Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	FLUID MECHANICS 1
COURSE CODE	:	BDA 20603
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY 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) 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 (see **Figure Q1 (a)**) . The specific weight of the liquid is 1.2×10^4 N/m^3 and the value of the surface tension for this liquid is 31.5×10^{-3} N/m. Determine the contact angle between the liquid and the tube.

(10 marks)

(b) A sled slides along on a thin horizontal layer of water between the ice and the sled. The horizontal force that the water puts on the sled is equal to 5 N when the sled's speed is 20 m/s. The total area of the sled in contact with the water is 0.008 m^2, and the viscosity of the water is 0.354×10^{-3} Pa/s. Determine the thickness of the water layer under the runners. Assume a linear velocity distribution in the water layer.

(10 marks)

Q2 (a) The inverted U-tube manometer of **Figure Q2 (a)** contains gage fluid 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 gage fluid.

(5 marks)

(b) Determine the specific gravity, SG_{oil}, if the force F that holds the 4-m-width and 5-m-height gate in **Figure Q2 (b)** close is 170 kN. Given that h is 2 m.

(15 marks)

Q3 (a) Compare the stability of a submerged body and a floating body whose centre of gravity is above the centre of buoyancy.

(6 marks)

(b) The volume and average density of a metal composite are to be determined by using a spring scale. Calculate the volume and the density of the metal composite it weighs 7200 N in air and 4790 N in water.

(6 marks)

(c) An open rectangular tank with 1 m wide, 2m long contains water to a depth of 1 m is to be transported on the back ofa truck. If the height of the tank sides is 1.5 m, determine the maximum horizontal acceleration that can develop before the water would begin to spill if

i. The long side is parellel to the direction of motion.
ii. The short side is parellel to the direction of motion.
iii. Based on your answers in (i) and (ii), provide recommendation on how the tank should be aligned in order to avoid spilling at a higher acceleration.

(8 marks)

Q4 (a) Explain the limitations on the use of the Bernoulli Equation

i. Steady flow
ii. Negligible viscous effects
iii. Flow along a streamline

(6 marks)

(b) As shown in **Figure Q4 (b)**, a venturi meter with a 5 cm diameter is use to measure air flows through a 18 cm duct. The manometric fluid used to measure the 40 cm differential height is water. Determine;

i. The maximum mass flow rate of air if the discharge coefficient is 0.98.
ii. The volume flow rate for a differential height of 25 cm.

(14 marks)

Q5 (a) Compare the body forces and surface forces that act on a control volume.

(3 marks)

(b) As shown in **Figure Q5 (b)**, a reducing elbow deflects water at 14 kg/s in a horizontal pipe upward 30° while accelerating it. The elbow discharges water into the atmosphere. The cross-sectional area of the elbow is 113 cm^2 at the inlet and 7 cm^2 at the outlet. The elevation difference between the centers of the inlet and outlet is 30 cm. The weight of the elbow and the water in it is negligible. Determine;

i. The gage pressure at the centre of the inlet of the elbow.
ii. The anchoring force that is needed to hold the elbow in place.

(17 marks)

PART B: ANSWER ALL QUESTIONS

Q6 (a) State the law of dimensional homogeneity and briefly describe an example of it.

(3 marks)

(b) Consider the flow of an incompressible fluid of density ρ and viscosity μ through a long horizontal pipe, as shown in **Figure Q6 (b)**. Given that D is pipe diameter, V is the average speed across the pipe cross-section, ϵ is the roughness of pipe and τ_w is the shear stress on the inside pipe wall.

i. State 2 assumptions to proceed with the non-dimensional analysis.

ii. Develop a non-dimensional relationship between shear stress τ_w and the other parameters by choosing ρ, μ and V as the repeating variables.

(17 marks)

-END OF QUESTION-

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2021/2022
COURSE NAME : FLUID MECHANICS 1
PROGRAMME CODE : BDD
COURSE CODE : BDA20603

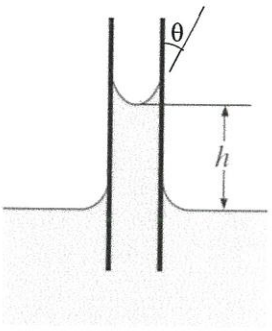

Figure Q1 (a)

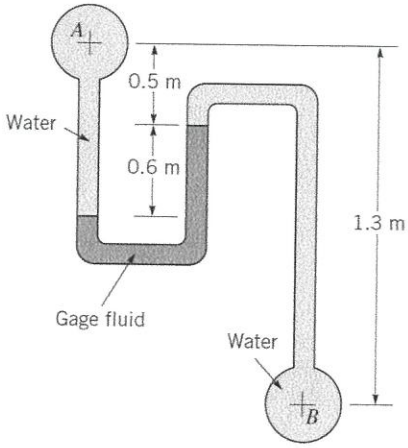

Figure Q2 (a)

