UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT NAME	:	FLUID MECHANICS
SUBJECT CODE	:	BFC 1043
COURSE	:	1 BFC
EXAMINATION DATE	:	APRIL 2010
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS PAPER CONSIST OF THIRTEEN (13) PAGES

Q1. (a) Both ends of the manometer are open to the atmosphere as shown in Figure Q1 (a). Calculate the specific gravity of Fluid X. Given density of SAE 30 Oil is 891 kg/m^3.

(4 marks)

(b) Both the tank and the tube are open to the atmosphere as shown in Figure Q1 (b). If L = 2.13 m, what is the angle of tilt θ of the tube?

(6 marks)

(c) With the aid of sketches, show that the pressure intensity at a point is of equal magnitude in all directions.

(10 marks)

Q2. (a) Consider two identical 5cm diameter spherical ball submerged in water-one is made of aluminium , the other of iron-submerged in water. Will the buoyant forces acting on these two balls be the same or different? Explain.

(3 marks)

(b) Someone claims that she can determine the magnitude of the hydrostatic force acting on a plane surface submerged in water regardless of its shape and orientation if she knew the vertical distance of the centroid of the surface measured from the free surface and the area of the surface. Is this a valid claim? Explain.

(4 marks)

(c) A 4-m-long quarter-circular gate of radius 3 m and of negligible weight is hinged its upper edge A, as shown in Figure Q2 (b). The gate controls the flow of water over the edge at B, where the gate is pressed by 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.

(13 marks)

Q3. (a) Water at 10 ^{0}C is flowing at 0.075 m^3/s. Calculate the weight flowrate and the mass flowrate. Given that the density and specific weight of water at 10 ^{0}C are 1000 kg/m^3 and 9.81 kN/m^3 respectively.

(3 marks)

(b) The tube in Figure Q3 (b) shows the flowing fluid of CO_2 at 20^{0}C (ρg = 17.9 N/m^3). If P_1 = 170 kPa and the manometer fluid is Meriam Red oil (SG= 0.827), calculate P_2 and the gas flowrate in m^3/h. Neglect losses.

(7 marks)

(c) Water at 20^{0}C (998kg/m^3) flows steadily through the box in Figure Q3(c) entering station 1 at 2 m/s. Calculate the resultant forces (magnitude and direction) required to hold the box stationary against the flow momentum.

(10 marks)

Q4 (a) Indicate 4 zones of flow in Moody charts

(2 marks)

(b) Explain major head loss in pipe and turbulent flow.

(5 marks)

(c) Tank A transport oil at rate of 100 L/s to tank B as shown in Figure Q4 (c). If the pipe diameter is 150 mm and loss coefficient for inlet, outlet and bend are 0.4, 1 and 0.9 respectively, calculate

(i) Reynolds number
(ii) Energy losses, h_L in the system
(iii) Additional energy by pump, h_{pump}
(iv) Pressure at point B

(Given: friction factor, f = 0.016, specific gravity for oil, sg = 0.92, kinematics viscosity, v = 0.003 m^2/s)

(13 marks)

Q5 (a) Pipe A is connected in parallel between two points M and N with pipe B. A total discharge of 20 L/s enters the parallel pipes through division at M to join at N as shown in Figure Q5 (a). Estimate the division of discharge in the pipes in L/s if the friction factor, f for pipe A and B are 0.018 and 0.02 respectively

(6 marks)

(b) Figure Q5 (b) shows three reservoirs connected by pipes. Each pipes is 300 mm in diameter and assume the coefficient of friction for each pipe, f is 0.01. Estimate the discharge in each pipe.

(14 marks)

Q6. (a) State two (2) advantages of similitude.

(2 marks)

(b) An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 L/s through a 1.2 m diameter pipe. Tests were conducted on a 12 cm diameter pipe using water. If the viscosity of water is 0.01 poise, find

(i) velocity of flow for model
(ii) rate of flow for model in L/s
(iii) ratio of length, L_r
(Given : 1 poise = 0.1 Ns/m^2)

(7 marks)

(c) The terminal velocity of descent V of a hemispherical parachute is found to depend on its diameter D, weight W, acceleration due to gravity g, density of air ρ and viscosity of air μ. By using Buckingham method, prove that

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

(11 marks)

S1. (a) Kedua-dua hujung manometer adalah terdedah kepada atmosfera seperti ditunjukkan dalam Rajah S1(a). Kira graviti tentu bagi Bendalir X. Diberi ketumpatan minyak SAE 30 ialah 891 kg/m^3.

