CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BFC10403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Describe the difference between a fluid property and a flow property. Give an example of each kind of property.

(4 marks)

(b) A volume of 1×10^6 cm^3 water is contained in a rigid container. Estimate the percentage change in the volume of the water when a piston applies a pressure of 35 MPa. Bulk modulus of water is 2.15×10^9 N/m.

(6 marks)

(c) A rectangular barge, with 9 m wide and 30 m long whose cross section is approximately rectangular carries a load of grain. The depth of barge submerged for unloaded and load with grains is 1.8 m and 2.5 m, respectively. Determine:

(i) The unloaded weight of the barge. (5 marks)

(ii) The weight of the grains. (5 marks)

Q2 (a) Explain briefly the potential energy and pressure head.

(4 marks)

(b) A high pressure hose 200 mm diameter ends in a nozzle with an exit diameter of 50 mm as shown in **Figure Q2(b)**. The exit velocity is 40 m/s. Calculate pressure at section 1 and rate of change of momentum.

(6 marks)

(c) Determine the flowrate of water from the tank as shown in **Figure Q2(c)** if viscous effects are neglected and the tank is large.

(10 marks)

Q3 (a) Define the major and minor head losses with illustration of diagram.

(6 marks)

(b) Show that the Reynolds number for flow in a circular pipe of diameter, D can be expressed as

$$Re = \frac{4\,\dot{m}}{\pi D \mu}$$

where $\dot{m}$ is mass flow rate (kg/s) and μ is dynamic viscosity (kg/m.s)

(6 marks)

(c) **Figure Q3(c)** shows the water flows from the nozzle attached to the spray tank shown. Determine the flowrate if the loss coefficient for the nozzle is 0.75 and the friction factor for the rough hose is 0.11.

(8 marks)

Q4 (a) Distinguish between series and parallel pipes in term of flow rate and head loss.

(4 marks)

(b) Water flows through a horizontal branching pipe as shown in **Figure Q4(b)**. Determine the pressure at section (3).

(8 marks)

(c) **Figure Q4(c)** shows a certain part of cast iron piping of a water distribution, and the flow is fully turbulent. Determine flow rate in pipe B if flow rate through in pipe A is 0.4 m^3/s. Neglecting minor loss.
Given: $\mu = 1.138 \times 10^{-3}$ kg/m.s and friction factor of both pipes is same.

(8 marks)

Q5 (a) List **TWO (2)** primary purposes of dimensional analysis.

(4 marks)

(b) A ship whose hull length is 140 m is travel with speed 27 km/hr.

(i) Compute Froude number. (3 marks)

(ii) Calculate velocity of model with scale 1:30 to be towed through water. (5 marks)

(c) At a sudden contraction in a pipe the diameter changes from D_1 to D_2. The pressure drop, Δp, which develops across the contraction is a function of D_1 and D_2 as well as the velocity, V, in the larger pipe, and the fluid density, ρ and viscosity, μ. Use D_1, V and μ as repeating variables to determine a suitable set of dimensionless parameters.

(8 marks)

– END OF QUESTIONS –

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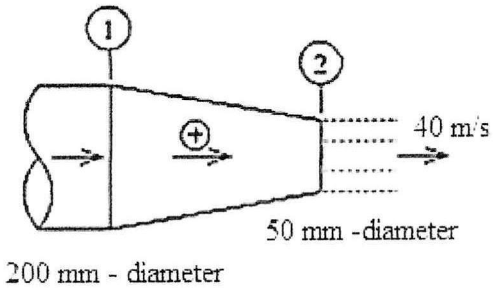

FIGURE Q2 (b)

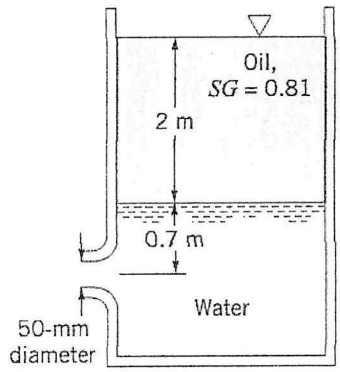

FIGURE Q2(c)

