Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	FLUID MECHANICS 1
COURSE CODE	:	BDA 20603
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	FEBRUARY 2023
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 EXAMNINATION 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 PAPER CONSISTS OF **EIGHT (8)** PAGES

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

Q1 (a) Determine the mass of air in a 4 m^3 tank at a temperature of 24 °C and an absolute pressure within the tank is 200 kPa (abs). The gas constant of air is 287 J/kg.K.

(5 marks)

(b) The liquid is observed to rise 5 mm above the free surface of a liquid when a 1-mm-diameter tube is inserted into the liquid in an open tank as shown in **Figure Q1 (b)**. The specific weight of the liquid is 1.2 x 10^4 N/m^3 and the value of the surface tension for this liquid is 31.5 x 10^{-3} N/m. Determine the contact angle between the liquid and the tube.

(7 marks)

(c) Determine the specific weight of Fluid 3, shown in **Figure Q1 (c)** if the specific weight of Fluid 1 is 10840 N/m^3 and the density of Fluid 2 is 820 kg/m^3.

(8 marks)

Q2 (a) The pressure of water flowing through a pipe is measured by the arrangement shown in **Figure Q2 (a)**. For the manometric fluid having specific weight of 23.5 kN/m^3, calculate the pressure in the pipe.

(8 marks)

(b) A rectangular gate having 4 m high and 4 m wide is hinge at the bottom of the partition as shown in **Figure Q2 (b)**. Gasoline is filled at one side of the tank until the level reach 4 m, and then water is added to the empty side of the tank. Find the value of h, when the gate will start to open. Take the density of water and gasoline as 1000 kg/m^3 and 700 kg/m^3, respectively.

(12 marks)

Q3 (a) A spherical shell is immersed in water. The density of the spherical shell is 1650 kg/m^3. If the inner diameter and outer diameter are equal to 5 cm and 6 cm, respectively. Assuming that the inner part of the shell is a vacuum, calculate the percentage of the shell's total volume that would be submerged.

(5 marks)

(b) A truck is used to carry a cubical water tank and accelerates from 0 to 90 km/h in 10s. The side length of water is 3 m, half filled with water and open to the atmosphere at 100 kPa. Determine the maximum pressure in water.

(5 marks)

(c) A cylinder with diameter of 0.6 m is connected to a 2 m wide rectangular gate as shown in **Figure Q3 (c)**. The gate will be opened if the water level, h drop below 2.5m. By neglecting the frictional effects at the gate hinge and the pulley, determine the mass of the cylinder.

(10 marks)

Q4 (a) To anticipate the flow rate in the pipe precisely, flowmeters with an orifice, nozzle, or venturi have been used for a very long period. To the purpose of selecting the optimum flow rate measurement instrument, briefly discuss by comparing the design and manufacturing flow concepts, benefits, and drawbacks.

(6 marks)

(b) As shown in **Figure Q4 (b)**, the owner of the opulent home desired to construct a viewless swimming pool with a double layer treated water supply. The water flow steadily through the large tanks. Determine *h* to keep the water level at secondary tank at 2 m depth.

(7 marks)

(c) Air is drawn into a wind tunnel used for testing the Proton Waja as shown in **Figure Q4 (c)**. If the specific gravity of oil is 0.815, determine;

(i) The height, h, when the velocity in the test section is 90 km/hr. Please note that there is 25 mm column of oil on the water manometer.
(ii) The difference between the stagnation pressure on the front of the vehicle and the pressure in the test section.

(7 marks)

Q5 (a) Water flowing steadily at the rate of 0.16 m^3/s is deflected downward by an angled elbow as shown in **Figure Q5 (a)**. Given the parameter such D = 30 cm, d = 10cm, h = 50 cm, and mass of the elbow is 200 kg. Determine the force acting on the flanges of the elbow and the angle its line of the action make with the horizontal. Take the internal volume of the elbow to be 0.03 m^3 and disregard the frictional effects.

(8 marks)

(b) Water flow steadily from a tank mounted on the cart as shown in **Figure Q5 (b)**. After the water jet leaved the nozzle tank, it falls and strikes a vane attached to another cart. The cart's wheels are frictionless and the fluid is inviscid. Determine;

(i) The speed of the water leaving the tank, V_1, and the water speed leaving the cart, V_2.
(ii) The tension in rope A and B.

