Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNQ 10304
PROGRAMME	:	BNN
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS.
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.**
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

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

Q1 (a) Differentiate between absolute pressure and gage pressure. State which pressure is measured in a car tires.

(3 marks)

(b) The absolute pressure in water at a depth of 8 m is read to be 175 kPa. If a liquid has specific gravity of 0.78 and at the same location, determine:

(i) the local atmospheric pressure.

(4 marks)

(ii) the absolute pressure at a depth of 8 m.

(3 marks)

(c) Consider a 55-kg woman who has a total foot imprint area of 400 cm^2. She wishes to walk on the snow, but the snow cannot withstand pressures greater than 0.5 kPa. Determine the minimum size of the snowshoes needed (imprint area per shoe) to enable her to walk on the snow without sinking. Comment on the practicality of the results.

(5 marks)

(d) Consider a hydraulic jack being used in a car repair shop, as in **Figure. Q1 (d)**. The pistons have an area of $A_1 = 50.8$ cm^2 and $A_2 = 50.04$ m^2. Hydraulic oil with a specific gravity of 0.870 is pumped in as the small piston on the left side is pushed up and down, slowly raising the larger piston on the right side. A car that weighs 13,000 N is to be jacked up.

(i) At the beginning, when both pistons are at the same elevation (h = 0), calculate the force F_1 in Newtons required to hold the weight of the car.

(3 marks)

(ii) Repeat the calculation after the car has been lifted two meters (h = 2 m).

(4 marks)

(iii) Compare the results in (i) and (ii) and discuss your findings.

(3 marks)

Q2 (a) Buoyancy is what cause an object to feel lighter and weigh less in a liquid than it does in air.

(i) Define the term 'buoyant force'.

(2 marks)

(ii) Explain what causes it and how it can be determined.

(3 marks)

(iii) Sketch an object that floats in water and label the direction as well as the line of action of the buoyant force passing through that object.

(4 marks)

(b) Explain whether or not the buoyant forces are the same for each ball for each cases below.

(i) Two identical spherical balls submerged in water at different depths.

(2 marks)

(ii) Two 5-cm diameter spherical balls submerged in water, one is made of aluminum and the other is made of iron.

(2 marks)

(iii) A 3-kg copper cube and a 3-kg copper ball submerged in a liquid.

(2 marks)

(c) Consider a large cubic ice block floating in seawater (**Figure Q2 (c)**). The specific gravities of ice and seawater are 0.92 and 1.025 respectively. If a 25-cm high portion of the ice block extends above the surface of the water, determine the height of the ice block below the water surface and briefly discuss the finding. State all assumptions.

(10 marks)

Q3 (a) A water tank of diameter *Do* and height *H* opens to the atmosphere is initially filled with water, as shown in **Figure Q3(a)**. An orifice of diameter *D* with a smooth entrance (no losses) at the bottom drains to the atmosphere. Note that the shape of orifice is round, so the frictional losses are negligible. Develop an equation for time (t) in terms of the water height (z), diameter and gravity acceleration.

(13 marks)

(b) Water enters a two-armed sprinkler vertically (unequal arms and unequal discharge area), and leaves the nozzles horizontally. The smaller jet has a discharge area of 3 cm^2 and a normal distance of 50 cm from the axis of rotation. The larger jet has a discharge area of 5 cm^2 and a normal distance of 35 cm from the axis of rotation. Neglect any frictional effects. Determine the rotational speed of the sprinkler in rpm.

(12 marks)

Q4 The flow rate of water at 15 °C in pipe (10 cm diameter) is to be measured with an orifice meter (diameter = 4.6 cm), as shown in **Figure Q4**. A mercury manometer is used to measure the pressure difference across the orifice.

If the differential height of the manometer is 18 cm,

(a) Determine the estimated flow rate using guessed value of orifice discharge coefficient relation, C_d.

(10 marks)

(b) Calculate the estimated average velocity.

(3 marks)

(c) Determine the estimated orifice discharge coefficient relation (C_d). Based on the answer in **Q4 (a)** and **(b)**, determine the refined value of flow rate, average velocity and head loss.

