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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNP 10303
PROGRAMME	:	1 BNA/BNB/BNC
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

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Q1. (a) Discuss the term of viscosity and the cause of it in liquids and in gases. Between liquid and gas, which has a higher viscosity? Explain.

(5 marks)

(b) Describe the term of capillary effect and it cause. Explain how is it affected by the contact angle.

(5 marks)

(c) Determine the atmospheric pressure at a location where the barometric reading is 735 mmHg. Assume the density of mercury is 13,600 kg/m^3.

(5 marks)

(d) A 5 m long quarter circular gate of radius 3 m and of negligible weight is hinged about its upper edge A, as shown in **Figure Q1(d)**. The gate controls the flow of water over the ledge at B, where the gate is pressed by a 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.

(10 marks)

Q2. (a) Explain the **THREE (3)** major assumptions used in the derivation of the Bernoulli Equation.

(6 marks)

(b) A piezometer and Pitot tube are tapped into a 5 cm diameter horizontal water pipe, and the height of the water columns are measured to be 25 cm in the piezometer and 40 cm in the Pitot tube (both measured from the top surface of the pipe) as shown in **Figure Q2(b)**. Determine the velocity at the center of the pipe.

(7 marks)

(c) A reducing elbow is used to deflect water flow by an angle $\theta = 45^{\circ}$ with mass flow rate of 30 kg/s from the flow direction while accelerating it. The elbow discharges water into the atmosphere. The cross-sectional area of the elbow is 100 cm^2 at the inlet and 20 cm^2 at the exit. The elevation difference between the centers of the exit and the inlet is 40 cm. The mass of the elbow and the water in it is 50 kg. Determine the anchoring force needed to hold the elbow in place.

(12 marks)

Q3 (a) Based on your opinion, explain reasons of the circular pipes usually used to transport the liquid. For transportation of gasses, especially in low pressure, state the type of pipes used, circular or non-circular.

(5 marks)

(b) Water at 20ºC (density = 998 kg/m^3 and dynamic viscosity 1.02 × 10^{-3} Ns/m^2 is flow steadily in a 40 m long and 6 cm diameter horizontal pipe made of stainless steel at a rate 10 L/s. The roughness of stainless steel is 0.002 mm. Determine:

(a) Head loss
(b) Pressure drop
(c) Required pumping power

(10 marks)

(c) **Figure Q3(c)** shows water at 20°C is pumped between two reservoirs at a rate of 5 L/s through a 100 m long and 300 mm diameter galvanized iron pipe. The roughness of galvanized steel pipe is 0.15 mm and kinematic viscosity is 1.003× 10^{-6} m^2/s. Compute the minimum required power provided the pump. Account for all major and minor head losses.

(10 marks)

Q4 (a) With aid of diagram, differentiate briefly between hydraulic grade line and energy line

(4 marks)

(b) Given is three-pipe series system, as in **Figure Q4 (b)**. The total pressure drop is $P_A - P_B$ = 140 kPA and elevation drop $z_A - z_B$ = 6 m. Pipe data are shown in **Table Q4 (b).**

Table Q4 (b)

Pipe	L (m)	d (cm)	*f*
1	100	8	0.0288
2	150	6	0.0260
3	80	4	0.0314

Calculate the flow rate through the system with density of water is 1000 kg/m^3 and kinematic viscosity is 1.003× 10−6 m2/s. Neglect minor losses.

(10 marks)

(c) Three reservoirs connected by pipes as shown in **Figure Q4 (c)**. The diameter for each pipe is 300 mm and assumes coefficient of friction, f is 0.002. Analyze the discharge in each pipe.

