

**INSTRUCTION:**

This section consists of **FOUR (4)** structure questions. Answer **ALL** questions.

**ARAHAN:**

*Bahagian ini mengandungi EMPAT (4) soalan struktur. Jawab SEMUA soalan..*

**QUESTION 1****SOALAN 1**CLO1  
C1

- (a) State Archimedes' Principle and based on this principle, list its **2 (TWO)** applications.

*Nyatakan Prinsip Archimedes dan senaraikan 2 (DUA) aplikasi Archimedes.*

[5 marks]

[5 markah]

CLO1  
C2

- (b) If pressure of 320 kN/m<sup>2</sup> is produced, calculate the depth, *h*, of fluid below the surface of fluid if the fluid is;

*Jika tekanan 320 kN/m<sup>2</sup> dihasilkan, kirakan kedalaman, h, bendalir di bawah permukaan bendalir jika bendalir adalah;*

- i. Water  
*Air*

[2 marks]

[2 markah]

- ii. Oil (relative density,  $s = 0.8$ )  
*minyak (ketumpatan relatif,  $s : 0.8$ )*

[3 marks]

[3 markah]

CLO1  
C3

- (c) An inverted U-tube mercury manometer shown in Diagram 1(c) is used to measure small pressure differences of 2 point of liquid in a pipe. The difference of gauge pressure,  $P_B - P_A$  is 2.975 kPa. Assuming the relative density,  $s$ , of liquid and mercury are 0.75 and 12.5 respectively, calculate  $h$ ,  $h_1$  and  $h_2$  if  $h = 2h_1 = 4h_2$  and the specific weight of water is  $10 \text{ kNm}^{-3}$ .

*Manometer merkuri tiub-U terbalik yang ditunjukkan seperti Rajah 1(c) digunakan untuk mengukur perbezaan tekanan di antara 2 titik cecair di dalam paip. Perbezaan pada pengukur tekanan,  $P_B - P_A$  is 2.975 kPa. Dengan anggapan graviti tentu,  $s$ , untuk cecair dan merkuri adalah 0.75 dan 12.5 masing-masing, kirakan  $h$ ,  $h_1$  and  $h_2$  if  $h = 2h_1 = 4h_2$  dan berat tentu air adalah  $10 \text{ kNm}^{-3}$ .*

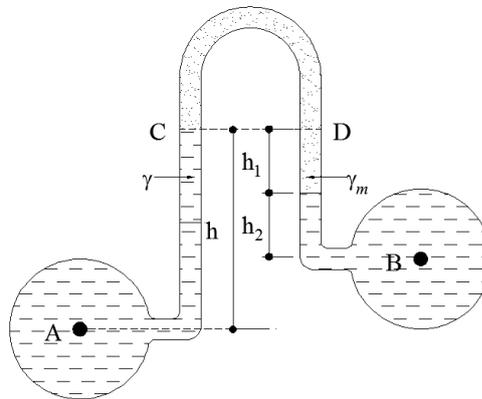


Diagram 1(c) / Rajah 1 (c)

[15 marks]  
[15 markah]

## QUESTION 2

### SOALAN 2

CLO1  
C1

- (a) Define the Bernoulli's Law. State **THREE (3)** restrictions of its applicability.

*Berikan definisi Hukum Bernoulli. Nyatakan **TIGA (3)** kekangan dalam penggunaan teori tersebut.*

[5 marks]  
[5 markah]

CLO1  
C2

- (b) Oil flows through a RS pipe and split into two pipes, which are ST and SU as shown in Diagram 2(b). Calculate the discharge and mass flow rate of oil at pipe RS if the velocity is 2.5 m/s. Given that diameter pipe RS = 250 mm and Specific gravity of oil,  $S_{oil} = 0.95$ .

*Minyak mengalir melalui paip RS dan berpecah kepada dua paip, iaitu ST dan SU seperti yang ditunjukkan dalam Rajah 2(b). Kirakan pelepasan dan kadar aliran jisim minyak pada paip RS jika halajunya ialah 2.5 m/s. Diberikan diameter paip RS = 250 mm dan gravity tentu minyak,  $S_{minyak} = 0.95$ .*



Diagram 2(b) / Rajah 2(b)

[5 marks]  
[5 markah]CLO1  
C3

- (c) Diagram 2 (c) shows a drainage system consists of round pipes and multiple reducers. Two different inlet sources are combined and drained to a larger pipe via Y-type connection and finally to the main drain pipe through a reducer. Calculate  $Q_1$ ,  $Q_2$ ,  $v_3$  and  $v_4$ . Assume 1" = 0.025 m.