(12 marks)

- END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 20222023
COURSE NAME : FLUID MECHANICS
PROGRAMME : BNN
COURSE CODE : BNQ 10304

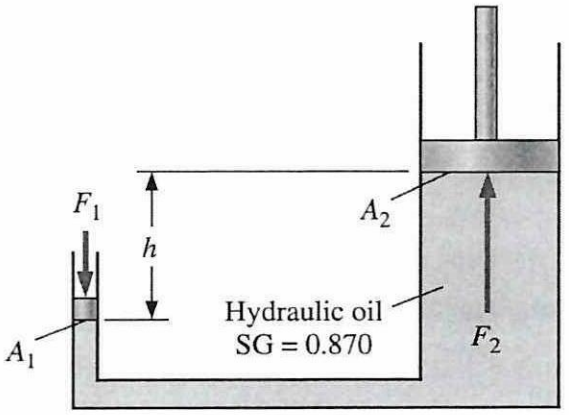

Figure Q1 (d)

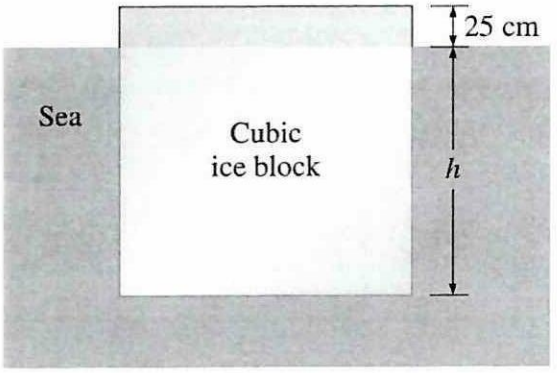

Figure Q2 (c)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 20222023
COURSE NAME : FLUID MECHANICS
PROGRAMME : BNN
COURSE CODE : BNQ 10304

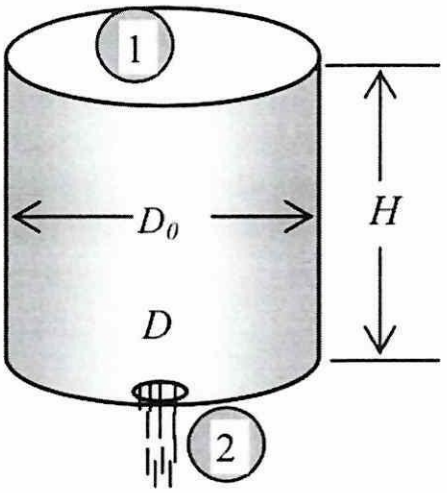

Figure Q3(a)

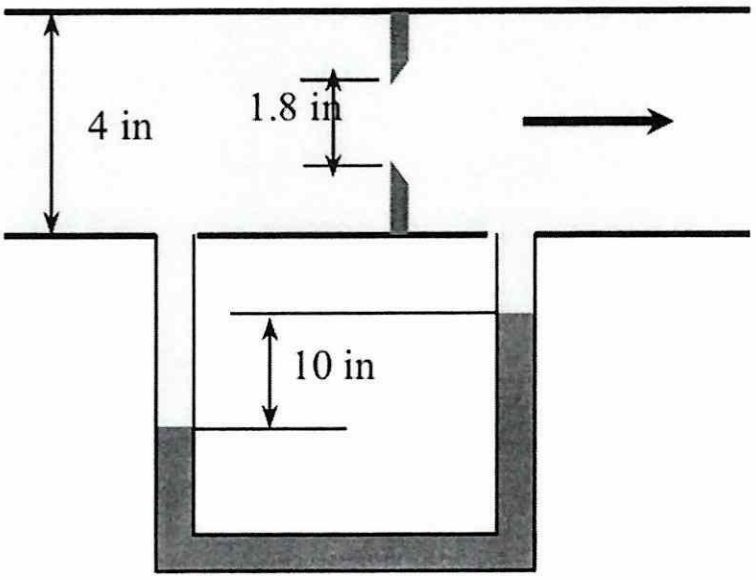

Figure Q4