Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	FLUID MECHANICS 1
COURSE CODE	:	BDA 20603
PROGRAMME	:	BDD
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A:** ANSWER **FOUR (4)** QUESTIONS **ONLY** OUT OF **FIVE (5)** QUESTIONS **PART B:** ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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

Q1 (a) An air-filled, hemispherical shell is attached to the ocean floor at a depth of 10 m. as shown in **Figure Q1 (a)**. The absolute pressure inside the shell is 100 kPa, and a mercury U tube manometer designed to give the outside water pressure indicates a differential reading of h, which is equal to 735 mm. Based on these data, determine the atmospheric pressure at the ocean surface. Determine the value of h when the mercury is replaced by a liquid with a specific gravity of 5. (Get the specific gravities of mercury and seawater from the internet)

(8 marks)

(b) An open tank has a vertical rectangular gate as a partition, and on one side contains gasoline. The rectangular gate, that is 5 m high and 2 m wide, is hinged at the bottom end of the partition. A stopper is located at the top end of the gate, which only allows the gate to swing open towards the gasoline side of the tank. Water is slowly added to the empty side of the tank. If the depth of the gasoline is 4.5 m, determine the depth of the water when the gate is about to open?

(12 marks)

Q2 A wooden cylinder has the dimension: diameter, $d = 40$ cm and height, $h_{cyl} = 40$ cm. The specific gravity of the wooden cylinder is 0.6. A copper disc with a diameter of 40 cm and height, $h_{cu} = 1$ cm is rigidly attached to the bottom end of the wooden cylinder. The specific gravity of the copper disc is 8.8. The combination of the wooden cylinder and copper disc is placed in the water with their axis are in a vertical position.

(i) Calculate the height of the combined body, which is below the water surface.
(ii) If the height of the copper is to be changed, determine its minimum value so that the combined body is fully submerged.

(20 marks)

Q3 Water is siphoned from the tank shown in **Figure Q3 (a)**. Determine the flow rate from the tank and the pressure at points (2), (3), and (4) if viscous effects are negligible.

(20 marks)

Q4 A jet of water 50 mm in diameter with a velocity of 20 m/s strikes a flat plate inclined at an angle of 30° to the axis of the jet. Determine

(i) the normal force exerted on the plate when the plate is stationary;
(ii) the normal force exerted on the plate when the plate is moving at 5 m/s in the direction of the jet;
(iii) the work-done on the plate and the efficiency for case (ii).

(20 marks)

Q5 Water flows through the pipe bend and nozzle arrangement shown in **Figure Q5** which lies with its axis in the horizontal plane. The water issues from the nozzle into the atmosphere as a parallel jet with a velocity of 20 m/s and the pressure at A is 200 kN/m^2 gauge. Friction may be neglected. Determine

(i) the anchoring force in the x-axis;
(ii) the anchoring force in the y-axis;
(iii) the moment of the resultant force due to the water on this arrangement about a vertical axis through point B.

(20 marks)

PART B: ANSWER ALL QUESTIONS

Q6 (a) The aerodynamic drag of a car, F_{drag}, is a function of surrounding air density ρ and viscosity μ, velocity of the car V, and length of the car L. Using ρ, V, and L as repeating variables, express this relationship in dimensionless form.

(16 marks)

(b) The aerodynamic drag of a new sports car is to be predicted at a speed of 100 km/hr at an air temperature of 25°C. Automotive engineers build a one fifth scale model of the car to test in a wind tunnel. It is winter, and the wind tunnel is located in an unheated building; the temperature of the wind tunnel air is only about 5°C. Determine how fast the engineers should run the wind tunnel to achieve similarity between the model and the prototype.

(4 marks)

- END OF QUESTIONS –

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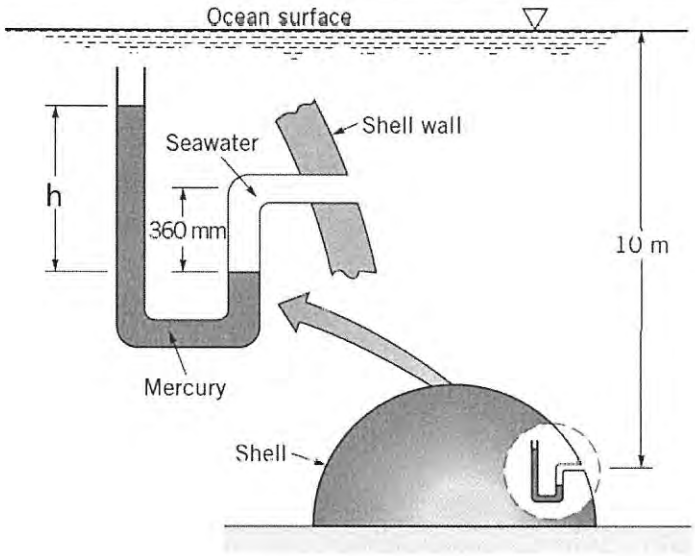

Figure Q1 (a)

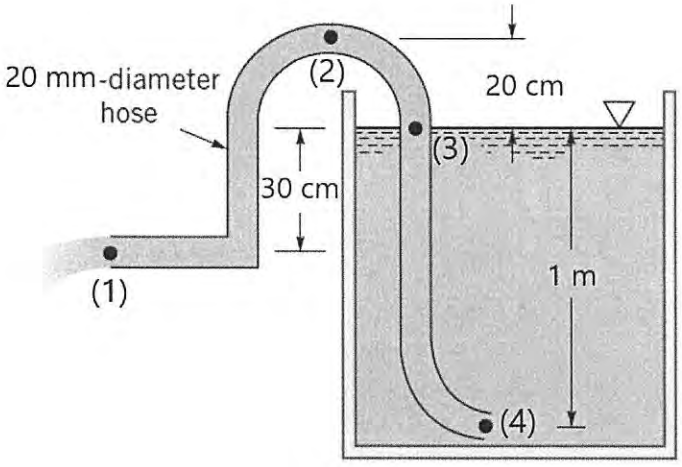

Figure Q3 (a)

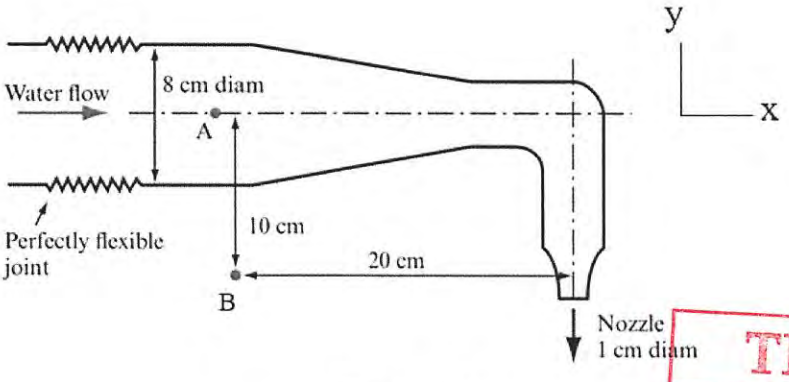

Figure Q5