Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	FLUID MECHANICS 1
COURSE CODE	:	BDA 20603
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JANUARY/FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. **PART A:** ANSWER **FOUR (4)** QUESTIONS **ONLY** OUT OF **FIVE (5)** QUESTIONS **PART B:** ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

PART A: ANSWER FOUR (4) QUESTIONS ONLY OUT OF FIVE (5) QUESTIONS

Q1 (a) Proof that a solid aluminum block of 4 mm x 3 mm x 3 mm, such as shown in **Figure Q1 (a),** can float on water at 20 °C due to the effect of surface tension. The density of the aluminum block is 2700 kg/m^3. Determine the contact angle.

(10 marks)

(b) A solid alloy cylinder having a diameter of 6.48 cm slides downward at a terminal velocity of V through a vertical pipe. The downward motion is resisted by an oil film between the piston and the pipe wall. Determine the oil viscosity when the velocity V is 5 m/s. The inner diameter of the vertical pipe is 6.5 cm, and the alloy density is 3500 kg/m^3.

(10 marks)

Q2 (a) The inverted U-tube manometer of **Figure Q2 (a)** contains oil and water as shown. The pressure differential between pipes A and B, p_A - p_B is 5 kPa. Determine the specific gravity of the oil if the differential reading h is 150 cm.

(5 marks)

(b) Determine the force F that holds the 4-m-width and 5-m-height gate in **Figure Q2 (b)** close. Given that h is 2 m and SG_{oil} is 0.86.

(15 marks)

Q3 (a) A bucket of water is being placed in a moving lift that goes upwards at a constant speed of 1 m/s. If the height of water in the bucket is 0.75 m, determine the hydrostatic pressure at the bottom of the bucket.

(7 marks)

(b) A 1-m-diameter, 2-m-long cylinder floats in an open tank containing a liquid having a specific weight γ. 10% of the cylinder is above the free surface. A U-tube manometer is connected to the tank as shown in **Figure Q3 (b)**. When the pressure in pipe A is 0.5 kPa above the atmospheric pressure, the various fluid levels are as shown. Determine the weight of the cylinder.

(13 marks)

Q4 (a) The speed of an aircraft flying at an altitude is measured by a pitot-static probe. A mercury manometer attached to the pitot probe indicates a differential reading of 7.5 cm. If the speed of the aircraft is 770 km/h, determine the density of air in kg/m^3. Take the mercury density to be 13600 kg/m^3.

(5 marks)

(b) The water is siphoned out of the tank shown in **Figure Q4 (b)**. Determine the pressure at points (1). If vapor pressure is -99 kPa, determine maximum height h before the water stop flowing.

(15 marks)

Q5 (a) Water enters a rigid, sealed, cylindrical tank through an inlet at the bottom of the tank at a steady rate of 100 liters/hr and forces engine oil ($SG = 0.87$) out through an outlet at the top of the tank. What is the time rate of change of mass of the combined oil and water in the tank?

(7 marks)

(b) A 90° elbow shown in **Figure Q5 (b)** is to direct water flow upward into the atmosphere. The water is flowing from a horizontal pipe at the elbow's inlet. The inner diameter of the entire elbow is 10 cm. The elevation difference between the exit and the centers of the inlet of the elbow is 50 cm. The maximum horizontal anchoring force to hold the elbow in place is 400 N. Determine the maximum mass flowrate of water going into the elbow.

(13 marks)

PART B: ANSWER ALL QUESTIONS

Q6 The lift of a wing, F_{lift}, is a function of wingspan, W, chord length, H, surrounding air density, ρ, and viscosity, μ, and velocity, V. Using μ, V, and W as repeating variables, express this relationship in dimensionless form.

(20 marks)

- END OF QUESTIONS –

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Figure Q1 (a)

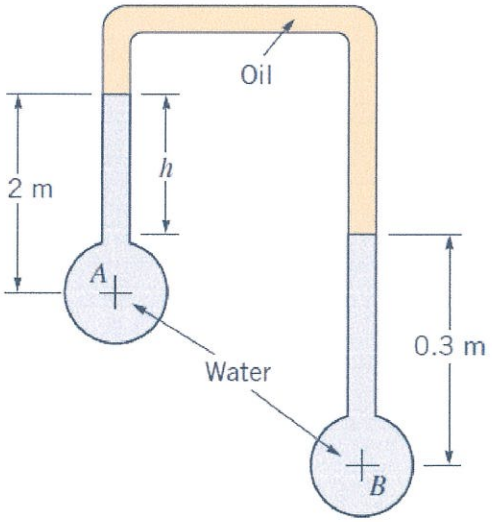

Figure Q2 (a)