(11 marks)

- END OF QUESTIONS-

Appendix I

FINAL EXAM

SEMESTER/SESSION	: II/2013/2014	PROGRAMME	: 1 BNA/BNB/BNC
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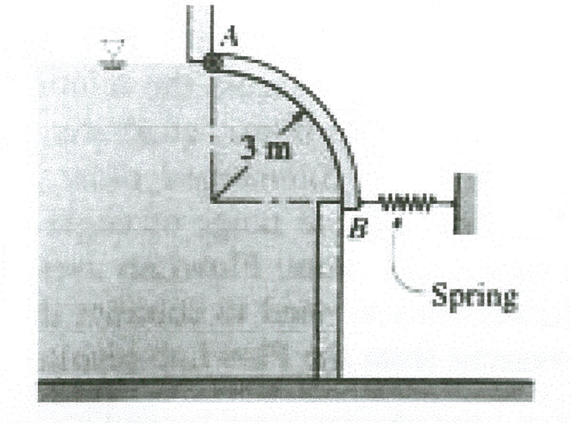

FIGURE Q1 (d)

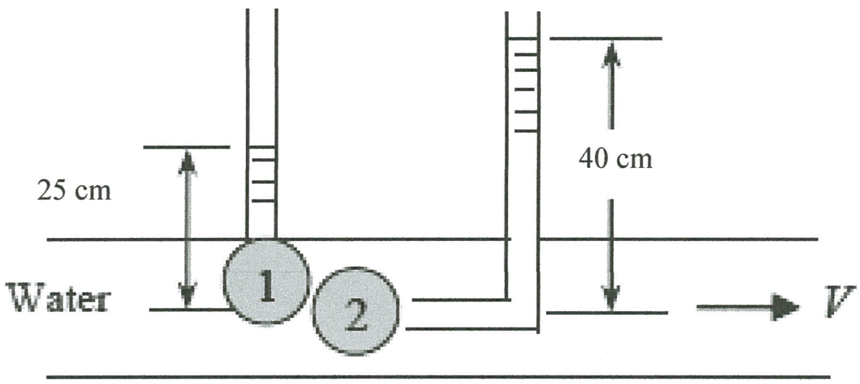

FIGURE Q2 (b)

Appendix II

FINAL EXAM

SEMESTER/SESSION	: II/2013/2014	PROGRAMME	: 1 BNA/BNB/BNC
COURSE	: FLUID MECHANICS	COURSE CODE	: BNP10303

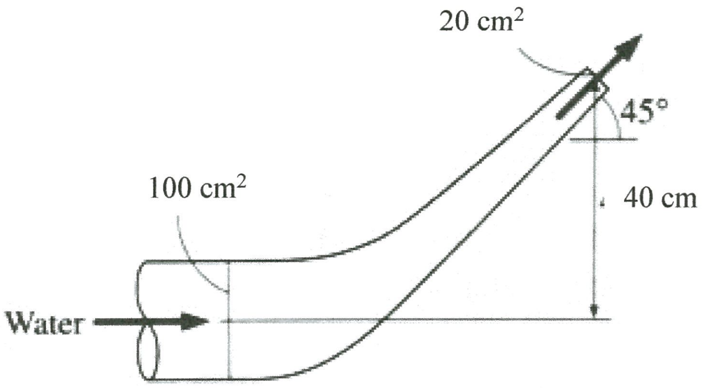

FIGURE Q2 (c)

