Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BDU 11403
PROGRAMME CODE	:	BDM
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **FOUR (4)** QUESTIONS ONLY.
		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 PAPER CONSISTS OF **SEVEN (7)** PAGES

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ANSWER **FOUR (4)** QUESTIONS ONLY.

Q1 (a) Provide an explanation on the following:

(i) Fluid statics

(1 marks)

(ii) Cohesive Forces with one example

(2 marks)

(iii) Adhesive Forces with one example

(2 marks)

(b) A glass tube is inserted into water at 40°C as shown in **Figure Q1 (b)** and the physical properties of water are shown in **Table Q1 (b)**. If contact angle of water with a glass surface is 0° and the water surface tension, σ is 0.0696 N/m.

(i) Examine and plot the height, h of the water as a function of the tube's inner diameter D for 0.5 mm $\leq$ D $\leq$ 3 mm. Use increments of 0.5 mm.

(16 marks)

(ii) Based on the plot in **Q1 (b)(i),** explain the relation between height and diameter of the glass tube.

(4 marks)

Q2 (a) A hydrometer is used to measure the specific gravity of the liquid. For the certain liquid, a hydrometer reading indicates a specific gravity of 1.15. Determine the density and specific weight of that liquid.

(5 marks)

(b) A piston that having a cross-sectional area of 0.07 m^2 is located in a cylinder containing water. An open U-tube manometer is connected to the cylinder as shown in **Figure Q2 (b)**. The weight of the piston is negligible.

(i) Examine the force, ***P*** acting on the piston. Take h_1 = 60 mm, h = 100 mm and density of the mercury is 13600 kg/m^3.

(16 marks)

(ii) Compare your answer, if the mercury is changed to water, will the similar answer of the force, ***P*** as **Q2(b)(i)** is obtained. Take the same value of h_1 and h .

(4 marks)

Q3 (a) Provide an explanation on the following:

(i) Density

(1 marks)

(ii) Bernoulli's Principle

(2 marks)

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(b) As a designer, you are requested to choose the suitable width of the overhang sea wall along *ABC* which are 2 m and 5 m wide as shown in **Figure Q3(b)**. Compare the resultant force that water exerts on the overhang sea wall if the wall is 2 m and 5 m wide.

(22 marks)

Q4 (a) As shown in **Figure Q4 (a)**, water flows out of faucet at ***A*** at 6m/s. Determine the velocity of the water just before it strikes the ground surface at ***B***.

(5 marks)

(b) The uniform 5 m long wooden rod in **Figure Q4 (b)** is tied to the bottom by string. The wooden rode is in equilibrium under the action of weight and buoyant forces. The physical properties of water are shown in **Table Q4 (b).**

(i) Analyse the string tension.

(15 marks)

(ii) Determine the specific gravity of the wood.

(3 marks)

(iii) Determine the inclination angle, θ.

(2 marks)

Q5 (a) At cruise conditions of Airbus A380, air flows into a Rolls-Royce Trent 900 turbofan engine (**Figure Q5(a)**) at a steady rate of 27.22 kg/s. Fuel enters the engine at a steady rate of 0.27 kg/s. The average velocity of the exhaust gases is 452.2 m/s relative to the engine. If the engine exhaust effective cross section area is 0.325 m^2, determine the density of the exhaust gases in kg/m^3.

(8 marks)

(b) A free jet of fluid strikes a wedge of the total flow, a portion is deflected 30° ; the remainder is not deflected as shown in **Figure Q5(b)**. The horizontal and vertical components of force needed to hold the wedge stationary are F_H and F_V, respectively. Gravity is negligible and the fluid speed remains constants. Analyse the force ratio, F_H/F_V.

(17 marks)

- END OF QUESTIONS -

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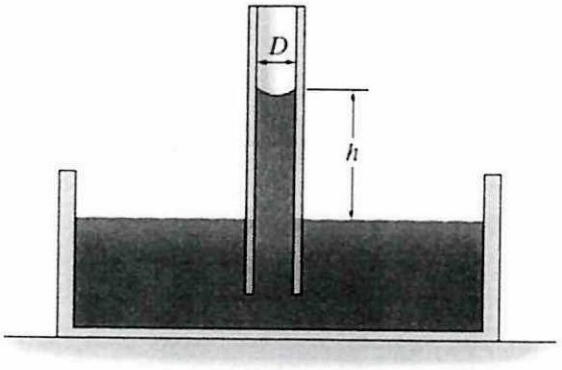

Figure Q1(b)

Table Q1(b)

Temperature T (°C)	Density ρ (kg/m^3)	Dynamic Viscosity μ (N·s/m^2)	Kinematic Viscosity ν (m^2/s)	Vapor Pressure p_v (kPa)
0	999.8	$1.80(10^{-3})$	$1.80(10^{-6})$	0.681
5	1000.0	$1.52(10^{-3})$	$1.52(10^{-6})$	0.872
10	999.7	$1.31(10^{-3})$	$1.31(10^{-6})$	1.23
15	999.2	$1.15(10^{-3})$	$1.15(10^{-6})$	1.71
20	998.3	$1.00(10^{-3})$	$1.00(10^{-6})$	2.34
25	997.1	$0.897(10^{-3})$	$0.898(10^{-6})$	3.17
30	995.7	$0.801(10^{-3})$	$0.804(10^{-6})$	4.25
35	994.0	$0.723(10^{-3})$	$0.727(10^{-6})$	5.63
40	992.3	$0.659(10^{-3})$	$0.664(10^{-6})$	7.38
45	990.2	$0.599(10^{-3})$	$0.604(10^{-6})$	9.59
50	988.0	$0.554(10^{-3})$	$0.561(10^{-6})$	12.4

