UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BFC 1043 / BFC 10403
PROGRAMME	:	BFF
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1. (a) Differentiate briefly gauge pressure, absolute pressure and vacuum pressure.

(5 marks)

(b) A 0.5mm diameter glass tube is inserted into liquid (density, ρ = 1000 kg/m^3, surface tension, σ = 0.073 N/m) in a cup as shown in Figure Q1 (b). Determine the capillary rise of water, h in the tube if interface angle between tube and liquid is 45°.

(4 marks)

(c) Figure Q1 (c) shows the 4m width of dam and density of liquid is constant and equal to 1000 kg/m^3, determine

(i) Resultant force acting on the curved surface (radius = 2.5 m)
(ii) Weight required to stabilize the dam by assuming the centre of gravity is in the middle of rectangular section.

(11 mark)

Q2 (a) Based on your opinion; explain why water pressure in a pipe that discharges to the atmosphere can be neglected.

(4 marks)

(b) Water flow in the pipes as shown in Figure Q2 (b). By assuming the flow in the pipe 2 is about 30% of total discharge and velocity of pipe 1 is 2 m/s, determine the discharge and velocity of pipe 2 and 3.

(6 marks)

(c) Figure Q2 (c) shows a reducing elbow in a vertical pipe is used to deflect water flow by an angle, θ = 45° from the flow direction to the atmosphere. The elevation difference between the centers of the exit and the inlet is 0.4 m and flow rate is 0.05m^3/s. Determine the magnitude and direction of resultant force, F_R on the reducer.
(note: neglect energy losses)

(10 marks)

Q3 (a) Differentiate parallel and series pipes.

(4 marks)

(b) Three reservoirs connected by pipes as shown in Figure Q3 (b). The diameter for each pipe is 250 mm and assumes coefficient of friction, f is 0.001. Analyze the discharge in each pipe.

(16 marks)

Q4 (a) Describe the difference between laminar and turbulent flow.

(4 marks)

(b) Calculate the friction head loss per kilometer required to maintain a velocity of 3 m/s in a 20 mm diameter pipe, if kinematics viscosity, $v = 4 \times 10^{-5}$ m^2/s.

(5 marks)

(c) Figure Q4 (c) shows water flows from closed tank Y through pipe with 200 mm diameter. Given that flow rate of 0.25 m^3/s, kinematics viscosity of water, v is 0.113 x 10^{-5} m^2/s, pipe friction factor, f is 0.016 and coefficient of minor losses for entrance, bend and exit are $k_e = 0.5$, $K_b = 0.9$ and $k_o = 1$ respectively. Determine;

(i) Type of flow
(ii) Head losses in pipe
(iii) Pressure at P_1

(11 marks)

Q5. (a) Differentiate model and prototype

(4 marks)

(b) Oil (density = 917 kg/m^3 and dynamic viscosity = 0.29 Pa.s) flows in a 15 cm diameter pipe at velocity 2.0 m/s. Calculate the velocity of flow of water in a 1.0 cm diameter pipe in order to create the two flows dynamically similar by using Reynolds Number. Density and dynamic viscosity is given as 1000kg/m^3 and 1.31 x 10^{-3} Pa.s respectively.

(5 marks)

(c) By using Buckingham method, prove that

$$V = \sqrt{gD}\, fn\left(\frac{W}{\rho D^3 g}, \frac{\mu}{\rho D\sqrt{gD}}\right)$$

Where terminal velocity of descent V of a hemispherical parachute is assumed depend on its diameter D, weight W, acceleration due to gravity g, density of air ρ and viscosity of air μ.

(11 marks)

S1. (a) Bezakan tekanan ukur, tekanan mutlak dan tekanan vakum.

(5 markah)

(b) Tiub kaca berdiameter 0.5mm dimasukkan ke dalam cawan cecair (ketumpatan, ρ = 1000 kg/m^3, tegangan permukaan, σ = 0.073 N/m) seperti ditunjukkan dalam Rajah Q1 (b). Tentukan kenaikan kapilari, h jika sudut antara muka diantara tiub dengan cecair adalah 45°.