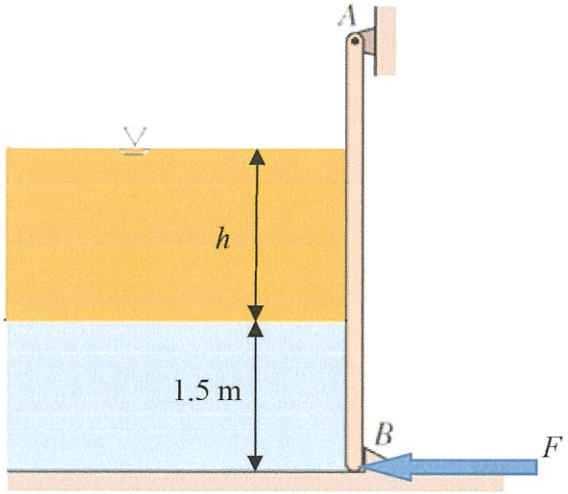

Figure Q2 (b)

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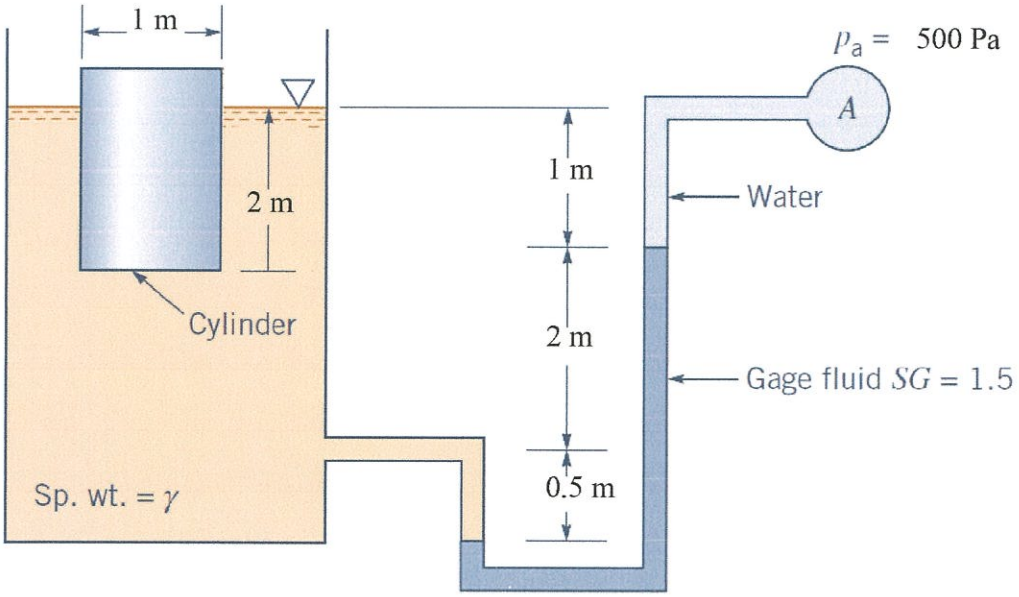

Figure Q3 (b)

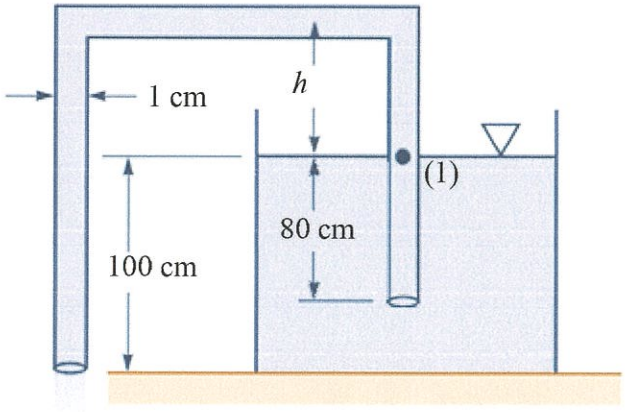

Figure Q4 (b)

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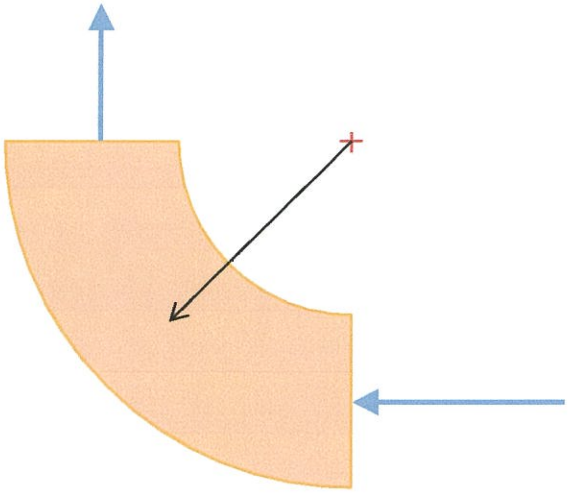

Figure Q5 (b)