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UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE	:	SCB24603 (V1)
COURSE TITLE	:	FLUID MECHANICS
PROGRAMME NAME	:	BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MECHANICAL (AUTOMOTIVE)
DATE	:	29 JANUARY 2026
TIME	:	9:00AM - 12:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☑ *Tick if applicable*

THERE ARE 10 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Answer the following questions.

(a) A tank of liquid Y has a mass of 98 kg and volume of 0.92 m^3. Density of water is 1000 kg/m^3. Determine:

i. Weight of liquid Y

(2 marks)

ii. Density

(2 marks)

iii. Specific weight

(2 marks)

(b) The space between two square flat parallel plates is filled with oil. The area of the each plate is 72 cm x 72 cm. The thickness of the oil film is 15.5 mm. The upper plate moves at 5.5 m/s with required force at 105 N to maintain the speed. Determine:

i. The kinematic viscosity of the oil if the specific gravity of the oil is 0.97

(6 marks)

ii. The dynamic viscosity of the oil

(8 marks)

Question 2

Answer the following questions.

(a) A diver is working at a depth of 25 m below the surface of sea water. If the specific weight of sea water is 10 kN/m^3 calculate:-

i. The gauge pressure at this depth

(4 marks)

ii. The absolute pressure at this depth if barometer reads 760 mm of mercury (SG=13.6) column at the sea level.

(4 marks)

(b) The following figure shows a compound manometer one end of which is fitted to pipe A and the other end is open to atmosphere. If the manometer fluid is mercury (SG=13.6) and the fluid in the pipe and in the tubing which connects the two U-tubes is water, find the gauge pressure at pipe A.

Refer Below - Figure1 : Compound manometer.

(12 marks)

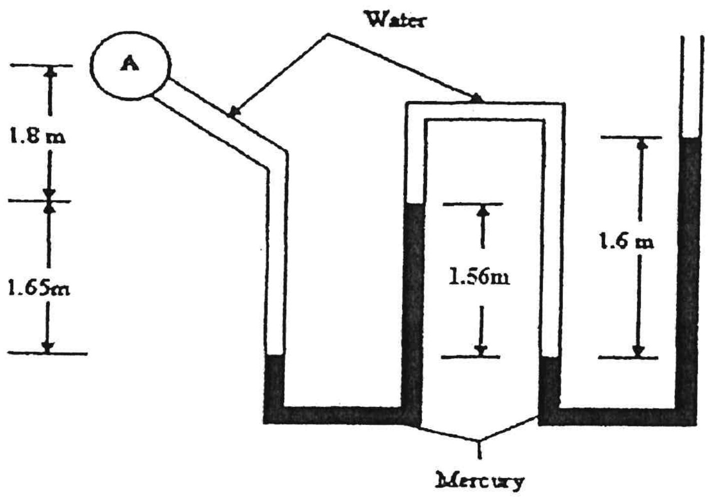


Figure 1: Compound manometer

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Answer the following questions.

(a) A 4m long quarter-circular gate of radius 3 m and negligible weight is hinged about its upper edge A as shown in the following figure. The gate controls the flow of water over the ledge at B, where the gate is pressed by a spring. Determine the minimum spring force required to keep the gate closed when the water level rises to A at the upper edge of the gate.
Refer Below - Figure2 : A long quarter-circular gate of radius 3 m .

(12 marks)

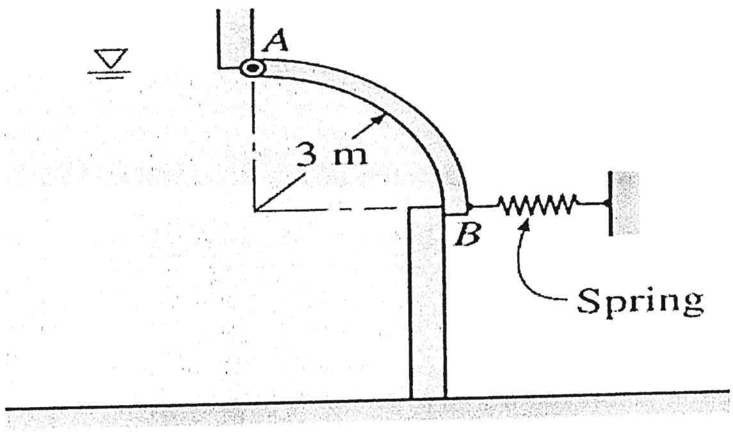


Figure 2: A long quarter-circular gate of radius 3 m

(b) The following figure shown that 90 percent of an iceberg's volume is below the surface, while only 10 percent is visible above the surface. For seawater with a density of 1025 kg/m^3, calculate the density of the iceberg.
Refer Below - Figure3 : Iceberg .