(4 markah)

(c) Rajah S1 (c) menunjukkan empang dengan kelebaran 4 m. Dengan mengandaikan ketumpatan cecair adalah 1000 kg/m^3, tentukan

(i) Jumlah daya yang bertindak dan lokasi ke atas permukaan lengkung (jejari = 2.5 m)

(ii) Berat yang diperlukan untuk menstabilkan empang dengan andaian pusat graviti berada di tengah bahagian segiempat.

(11 markah)

S2 (a) Pada pendapat anda, terangkan mengapa tekanan air didalam paip yang dialirkan ke atmosfera boleh diabaikan.

(4 markah)

(b) Air mengalir didalam paip seperti di Rajah S2 (b). Dengan mengadaikan aliran didalam paip 2 adalah 30% daripada keseluruhan kadar alir dan halaju paip 1 adalah 2 m/s, kira kadar alir dan halaju bagi paip 2 dan 3.

(6 markah)

(c) Rajah S2 (c) menunjukkan siku pengurangan di dalam paip menegak digunakan untuk memesongkan aliran air oleh sudut, θ = 45° dari arah aliran ke atmosfera. Perbezaan ketinggian bahagian keluar dan masuk paip adalah 0.4m dan kadar alir diberi sebanyak 0.05 m^3/s. Tentukan magnitud dan arah daya panduan, F_R keatas siku pengurang.
(nota: abaikan kehilangan tenaga)

(10 markah)

S3 (a) Bezakan paip selari dan bersiri.

(4 markah)

(b) Tiga takungan dihubungkan dengan beberapa paip seperti di Rajah S3 (b). Diameter setiap paip adalah 250 mm dan dengan mengandaikan pekali geseran, f adalah 0.001. Analysis kadar alir untuk setiap paip.

(16 markah)

S4 (a) Nyatakan perbezaan diantara aliran lamina dan gelora

(4 markah)

(b) Kira kehilangan tenaga disebabkan oleh geseran per kilometer yang diperlukan untuk mengekalkan halaju 3 m/s dalam paip berdiameter 20 mm, jika diberi kelikatan kinematik, $v = 4 \times 10^{-5}\ m^2/s$.

(5 markah)

(ci) Rajah S4 (c) menunjukkan air mengalir dari tangki bertutup melalui paip berdiameter 200 mm. Diberi kadar alir, Q adalah 25 m^3/s, kelikatan kinematik air, v is $0.113 \times 10^{-5}\ m^2/s$, factor geseran paip, f adalah 0.016 dan pekali kehilangan kecil untuk masukkan, lenturan dan keluaran masing-masing adalah $k_e = 0.5$, $K_b = 0.9$ dan $k_o = 1$. Tentukan;

(i) Jenis aliran
(ii) Kehilangan tenaga
(iii) Tekanan pada P_1

(11 markah)

S5. (a) Bezakan model dan prototaip.

(4 markah)

(b) Minyak (ketumpatan = 917 kg/m^3 dan kelikatan dinamik = 0.29 Pa.s) mengalir dalam paip berdiameter 15 cm pada halaju 2.0 m/s. Kira halaju air yang mengalir dalam paip berdiameter 1.0 cm untuk membolehkan dua aliran ini serupa dari segi dinamik dengan menggunakan formula Nombor Reynolds. Diberi: ketumpatan dan kelikatan dinamik bagi air masing-masing adalah 1000kg/m^3 dan 1.31×10^{-3} Pa.s.

(5 markah)

(c) Dengam menggunakan kaedah Buckingham, buktikan

$$V = \sqrt{gD}\, fn\left(\frac{W}{\rho D^3 g}, \frac{\mu}{\rho D\sqrt{gD}}\right)$$

dimana halaju terminal penurunan, V bagi payung terjun berbentuk hemisfera diandaikan bergantung kepada diameter D, berat W, pecutan graviti g, ketumpatan udara ρ and kelikatan dinamik udara μ.

