SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI II : 2024/2025

DCC30122 : FLUID MECHANICS

TARIKH : 25 MEI 2025
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **EMPAT BELAS (14)** halaman bercetak.
Bahagian A: Subjektif (2 soalan)
Bahagian B: Subjektif (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A: 50 MARKS
BAHAGIAN A: 50 MARKAH

INSTRUCTION:
This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1 (a) In an experiment on the properties of a fluid, students were asked to determine the value of specific gravity and specific volume of fluid. Describe the meaning of specific gravity and specific volume of fluid.
Dalam eksperimen tentang sifat bendalir, pelajar diminta untuk menentukan nilai graviti tentu dan isipadu tentu bendalir. Huraikan maksud graviti tentu dan isipadu tentu bendalir.

[4 marks]
[*4 markah*]

CLO1 (b) Fluid is a substance that deforms continuously when subjected to external shear stress and it has no fixed shape. Explain briefly ideal fluid, real fluid, Newtonian fluid and non-Newtonian fluid.
Bendalir ialah bahan yang berubah bentuk secara berterusan apabila dikenakan tegasan ricih luar dan ia tidak mempunyai bentuk yang tetap. Terangkan secara ringkas bendalir ideal, bendalir sebenar, bendalir Newtonian dan bukan bendalir Newtonian.

[8 marks]
[*8 markah*]

CLO1

(c) A square tank is filled with water as shown in Figure A1(c). Given the value of water density is 950 $\frac{kg}{m^3}$. Estimate:

Sebuah tangki segi empat sama diisi dengan air seperti yang ditunjukkan dalam Rajah A1(c). Diberi nilai ketumpatan air ialah 950 $\frac{kg}{m^3}$ *. Anggarkan:*

i. Mass and specific volume of water.
Jisim dan isipadu tentu air.

[6 marks]
[*6 markah*]

ii. If a similar tank is filled with an oil, identify the value of density, specific weight and its weight. Given specific gravity of the oil is 0.85.
Jika tangki yang serupa diisi dengan minyak, kenal pasti nilai ketumpatan, berat tentu dan beratnya. Diberi graviti tentu minyak ialah 0.85.

[7 marks]
[*7 markah*]

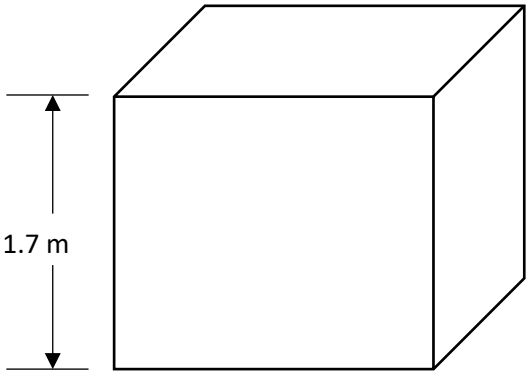

Figure A1(c) / *Rajah A1(c)*

QUESTION 2

SOALAN 2

CLO1 (a) In determining the pressure, various pressure measuring equipment are used. Draw the differential manometer with an appropriate figure and label.

Dalam menentukan tekanan, pelbagai peralatan pengukur tekanan digunakan. Lukiskan manometer berbeza dengan rajah yang sesuai dan labelkan.

[4 marks]

[*4 markah*]

CLO1 (b) The right limb of a simple U-tube manometer as shown in Figure A2(b) containing mercury is exposed to the atmosphere while the left limb is connected to a pipe that flows a fluid with a specific gravity of 0.9. The centre of the pipe is 15 cm below the level of mercury in the right limb. Estimate the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 22 cm.

Tiub kanan sebuah manometer tiub U seperti yang ditunjukkan dalam Rajah A2(b) mengandungi merkuri terdedah dengan atmosfera dan tiub kiri pula bersambung dengan paip yang mengalirkan cecair dengan graviti tentu 0.9. Titik tengah paip berada 15 cm dibawah aras ketinggian merkuri. Anggarkan tekanan cecair di dalam paip jika perbezaan aras ketinggian merkuri dari titik pertemuan dua cecair adalah 22 cm.

