1.5 m. If a = 3 m, b = 1 m and c = 1.35 m, determine,

(i) the magnitude; and

(ii) the direction of resultant force acting on the gate ABC.

(14 marks)

Q2 (a) With the aid of diagrams, explain the stability of a fully immersed body and a submerged body.

(8 marks)

(b) A wood block is submerged in oil and attached with a 0.6 m width aluminum at the bottom as shown in **Figure Q2 (b)**. The specific weight of aluminum is 26.3 kN/m^3, specific gravity of wood and aluminum is 0.7 and 0.8, respectively. Determine:

(i) the total mass of the whole body; and

(ii) the net force required to hold the body in the position.

(12 marks)

Q3 (a) The water flows through a venturi pipe as is shown in **Figure Q3 (a)**. If P_1 and P_2 are the static pressures measured by the inverted U-tube manometer containing oil of specific gravity, *SG* is less than one, show that the height of manometer reading, h can be expressed as;

$$h = (Q/A_2)^2 \frac{1-(A_2/A_1)^2}{2g(1-SG)}$$

(12 marks)

(b) Water (*SG* = 1.0) flows upward through a 15.2 cm inlet diameter of inverted U-tube manometer at velocity of 4.6 m/s. The diameter of the throat is 10.2 cm, while the elevation differential between inlet and throat of venturi is 12.3 cm and the differential height, *l*, from throat to the level of oil (*SG* = 0.79) is 9.2 cm. Determine the elevation, h, of the inverted U-tube manometer by using the same equation expressed in **Q3 (a)**. Assume the viscous is negligible.

(8 marks)

Q4 (a) Oil having a specific gravity of 0.9 is pumped as depicted in **Figure Q4 (a)** with a water jet. The water volume flow rate is 1 m^3/s. The water and oil mixture has an average specific gravity of 0.95. Calculate the rate, in m^3/s, at which the pump moves oil.

(6 marks)

(b) Water flowing steadily at a rate of 0.13 m^3/s is deflected downward by an angled elbow as shown in **Figure Q4 (b)**, For D = 30 cm, d = 10 cm and h = 50 cm, Determine the forces acting on the flange of the elbow and the angle its line of action makes with the horizontal. Take the internal volume of the elbow to be 0.03 m^3 and the weight of the elbow is 5 kg.

(14 marks)

PART B: ANSWER ALL QUESTIONS

Q5 (a) Someone claims that the average velocity in a circular pipe in fully developed laminar flow can be determined by simply measuring the velocity at *R/2* (midway between the wall surface and the centerline).

(i) What is your opinion about the statement, do you agree or not; and

(ii) Justify your answer

(4 marks)

(b) Water at 10°C (ρ = 999.7 kg/m^3 and μ = 1.307 x 10^{-3} kg/m·s) is flowing steadily in a 0.20 cm diameter, 15 m long pipe. In the fully developed laminar flow region, the velocity at *R/2* (midway between the wall surface and the centerline) is measured to be 1.8 m/s. Determine the velocity at the center of the pipe.

(4 marks)

(c) Water at 10°C (ρ = 999.7 kg/m3 and μ = 1.307 x 10-3 kg/m · s) is flowing steadily in a 5 cm diameter, 30 m long pipe horizontal pipe made of stainless steel at a rate of 9 L/s as shown in **Figure Q5 (c)**. Determine:

(i) the pressure drop;

(ii) the head loss; and

(iii) the pumping power requirement to overcome this pressure drop.

(12 marks)

Q6 (a) State **Four (4)** criteria in selecting repeating variables in Buckingham's π analysis

(4 marks)

(b) The Drag, *Dg* on a sphere located in a pipe through which a fluid is flowing to determined experimentally as shown in **Figure 6 (b)**. Assume that the drag is function of the sphere diameter, *d*, the pipe diameter, *D*, the fluid velocity, *V* and the fluid density, ρ.

(i) Show that the dimensionless groups that exist is

$$\frac{Dg}{\rho V^2 d^2} = \phi \frac{D}{d}$$

(ii) An experiments using water indicate that for d = 0.5cm, D = 1.25 cm and V = 0.6 m/s, Drag is 6 x 10^{-3} N. Estimate the drag on a sphere located in a 0.6 m diameter pipe through which water is flowing with a velocity of 1.8 m/s if the geometric similarity of sphere diameter is maintained.

(16 marks)

- END OF QUESTION -

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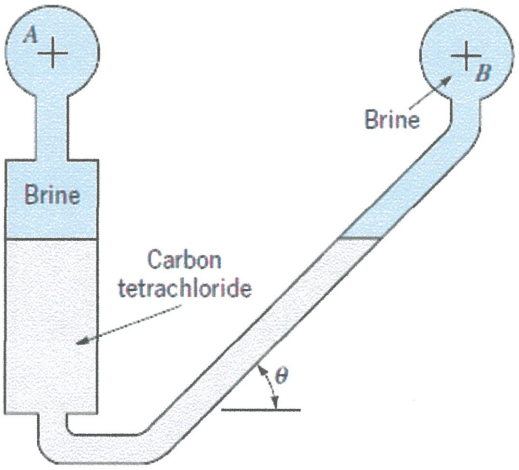

FIGURE Q1 (a)