(4 markah)

(b) Kedua-dua tangki dan tiub terdedah kepada atmosfera seperti ditunjukkan dalam Rajah S1(b). Jika L = 2.13 m, apakah sudut θ.

(6 markah)

(c) Dengan bantuan gambarajah, tunjukkan bahawa tekanan adalah sama di semua arah di satu titik rujukan.

(10 markah)

S2. (a) Pertimbangkan 2 biji bebola bersaiz 5cm diameter yang terendam didalam air. Sebiji bola adalah aluminium dan sebiji lagi besi. Adakah daya keapungan yang bertindak keatas kedua-dua bola tersebut sama atau tidak?. Terangkan.

(3 markah)

(b) Seseorang menyatakan bahawa beliau boleh menentukan magnitud daya hidrostatik yang bertindak pada satu jasad terendam tanpa mengira bentuk dan kedudukannya sekiranya beliau tahu kedudukan menegak dari titik sentroid ke permukaan air dan luas permukaan jasad. Adakah kenyataan ini benar?. Terangkan.

(4 markah)

(c) Sebuah pintu air berdimensi 4m panjang berbentuk suku bulatan dengan diameter 3 m adalah diengselkan di titik A seperti Rajah **S2 (b).** Pintu air tersebut mengawal air dari melimpah di titik B, dimana pintu air tersebut ditekan dengan spring. Tentukan daya spring yang diperlukan untuk memastikan pintu air tertutup apabila air berada pada aras A.

(13 markah)

S3. (a) Air bersuhu 10 ^{0}C mengalir pada 0.075 m^3/s. Tentukan kadaralir berat dan kadaralir jisim. Diberi ketumpatan dan berat tentu air bersuhu 10 ^{0}C adalah masing-masing 1000 kg/m^3 dan 9.81 kN/m^3

(3 markah)

(b) Gas CO_2 pada suhu 20^{0}C (ρg = 17.9 N/m^3) mengalir dalam tiub seperti dalam Rajah **S3(b).** Jika P_1 = 170 kPa dan cecair dalam manometer ialah minyak *Meriam Red* (SG= 0.827), tentukan P_2 kadar alir gas dalam m^3/h. Abaikan kehilangan.

(7 markah)

(c) Air bersuhu 20^{0}C (998kg/m^3) mengalir mantap melalui sebuah kotak seperti Rajah **S3(c)** memasuki stesyen 1 dengan kelajuan 2 m/s. Hitung daya paduan yang diperlukan untuk mengekalkan kotak pada kedudukannya menentang momentum aliran dan arah tindakan daya.

(10 markah)

Q4 (a) Namakan 4 zon aliran didalam carta Moody.

(2 markah)

(b) Terangkan kehilangan major dan minor dalam paip

(5 markah)

(c) Tangki A mengangkut minyak pada kadar alir 100 L/s ke tangki B seperti di Rajah Q4 (c). Jika diameter adalah 150 mm dan pekali kehilangan bagi masukkan, keluaran dan lenturan masing-masing ialah 0.4, 1 dan 0.9, kira

(i) Nombor Reynolds aliran
(ii) Kehilangan tenaga, h_L bagi sistem
(iii) Tambahan tenaga pam, h_{pump}
(iv) Tekanan kat B

(Diberi: faktor geseran f = 0.016, graviti tentu bagi minyak, sg = 0.92, kelikatan kinematik, v = 0.003 m^2/s)

(13 markah)

Q5 (a) Paip A bersambung secara selari di antara 2 titik M dan N dengan paip B. Sebanyak 20 L/s kadar alir yang memasukki paip selari berpecah melalui M dan bergabung semula di N seperti di Rajah Q5 (a). Anggarkan pecahan kadar alir di dalam paip tersebut dalam L/s jika faktor geseran , f bagi paip A dan B masing-masing ialah 0.018 dan 0.02 .