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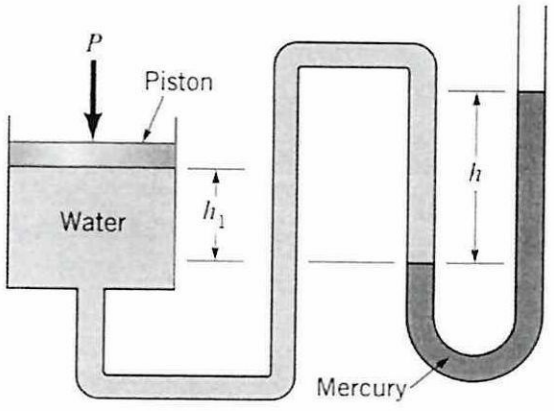

Figure Q2(b)

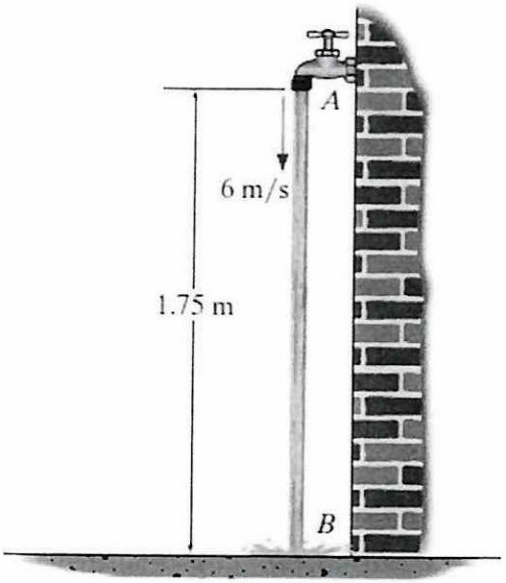

Figure Q4 (a)

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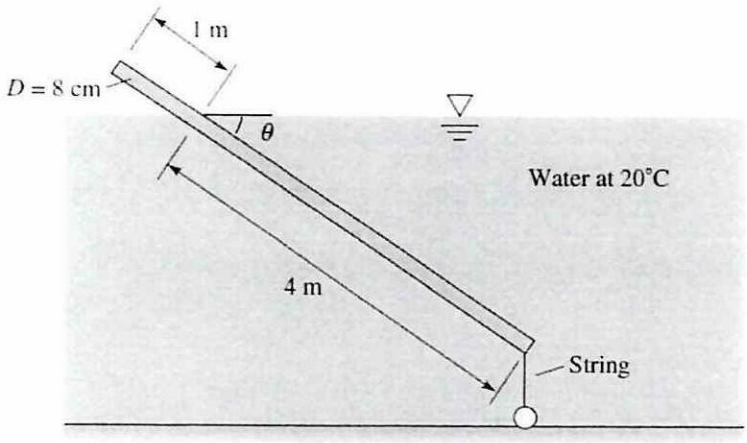

Figure Q4 (b)

Table Q4(b)

Temperature T (°C)	Density ρ (kg/m^3)	Dynamic Viscosity μ (N·s/m^2)	Kinematic Viscosity ν (m^2/s)	Vapor Pressure p_v (kPa)
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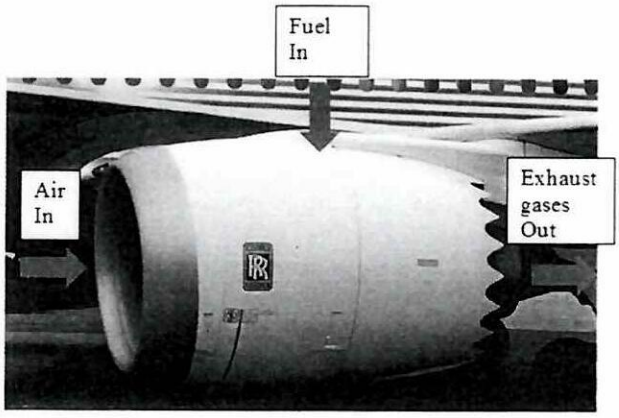

Figure Q5(a)

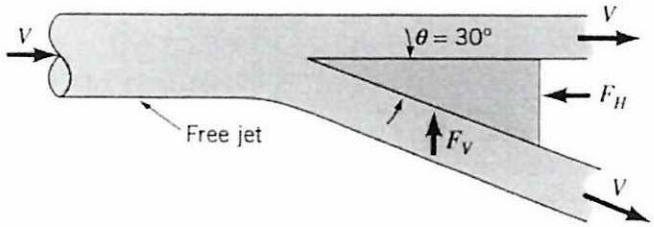

Figure Q5(b)

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