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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BFC 1043 / BFC 10403
PROGRAMME	:	1 BFF
EXAMINATION DATE	:	DECEMBER 2013/ JANUARI 2014
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FOUR (4)** FROM SIX (6) QUESTIONS 2. ATTACH **APPENDIX III** WITH YOUR ANSWER BOOKLET

THIS PAPER CONSISTS OF **NINE (9)** PAGES

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Q1 (a) Give **SIX (6)** examples on fluid mechanics application on human activities.

(6 marks)

(b) Determine the specific weight, density, specific volume and specific gravity of certain liquid with volume 6.5 m^3 and weight 55 kN.

(12 marks)

(c) Calculate the minimum diameter of a glass tube if a capillary rise is not more than 0.25 mm. Given, the surface tension = 0.075 N/m and specific weight of water , $\gamma = 9810$ kg/m^3 .

(7 marks)

Q2 (a) Explain why the pressure in fluid increases with depth?

(4 marks)

(b) Calculate the pressure difference (P_B-P_A) in double–fluid manometer as shown in Figure **Q2(b)**.

(12 marks)

(c) Determine the absolute pressure in unit kPa if barometer reads 60 kPa. Given, barometer height at sea level is 740 mmHg and $sg_{merkuri} = 13.6$

(9 marks)

Q3 (a) Define the principle of Bernoulli's Theorem and what are the three major assumptions used in the derivation of the Bernoulli equation?

(8 marks)

(b) Figure **Q3(b)** shows a pressurized tank of water has a 10-cm-diameter orifice at the bottom, where water discharges to the atmosphere. The water level is 3 m above the outlet. The tank air pressure above the water level is 300 kPa while the atmospheric pressure is 100 kPa. Neglecting frictional effects, determine the initial discharge rate of water from the tank.

(13 marks)

(c) By using fluid parameters, derive the momentum equations.

(4 marks)

Q4 (a) State **FOUR (4)** differences for laminar and turbulent flow.

(8 marks)

(b) Fluid A flows through a galvanised iron pipe with length and diameter are 45 m and 150 mm respectively for discharge 5.630 L/s. Calculate the head loss due to fluid friction of pipe.
(Given $\rho = 869$ kg/m^3, $\mu = 8.14 \times 10^{-2}$ Pa.s, 1 m^3 = 1000 L).

(6 marks)

(c) Figure **Q4(c)** shows water at 20°C is pumped between two reservoirs at a rate of 0.30 m^3/min through a 120 m long and 250 mm diameter galvanized iron pipe. Compute the minimum required power provided the pump. Account for all major and minor head losses.

(11 marks)

Q5 (a) A reservoir has been discharge through a horizontal pipeline to the atmosphere. The pipeline is connected in series and consisted of two pipes which are 10 cm diameter and 25 m long and 12 cm diameter and 35 m long. The friction factor is 0.002 for both pipes. The water level in the tank is 10 m above the centre-line of the pipe at the entrance. Considering all the head losses, calculate the discharge when the 10 cm diameter pipe is connected to the tank.

(12 marks)

(b) Briefly explain the characteristics of discharge Q and head loss h_f of flow in pipes installed as follows;
(i) Series
(ii) Parallel

(6 marks)

(c) Define hydraulic grade line and energy grade line. Sketch the hydraulic grade line and the energy grade line between two reservoirs as shown in Figure **Q5(c)**. Please attach in your answer book.

(7 marks)

Q6 (a) What is definition of model and prototype?

(4 marks)

(b) Derive an equation of non-dimension group to describe the resistance force *(F)* with Buckingham Theorem. The equation of resistance force *(F)* for a boat has related with a function of length *L*, velocity *V*, acceleration gravity *g*, density flow ρ , and dynamic viscosity μ. (Repeating variables : L, V and ρ)

(15 marks)

(c) Clearly explain the differences between geometry and kinematics similitude.