*Rajah 2 (c) menunjukkan sistem saliran yang terdiri daripada paip bulat dan peredam. Dua saluran masuk yang berbeza digabungkan dan disalurkan ke paip besar dengan sambungan jenis Y dan akhirnya ke paip utama. Hitungkan  $Q_1$ ,  $Q_2$ ,  $v_3$  dan  $v_4$ . Anggapkan 1" = 0.025 m.*

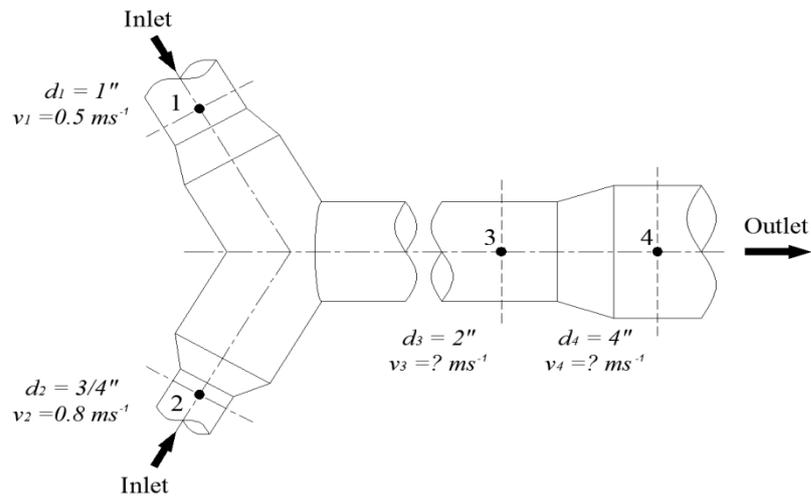


Diagram 2(c) / Rajah 2(c)

[15 marks]

[15 markah]

### QUESTION 3

#### SOALAN 3

CLO2  
C1

- (a) List down **2 (TWO)** types of energy loss in pipe line. Sketch 2 profiles of the loss of energy mentioned.

*Senaraikan 2 (DUA) jenis kehilangan tenaga di dalam saluran paip. Lakarkan 2 jenis profil untuk kehilangan tenaga tersebut.*

[5 marks]

[5 markah]

CLO2  
C2

- (b) Horizontal pipes X with cross-section  $0.5 \text{ m}^2$ , joined by a sudden enlargement to a Y pipe with diameter 400 mm as shown in Diagram 3 (b). The water velocity through the pipe Y is 4.6 m/s. Determine :

*Paip mendatar X dengan keratan rentas  $0.5 \text{ m}^2$ , disambungkan oleh pembesaran secara mendadak kepada paip Y dengan diameter 400 mm seperti ditunjukkan dalam Rajah 3 (b). Halaju air melalui paip Y ialah 4.6 m/s. Tentukan:*

- i. The flow rate through the pipe

*Kadar aliran melalui paip*

[2 marks]

[2 markah]

- ii. Head loss due to a sudden enlargement

*Kehilangan turus disebabkan oleh pembesaran mendadak*

[3 marks]

[3 markah]

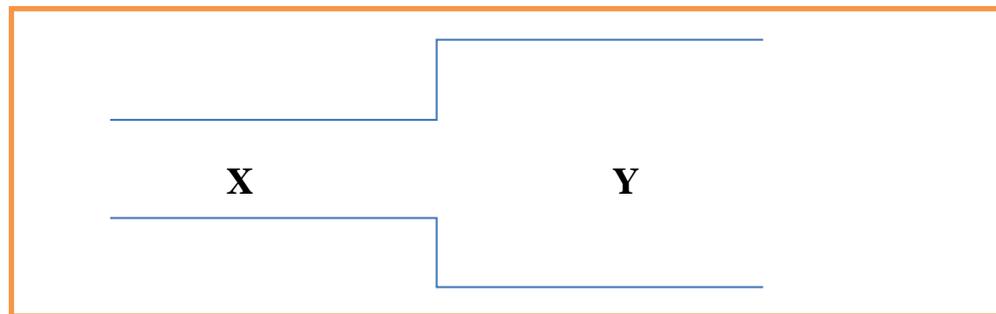


Diagram 3 (b) / Rajah 3 (b)

