CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JULY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMD14002**
SUBJECT TITLE	:	**FLUID MECHANICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN MARINE ENGINEERING**
TIME / DURATION	:	**09.00 AM - 11.30 AM (2 HOURS 30 MINUTES)**
DATE	:	**23 DECEMBER 2025**

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** 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** question in Section A, and **TWO (2)** questions **ONLY** in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Table of formulae and appendices has been appended for your reference.

THERE ARE 10 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

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

Question 1

With reference to pressure of a fluid:

(a) i. Sketch a simple diagram of barometer.

(3 marks)

ii. Explain the working principle of barometer.

(4 marks)

iii. Given that the relative density of mercury is 13.6, calculate the value of the standard atmospheric pressure.

(6 marks)

(b) A U-tube manometer is used to measure the pressure of the liquid in tank Q as shown in Figure 1. The specific gravity of liquid A is 0.85, liquid B has a relative density of 2.2 with h_A and h_B of 12 cm and 10 cm, respectively. Calculate the pressure in tank Q if the atmospheric pressure is 102 kPa.

(7 marks)

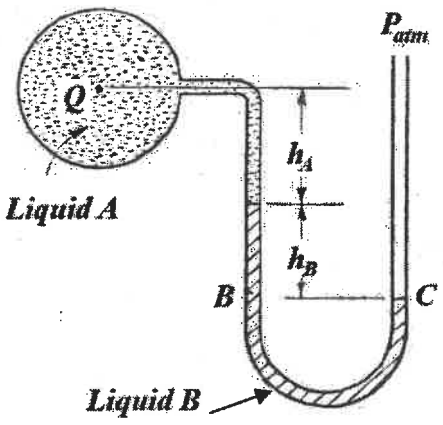

Figure 1

Question 2

With reference to Archimedes' Principle, Bernoulli's Equation and fluid head:

(a) A navigation buoy of mass 145 kg is observed to float in seawater (density 1020 kg/m^3) with one-fifth of its volume submerged. Calculate:

i. the volume of the seawater displaced by the buoy

(4 marks)

ii. the density of the buoy material.

(5 marks)

(b) A ballast-water pump transfers seawater of density 1020 kg/m^3 through the pipe arrangement shown in Figure 2. At section A, the gauge pressure is 140 kPa and the velocity is 2 m/s. The diameter at A is 300 mm while section B that is 11 m higher, has a diameter of 250 mm. Compute:

i. the velocity at point B

(3 marks)

ii. the total head at point A

(4 marks)

iii. the pressure at point B using Bernoulli Equation (neglect losses).

(4 marks)

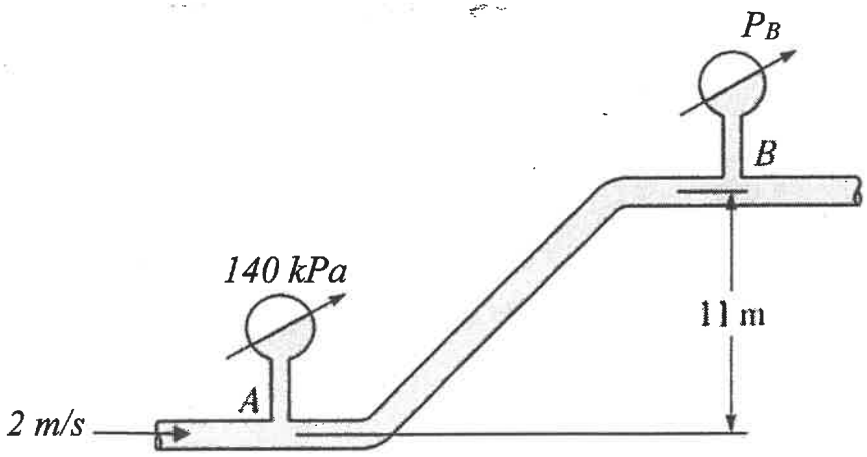

Figure 2

Question 3

With reference to fluid flow and Continuity Equation:

In a chemical processing plant, glycerin flows through pipe A at a rate of 30 kg/s as shown in Figure 3. The pipe is then split into two branches with the diameter of pipe B being 8 cm and pipe C being 5 cm. The specific gravity of glycerin is 1.26, calculate:

(a) the volume flow rate in pipe A

(4 marks)

(b) the diameter of pipe A if the velocity is 1.3 m/s

(3 marks)

(c) the velocity in pipe C if the volume flow rate at C is 45% of the total flow rate

(5 marks)

(d) the volume flow rate in pipe B

(2 marks)

(e) the velocity of pipe B

(3 marks)

(f) the mass flow rate at B.

