UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BFC 10403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

Q1 (a) Briefly explain the surface tension and capillary rise .

(4 marks)

(b) A reservoir of glycerin has a mass of 1200 kg and a volume of 0.952 m^3. Find the glycerin's weight (W), mass density (ρ), specific weight (γ) and specific gravity.

(8 marks)

(c) The values of surface tension for water and mercury in contact with air are 0.0735 N/m and 0.510 N/m respectively. The contact angle for water is $\theta = 0^o$ and for mercury $\theta = 130^o$. Given that specific weight of water , $\gamma_{water} = 9.81 \text{x } 10^3$ N/m^3 and specific weight mercury, $\gamma_{mercury} = 132.8 \text{x } 10^3$ N/m^3, calculate the capillary effect in a glass tube of 4mm diameter, when immersed in water and mercury.

(8 marks)

Q2 (a) **Figure Q2(a)** illustrates a piston with diameter of 15 cm located in cylinder containing water. An open U-tube manometer is connected to the cylinder. Determine the value of the applied force, P. Negligible the weight of piston.
$(\gamma_{mercury} = 1.33 \times 10^5 \text{ N/m}^3)$

(10 marks)

(b) **Figure Q2(b)** shows the inverted U-tube manometer contains oil (ρ = 910 kg/m^3) and water. Determine the height, h; where the pressure differential between pipes A and B is – 0.08 atm.

(10 marks)

Q3 (a) Benzene flows through a 100 mm diameter pipe at a mean velocity of 3 m/s. If the specific gravity of a benzene is 0.876, calculate

(i) volume flow rate

(2 marks)

(ii) weight flow rate

(2 marks)

(iii) mass flow rate

(2 marks)

(b) The venturi meter shown in **Figure Q3(b)** carries water at 60°C. The specific gravity of the gage fluid in the manometer is 1.25. Calculate the velocity of flow at section A and the volume flow rate of water.

(10 marks)

(c) A pipeline carries oil (SG = 0.86) at v = 2 m/s through a 20 cm diameter pipe. At another section the diameter is 8 cm. Determine the velocity at this section and the mass flow rate.

(4 marks)

Q4 (a) In pipe flow analysis, what are the criteria affecting the friction factor? Briefly explain **TWO(2)** methods to determine the friction factor.

(6 marks)

(b) Water at 20°C (ρ=998 kg/m^3; μ=0.001 kg/m.s.) is to be siphoned through a tube 1 m long and 2 mm in diameter, as in the **Figure Q4(b)**.

(i) Assume laminar flow and find the flow rate Q in m^3/hr, if H = 50 cm. Neglect minor losses including the tube curvature.

(8 marks)

(ii) Verify the laminar flow assumption.

(3 marks)

(iii) Find the H if the Re = 2000.

(3 marks)

Q5 (a) The fluid is pumped through the horizontal smooth pipe at 4 m^3/s. Determine the minimum pipe diameter allowable to comply with the following requirements,

(i) the flow is laminar
(ii) the pressure drop should be not more than 95 Pa/m.

Given specific gravity of fluid is 1.26 and μ is 1.49 kg/m.s.

(7 marks)

(b) Two pipes connect two reservoirs which have a height difference of 10 m as shown in **Figure Q5(b)**. Pipe 1 has a diameter 50 mm and length 100 m. Pipe 2 has a diameter 100 mm and length 100 m. Both have entry loss k_L = 0.5 and exit loss, k_L = 1.0. Given friction loss, f = 0.008, find the discharge, Q (m^3/s) for each pipe and calculate the total discharge, Q (m^3/s).

(13 marks)

Q6 (a) For an ideal liquid, express the flow Q through an orifice in terms of the density of the liquid, the diameter of the orifice, and the pressure difference.