(12 marks)

PART B: ANSWER ALL QUESTIONS

Q6 (a) Verify the Reynolds Number, $Re = \frac{\rho VD}{\mu}$ is dimensionless.

(3 marks)

(b) **Figure Q6 (b)** shows water flows over a dam. Assume flowrate Q, along the dam depends on the head H, width b, acceleration of gravity, g, fluid density, ρ and fluid viscosity μ. Develope a non-dimensional relationship between Q and the other parameters by choosing b, g, and ρ as the repeating variables.

(17 marks)

-END OF QUESTION-

FINAL EXAMINATION

SEMESTER / SESSION : SEM I 2022/2023 PROGRAMME CODE : BDD
COURSE NAME : FLUID MECHANICS 1 COURSE CODE : BDA20603

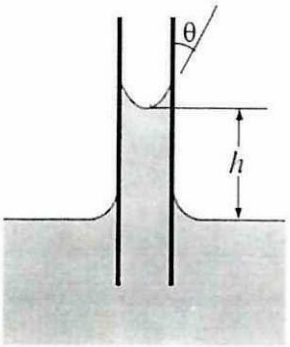

Figure Q1 (b)

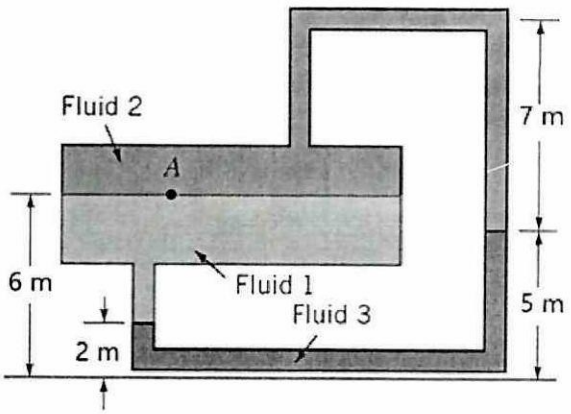

Figure Q1 (c)

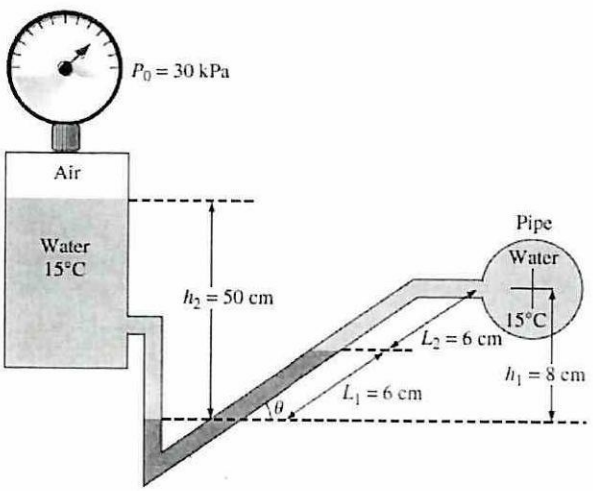

Figure Q2 (a)