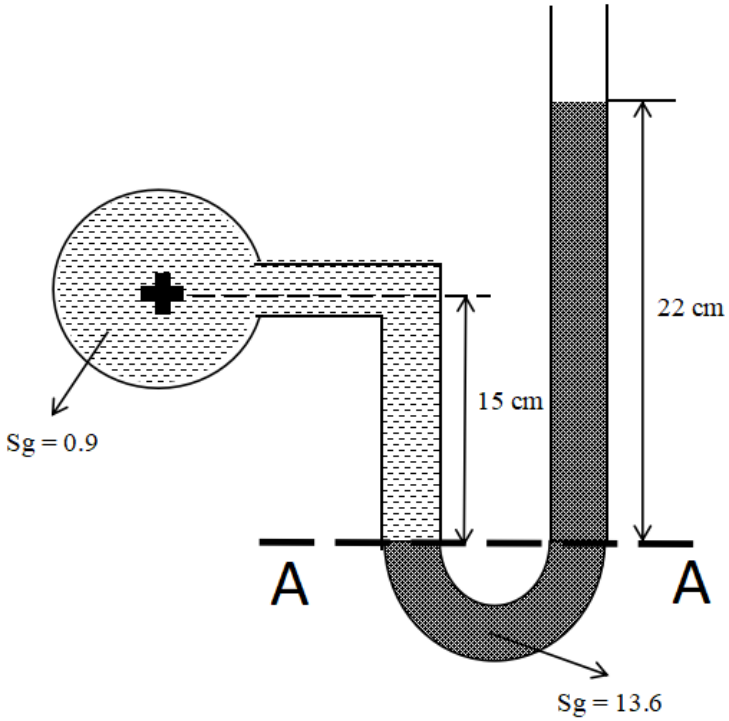

Figure A2(b) / *Rajah A2(b)*

[8 marks]

[*8 markah*]

CLO1 (c) Figure A2(c) shows an inverted differential manometer connected to two pipes A and B by flowing water. The fluid in the manometer is an oil with a specific gravity 0.9.

Rajah A2(c) menunjukkan manometer songsang yang bersambung dengan 2 paip A dan B dengan mengalirkan air. Cecair di dalam manometer adalah minyak dengan graviti tentu adalah 0.9.

i. Express an equation with unit S.I for the pressure in an inverted differential manometer.

Tunjukkan persamaan dengan Unit SI untuk nilai tekanan di dalam manometer songsang.

[6 marks]

[*6 markah*]

ii. Estimate the pressure differences between pipe A and pipe B.
Anggarkan perbezaan tekanan antara paip A dan B

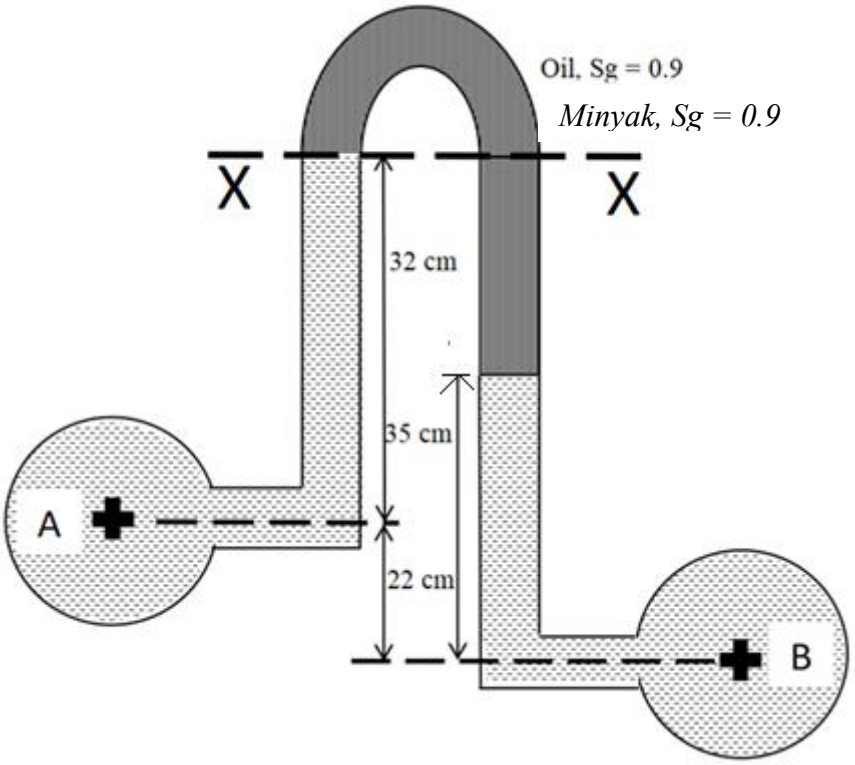

Figure A2(c) / *Rajah A2(c)*

[7 marks]
[*7 markah*]

SECTION B : 50 MARKS

BAHAGIAN B : 50 MARKAH

INSTRUCTION:

This section consists of **FOUR (4)** subjective questions. Answer **TWO (2)** questions only.