(4 marks)

(b) Assuming the power delivered to a pump is a function of the specific weight of the fluid, the flow in m^3/s, and the head delivered, establish an equation by Buckingham theorem using **Table Q6(b).**

(6 marks)

(c) A 1/10 scale model of a blimp is tested in a wind tunnel under dynamically similar conditions. The speed of the blimp through still air is 10m/s. A 17.8 kPa pressure difference is measured between two points on the model. Calculate the pressure difference between the two corresponding points on the prototype. The temperature and pressure in the wind tunnel is the same as the prototype.

(5 marks)

(d) A 1/10 scale model of a blimp is tested in a wind tunnel under dynamically similar conditions. The speed of the blimp through still air is 10 m/s. If the drag force on the model blimp is measured to be 1530 N, calculate the corresponding force could be expected on prototype. The air pressure and temperature are the same as for both model and prototype.

(5 marks)

- END OF QUESTIONS -

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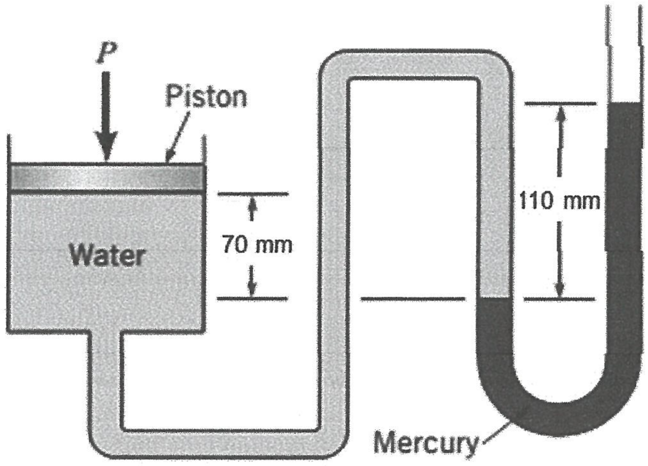

FIGURE Q2(a)

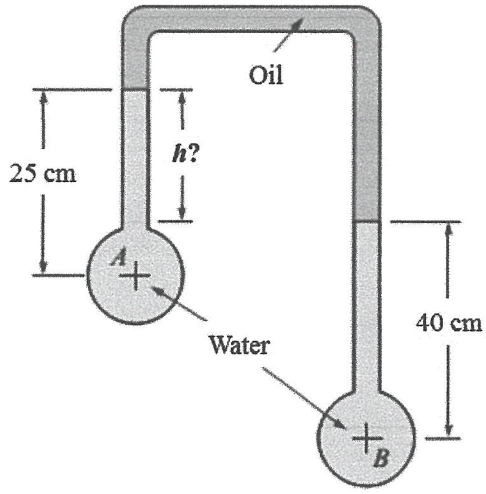

FIGURE Q2(b)

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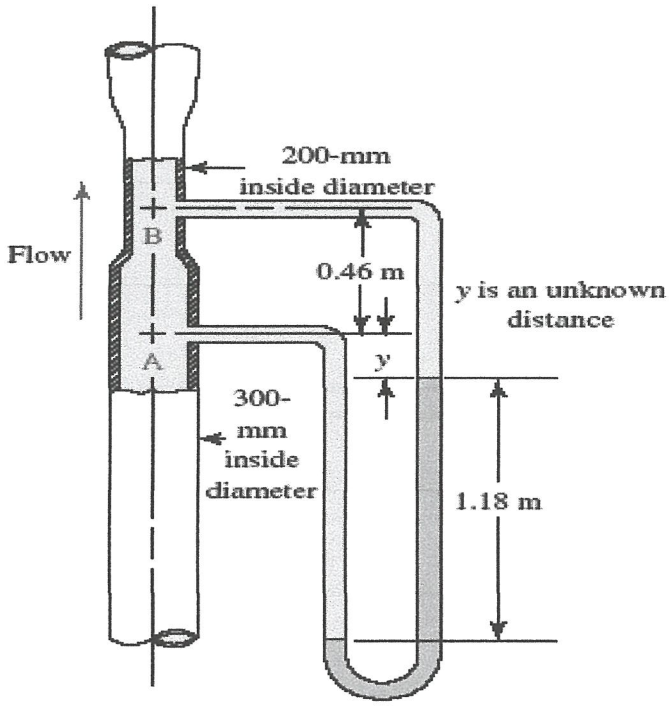