(11 markah)

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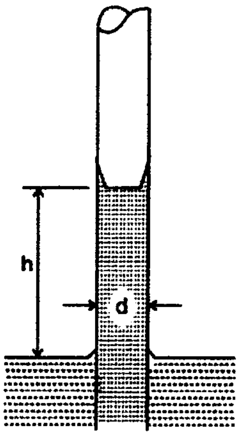

Figure Q1(b)/ Rajah S1 (b)

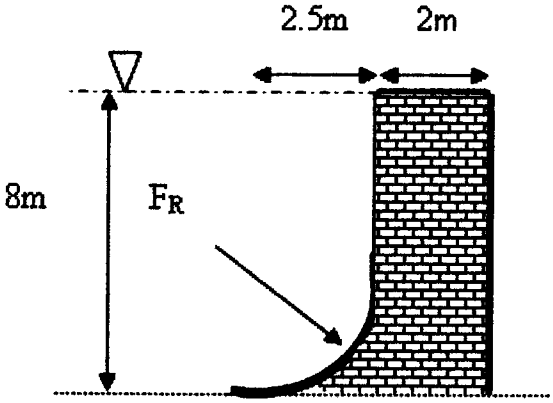

Figure Q1(c)/Rajah S1(c)

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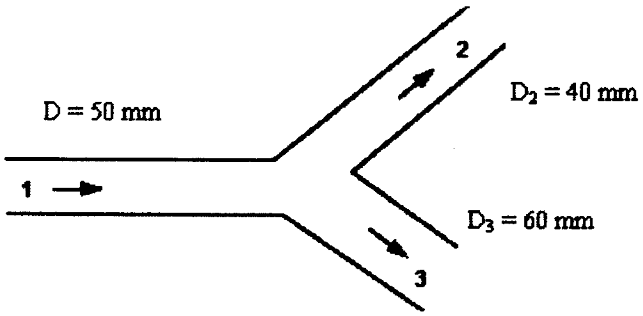

Figure Q2(b)/Rajah S2 (b)

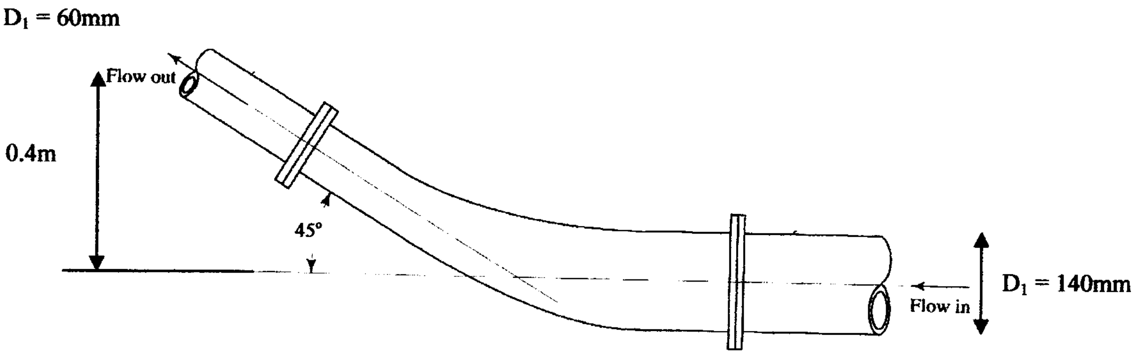

Figure Q2 (c)/Rajah S2 (c)

Appendix III

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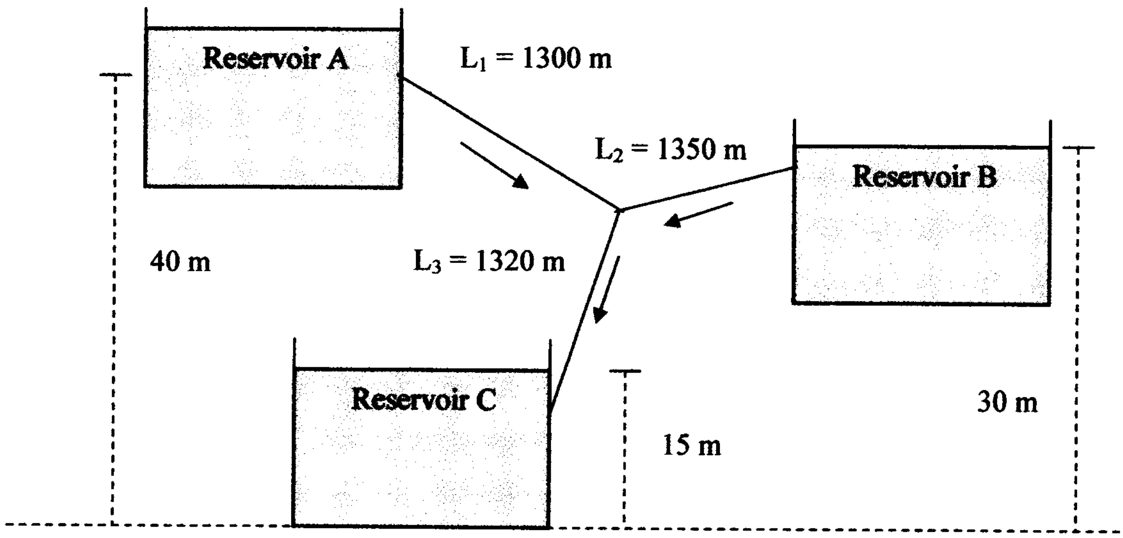