ARAHAN :

*Bahagian ini mengandungi **EMPAT (4)** soalan esei. Jawab **DUA (2)** soalan sahaja.*

QUESTION 1

SOALAN 1

CLO2

(a) The Reynold's Number is the ratio of inertial forces to viscous forces within a fluid, which is subjected to relative internal movement due to different fluid velocities. Identify **THREE (3)** categorization of Reynold's Number with the Reynold's Number formula.

*Nombor Reynold adalah nisbah daya inersia kepada daya kelikatan di dalam bendalir, tertakluk kepada pergerakan dalaman relatif disebabkan halaju bendalir yang berbeza. Kenalpasti **TIGA (3)** kategori Nombor Reynold's beserta formula Nombor Reynold's.*

[4 marks]

[*4 markah*]

CLO2 (b) The Reynold's Number (R_e) is an important dimensionless quantity in fluid mechanics used to help predict flow patterns in fluid flow situation. An oil having dynamic viscosity of 0.205 Ns/m^2 and specific gravity of 0.9 is flowing through a pipe of 778 mm in diameter. The value of discharge through the pipe is 150 liter/s. Determine the types of fluid flow.

Nombor Reynold (Re) ialah kuantiti tanpa dimensi di dalam mekanik bendalir yang digunakan untuk membantu meramal corak aliran dalam situasi aliran bendalir. Minyak mempunyai kelikatan dinamik 0.205 Ns/m^2 dan graviti tentu 0.9 sedang mengalir melalui paip berdiameter 778 mm. Nilai kadar alir yang melalui paip ialah 150 liter/s. Tentukan jenis aliran dalam bendalir.

[9 marks]

[*9 markah*]

CLO2 (c) A student has conducted a Reynold's experiment in a hydraulic laboratory and the test result is shown in Table B1(c).

Seorang pelajar telah menjalankan eksperimen Reynold's di makmal hidraulik dan keputusan ujian adalah seperti Jadual B1(c).

Table B1(c) / *Jadual B1(c)*

Diameter of pipe, d *Diameter paip, d*	0.01 m
Kinematic viscosity of water, ν *Kelikatan kinematic air, ν*	$1 \times 10^{-3}\, m^2/s$
Volume, V *Isipadu*, V	500 ml
Time *Masa*	42.39 s

Calculate cross section for the pipe, flow rate, flow velocity, Reynold's Number and type of flow.

Kirakan luas keratan rentas, kadar alir, halaju aliran, Nombor Reynold's dan jenis aliran.

[12 marks]

[*12 markah*]

QUESTION 2

SOALAN 2

CLO2 (a) If an incompressible liquid is continuously flowing through a pipe or a channel the quantity of liquid passing per second is the same at all section ($Q_1 = Q_2$). With the aid of diagram, write the continuity equation.

Jika cecair tidak dimampatkan mengalir secara berterusan melalui paip atau saluran, kuantiti cecair yang melalui sesaat adalah sama di semua bahagian ($Q_1 = Q_2$). Dengan bantuan gambarajah, tuliskan *persamaan keterusan.*

[4 marks]

[*4 markah*]

CLO2 (b) Water is flowing through AB pipe of 40 cm diameter. It branches into BC and BD. BC pipe is 30 cm diameter while BD pipe is 25 cm diameter. If the velocity in AB pipe is 3.5 m/s and 3 m/s in BC pipe, calculate the discharge in all pipes and the velocity in 25 cm pipe.

Air mengalir melalui sebatang paip AB diameter 40 cm. Paip tersebut bercabang kepada paip BC dan BD. Diameter paip BC adalah 30 cm manakala BD adalah 25 cm. Jika halaju dalam paip AB ialah 3.5 m/s dan 3 m/s dalam paip BC, kirakan kadaralir dalam semua paip dan halaju dalam paip yang berdiameter 25 cm.