CLO2  
C3

- (c) Two reservoirs as in Diagram 3 (b) have a difference in level of  $H$  which is 8 m and are connected by a pipe line, which is 40mm in diameter for the first 12m and 25mm for the remaining 5m. Calculate the discharge of flow in  $\text{m}^3/\text{s}$  if coefficient of friction,  $f = 0.001$  for both pipes and coefficient of contraction,  $C_c = 0.66$ .

*Dua takungan seperti dalam Rajah 3 (b) mempunyai perbezaan dalam tahap  $H$  iaitu 8 m dan dihubungkan dengan talian paip, iaitu bergaris pusat 40mm untuk 12m pertama dan 25mm untuk 5m selebihnya. Kirakan kadaraliran dalam  $\text{m}^3/\text{s}$  jika pekali geseran,  $f = 0.001$  untuk kedua-dua paip dan pekali pengecutan,  $C_c = 0.66$ .*

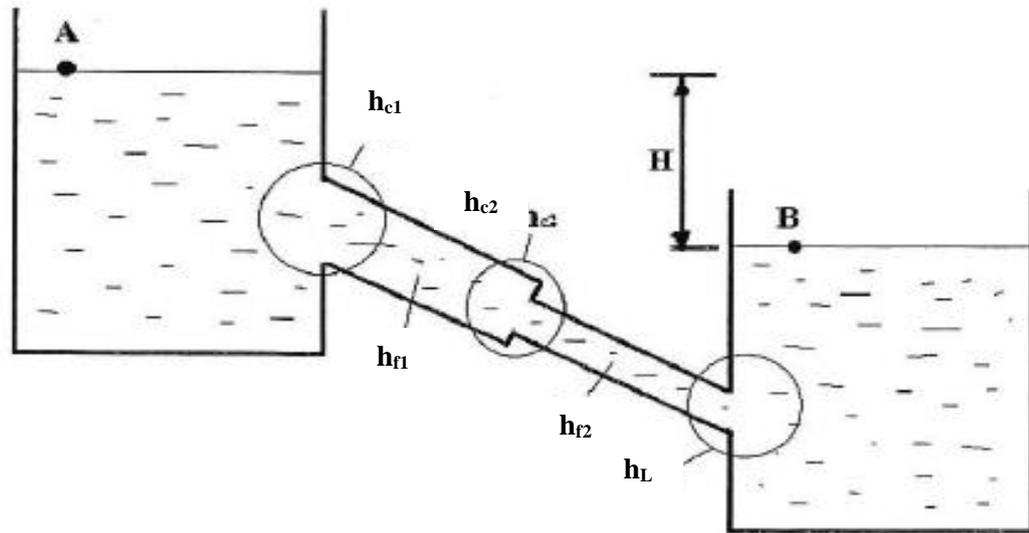


Diagram 3(c) / Rajah 3(c)

[15 marks]

[15 markah]

**QUESTION 4**  
**SOALAN 4**

CLO2  
C1

- (a) By using dimensional analysis, show that the equation momentum = mass  $\times$  velocity is homogeneous in both S.I unit and basic dimension

*Dengan menggunakan kaedah analisis dimensi, tunjukkan persamaan momentum = jisim  $\times$  halaju adalah homogen dalam unit S.I dan dimensi asas.*

[5 marks]

[5 markah]

CLO2  
C2

- (b) Figure 4 (b) shows a pipe bends through an angle of  $45^\circ$  in the vertical plane. At the inlet, it has a cross sectional area of  $40\text{m}^2$  and a gauge pressure of  $40\text{kPa}$ . At the exit it has a cross sectional area of  $30\text{m}^2$  and a gauge pressure of  $10\text{kPa}$ . Calculate the vertical and horizontal forces due to the pressure.