FIGURE Q3(b)

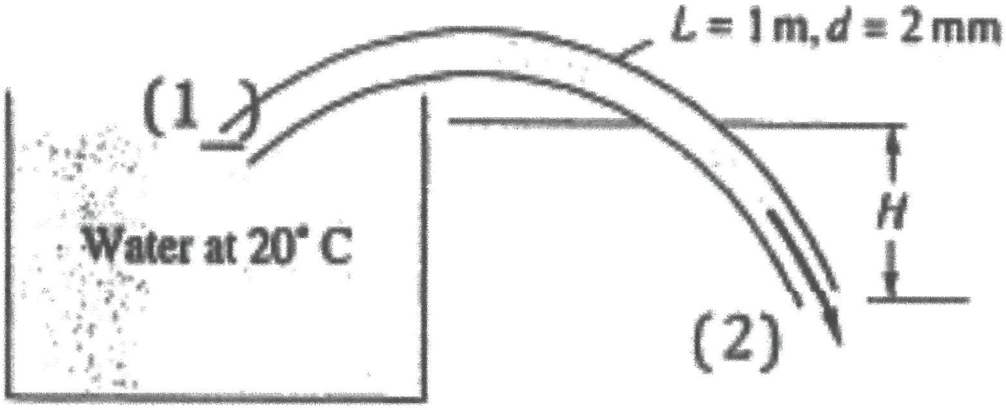

FIGURE Q4(b)

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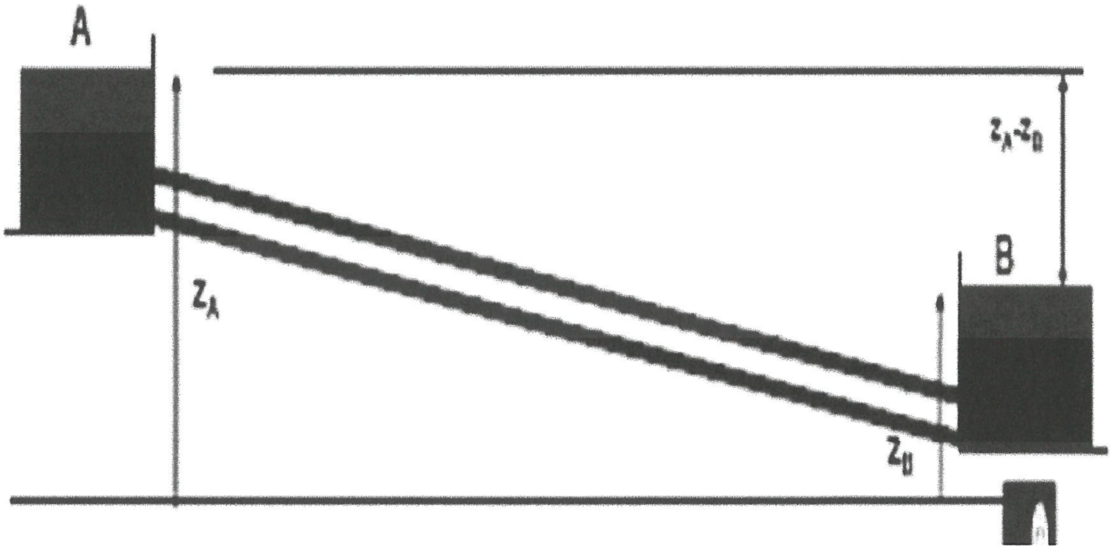

FIGURE Q5(b)

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Table Q6(b): Dimensionless and Quantity for Fluid Mechanics