(6 markah)

(b) Figure Q5 (b) menunjukkan 3 takungan dihubungan dengan paip.Setiap Diameter setiap paip ialah 300 mm dan diandaikan bahawa pekali geseran bagi setiap paip , f ialah 0.01. Anggarkan kadar alir setiap paip.

(14 marks)

Q6. (a) Nyatakan dua (2) kebaikan keserupaan

(3 markah)

(b) Minyak dengan graviti tentu dan kelikatan dinamik masing-masing ialah 0.92 dan 0.03 poise diangkut pada kadar alir 2500 L/s melalui paip berdiameter 1.2 m . Ujian telah dilakukan ke atas paip berdiameter 12 cm dengan menggunakan air. Jika kelikatan dinamik air ialah 0.01 poise, dapatkan

(i) Halaju aliran bagi model
(ii) Kadar alir dalam L/s
(iii) ratio of length.
(Diberi : 1 poise = 0.1 Ns/m^2)

(6 markah)

(c) The terminal velocity of descent V of a hemispherical parachute is found to depend on its diameter D, weight W, acceleration due to gravity g, density of air ρ and viscosity of air μ. By using Buckingham method, prove that

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

(11 markah)

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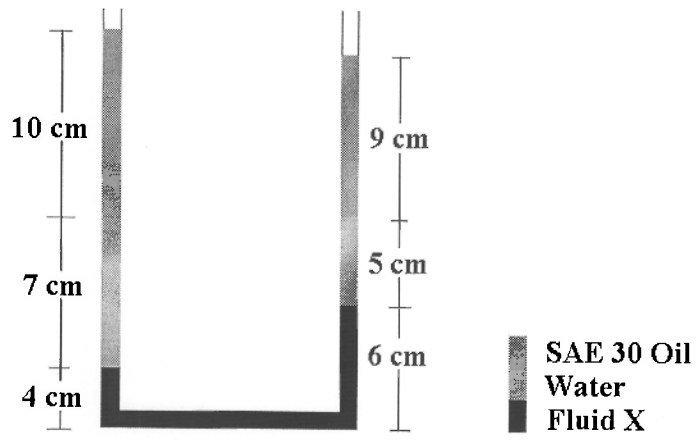

Figure Q1(a)

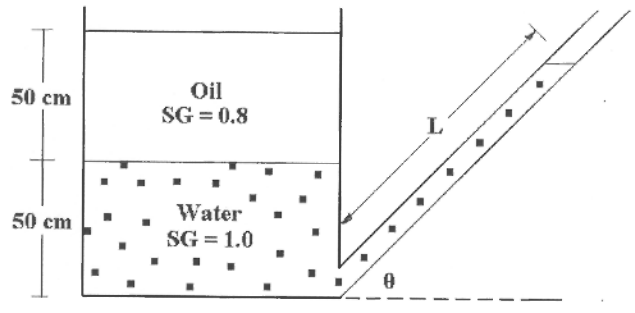

Figure Q1 (b)

Appendix II

FINAL EXAM

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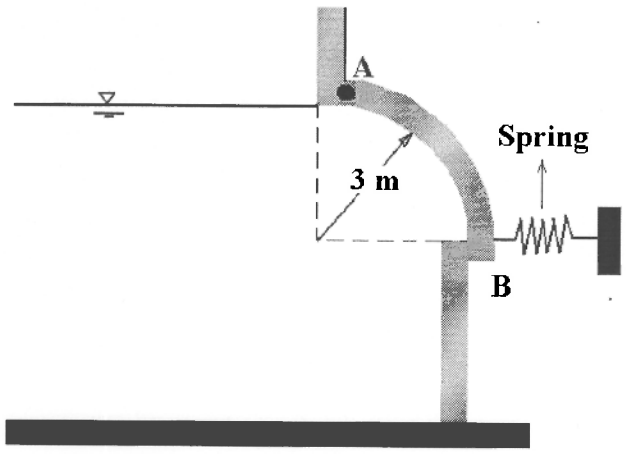