Rajah 4 (b) menunjukkan satu paip membengkok pada sudut  $45^\circ$  dalam satah menegak. Pada masukan, paip memiliki luas keratan rentas sebanyak  $40\text{m}^2$  dan tekanan tolok sebanyak  $40\text{kPa}$ . Pada keluaran, paip memiliki luas keratan rentas sebanyak  $30\text{m}^2$  dan tekanan tolok sebanyak  $10\text{kPa}$ . Kirakan daya menegak dan mendatar yang disebabkan oleh tekanan sahaja.

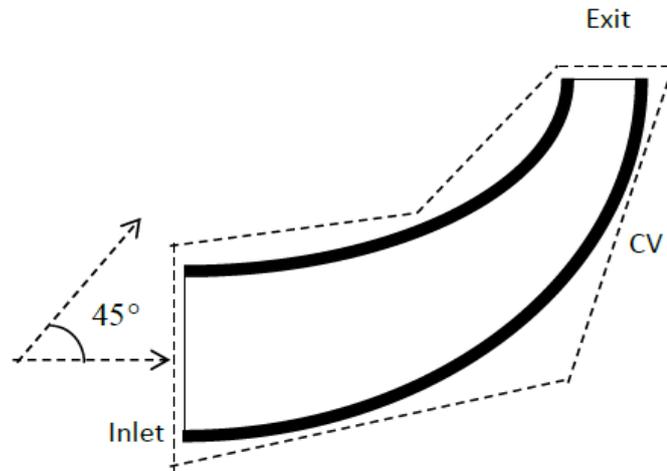


Diagram 4 (b) / Rajah 4 (b)

[8 marks]

[8 markah]

CLO2  
C3

- (c) A pipe of 300mm diameter streaming  $0.3\text{m}^3/\text{s}$  of water has a right angle bend in a horizontal plane. Calculate the resultant force and angle exerted on the bend if the pressure at inlet and outlet of the bend are  $24\text{kN}/\text{m}^2$  and  $23\text{kN}/\text{m}^2$ .

Sebatang paip berdiameter 300mm mengalirkan air pada  $0.3\text{m}^3/\text{s}$  yang berbentuk sudut tepat dalam keadaan mengufuk. Kirakan daya paduan yang bertindak ke atas bentuk itu jika tekanan di bahagian masuk dan keluar adalah  $24\text{kN}/\text{m}^2$  dan  $23\text{kN}/\text{m}^2$ .

[12 marks]

[12 markah]

SOALAN TAMAT

**LIST OF FORMULA**  
**DGP2053 FLUID MECHANICS**

**FLUID DYNAMICS**

$$\frac{P_1}{\omega} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\omega} + \frac{v_2^2}{2g} + z_2$$

$$Q_{actual} = C_d \times A_1 \sqrt{\frac{2gH}{(m^2 - 1)}}$$

$$Q_{actual} = \frac{C_d \times A_1}{\sqrt{(m^2 - 1)}} \sqrt{2g \left[ \frac{P_1 - P_2}{\omega} + (z_1 - z_2) \right]}$$

$$H = \frac{P_1 - P_2}{\omega_{Sub}} = x \left[ \frac{\omega_{Hg}}{\omega_{Sub}} - 1 \right]$$

**MOMENTUM****Total Force**

$$F_x = \dot{m}(u_2 \cos \theta_2 - u_1 \cos \theta_1)$$

$$F_y = \dot{m}(u_2 \sin \theta_2 - u_1 \sin \theta_1)$$

**Resultant Force**

$$F_R = \sqrt{F_x^2 + F_y^2}$$

$$\theta = \tan^{-1} \left( \frac{F_y}{F_x} \right)$$

**Pressure Force**

$$F_{Px} = P_1 A_1 \cos \theta_1 - P_2 A_2 \cos \theta_2$$

$$F_{Py} = P_1 A_1 \sin \theta_1 - P_2 A_2 \sin \theta_2$$

**PIPE SYSTEMS**

$$h_c = \left[ \frac{1}{Cc} - 1 \right]^2 \times \frac{v_2^2}{2g}$$

$$h_i = 0.5 \frac{v_1^2}{2g}$$

$$h_f = \frac{4fL v^2}{d 2g}$$

$$h_L = \frac{(V_1 - V_2)^2}{2g}$$

$$h_o = \frac{V_2^2}{2g}$$