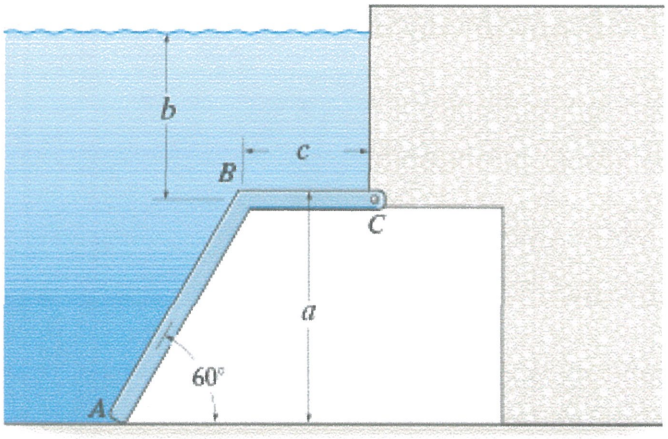

FIGURE Q1 (b)

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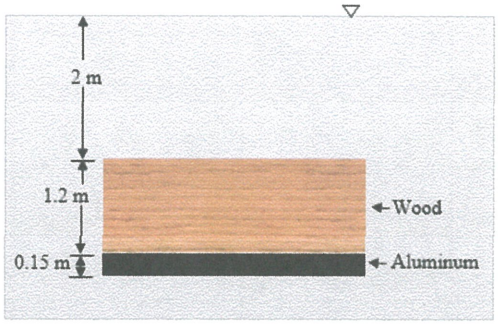

FIGURE Q2 (b)

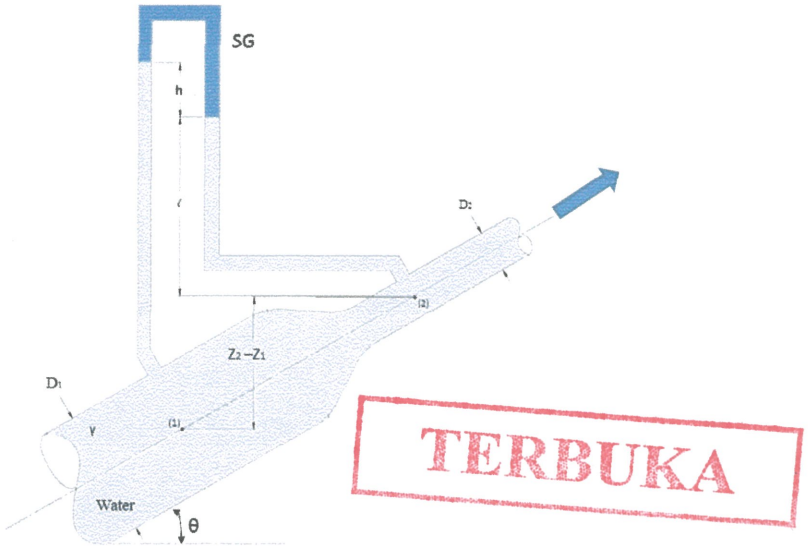

FIGURE Q3 (a)

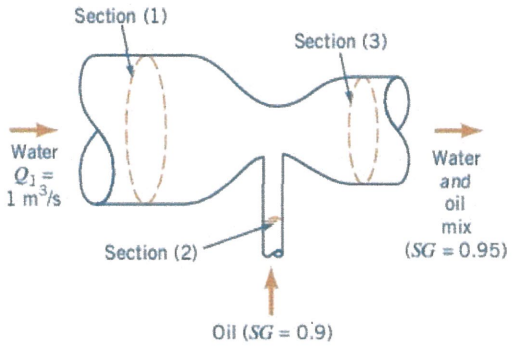

FIGURE Q4 (a)

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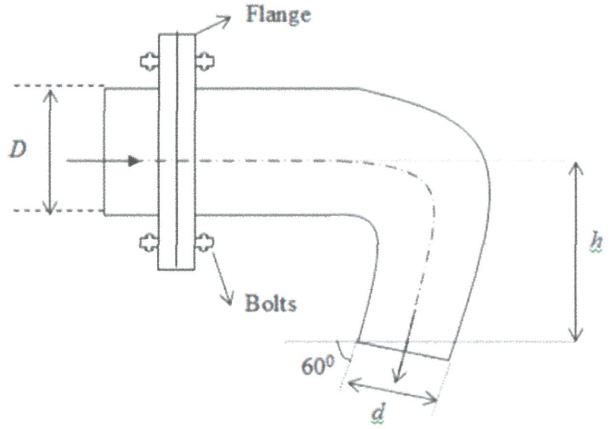

FIGURE Q4 (b)

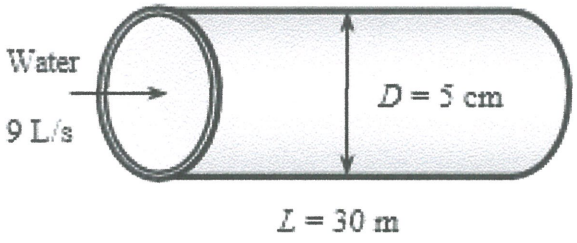

FIGURE Q5 (c)

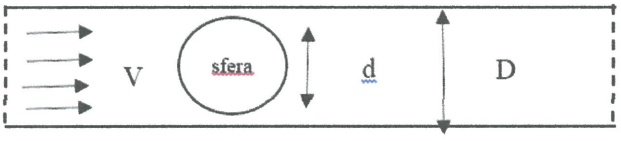

FIGURE Q6 (b)