FINAL EXAMINATION

SEMESTER / SESSION : SEM I 2022/2023 PROGRAMME CODE : BDD
COURSE NAME : FLUID MECHANICS 1 COURSE CODE : BDA20603

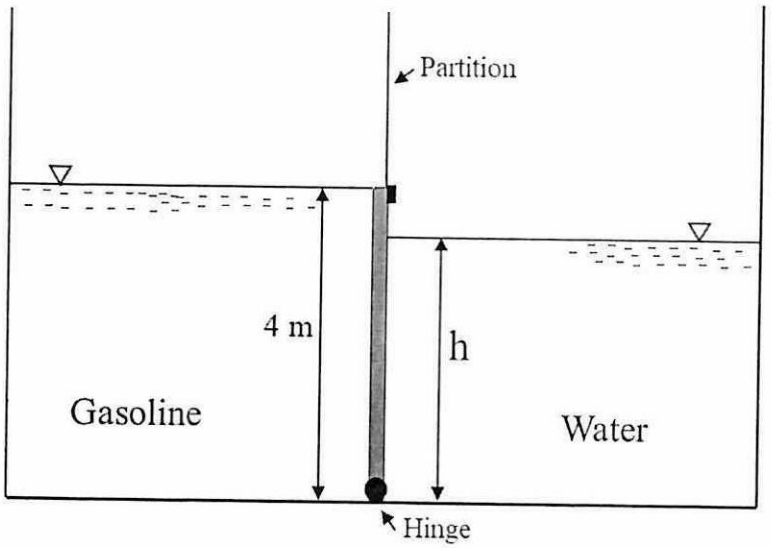

Figure Q2 (b)

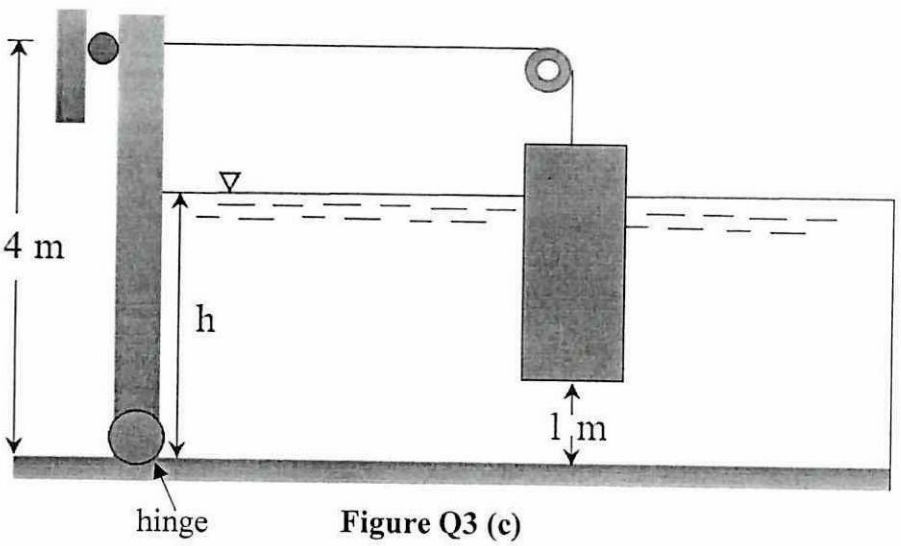

Figure Q3 (c)

FINAL EXAMINATION

SEMESTER / SESSION : SEM I 2022/2023 PROGRAMME CODE : BDD
COURSE NAME : FLUID MECHANICS 1 COURSE CODE : BDA20603

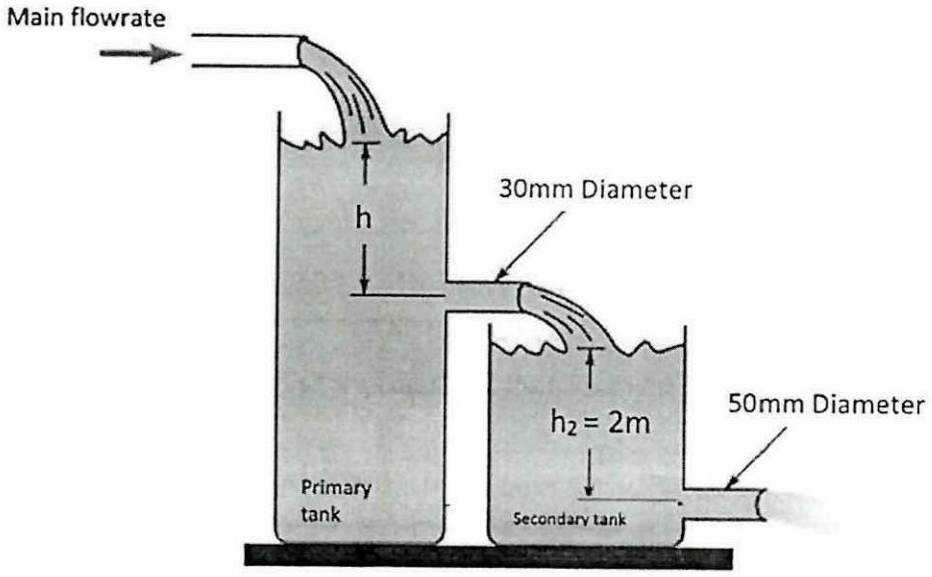

Figure Q4 (b)