(3 marks)

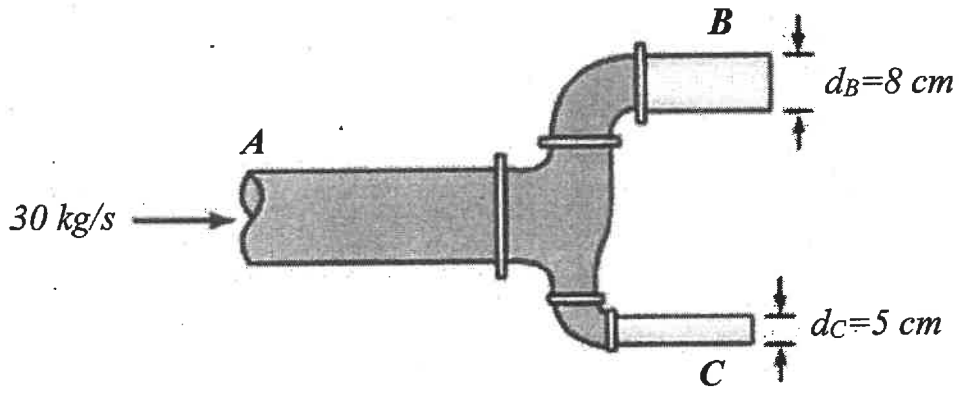

Figure 3

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO (2) questions.
Please use the answer booklet provided.

Question 4

With reference to losses in a horizontal pipe:

Diesel fuel is pumped through a fuel-transfer line at a rate of 30 L/s through a commercial steel pipe with an internal diameter of 100 mm and a length of 60 m. The kinematic viscosity of diesel is 4.2×10^{-6} m^2/s, and its relative density is 0.85. Determine:

(a) the type of flow regime

(8 marks)

(b) the friction factor

(6 marks)

(c) the head loss in the pipe

(3 marks)

(d) the pressure drops due to head loss.

(3 marks)

Question 5

With Reference to head loss due to fittings and system head:

Figure 4 shows water at 25°C is pumped between two tanks at a rate of 18 L/s through 70 m and 45 mm diameter PVC pipe. The friction factor is 0.036 and pump shaft power 10 kW. Determine:

(a) the K factors for all fitting

(7 marks)

(b) the total head loss in a system

(7 marks)

(c) the efficiency of the system if the system head is 40 m.

(6 marks)

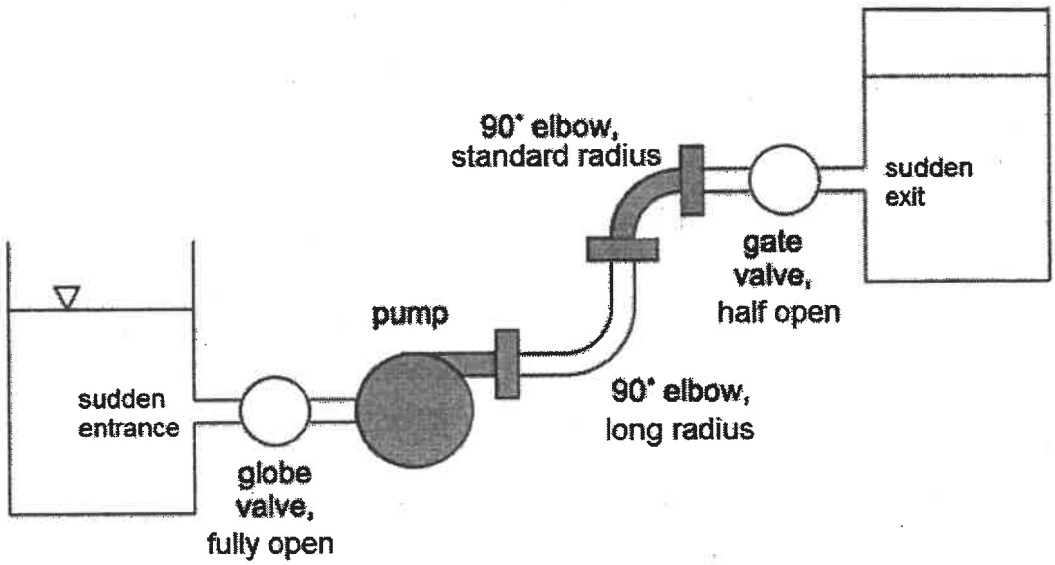

Figure 4

Question 6

With reference to fluid force:

(a) A steam jet of 30 mm in diameter and velocity of 90 m/s strikes a flat plate inclined at an angle of 20° as shown in Figure 5. The specific volume of the steam is 1.69 m^3/kg. Determine the magnitude and the direction of force exerted on the plate.