[9 marks]

[*9 markah*]

CLO2

(c) Water is flowing through a pipe with a diameter of 220 mm and 350 mm from the bottom to upper end respectively as shown in Figure B2(a). The intensity of pressure at the bottom end is 310 Pa and the upper end is 420 Pa. Compare the difference in datum head if the rate of flow through the pipe is 0.22 m^3/s.

Air mengalir dalam paip berdiameter 220 mm dan 350 mm dari hujung bawah ke atas seperti ditunjukkan dalam Rajah B2(a). Taburan tekanan di hujung bawah ialah 310 Pa dan hujung atas 420 Pa. Bandingkan perbezaan ketinggian paip dari datum jika kadaralir melalui paip adalah 0.22 m^3/s.

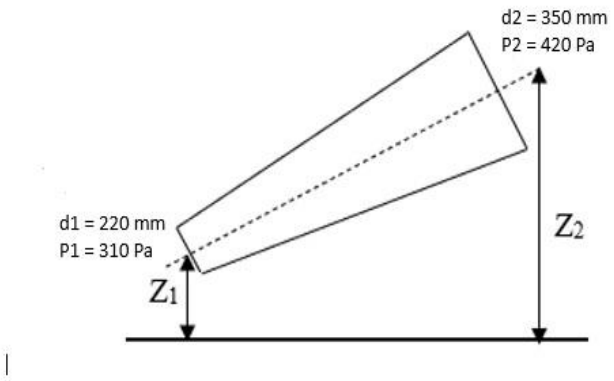

Figure B2(a) / *Rajah B2(a)*

[12 marks]

[*12 markah*]

QUESTION 3

SOALAN 3

CLO2 (a) Pipe losses its energy due to several factors and occur as the fluid flows along straight lengths of pipe. Identify **FOUR (4)** types of minor losses in pipe.

*Kehilangan tenaga di dalam paip berlaku disebabkan beberapa faktor dan berlaku sepanjang aliran paip. Kenalpasti **EMPAT (4)** jenis kehilangan tenaga kecil dalam paip.*

[4 marks]

[*4 markah*]

CLO2 (b) The amount of energy lost depends on a number of factors such as the fluid's speed and viscosity. Calculate the energy loss due to friction in a pipe, with the pipe length of 500 m and diameter of 30cm. Given the velocity of water is 3 m/s and coefficient of friction = 0.01.

Jumlah tenaga yang hilang bergantung kepada beberapa faktor seperti kelajuan dan kelikatan bendalir. Kirakan kehilangan tenaga bagi geseran dalam paip, panjang paip ialah 500 m dan diameter ialah 30 cm. Diberi halaju air ialah 3 m/s dan pekali geseran = 0.01.

[9 marks]

[*9 markah*]

CLO2 (c) Referring to Figure C3, two pipes are connected parallel to each other between two reservoirs. The diameter is 50 mm for pipe 1 and 100 mm for pipe 2 and both pipes have the length of 150 m. Calculate the discharge in pipe 1. Given coefficient of friction, f = 0.008.

Merujuk Rajah C3, dua paip disambung secara selari di antara dua takungan. Diameter paip 1 ialah 50 mm dan diameter paip 2 ialah 100 mm dan kedua-dua paip mempunyai panjang 150 m. Kira kadaralir aliran dalam paip 1. Di beri pekali geseran, f=0.008.

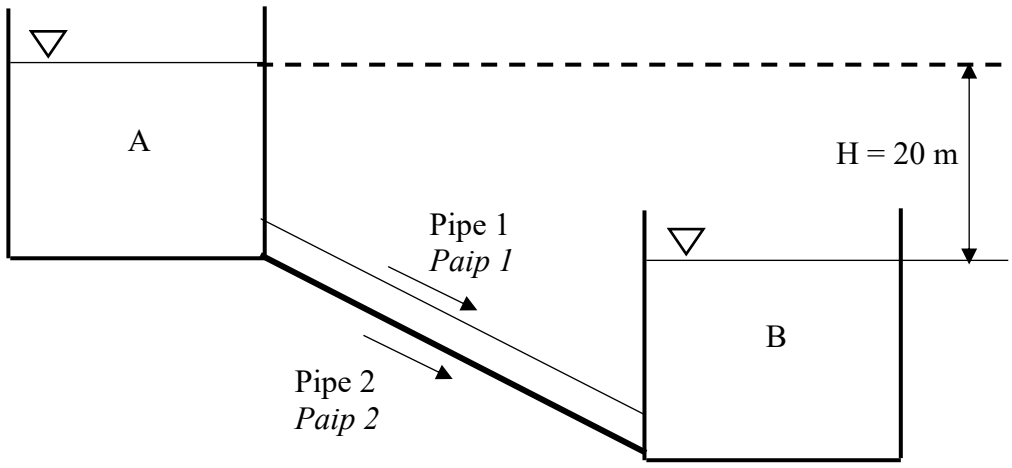

Figure C3(c) / *Rajah C3(c)*

[12 marks]