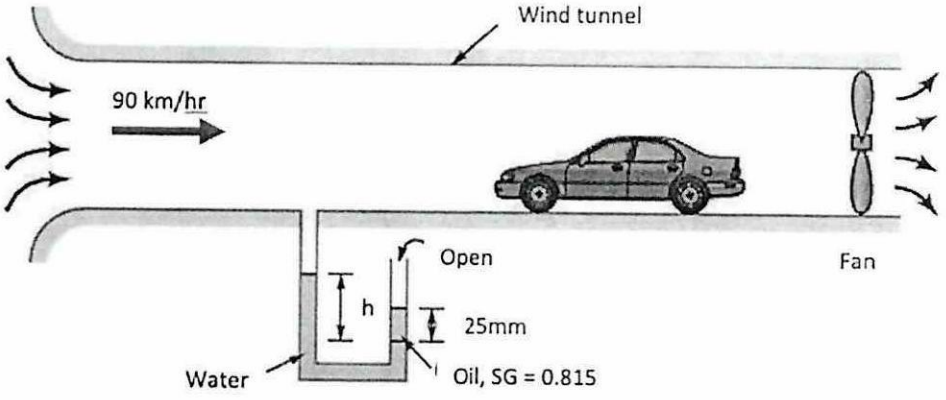

Figure Q4 (c)

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2022/2023 PROGRAMME CODE : BDD
COURSE NAME : FLUID MECHANICS 1 COURSE CODE : BDA20603

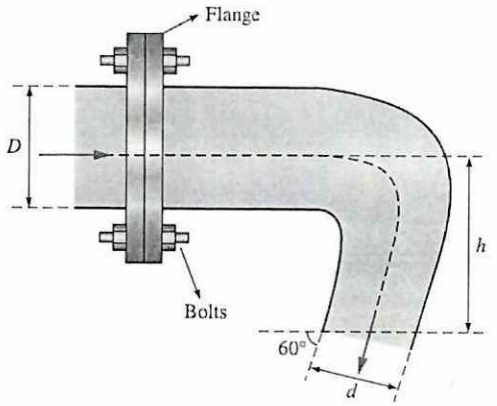

Figure Q5 (a)

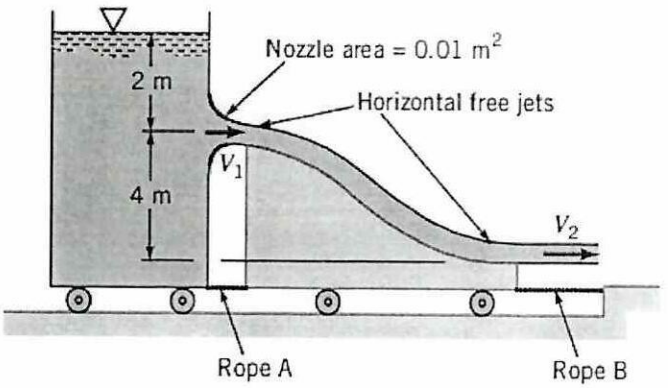

Figure Q5 (b)

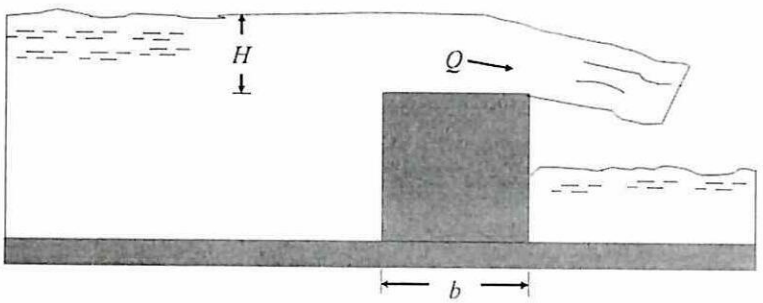

Figure Q6 (b)