(9 marks)

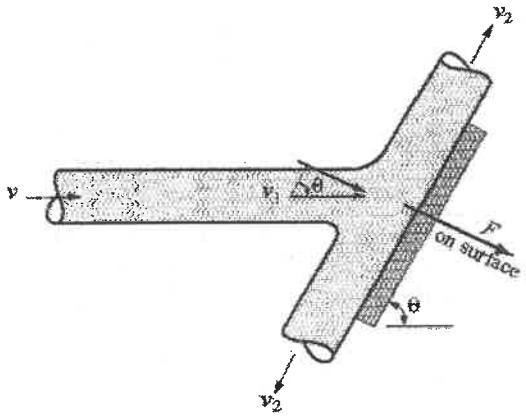

Figure 5

(b) A water jet of 50 mm in diameter in Figure 6 is discharged from a nozzle with a velocity of 8 m/s strikes a curved turbine blade that deflects at an angle of 40°. The density of the water is 1000 kg/m^3. Calculate the x and y components of the force on the fluid.

(11 marks)

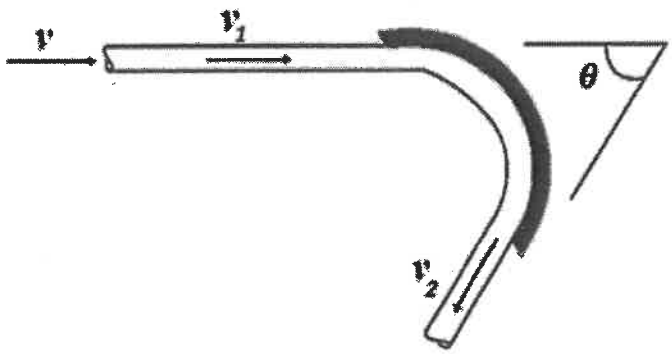

Figure 6

END OF EXAMINATION PAPER

APPENDICES

1. TABLE OF FORMULAE

$\rho = \frac{m}{V}$	$RD = \frac{\rho_{substance}}{\rho_{water}}$
$P = \frac{F}{A}$	$P = \rho g h$
$F_B = W_o$	$F_B = \rho_f V_f g$
$A = \frac{\pi d^2}{v}$	$\dot{V} = Av$
$\dot{m} = \rho A v$	$P + \frac{1}{2}\rho v^2 + \rho g h = constant$
$h + \frac{P}{\rho g} + \frac{v^2}{2g} = constant$	$Re = \frac{vd}{v}$
$Re = \frac{\rho v d}{\mu}$	$f = \frac{64}{Re}$
$\varepsilon_R = \frac{\varepsilon}{d}$	$f = 0.0055\,[1 + (20000\varepsilon_R + \frac{10^6}{Re})^{\frac{1}{3}}]$
$\Delta P = \rho g H_L$	$H_L = \frac{fLv^2}{d2g}$
$H_L = \Sigma K \frac{v^2}{2g}$	$H_L = \left(\frac{fL}{d} + \Sigma K\right)\frac{v^2}{2g}$
$L_E = \frac{\Sigma K d}{f}$	$P_f = \dot{m} g H$
$\eta = \frac{P_f}{P}$	$\frac{1}{\rho} = \frac{V}{m}$
$F = \dot{m}(v_2 - v_1)$	$F_R = \sqrt{F_x^2 + F_y^2}$

2. DENSITY & DYNAMIC VISCOSITY OF WATER

Temperature (°C)	Density (kg/m^3)	Dynamic Viscosity (Pas)
0	1000	1.80×10^{-3}
5	1000	1.52×10^{-3}
10	1000	1.31×10^{-3}
15	999	1.15×10^{-3}
20	998	1.00×10^{-3}
25	997	0.90×10^{-3}
30	996	0.80×10^{-3}
35	994	0.72×10^{-3}
40	992	0.66×10^{-3}
45	990	0.60×10^{-3}
50	988	0.55×10^{-3}
55	986	0.51×10^{-3}
60	983	0.47×10^{-3}
65	980	0.44×10^{-3}
70	977	0.41×10^{-3}
75	974	0.38×10^{-3}
80	971	0.36×10^{-3}
85	968	0.34×10^{-3}
90	965	0.32×10^{-3}
95	962	0.30×10^{-3}
100	958	0.28×10^{-3}

3. K-FACTOR OF COMMON FITTING

FITTING/VALVE	CONDITION	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 type	0.03
Tee	Along line of flow	0.3
	Through side	0.8
Gate Valve	Fully open	0.2
	½ open	4.5
Globe Valve	Fully open	6.0
	¾ open	8.0
	½ open	12.0
	¼ 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
Pipeline	Sudden contraction	0.25
	Sudden enlargement	1.0
Tank to pipeline	Sudden entrance	0.5
Pipeline to tank	Sudden exit	1.0

4. ABSOLUTE ROUGHNESS VALUES OF VARIOUS COMMON PIPE MATERIALS

Materials	Absolute Roughness, ε (mm)
Cast iron	0.25
Commercial steel/wrought iron	0.045
Galvanized iron/steel	0.15
Concrete (cast on steel forms)	0.20
Concrete (spun)	0.10
PVC and other drawn tubing	0.0015