Figure Q2(b)

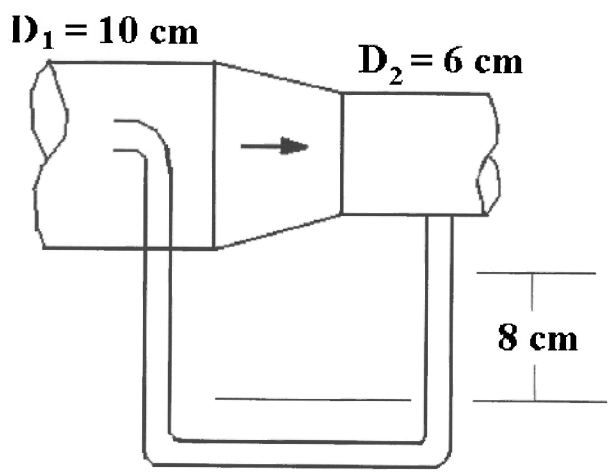

Figure Q3 (b)

Appendix III

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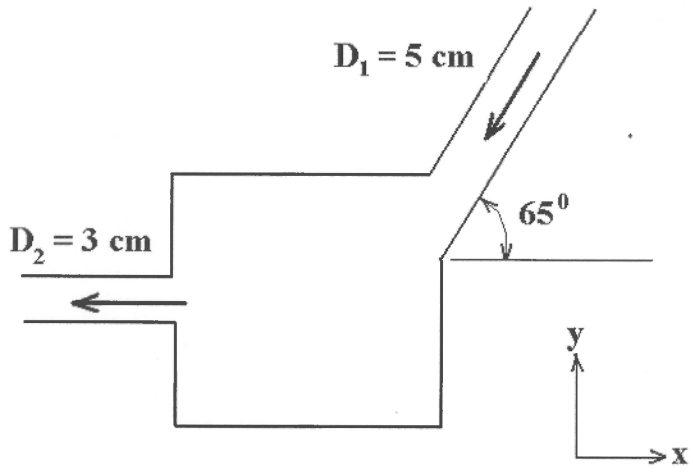

Figure Q3 (c)

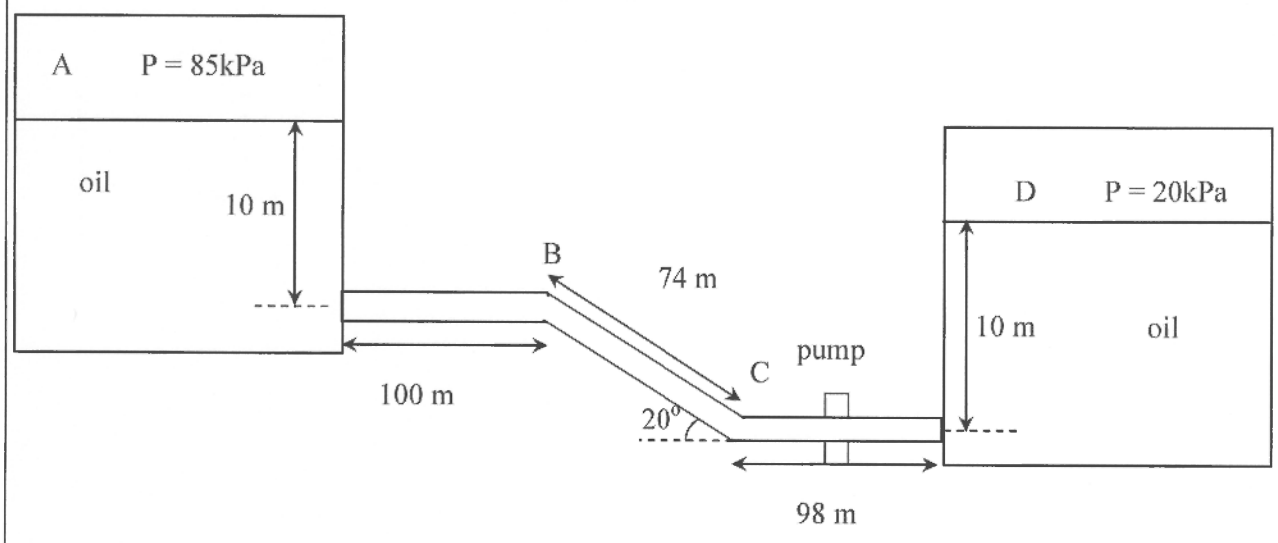

Figure Q4 (c)