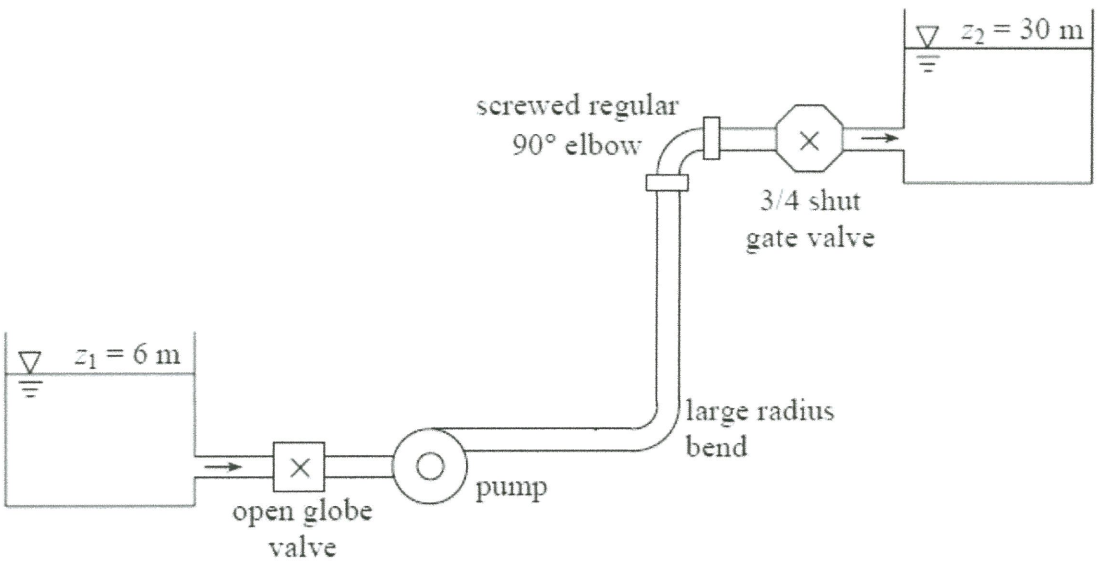

Figure Q3 (c)

Appendix III

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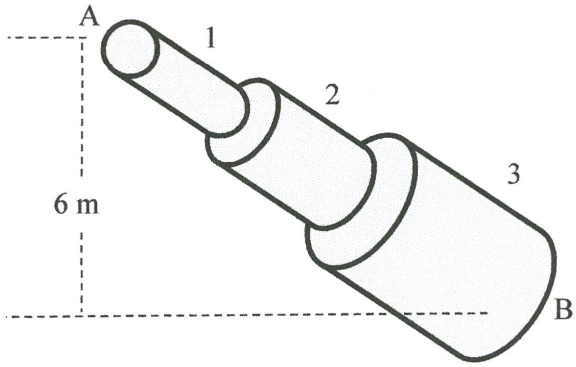

Figure Q4 (b)

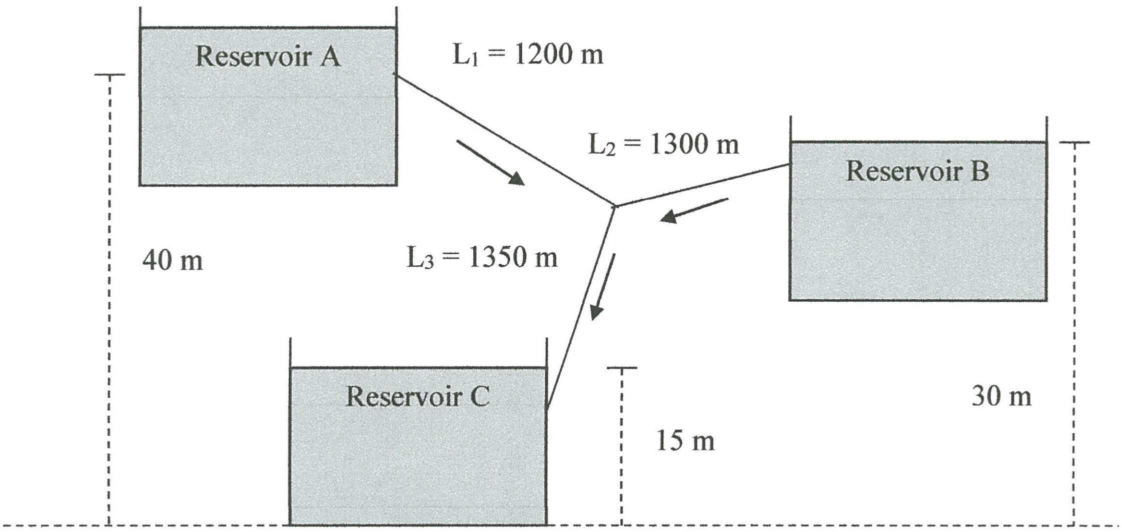

FIGURE Q4 (c)

