CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

OCTOBER 2025 SEMESTER SESSION

SUBJECT CODE	:	**LGB22503 / LGB22403**
SUBJECT TITLE	:	**FLUID MECHANICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF ENGINEERING TECHNOLOGY (OFFSHORE) WITH HONOURS** **BACHELOR OF ENGINEERING TECHNOLOGY (NAVAL ARCHITECTURE AND SHIPBUILDING) WITH HONOURS**
TIME / DURATION	:	**2.00 PM - 5.00 PM (3 HOURS)**
DATE	:	**26 JANUARY 2026**

INSTRUCTIONS TO CANDIDATES

1. Please **CAREFULLY** read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** questions in Section A. For Section B answer **THREE (3)** question **ONLY**.
5. Please write your answers on the answer booklet provided.
6. Answer **ALL** questions in English language only.
7. Formulae sheet has been appended for your reference.

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS COVER PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

a) Define specific density, pressure and viscosity

(6 marks)

b) The specific weight of fluid is 6.54 kN/m^3 and its mass is 8.3 kg. Calculate:

i. volume of a fluid

(2 marks)

ii. specific volume of a fluid

(2 marks)

iii. density of a fluid

(2 marks)

c) The water in a tank is pressurized by air, and the pressure is measured by a multifluid manometer as shown in Figure 1. Determine the gage pressure of air in the tank if h_1= 0.4 m, h_2 = 0.6 m, and h_3 = 0.8 m. Take the densities of water, oil, and mercury to be 1000 kg/m^3, 850 kg/m^3, and 13600 kg/m^3, respectively.

(8 marks)

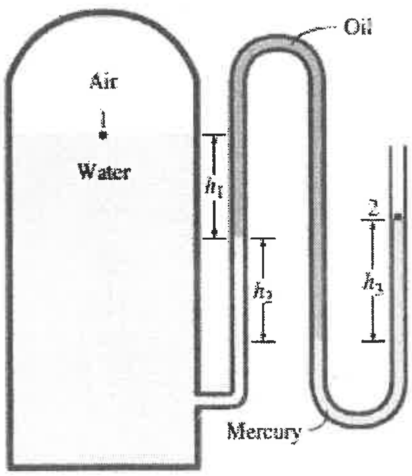

Figure 1: Pressure measurement using water, oil, and mercury manometer

Question 2

a) A pipe is split into 2 pipes which are BC and BD as shown in Figure 2. The following information is given:

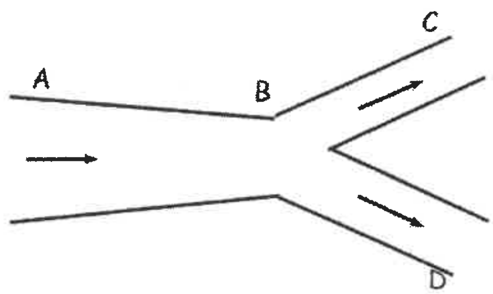

Figure 2: Branch pipe

Table 1: Pipe Data

Item	Data
Diameter pipe AB at A	0.4 m
Diameter pipe AB at B	0.3 m
Diameter pipe BC	0.2 m
Diameter pipe BD	0.15 m

Calculate:

i. volume flow rate at section A if V_A = 4 m/s

(3 marks)

ii. velocity at section B

(3 marks)

iii. velocity at section D if velocity at section C = 8 m/s

(6 marks)

b) A pressurized tank of water has a 10cm diameter orifice at the bottom, where water discharges to the atmosphere. The water level is 2.5 m above the outlet. The tank air pressure above the water level at point 1 is P_1 = 250 kPa (absolute) while the atmospheric pressure at point 2 is P_2 =100 kPa. Neglecting frictional effects, determine the initial discharge rate of water from the tank.

(8 marks)

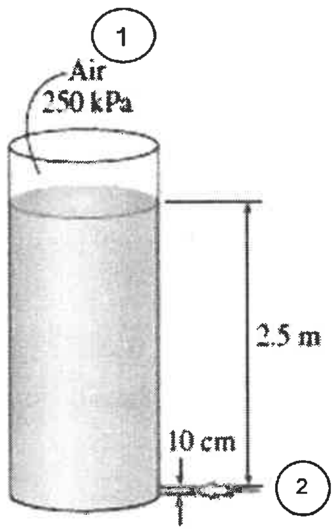

Figure 3: Pressurized water tank with bottom orifice discharge.