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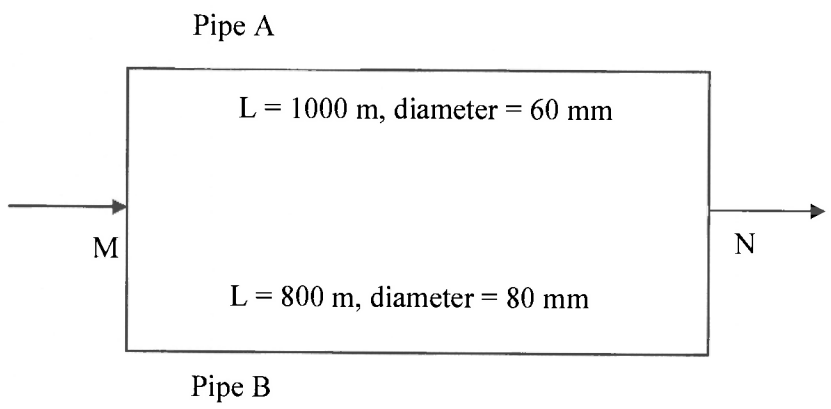

Figure Q5 (a)

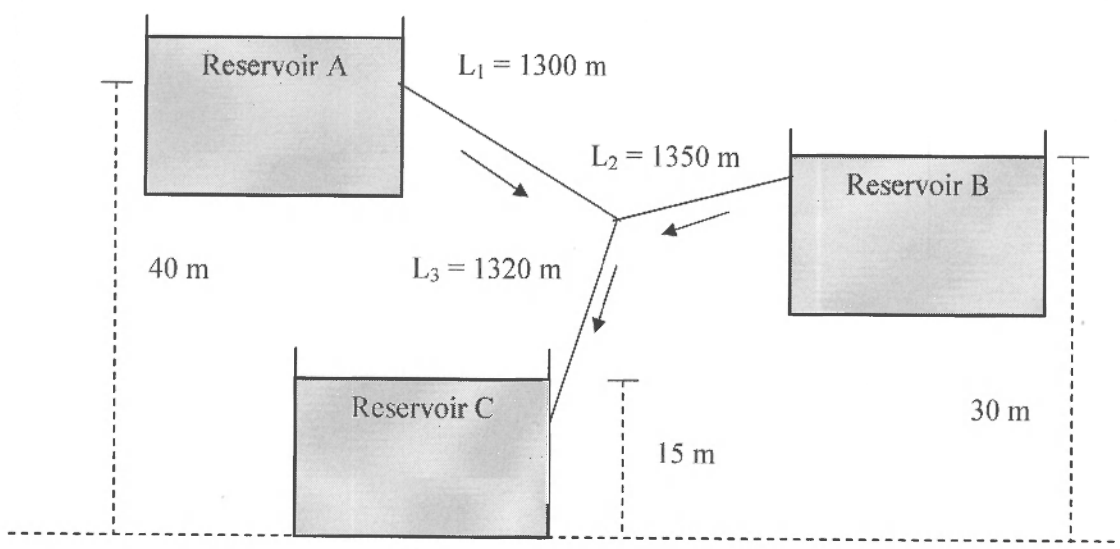

Figure Q5 (b)

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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Formulae:

$$\mathrm{Re} = \frac{\rho VD}{\mu} = \frac{DV}{\nu} \qquad h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g} \qquad F = \sqrt{F_x^{\,2} + F_y^2}$$

$$H = \frac{P}{\gamma} + z + \frac{V^2}{2g} \qquad F_x = \rho g h A \qquad P = \rho g h$$

$$F_y = \rho g V \qquad h_L = k\frac{v^2}{2g}$$