Appendix IV

FINAL EXAM

SEMESTER/SESSION : II/2012/2012 PROGRAMME : 1BNB

COURSE : FLUID MECHANICS COURSE CODE : BNP 10303

Table 1. 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

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Appendix V

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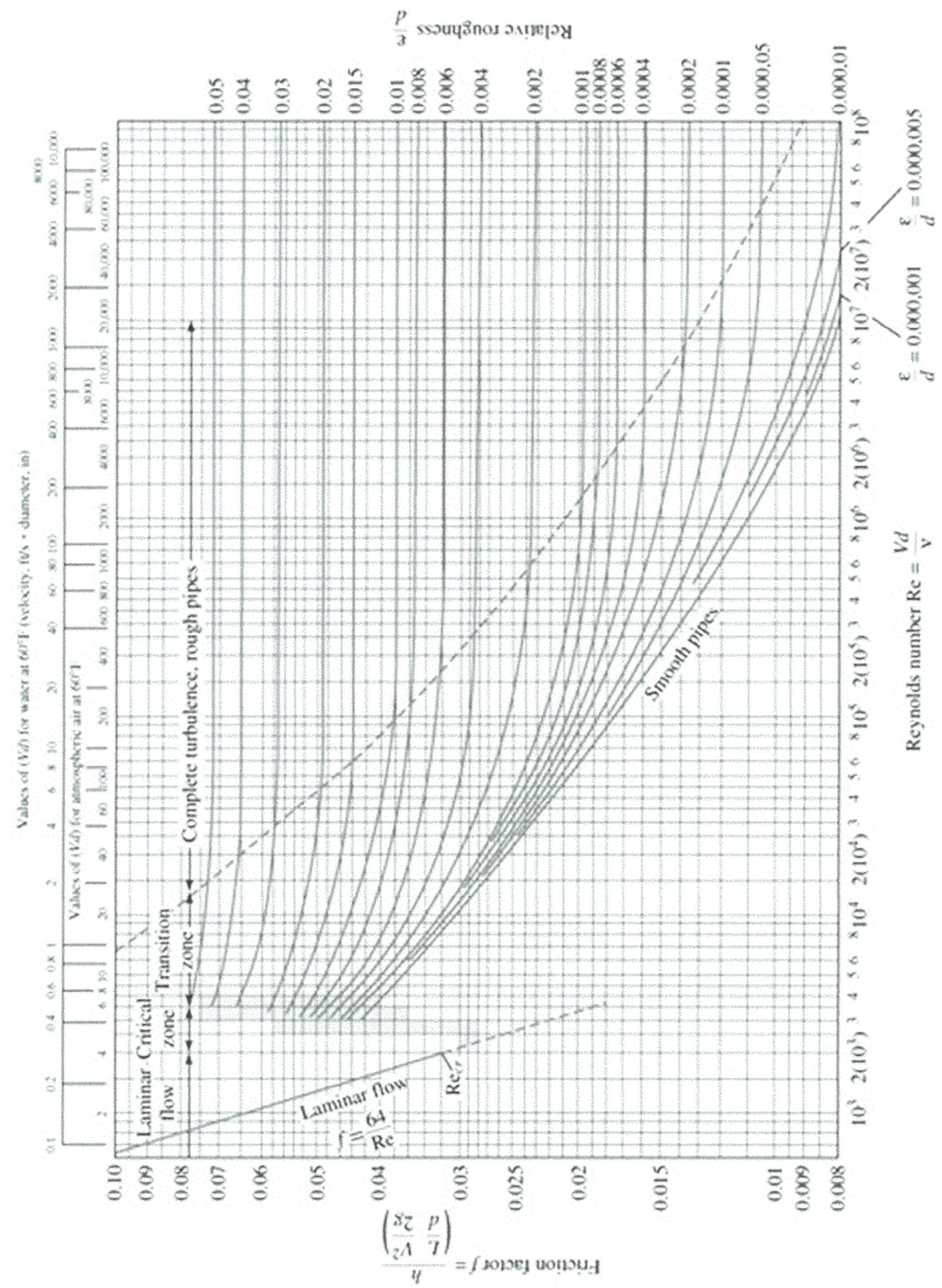
COURSE	: FLUID MECHANICS	COURSE CODE	: BNP 10303



Appendix VI

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SEMESTER/SESSION	: II/2012/2012	PROGRAMME	: 1BNB
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FORMULA :

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

$$F_V = \rho g V$$

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

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

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

$$F_H = \rho g h_c A$$

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

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

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

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

$$W = \gamma A L$$

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

$$K = \frac{-\delta p}{\delta V / V}$$

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

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

$$\dot{m} = \rho Q$$

$$\varepsilon = \frac{e}{D}$$

$$W_{pump,L} = Q\Delta P = Q\rho f\frac{LV^2}{2D}$$