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.
Please use the answer booklet provided.

Question 3

a) Explain the flow regime below:

i. Laminar low

ii. Transition flow

iii. Turbulent flow

(6 marks)

b) Water at 40 ^{0}F (ρ= 5 62.42 lbm/ft^3 and μ =1.038 x10^{-3} lbm/ft·s) is flowing steadily through a 0.010 ft diameter and 30 ft long horizontal pipe at an average velocity of 3.0 ft/s.

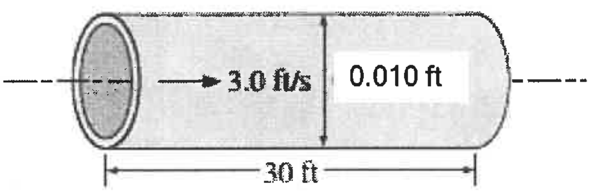

Figure 4: Pressure drop and head loss in a pipe

Determine:

i. the head loss

(4 marks)

ii. the pressure drop.

(4 marks)

iii. the pumping power requirement to overcome this pressure drop.

(6 marks)

Question 4

Water at 15ºC is pump through the cast iron pipes as shown in Figure 5. Both parallel pipes have a diameter of 30 cm, and the flow is fully turbulent. One of the branches (pipe A) is 1500 m long while the other branch (pipe B) is 2500 m long. If the flow rate through pipe A is 0.4 m^3/s, calculate:

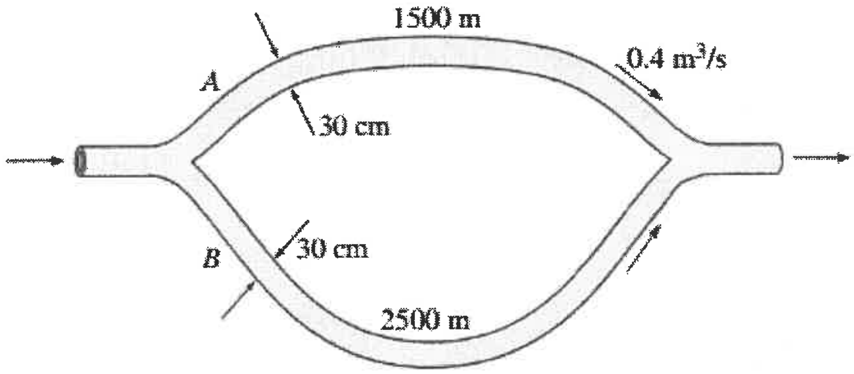

Figure 5: Parallel pipe

i. velocity at Pipe A. (4 marks)

ii. velocity through pipe B. (4 marks)

iii. flow rate at pipe B. (4 marks)

iv. Reynold number at pipe B. (4 marks)

v. relative roughness for the pipe. (4 marks)

Question 5

a) State Archimedes' Principle. Then, explain how this principle is used to determine the buoyant force acting on a body immersed in a fluid, and give two practical applications of Archimedes' Principle.

(5 marks)

b) Explain why some objects float while others sink in a fluid. State two factors that affect the magnitude of buoyant force.

(5 marks)

c) A crane is used to lower weights into the sea (density= 1025 kg/m^3) for an underwater construction project. Determine the tension in the rope of the crane due to rectangular 0.4m x 0.4m x 3m concrete block (density = 2300 kg/m^3) when it is

i. suspended in the air

(5 marks)

ii. completely immersed in water.

(5 marks)