(8 marks)

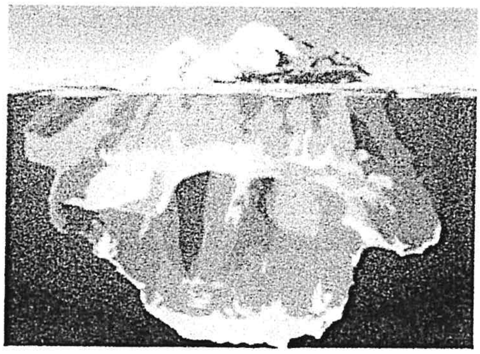


Figure 3: Iceberg

Question 2

Answer the following questions.

(a) Sketch and describe the following pump impellers with proper labels:

i. Radial Flow Impeller

(3 marks)

ii. Axial Flow Impeller

(3 marks)

(b) For the system shown in the following figure, determine the vertical distance between the surface of two reservoirs when water with a dynamics viscosity of 1.3×10^{-6} m/s flow from the upper level A to the lower level B at rate $0.03 m^3/s$. Data of the system are as follow:-
Total length of 75mm pipe diameter is 100m
Total length of 150mm pipe diameter is 300m
Relative roughness for coated ductile iron pipes is 1.2×10^{-4}
Refer Below - Figure4 : Piping system .

(14 marks)

$K_{elbow} = 0.75$
$K_{entrance} = 1.0$
$K_{exit} = 1.0$
$K_{enlargement} = 0.43$
$K_{gate\ valve} = 4.5$

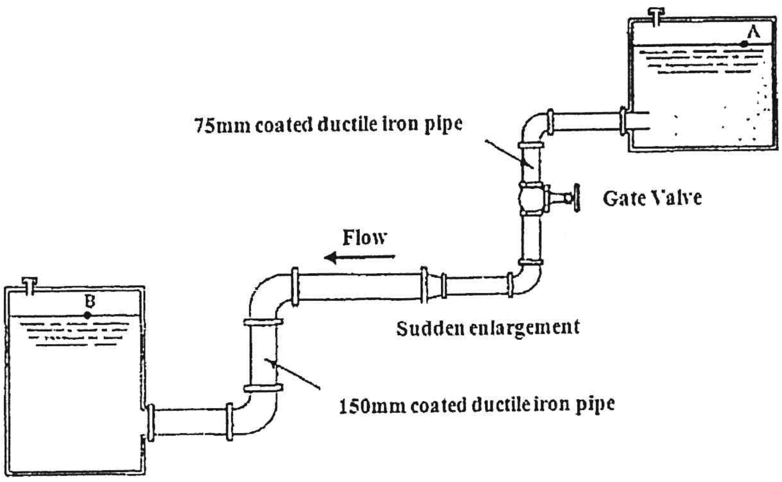


Figure 4: Piping system

Question 3

Answer the following questions.

(a) Consider a heavy car submerged in water in a lake with a flat bottom as shown in the following figure. The driver's side door of the car is 1.2 m high and 0.8 m wide, and the top edge of the door is 8 m below the water surface. Determine the net force acting on the door (normal to its surface) and the location of the pressure center if:-

Refer Below - Figure5 : Car submerged in a lake .

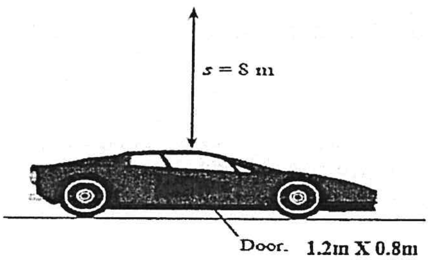


Figure 5: Car submerged in a lake

i. The car is well-sealed and it contains air at atmospheric pressure.

(8 marks)

ii. The car is filled with water.

(2 marks)

(b) A 5 m high, 5 m wide rectangular plate blocks the end of a 4 m deep freshwater channel, as shown in the following figure. The plate is hinged about a horizontal axis along its upper edge through point A and is restrained from opening by a fixed stopper at point B. Density of water is 1000 kg/m^3. Draw a free body diagram (FBD) and determine the reaction force R_B exerted by the stopper at B.

Refer Below - Figure6 : Rectangular plate .

