Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	DAC 22303
PROGRAMME CODE	:	DAA
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FIVE (5)** 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 **NINE (9)** PAGES

Q1 (a) List **two (2)** examples of Newtonian fluids and **two (2)** examples of non-Newtonian fluids.

(2 marks)

(b) Define the relative density.

(2 marks)

(c) Explain the surface tension for interior of liquid cylinder.

(4 marks)

(d) The density and the dynamic viscosity of a fluid are 753.6 kg/m^3 and 55.8 x 10^{-4} Pa.s respectively. Calculate the relative density, the specific weight and the kinematic viscosity.

(6 marks)

(e) The kinematic viscosity and the specific weight of a fluid are 8.26 x 10^{-5} m^2/s and 5.47 kN/m^3 respectively. Calculate the density, the dynamic viscosity, and the specific gravity of the fluid.

(6 marks)

Q2 (a) Define the Archimedes' principle related to buoyancy and stability.

(2 marks)

(b) Briefly explain and sketch the total pressure of fluid on the wall surfaces shown in **Figure Q2(b)**.

(6 marks)

(c) Two submarines are under the sea surface doing their daily job as shown in **Figure Q2(c)**. The seawater has specific gravity 1.521. Submarines A and B are 200 m and 5 m above the seabed respectively. As detected by the sensor, the pressure of seawater acting on submarine A is 4629 kPa. If the seabed is horizontal, calculate the pressure acting on submarine B.

(8 marks)

(d) Water is flowing in pipes A and B as shown in **Figure Q2(d)**. Calculate the pressure difference between B and A.

(4 marks)

Q3 (a) Briefly describe the volume of flow rate is the volume of fluid flowing past a section per unit time.

(2 marks)

(b) Refer to **Figure Q3(b)**, explain the continuity equation for fluid flow in pipe system.

(6 marks)

(c) Refer to **Table Q3(c)**, calculate mass of flow rate (kg/s) in a pipeline.

(3 marks)

(d) The water velocity and pressure head at point B are 5.3 m/s and 51 m. Radius of pipe at point A enlarges uniformly from 33 mm at 1.5 m datum level to 7.7 cm at 5.9 m

datum level at point B. Minor and major losses are neglected. Determine pressure head (m) at point A.

(9 marks)

Q4 (a) Define minor losses as a component of energy head loss.

(2 marks)

(b) Refer to **Figure Q4(b)**, explain the local disturbance in pipe system.

(6 marks)

(c) The galvanized iron pipe is 51 m long and has a diameter of 19.5 mm. Calculate as below base on given data:

(i) Reynolds number if the velocity of water is 0.17 m/s and kinematic viscosity of water is 1.19×10^{-6} m^2/s.

(2 marks)

(ii) Friction head loss (m).

(2 marks)

(iii)Relative roughness if absolute roughness of galvanized iron pipe is 0.15 mm.

(2 marks)

(d) **Table Q4(d)** shows two reservoirs are connected by pipelines in series arrangement. Determine the total of head loss (m).

(6 marks)

Q5 Two reservoirs were connected by using 2 mild steel pipes as shown in **Figure Q5**. An intern at Bina Expertise Sdn Bhd has asked for your guidance for the pipe network analysis. Based on your understanding, determine the following:

(i) Write the expression of V_1 in the term of V_2.

(2 marks)

(ii) Determine the $\sum h_L$ of to the system given the $k_e = 0.8$.

(12 marks)

(iii)Calculate the velocity at pipe 1 and pipe 2 respectively.

(6 marks)

Q6 (a) Briefly describe the Geometric, Kinematic and Dynamic Similarities in hydraulic and aeronautical engineering.

(4 marks)

(b) A model boat 1/500 size of its prototype has 6 N of resistance when simulating a speed of 10 m/s of the prototype. Calculate the corresponding resistance in the prototype. Neglect frictional forces.

(4 marks)

(c) An airfoil moves at 200 km/h through still air at 20°C. If the elastic stress and density of air at this temperature is 10 kg/cm2 and 0.3 kg/m3, calculate Mach's

number.

(4 marks)

(d) A 1:4 scale model of a passenger car is tested in a wind tunnel. The prototype velocity is 30 km/h. The air in the model and prototype can be assumed to have the same properties. If the model drag is 100 N, calculate the followings; calculate the drag force and power are required for the prototype.

(i) Calculate the drag force.

(4 marks)

(ii) Calculate the power required for the prototype.

(4 marks)

-END OF QUESTIONS –

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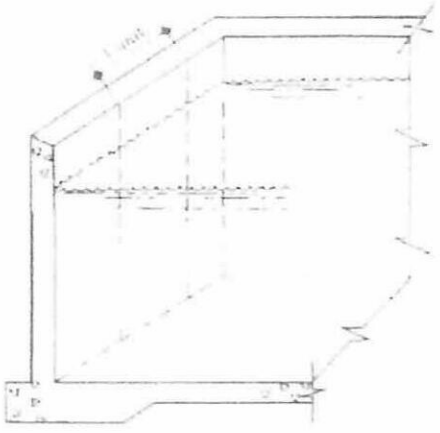

Figure Q2(b)

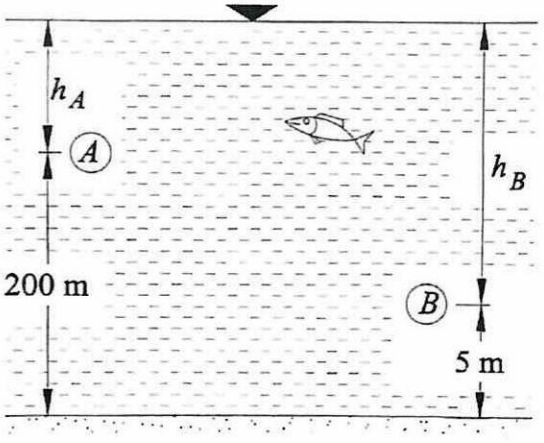

Figure Q2(c)