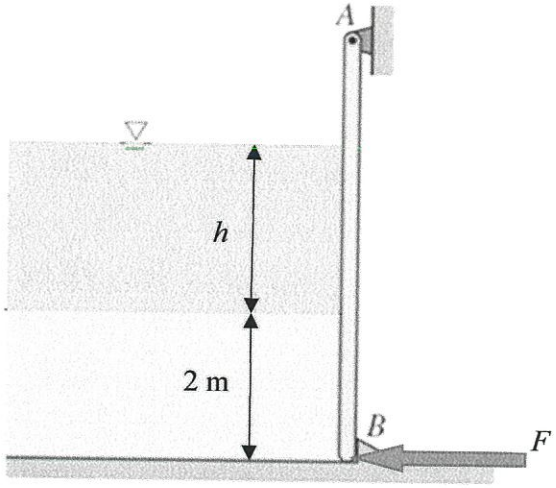

Figure Q2 (b)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2021/2022 PROGRAMME CODE : BDD
COURSE NAME : FLUID MECHANICS 1 COURSE CODE : BDA20603

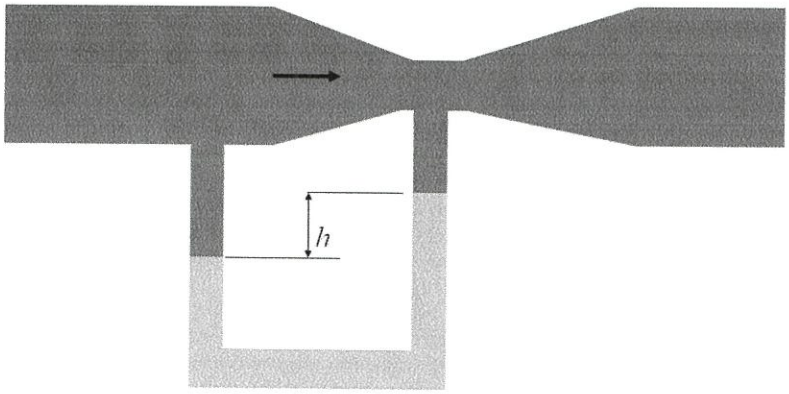

Figure Q4 (b)

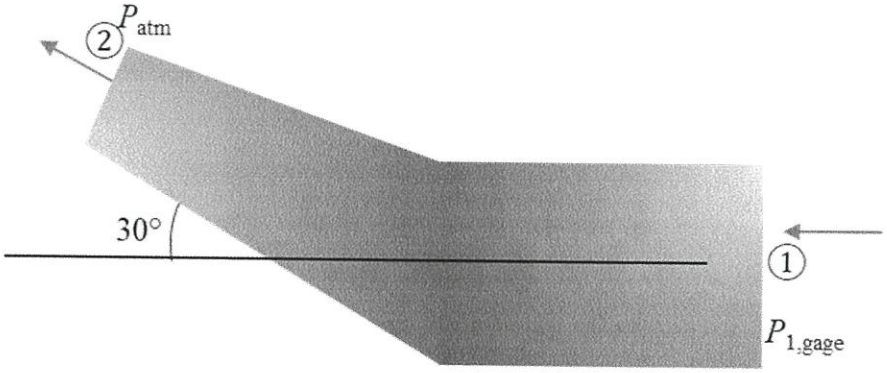

Figure Q5 (b)

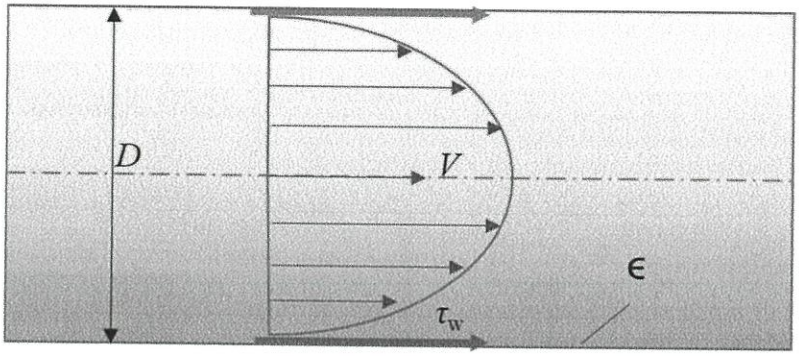

Figure Q6 (b)