[*12 markah*]

QUESTION 4

SOALAN 4

CLO2 (a) The momentum equation is a fundamental principle in fluid dynamics and physics. It describes the motion of a fluid (or object) based on the forces acting on it. It is used to determine the resultant force exerted on the boundary of a flow passage by fluid flow when the flow changes its direction or the magnitude of velocity or both. Explain the momentum equation and Newton's 2nd Law.

Persamaan momentum adalah prinsip asas dalam dinamik bendalir dan fizik. Ia menerangkan pergerakan bendalir (atau objek) berdasarkan daya yang bertindak ke atasnya. Ia digunakan untuk menentukan daya paduan yang dikenakan pada sempadan laluan aliran oleh aliran bendalir yang mengalir apabila aliran berubah arah atau magnitud halaju atau kedua-duanya. Terangkan persamaan momentum dan Hukum Newton ke-2.

[4 marks]

[*4 markah*]

CLO2 (b) A jet of water with 70 mm diameter and moving with a velocity of 40m/s is impinging normally on a plate. Calculate the force exerted by the jet on the fixed plane plate and moving plate with a velocity of 20 m/s in jet direction.

Aliran air berdiameter 70 mm dan bergerak dengan halaju 40 m/s melanggar secara normal pada plat. Kirakan daya hentaman jet ke atas plat tidak bergerak dan plat bergerak dengan halaju 20 m/s pada arah jet.

[9 marks]

[*9 markah*]

CLO2 (c) By referring to Figure B4 (c), water flow in 45° reducing bend is connected in pipeline where the diameter at inlet is 600 mm and outlet of the bend is 350 mm. The pressure at inlet and outlet is 180 kN/m^2 and 84.34 kN/m^2 also carrying 600 liter/s water. Calculate magnitude and direction of the resultant force.

Dengan merujuk Rajah B4(c), air mengalir melalui sebatang paip liku 45° *yang bersambung dengan satu siri paip di mana garis pusat bahagian masuk paip ialah 600 mm dan bahagian keluar ialah 350 mm. Tekanan di bahagian masuk dan keluar paip ialah 180 kN/m^2 dan 84.34 kN/m^2 juga mengalir dengan kadar 600 liter/s air. Kirakan magnitud dan arah daya paduan.*

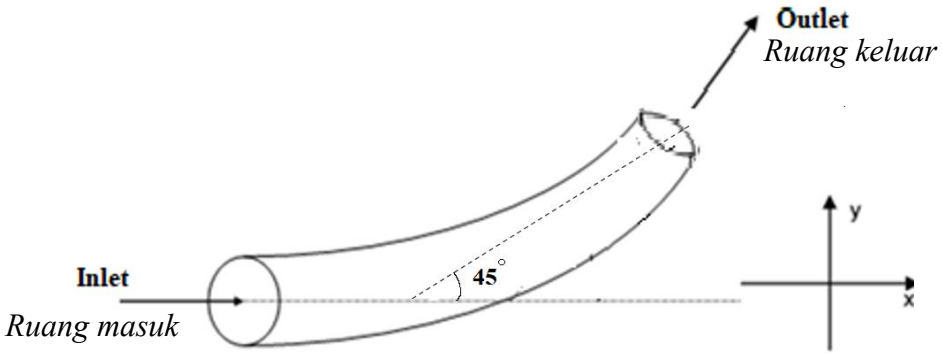

Figure B4(c) / *Rajah B4(c)*

[12 marks]

[*12 markah*]