Figure Q3 (b)/ Rajah S3 (b)

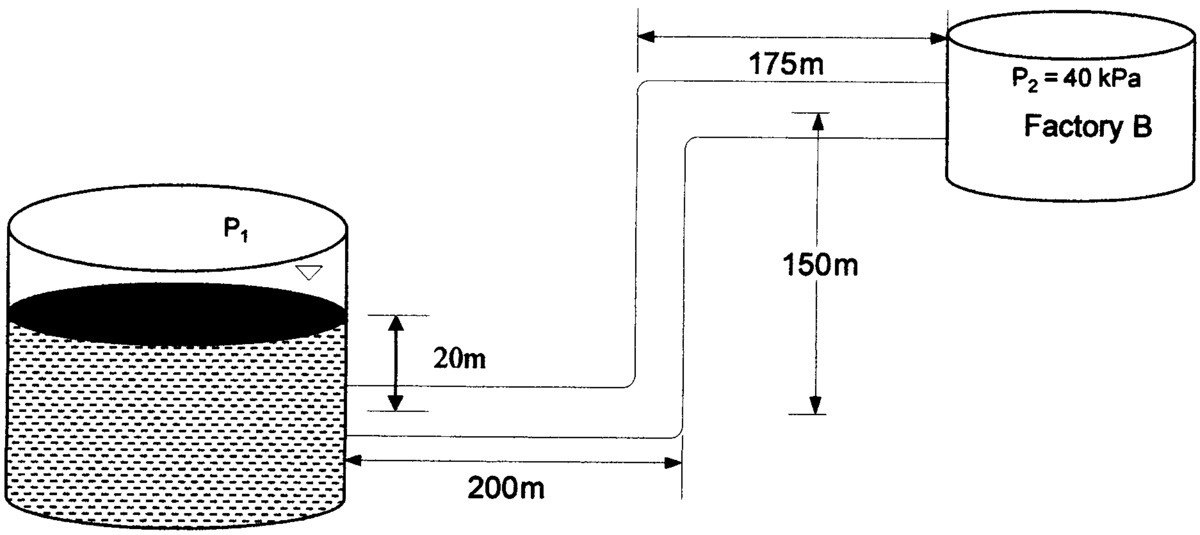

Figure Q4 (c)/ Rajah S4 (c)

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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}

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FORMULAE:

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

$$F_V = \rho g V$$

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

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

$$h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g}$$

$$F_H = \rho g h_c A$$

$$F = \sqrt{F_H{}^2 + F_V^2}$$

$$\phi = \tan^{-1}\frac{F_y}{F_x}$$

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

$$h = \frac{2\sigma\cos\theta}{\gamma r}$$

$$W = \gamma A L$$

$$y_p = y_c + \frac{I_{xc}}{y_c A}$$

$$h_{cp} = h_c + \frac{I_{xc}}{h_c A}$$

$$\bar{x}_c = \frac{A_1\overline{x_1} + A_2\overline{x_2}}{A_1 + A_2}$$

$$\mathrm{I} = \frac{bh^3}{12}$$

$$x = \frac{4r}{3\pi}$$

$$F = \dot{m}(V_2 - V_1)$$