Kuantiti	Quantity	Simbol	Dimensi
ASAS	**FUNDAMENTAL**		
Jisim	Mass	m	M
Panjang	Length	L	L
Masa	Time	t	T
GEOMETRI	**GEOMETRIC**		
Luas	Area	A	L^2
Isipadu	Volume	V	L^3
Sudut	Angle	θ	$M^0L^0T^0$
Momen luas pertama	First area moment	Ax	L^3
Momen luar kedua	Second area moment	Ax^2	L^4
Keterikan	Strain	e	L^0
DINAMIK	**DINAMIC**		
Daya	Force	F	MLT^{-2}
Berat	Weight	W	MLT^{-2}
Berat tentu	Specific weight	γ	$ML^{-2}T^{-2}$
Ketumpatan	Density	ρ	ML^{-3}
Tekanan	Pressure	P	$ML^{-1}T^{-2}$
Tegasan ricih	Shear stress	τ	$ML^{-1}T^{-2}$
Modulus keanjalan	Modulus of elasticity	E, K	$ML^{-1}T^{-2}$
Momentum	Momentum	M	MLT^{-1}
Momentum sudut	Angular momentum		ML^2T^{-1}
Momen momentum	Moment of momentum		ML^2T^{-1}
Momen daya	Force moment	T	ML^2T^{-2}
Daya kilas	Torque	T	ML^2T^{-2}
Tenaga	Energy	E	L
Kerja	Work	W	ML^2T^{-2}
Kuasa	Power	P	ML^2T^{-3}
Kelikatan dinamik	Dynamic viscocity	μ	$ML^{-1}T^{-1}$
Tegangan permukaan	Surface tension	σ	MT^{-2}
KINEMATIK	**KINEMATIC**		
Halaju lelurus	Linear velocity	U,v,u	LT^{-1}
Halaju sudut	Angular velocity	ω	T^{-1}
Halaju putaran	Rotational speed	N	T^{-1}
Pecutan	Acceleration	a	LT^{-2}
Pecutan sudut	Angular acceleration	α	T^{-2}
Graviti	Gravity	g	LT^{-2}
Kadar alir	Discharge	Q	L^3T^{-1}
Kelikatan kinematik	Kinematic viscosity	υ	L^2T^{-1}
Fungsi arus	Stream function	ψ	L^2T^{-1}
Pusaran	Circulation	Γ	L^2T^{-1}

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COMPLIMENTARY EQUATIONS:

$h = \dfrac{2\sigma_s}{\rho g R}\cos\phi$ $y_p = y_c + \dfrac{I_{xxC}}{[y_c + P_o/(\rho g \sin\theta)]A}$

$\mathrm{Re} = \dfrac{\rho V D}{\mu} = \dfrac{DV}{\nu}$ $\mathrm{F_r} = \dfrac{V}{\sqrt{gL}}$ $h_f = f\left(\dfrac{L}{D}\right)\dfrac{V^2}{2g}$

$H = \dfrac{P}{\gamma} + z + \dfrac{V^2}{2g}$ $h_k = k\dfrac{v^2}{2g}$ $F = \sqrt{F_x^{\ 2} + F_y^2}$ $F_y = \rho g V$

$F_x = \rho g A\bar{x}$ $\phi = \tan^{-1}\dfrac{F_y}{F_x}$ $BM = \dfrac{I}{V}$ $\mathrm{W = mg}$

$\mathrm{R = \rho g V}$ $\rho = \dfrac{M}{V}$ $P = \rho g h$ $\gamma = \rho g$

$V = \sqrt{2gh}$ $h_L = H - \dfrac{V_a}{2g}$ $\mathrm{F_r} = \dfrac{V}{\sqrt{gL}}$ $C_d = C_c x C_V$

$Q = C_d a\sqrt{2gH}$ $C_v = \dfrac{x}{\sqrt{4yH}}$ $\dot{m} = \rho A V$ $C_V = \dfrac{V_a}{V}$

$\mathrm{R_X} = \dot{m}(V_{X1} - V_{X2})$ $\mathrm{R_Y} = \dot{m}(V_{Y1} - V_{Y2})$ $R = \sqrt{R_X^{\ 2} + R_Y^{\ 2}}$