



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022**

- COURSE NAME : FLUID MECHANICS
- COURSE CODE : BFC 10403
- PROGRAMME CODE : BFF
- EXAMINATION DATE : JULY 2022
- DURATION : 3 HOURS
- INSTRUCTION
1. ANSWER ALL QUESTIONS.
 2. THIS FINAL EXAMINATION IS AN **ONLINE ASSESSMENT** AND CONDUCTED VIA **CLOSE 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

- Q1**
- (a) Differentiate:
 (i) Dynamic and kinematic viscosity
 (ii) Specific volume and bulk modulus
 (4 marks)
- (b) With the aid of sketch, explain how to determine the hydrostatic forces acting on a plane or curved surface submerged in a multilayered fluid of different densities.
 (5 marks)
- (c) Referring to **FIGURE Q1 (c)**, determine h if the gage pressure of air in the tank is 65 kPa.
 (7 marks)
- (d) A solid block of woods floats in water with 40 mm projection above the water surface. When placed in glycerin of specific gravity 1.35, the solid block projects 70 mm above the surface of that liquid.
- (i) Calculate the specific gravity of wood
 (7 marks)
- (ii) In your opinion, what will happen to the block if the wood is replaced by rubber floats in the tank filled with water ($sg = 1.15$).
 (2 marks)
- Q2**
- (a) Amount of mass entering and leaving a control volume during steady flow process are equal. Does this principle apply to unsteady flow process? State your opinion.
 (4 marks)
- (b) Explain the derivation of momentum equations using fluid parameters with the aid of sketch. State your opinion on momentum of a water body if the net force acting on it is zero.
 (5 marks)
- (c) A pipeline carrying oil ($sg = 0.87$) from point 1 with diameter of 200 mm to point 2 with 500 mm at 4 m higher than point 1. The pressure at point 1 and point 2 are 9.81 N/cm^2 and 5.886 N/cm^2 , respectively. If the discharge is 200 L/s, determine the head loss and direction of flow.
 (7 marks)
- (d) **FIGURE Q2 (d)** shows a 45° deflected angle reducing bend lies on the horizontal plane and tapers from 60 cm diameter to 30 cm diameter at the outlet. The pressure at the inlet is 15 kPa and flow through the bend is $0.5 \text{ m}^3/\text{s}$ of water. Determine the magnitude and direction of resultant force exerted by water on the bend.
 (9 marks)

- Q3** (a) Differentiate laminar and turbulent flow. (4 marks)
- (b) Discuss **FOUR (4)** zones in Moody chart with the aid of sketch. (5 marks)
- (c) An oil ($sg = 0.8$) flows in a pipe of 300 mm diameter and 800 m length at rate of $0.45 \text{ m}^3/\text{s}$. If kinematic viscosity is $0.3 \times 10^{-4} \text{ m}^2/\text{s}$, calculate :
 (i) head loss due to friction
 (ii) power required to maintain the flow (7 marks)
- (d) **FIGURE Q3(d)(i)** shows an industrial storage tank from a horizontal steel pipe with 100 m long and 525 mm diameter carries water at 25°C to a bulk food processing system. The steel pipe was delivery water at rate of flow 520 L/min. Relative roughness for steel pipe is 4.5×10^{-5} m. Determine the amount of pressure drop that occurs in the pipe from the storage tank to the processing system.
(Please refer to TABLE Q3 (d) for properties of water and FIGURE Q3 (c)(ii) Moody Chart.) (9 marks)
- Q4** (a) Differentiate Energy Grade Line and Hydraulic Grade Line. (4 marks)
- (b) Based your opinion, discuss the significant of Dimensionless Analysis in fluid mechanics. (5 marks)
- (c) Three pipes of diameters 300 mm, 200 mm and 400 mm and lengths 450 m, 255 m and 315 m respectively are connected in series. The difference in water surface levels in two tanks is 18 m. Determine the flowrate of water if coefficients of friction are 0.0075, 0.0078 and 0.0072, respectively by considering all minor losses. (9 marks)
- (d) Analyse shear stress, τ_o on the walls of triangular channel which depends on the vertex angle, θ , depth of flow, y , density, ρ and gravity, g . Obtain an expression in dimensionless equation using Buckingham Theorem if repeating variables are density, gravity and depth of flow. Refer **TABLE Q4 (d)** for dimensionless parameter. (7 marks)