(10 marks)

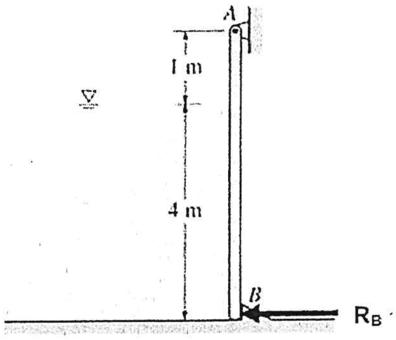


Figure 6: Rectangular plate

Question 4

Answer the following questions.

(a) Figure below shows oil with density (ρ) 876 kg/m^3 and μ=0.24 kg/m.s is flowing through a 1.5 cm diameter pipe that discharges into the atmosphere at 88 kPa. The absolute pressure 15 m before the exit is measured to be 135 kPa. Determine the volume flow rate of oil for laminar flow through the pipe if the pipe is: -

Refer Below - Figure7 : Oil flowing through a pipe .

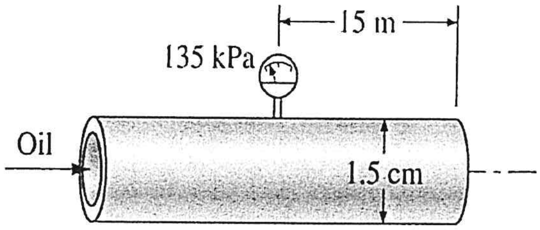


Figure 7: Oil flowing through a pipe

i. Horizontal.

(6 marks)

ii. Inclined 8° upward from the horizontal.

(3 marks)

iii. Inclined 8° downward from the horizontal.

(3 marks)

(b) Discuss the different pump performance characteristics curve as shown in the following figure. Explain the advantages of the system when pumps are arranged in condition (a) and (b). Give ONE (1) example when pumps are used in these conditions.

Refer Below - Figure8 : Pump performance characteristics curve .

(8 marks)

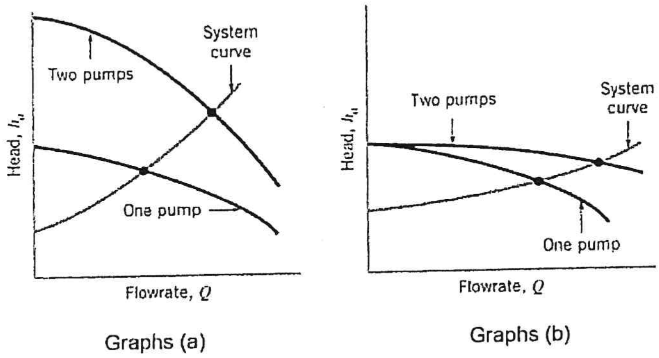


Figure 8: Pump performance characteristics curve

END OF EXAMINATION PAPER

LIST OF EQUATIONS

$\gamma = \frac{mg}{V} = \rho g$

$P = \frac{F}{A}$

$Re = \frac{\rho V D}{\mu}$

$PV = mRT$

$P = \rho g h$

$h_l + h_f + h_m$

$\tau = \mu \frac{\partial v}{\partial y}$

$y_{P = y_C} + \frac{\overline{I_X}}{A y_C}$

$h_f = \frac{f l V^2}{D 2g}$

$v = \frac{\mu}{\rho}$

$h_{P = h_C} + \frac{\overline{I}}{A h_C}$

$h_m = \frac{K V^2}{2g}$

$v = \frac{g d^2}{18 v} \left[\frac{\sigma}{\rho} - 1 \right]$

$M_A = Fd$

$f = \frac{64}{Re}$

$F_D = \tau \times A$

$F_R = \sqrt{F_h^2 + F_v^2}$

$v = \omega r$

$F_D = \mu \frac{\partial v}{\partial y} \times 2\pi R L$

$m = \rho_1 A_1 v_1$

$T = \rho Q (r_1 V_{t1} - r_2 V_{t2})$

$F_D = \frac{Torque}{R}$

$A_1 v_1 = A_2 v_2$

$\dot{W}_T = \omega T$

$k = -V \frac{dP}{dV}$

$Q = Av$

$\alpha_1 = \cot^{-1} \left(2\pi \frac{r_1^2 b_1 \omega}{Q} + \cot \beta_1 \right)$

$M = \sqrt{\frac{v^2 \rho}{k}}$

$\frac{P_1}{\gamma} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{v_2^2}{2g} + z_1$

$H_T = \frac{\dot{W}_T}{\gamma Q}$

$\sigma = \frac{F}{L}$

Venturi:-

$Q = C_d A_2 \left\{ \frac{2 g \Delta h}{1 - \left(\frac{A_2}{A_1} \right)^2} \right\}^{1/2}$