SOALAN TAMAT

LIST OF FORMULAS
DCC30122 FLUID MECHANICS

Fluid Characteristics

$$\rho = \frac{m}{V}$$

$$s = \frac{\rho_{liquid}}{\rho_{water}}$$

$$\omega = \frac{W}{V}$$

$$W = m\,g$$

$$V_s = \frac{1}{\rho}$$

$$\vartheta = \frac{\mu}{\rho}$$

Measurement of Pressure

$$P = \rho g h$$

$$P_{abs} = P_{atm} + P_g$$

Hydrodynamics

$$R_e = \frac{\rho\, v\, d}{\mu} = \frac{v\, d}{\vartheta}$$

Flow Measurement and Bernoulli's Equation

$$Q = A\, v$$

$$H = \frac{P}{\rho g} + \frac{v^2}{2g} + z$$

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

$$H = \left(\frac{S_h}{S_o} - 1\right) \times h$$

$$H = \left(1 - \frac{S_h}{S_o}\right) \times h$$

$$Q_{act} = C_d \times \left[\frac{A_1 \times A_2}{\sqrt{(A_1)^2 - (A_2)^2}}\right] \times \sqrt{2gh}$$

$$Q = \frac{2}{3} C_d\, b \sqrt{2g} \times \left[(H_2)^{\frac{3}{2}} - (H_1)^{\frac{3}{2}}\right]$$

$$C_c = \frac{A_j}{A_0}$$

$$C_v = \frac{v_{actual}}{v_{theory}}$$

$$C_d = C_v \times C_c$$

$$\mathrm{v}_{the} = \sqrt{2\, g\, H}$$

$$\mathrm{v}_{\mathrm{act}} = C_v \sqrt{2\, g\, H}$$

$$Q_{the} = A_o \sqrt{2\, g\, H}$$

$$Q_{act} = C_d A_o \sqrt{2\, g\, H}$$

Fluid Flow

$$h_L = \frac{(v_1 - v_2)^2}{2g}$$

$$h_L = \left[\frac{1}{C_c} - 1\right]\frac{(v_2)^2}{2g}$$

$$h_L = \frac{0.5\,(v_1)^2}{2g}$$

$$h_L = \frac{(v_2)^2}{2g}$$

$$h_L = \frac{k\,v^2}{2g}$$

$$h_f = \frac{4\,f\,L\,v^2}{2gd} = \frac{f\,L\,Q^2}{3d^5}$$

$$h_f = \frac{32\,\mu\,v\,L}{\rho g d^2}$$

$$\frac{P_1 - P_2}{\rho g} = h_f = \frac{32\,\mu\,v\,L}{\rho g d^2}$$

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

$$\frac{4\,f_1\,L_1\,(v_1)^2}{2gd_1} = \frac{4\,f_2\,L_2\,(v_2)^2}{2gd_2}$$

Momentum Equation

$$\mathrm{F_x} = \rho\,\mathrm{A}\,v^2$$

$$\mathrm{F}_x = \rho\,\mathrm{A}\,(v-u)^2$$

$$\mathrm{F}_n = \rho\,\mathrm{A}\,v^2 sin\theta$$

$$\mathrm{F_n} = \rho\,\mathrm{A}\,(v-u)^2\,sin\theta$$

$$\mathrm{F}_x = \mathrm{F}_n\,sin\theta$$

$$\mathrm{F}_y = \mathrm{F}_n\,cos\theta$$

$$\mathrm{F_x} = \rho\,\mathrm{A}\,\mathrm{v}\,[\,v_{1x}\,cos\,\alpha + v_{2x}\,cos\,\beta\,]$$

$$\mathrm{F_y} = \rho\,\mathrm{A}\,\mathrm{v}\,[\,v_{1y}\,sin\,\alpha - v_{2y}\,sin\,\beta\,]$$

$$\mathrm{F_x} = \rho\,\mathrm{A}\,(\mathrm{v}-\mathrm{u})[(v_{1x} - u)\,cos\,\alpha + (v_{2x} - u)\,cos\,\beta]$$

$$\mathrm{F_y} = \rho\,\mathrm{A}\,(\mathrm{v}-\mathrm{u})\big[(v_{1y} - u)\,sin\,\alpha - (v_{2y} - u)\,sin\,\beta\big]$$

$$\mathrm{F_x} = \rho\,\mathrm{Q}\,[\,v_{1x} - v_{2x}\,cos\,\theta\,] + P_{1x}A_{1x} - P_{2x}A_{2x}\,cos\,\theta\,]$$

$$\mathrm{F_y} = -\rho\,\mathrm{Q}\,(\,v_{2y}\,sin\,\theta\,) - P_{2y}A_{2y}\,sin\,\theta$$

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

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