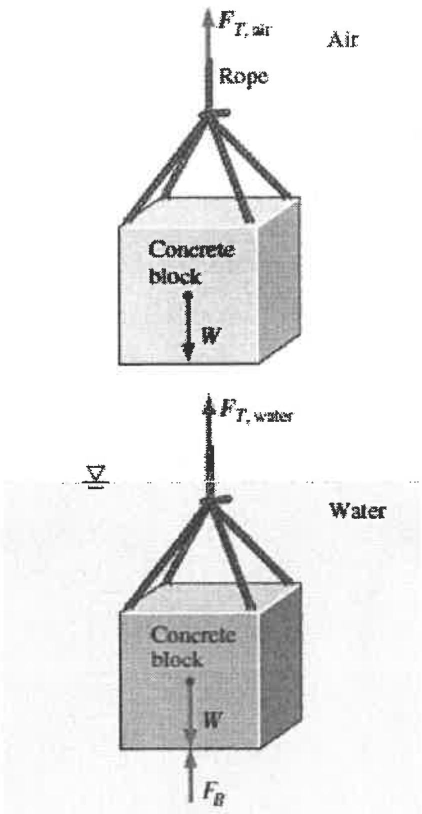

Figure 6: Forces acting on a concrete block suspended and immersed in seawater

Question 6

Water at 25°C is pumped between the feed tank and overhead tank using a 25 mm diameter commercial steel pipe. The flow rate is 30 L/s and the total length of the piping system is 120m. 2 regular elbows are used in the system. Determine:

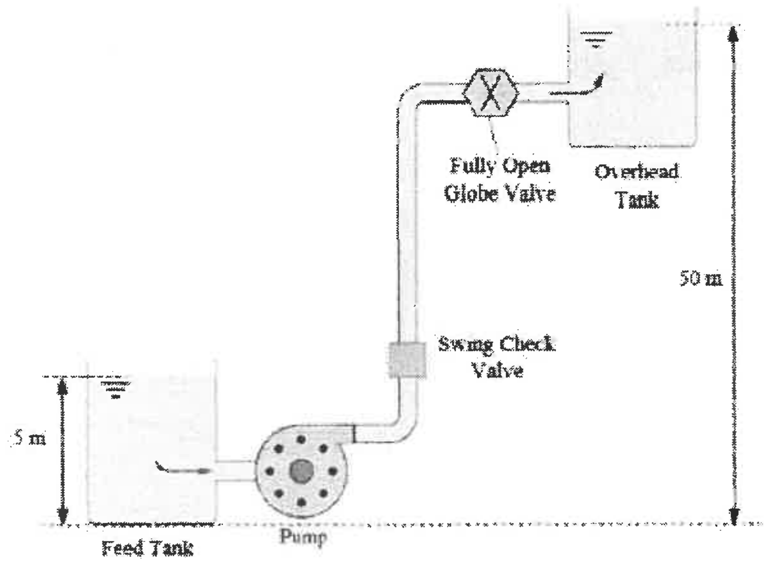

Figure 7: Water pumping system with pipe and fittings

i. the K – factor for all fittings (2 marks)

ii. the friction factor (4 marks)

iii. the head loss in the system (4 marks)

iv. the system head (2 marks)

v. the equivalent length of the piping system (4 marks)

vi. the efficiency of the pump if the shaft power is 10 MW. (4 marks

END OF EXAMINATION PAPER

FLUID MECHANICS 1

LGB 25003/LGB 22403

TABLES, FORMULAS AND CHARTS

Appendix 1: Density, Viscosity and Saturation Vapour Pressure of Water

Temperature (°C)	*Density* (kg/m^3)	*Dynamic viscosity* (Pas)	*Vapour pressure* (kPa (abs.))
0	1000	1.80×10^{-3}	0.61
5	1000	1.52×10^{-3}	0.87
10	1000	1.31×10^{-3}	1.23
15	999	1.15×10^{-3}	1.71
20	998	1.00×10^{-3}	2.34
25	997	0.90×10^{-3}	3.18
30	996	0.80×10^{-3}	4.25
35	994	0.72×10^{-3}	5.64
40	992	0.66×10^{-3}	7.38
45	990	0.60×10^{-3}	9.60
50	988	0.55×10^{-3}	12.3
55	986	0.51×10^{-3}	15.7
60	983	0.47×10^{-3}	20.0
65	980	0.44×10^{-3}	25.0
70	977	0.41×10^{-3}	31.2
75	974	0.38×10^{-3}	38.6
80	971	0.36×10^{-3}	47.4
85	968	0.34×10^{-3}	57.8
90	965	0.32×10^{-3}	70.1
95	962	0.30×10^{-3}	84.6
100	958	0.28×10^{-3}	101.3

Appendix 2: Absolute Roughness of Various Common Pipe Materials

Absolute roughness	mm
Cast iron	0.25
Commercial steel or wrought iron	0.045
Galvanised iron or steel	0.15
Concrete (cast on steel forms)	0.2
Concrete (spun)	0.1
Drawn tube	0.0015
Extruded tube made of metal, glass or plastic	0 (smooth)

Note The roughness values quoted are for pipes in the as-manufactured condition. The values are likely to increase with time, owing to the effects of corrosion, erosion and fouling.