$V_{t1} = u_1 + V_{n1} \cot \beta_1$

$V_{n1} = \frac{Q}{2 \pi r_1 b_1}$

$P = \frac{2\sigma}{R}$

$Q = K A_2 \sqrt{2 g \Delta h}$

$y_P = y_C + \frac{I_{xx}}{y_C A}$

$h = \frac{4\sigma cos\theta}{\gamma d}$

Orifice:-

$u(y) = \frac{y}{l} v$

$\tau = \mu \frac{\partial u}{\partial r}$

$Q = \frac{C_d A_0}{\sqrt{1 - C_c^2 A_0^2 / A_1^2}} \sqrt{2g\Delta h}$

$V_{avg} = \frac{\Delta P D^2}{32 \mu L}$

$\rho = \frac{m}{v}$

$c = \sqrt{kRT}$

$\dot{W} = \dot{V} \Delta P$

$M_a = \frac{V}{C}$

$\mu = \frac{Tl}{4\pi^2 R^3 \dot{n} L}$

$y_P = S + \frac{b}{2} + \frac{b^2}{12(s + \frac{b}{2})}$

$$P_c = P_{avg} = \rho g h_c = \rho g (s + \frac{b}{2})$$

Horizontal Pipe:

$$V_{avg} = \frac{(P_1 - P_2) D^2}{32 \mu L} = \frac{\Delta P D^2}{32 \mu L}$$

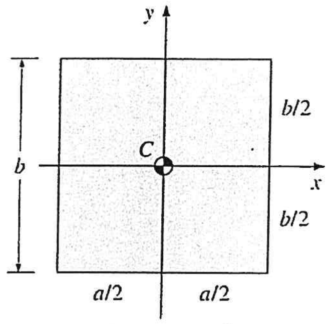
$$\dot{V} = A_c V_{avg} = \frac{(P_1 - P_2) \pi D^4}{128 \mu L} = \frac{\Delta P \pi D^4}{128 \mu L}$$

Inclined Pipe:

$$V_{avg} = \frac{(\Delta P - \rho g L \sin\theta) D^2}{32 \mu L}$$

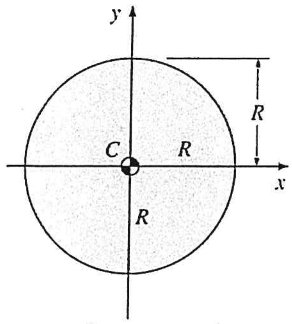
$$\dot{V} = A_c V_{avg} = \frac{(\Delta P - \rho g L \sin\theta) \pi D^4}{128 \mu L}$$

The centroid and the centroidal moments of inertia for some common geometries.