(6 marks)

END OF QUESTIONS

APPENDIX I

FINAL EXAMINATION

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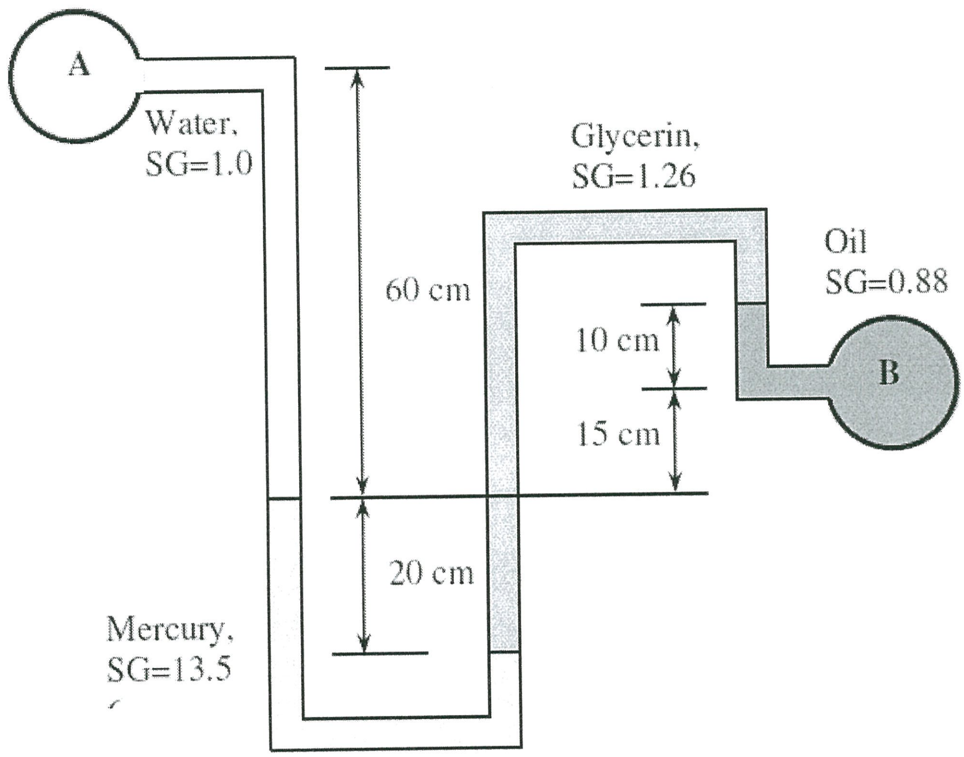

FIGURE Q2(b)

APPENDIX II

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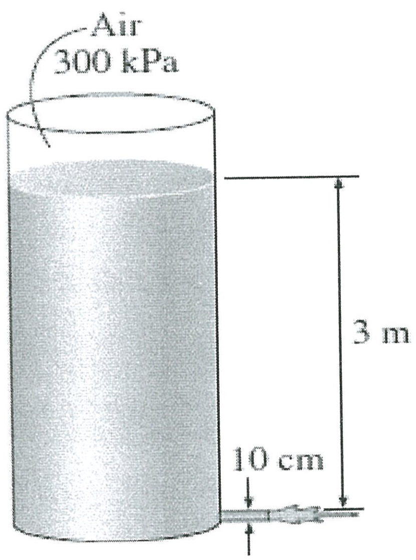

FIGURE Q3 (b)