– END OF QUESTIONS –

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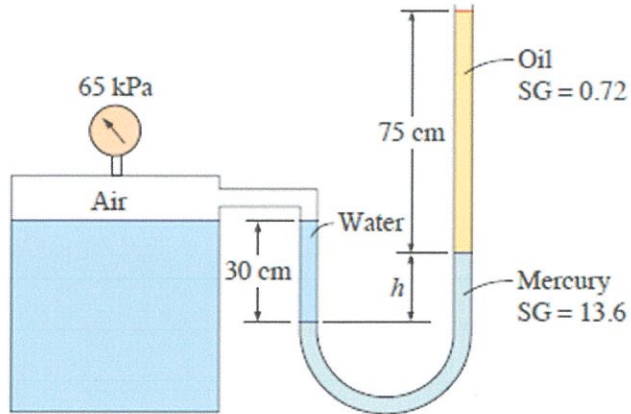


FIGURE Q1 (c)

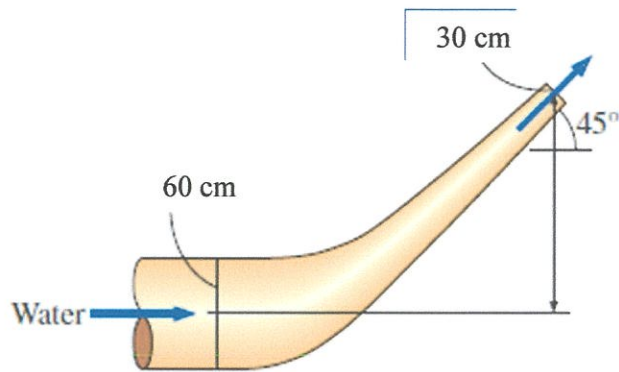


FIGURE Q2 (d)

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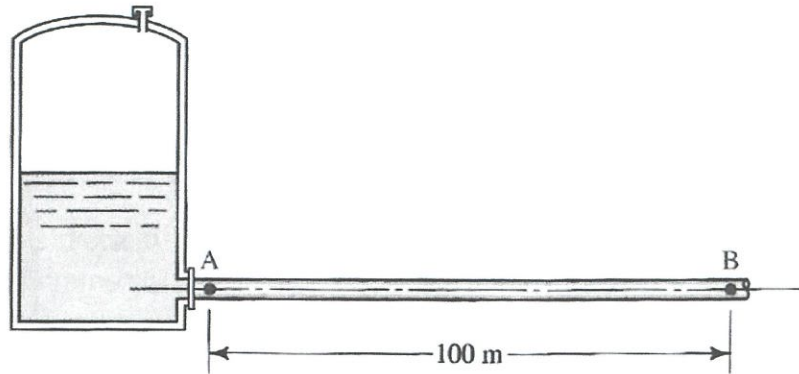


FIGURE Q3 (d)(i)

TABLE Q3 (c)

Temperature (°C)	Specific Weight γ (kN/m ³)	Density ρ (kg/m ³)	Dynamic Viscosity η (Pa·s)	Kinematic Viscosity ν (m ² /s)
0	9.81	1000	1.75×10^{-3}	1.75×10^{-6}
5	9.81	1000	1.52×10^{-3}	1.52×10^{-6}
10	9.81	1000	1.30×10^{-3}	1.30×10^{-6}
15	9.81	1000	1.15×10^{-3}	1.15×10^{-6}
20	9.79	998	1.02×10^{-3}	1.02×10^{-6}
25	9.78	997	8.91×10^{-4}	8.94×10^{-7}
30	9.77	996	8.00×10^{-4}	8.03×10^{-7}
35	9.75	994	7.18×10^{-4}	7.22×10^{-7}
40	9.73	992	6.51×10^{-4}	6.56×10^{-7}
45	9.71	990	5.94×10^{-4}	6.00×10^{-7}
50	9.69	988	5.41×10^{-4}	5.48×10^{-7}