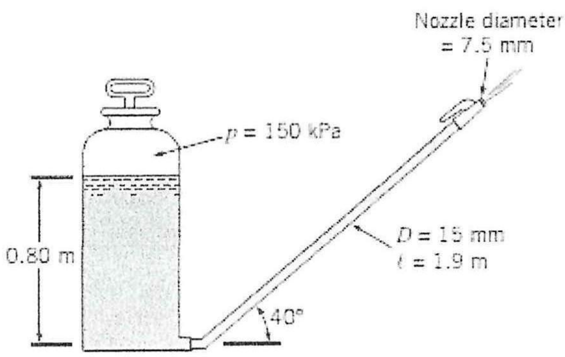

FIGURE Q3(c)

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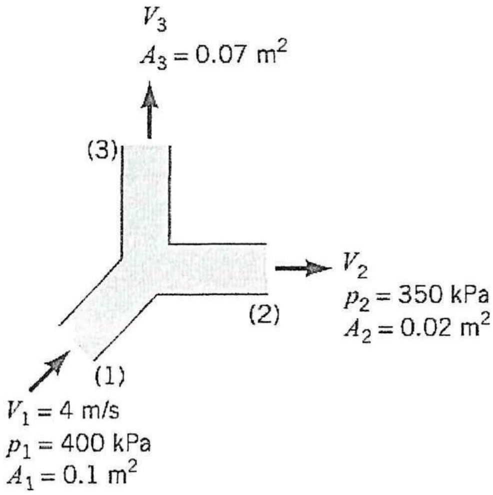

FIGURE Q4(b)

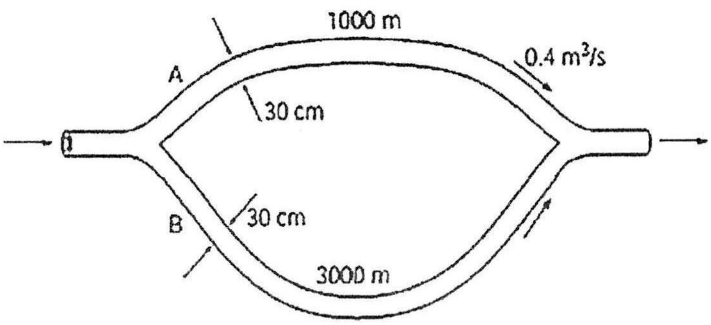

FIGURE Q4(c)

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Quantity	Symbol	Dimension	Froude
FUNDAMENTAL			
Mass	m	M	
Length	L	L	L_r
Time	t	T	$L_r^{1/2}g^{-1/2}$
GEOMETRIC			
Area	A	L^2	
Volume	V	L^3	L_r^2
Angle	θ	$M^0L^0T^0$	L_r^3
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 viscocity	μ	$ML^{-1}T^{-1}$	
Surface tension	σ	MT^{-2}	
KINEMATIC			
Linear velocity	U,v,u	LT^{-1}	$L_r^{1/2}g^{1/2}$
Angular velocity	ω	T^{-1}	
Rotational speed	N	T^{-1}	
Acceleration	a	LT^{-2}	g_r
Angular acceleration	α	T^{-2}	
Gravity	g	LT^{-2}	
Discharge	Q	L^3T^{-1}	$L_r^{5/2}g^{1/2}$
Kinematic viscosity	υ	L^2T^{-1}	
Stream function	ψ	L^2T^{-1}	
Circulation	Γ	L^2T^{-1}	

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LIST OF FORMULA

$$h_f = \frac{32\mu LV}{\rho g D^2}$$

$$Re = \frac{\rho VD}{\mu} = \frac{DV}{\nu}$$

$$Fr = \frac{V}{\sqrt{gD}}$$

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

$$Q = \frac{\Delta P \pi D^4}{128 L\mu}$$

$$H = \frac{P}{\gamma} + z + \frac{V^2}{2g}$$

$$F = \rho Q \Delta V$$

$$h_f = \frac{fLV^2}{2gD}$$

$$MG = MB - BG$$

$$MB = \frac{I_{xx}}{V}$$

$$P = \rho g h$$

$$Q = VA$$

$$I_{xx} = \frac{bh^3}{12}$$