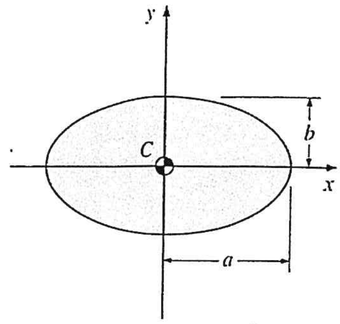
$A = ab,\ I_{xx,C} = ab^3/12$

(*a*) Rectangle



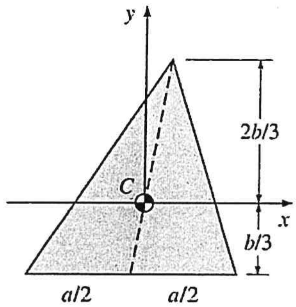
$A = \pi R^2,\ I_{xx,C} = \pi R^4/4$

(*b*) Circle



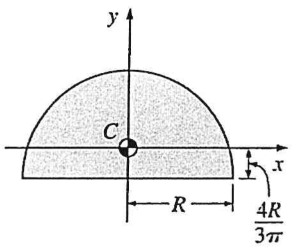
$A = \pi ab,\ I_{xx,C} = \pi ab^3/4$

(*c*) Ellipse



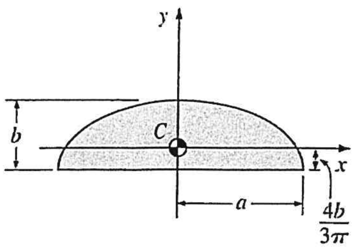
$A = ab/2,\ I_{xx,C} = ab^3/36$

(*d*) Triangle



$A = \pi R^2/2,\ I_{xx,C} = 0.109757R^4$

(*e*) Semicircle

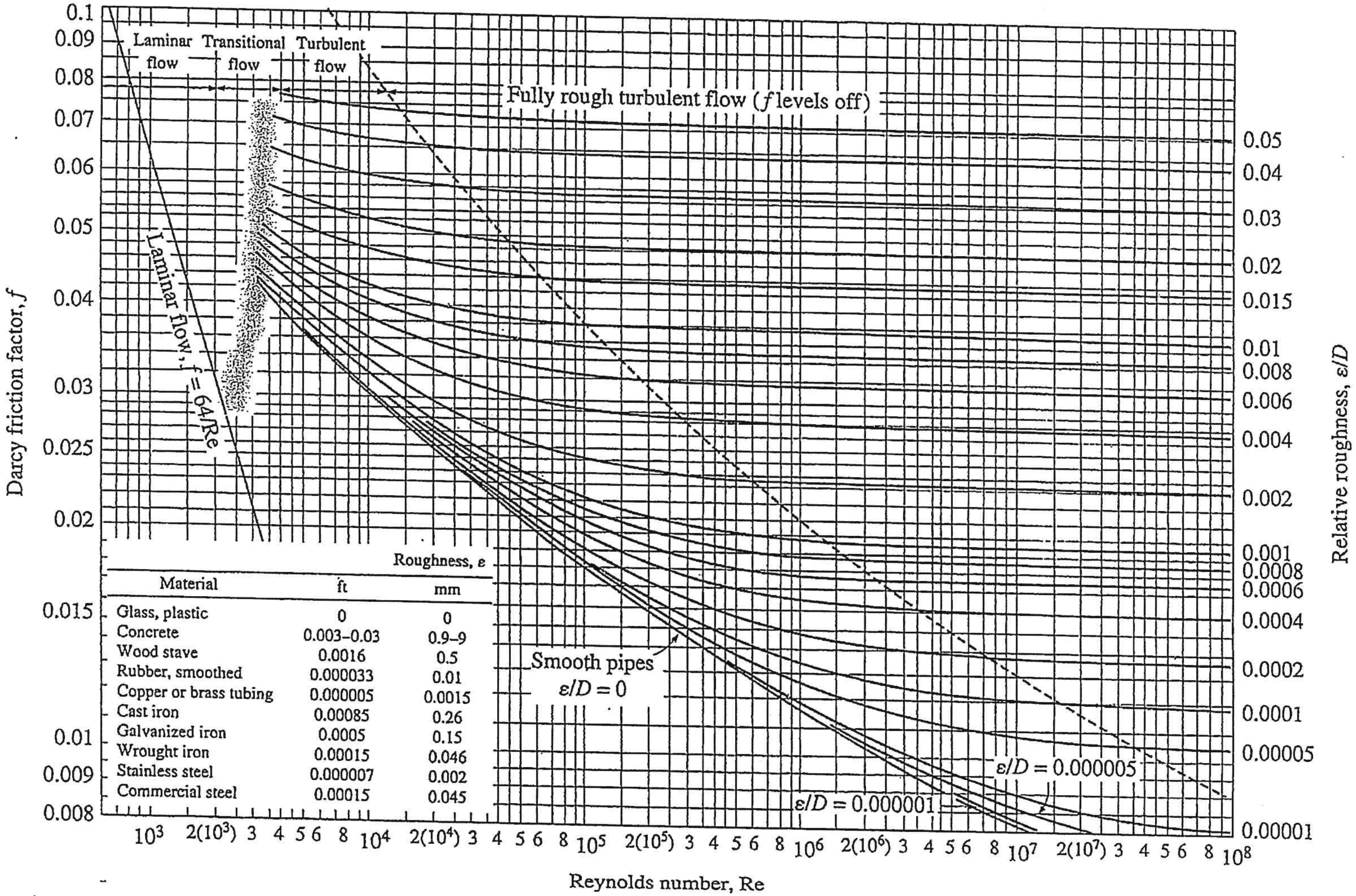


$A = \pi ab/2,\ I_{xx,C} = 0.109757ab^3$

(*f*) Semiellipse

APPENDIX

MOODY DIAGRAM



Material	Roughness, ε ft	Roughness, ε mm
Glass, plastic	0	0
Concrete	0.003–0.03	0.9–9
Wood stave	0.0016	0.5
Rubber, smoothed	0.000033	0.01
Copper or brass tubing	0.000005	0.0015
Cast iron	0.00085	0.26
Galvanized iron	0.0005	0.15
Wrought iron	0.00015	0.046
Stainless steel	0.000007	0.002
Commercial steel	0.00015	0.045

The Moody chart for the friction factor for fully developed flow in circular pipes for use ~~in the~~ head loss relation $h_L = f\frac{L}{D}\frac{V^2}{2g}$. Friction factors in the turbulent flow are evaluated from the Colebrook equation $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{\text{Re}\sqrt{f}}\right)$.