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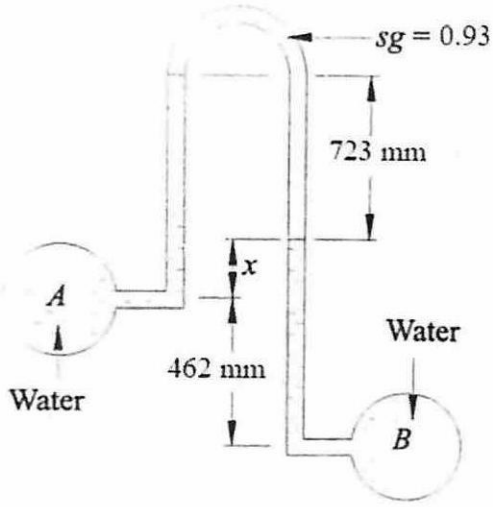

Figure Q2(d)

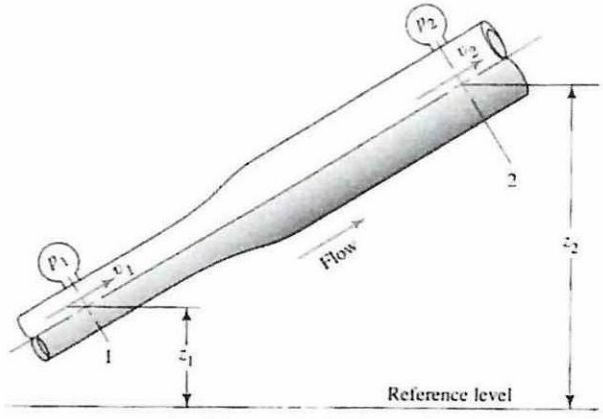

Figure Q3(b)

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Table Q3(c)

Item	Value
Velocity	0.71 m/s
Radius of pipe	0.019 m
Diameter of pipe	3 cm
Length of pipe	1000 mm
Density of water	1000 kg/m^3
Specific gravity of liquid	1.33

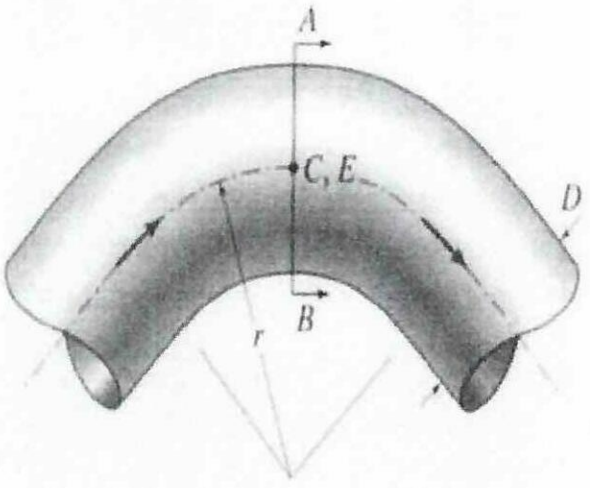

Figure Q4(b)

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Table Q4(d)

Item	Value
Entrance loss coefficient	0.04
Diameter of pipeline A	0.31 m
Area of pipeline A	0.075 m^2
Length of pipeline A	17 m
Friction factor of pipeline A	0.057
Velocity of pipeline A	3.3 m/s
Discharge of pipeline A	0.25 m^3/s
Sudden contraction loss coefficient	0.39
Diameter of pipeline B	0.093 m
Area of pipeline B	0.007 m^2
Length of pipeline B	15 m
Friction factor of pipeline B	0.035
Velocity of pipeline B	35.43 m/s
Discharge of pipeline B	0.25 m^3/s
Submerged discharge loss coefficient	1

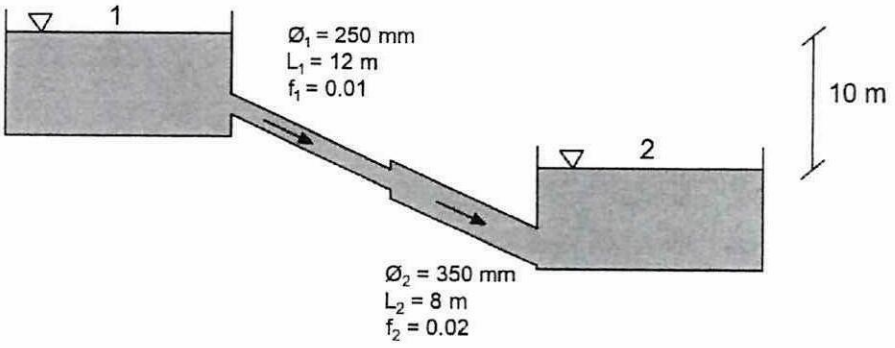

Figure Q5

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Formula

Loss	Formula
In pipe	$h_f = f\dfrac{L \cdot V}{2g \cdot D}$
Connection	
• Sudden Expansion	$h_f = \dfrac{(V_1 - V_2)^2}{2g}$
• Gradually Expansion	$h_f = k'\dfrac{(V_1 - V_2)^2}{2g}$
• Sudden Contraction	$h_f = k_c\dfrac{V^2}{2g}$
• Gradually Contraction	$h_f = k_c\dfrac{V^2}{2g}$
Entrance	$h_f = k_e\dfrac{V^2}{2g}$
Exit	$h_f = k_d\dfrac{V^2}{2g}$

$Q = A \cdot V \quad A_{circle} = \pi r^2 = \pi\dfrac{D^2}{4}$