Appendix 3: Simplified K Factors for Common Fittings

Fitting	*K factor*
45° elbow (standard radius)	0.3
90° elbow: standard radius	0.6
long radius	0.3
Return bend	0.8
Socket or coupler (screwed)	0.03
Tee: along line of flow	0.3
through side	0.8
Gate valve (fully open)	0.2
Globe valve: fully open	6.0
3/4 open	8.0
1/2 open	12.0
1/4 open	24.0
Check valve: hinged or swing disc	1.7
ball or poppet type	4.0
Foot valve with strainer:	
hinged or swing disc	3.0
ball or poppet type	7.0
Gradual transition: contracting	0 (negligible)
enlarging	0.75
Sudden contraction in a pipe	0.25
Sudden enlargement in a pipe	1.0
Sudden entrance (from tank to pipe)	0.5
Sudden exit (from pipe to tank)	1.0

Appendix 4: Formula List

FLUID STATIC		
Density	$\rho = \dfrac{\text{Mass}}{\text{Volume}}$	kg/m^3
Tangential Stress OR Shear Stress	$\tau = \mu \, {}^{dv}\!/_{dy}$	N/m^2 OR Pa
Dynamic Viscosity	μ	kg/ms OR Pa.s
Kinematic Viscosity	$\nu = \dfrac{\mu}{\rho}$	m^2/s
Static Pressure	$p = \rho g h$	N/m^2 OR Pa
Static Pressure	$p = \dfrac{F}{A}$	N/m^2 OR Pa
Relative Density	$RD. = \dfrac{\rho_{substance}}{\rho_{water}}$	
Specific Weight	$\omega = \rho g$	kg/m^2s^2 OR N/m^3
FLUID DYNAMIC		
Mass Flow Rate	$\rho A v$	kg/s
Volumetric Flow Rate	Av	m^3/s
Mass Conservation	$\dot{m}_{in} = \dot{m}_{out}$	kg/s
Continuity Equation	$\dot{V}_{in} = \dot{V}_{out}$	m^3/s
Bernoulli's Equation	$\dfrac{p}{\rho g} + \dfrac{V^2}{2g} + h = \text{constant}$ $P_1 + \rho g h + \dfrac{1}{2}\rho v_1^2 = Const$	
Fluid Force	$F = \dot{m} x [v]_n$	

	$F = \dot{m}(v_2 - v_1)$	
Laminar Flow in Pipes	$Re \le 2000$	
Turbulent Flow in Pipes	$Re > 4000$	
Reynold number	$\frac{\rho v d}{\mu} = \frac{vd}{\nu}$	
Friction factor, *f* (laminar)	64 / Re	
Friction factor, *f* (turbulent)	$f = 0.0055\,[\,1 + (20000\,\varepsilon_R + 10^6/Re)^{1/3}\,]$	
Head loss	$H_L = f\frac{L}{d}\frac{u^2}{2g}$ (Darcy equation)	m
	$H_L = \Sigma K\, v^2/2g$	m
	$H_L = (f\ L/d + \Sigma K)\, v^2/2g$	m
Relative roughness	$\varepsilon_R = \frac{\varepsilon}{d}$	
Static Head	$H_{stat} = \frac{p_2 - p_1}{\rho g} + h_2 - h_1$	
Dynamic Head	$H_{dyn} = \frac{v_2^2 - v_1^2}{2g} + (f\ L/d + \Sigma K)\, v^2/2g$	
System Head	$H = H_{stat} + H_{dyn}$	
Equivalent Length (series)	$\frac{f_E L_E}{d_E^5} = \frac{f_A L_A}{d_A^5} + \frac{f_B L_B}{d_B^5} + \ldots$	m
Equivalent Length (parallel)	$[\,d_E^5 / f_E\ L_E\,]^{1/2} = [\,d_A^5 / f_A\ L_A\,]^{1/2} + [\,d_B^5 / f_B\ L_B\,]^{1/2} + \ldots$	m