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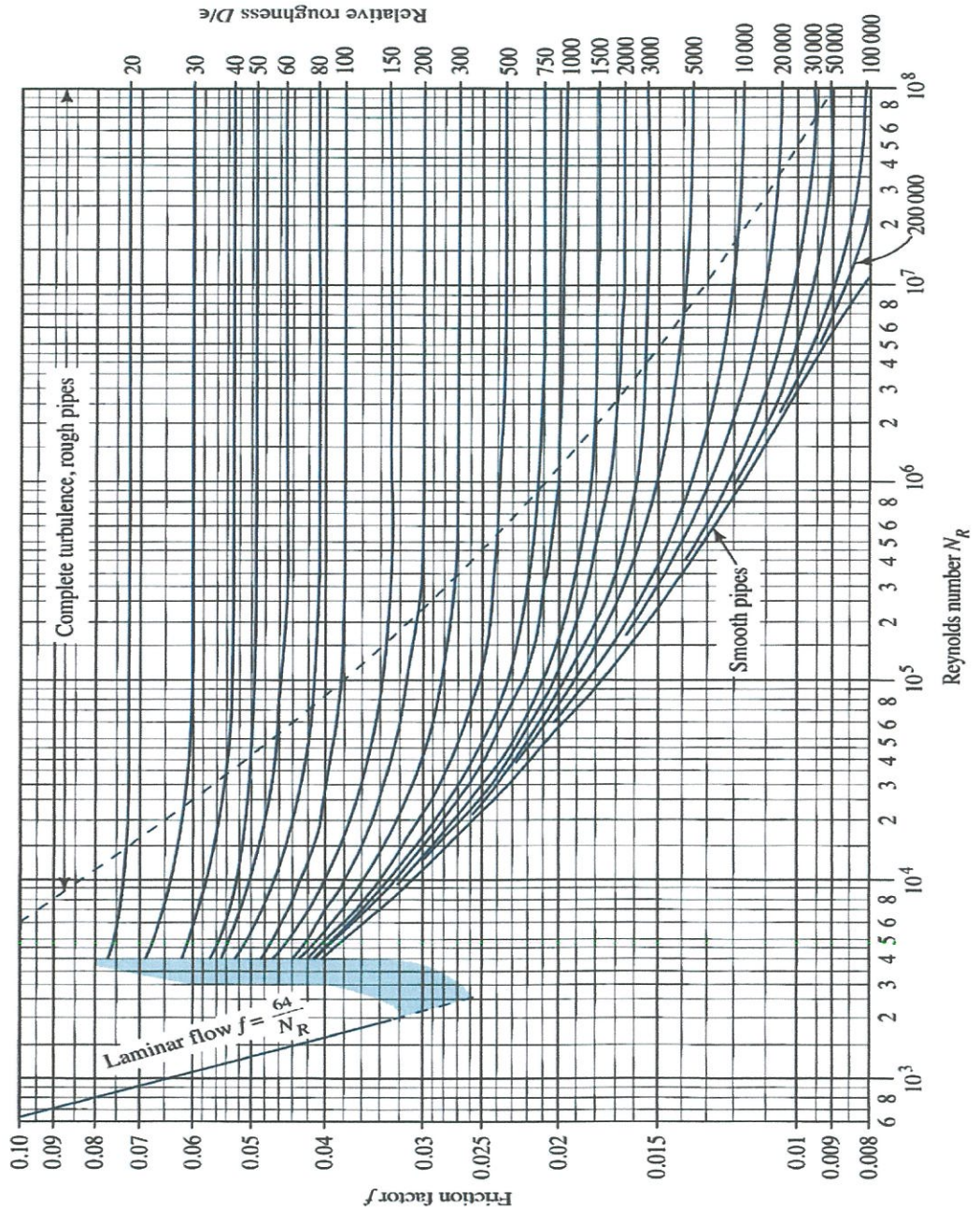
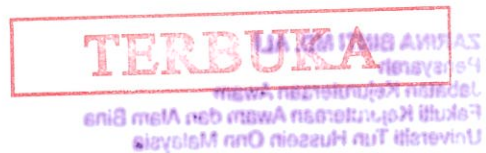


FIGURE Q3(d)(ii)



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TABLE Q4 (d) : Symbols and dimensions fluid mechanics quantities.

Quantity	Symbol	Dimension
FUNDAMENTAL		
Mass	m	M
Length	L	L
Time	t	T
GEOMETRIC		
Area	A	L^2
Volume	V	L^3
Angle	θ	$M^0L^0T^0$
First area moment	Ax	L^3
Second area moment	Ax^2	L^4
Strain	e	L^0
DINAMIC		
Force	F	MLT^{-2}
Weight	W	MLT^{-2}
Specific weight	γ	$ML^{-2}T^{-2}$
Density	ρ	ML^{-3}
Pressure	P	$ML^{-1}T^{-2}$
Shear stress	τ	$ML^{-1}T^{-2}$
Modulus of elasticity	E, K	$ML^{-1}T^{-2}$
Momentum	M	MLT^{-1}
Angular momentum		ML^2T^{-1}
Moment of momentum		ML^2T^{-1}
Force moment	T	ML^2T^{-2}
Torque	T	ML^2T^{-2}
Energy	E	L
Work	W	ML^2T^{-2}
Power	P	ML^2T^{-3}
Dynamic viscosity	μ	$ML^{-1}T^{-1}$
Surface tension	σ	MT^{-2}
KINEMATIC		
Linear velocity	U, v, u	LT^{-1}
Angular velocity	ω	T^{-1}
Rotational speed	N	T^{-1}
Acceleration	a	LT^{-2}
Angular acceleration	α	T^{-2}
Gravity	g	LT^{-2}
Discharge	Q	L^3T^{-1}
Kinematic viscosity	ν	L^2T^{-1}
Stream function	ψ	L^2T^{-1}
Circulation	Γ	L^2T^{-1}