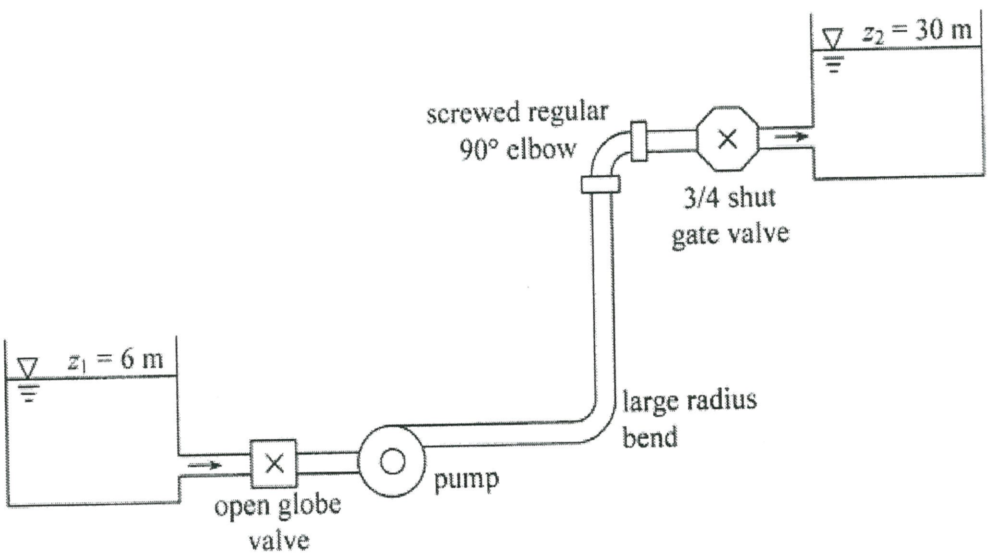

FIGURE Q4(c)

APPENDIX III

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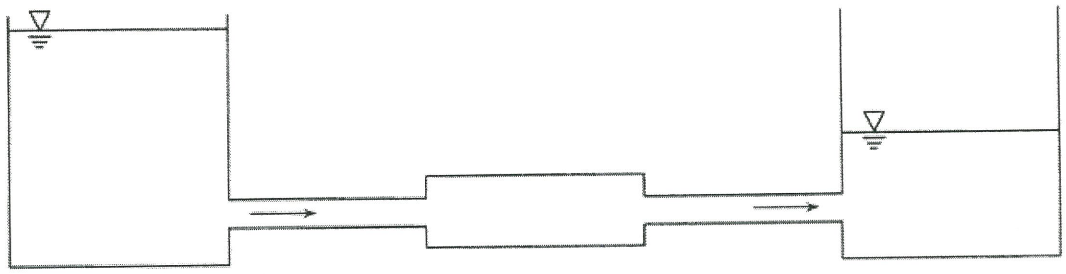

FIGURE Q5(c)

APPENDIX IV

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Formula:

$$\mathrm{Re} = \frac{\rho V D}{\mu} = \frac{DV}{\nu} \qquad f = \frac{64}{\mathrm{Re}} \qquad \mathrm{F_r} = \frac{V}{\sqrt{gL}}$$

$$h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g} \qquad H = \frac{P}{\gamma} + z + \frac{V^2}{2g} \qquad h_k = k\frac{v^2}{2g}$$

$$F_x = \rho g A\bar{x} \qquad F_y = \rho g V \qquad F = \sqrt{F_x^{\ 2} + F_y^2}$$

$$\phi = \tan^{-1}\frac{F_y}{F_x} \qquad BM = \frac{I}{V} \qquad \mathrm{W = mg}$$

$$\mathrm{R = \rho g V} \qquad \rho = \frac{M}{V}$$

$$P = \rho g h \qquad \gamma = \rho g$$

$$\mathrm{F_r} = \frac{V}{\sqrt{gL}} \qquad V = \sqrt{2gh} \qquad h_L = H - \frac{V_a}{2g}$$

$$C_V = \frac{V_a}{V} \qquad C_d = C_c x C_V$$

$$Q = C_d a\sqrt{2gH} \qquad C_v = \frac{x}{\sqrt{4yH}} \qquad m = \rho A V$$

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

APPENDIX V

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Table 1 : 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}
Putaran	Circulation	Γ	L^2T^{-1}
Pusaran	Vorticity	Ω	T^{-1}

APPENDIX VI

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Table 2: Head loss coefficients for a range of pipe fittings

Fitting	Loss coefficient *k*
Gate valve (open to 75 percent shut)	20
Globe valve	10
Spherical plug valve (fully open)	0.1
Pump foot valve	1.5
Return bend	2.2
90° elbow	0.9
45° elbow	0.4
Large-radius 90° bend	0.6
Tee junction	1.8
Sharp pipe entry	0.5
Radiused pipe entry	0.0
Sharp exit pipe	0.5