KOLEJ YAYASAN PELAJARAN JOHOR
ONLINE FINAL EXAMINATION

COURSE NAME	**:**	**FLUID MECHANICS**
COURSE CODE	**:**	**DKM 2122**
EXAMINATION	**:**	**JUNE 2022**
DURATION	**:**	**2 HOURS**

INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **ONE (1)** part : / *Kertas soalan ini mengandungi **SATU (1)** bahagian:* PART A (60 Marks) / *BAHAGIAN A (60 Markah)*

2. Answer ALL questions in the answer sheet which is A4 size paper (or other paper with the consent of the relevant lecturer). / *Jawab SEMUA soalan di dalam kertas jawapan iaitu kertas bersaiz A4 (atau lain-lain kertas dengan persetujuan pensyarah berkaitan).*

3. Write your details as follows in the upper left corner for each answer sheet: / *Tulis butiran anda sepertimana berikut di penjuru atas kiri bagi setiap kertas jawapan:*
   - *i.* Student Full Name / *Nama Penuh Pelajar*
   - ii. Identification Card (I/C) No. / *No. Kad Pengenalan*
   - iii. Class Section / *Seksyen Kelas*
   - iv. Course Code / *Kod Kursus*
   - v. Course Name / *Nama Kursus*
   - vi. Lecturer Name / *Nama Pensyarah*

4. Each answer sheet must have a page number written at the bottom right corner. / *Setiap helai kertas jawapan mesti ditulis nombor muka surat di penjuru bawah kanan.*

5. Answers should be **neat and clear in handwritten form**. / *Jawapan hendaklah ditulis tangan, kemas dan jelas.*

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

This examination paper consists of **15** printed pages including front page.
*Kertas soalan ini mengandungi **15** muka surat termasuk kulit hadapan.*

This section contains **FIVE (5)** questions.
Answer **FOUR (4)** questions from **FIVE (5)**. Answer in the Answer Booklet.
*Bahagian ini mengandungi **LIMA (5)** soalan.*
*Jawab **EMPAT (4)** daripada **LIMA (5)** soalan. Jawab dalam Buku Jawapan.*

QUESTION 1/ *SOALAN 1*

a) Specify what is surface tension and explain why is the surface tension also called surface energy.

Nyatakan maksud apakah yang dimaksudkan dengan tegangan permukaan dan terangkan mengapakah tegangan permukaan juga dikenali sebagai tenaga permukaan.

(5 marks/ *5 markah*)

b) A metal cube with 50 mm side is inserted into a container filled with fluid. The mass of spilled fluid is 50 kg. calculate:

Kiub besi dengan sisi 50 mm dimasukkan di dalam sebuah bekas yang berisi dengan bendalir. Jisim bendalir yang tertumpah ialah 50 kg. Kirakan:

i. Mass density of fluid

Ketumpatan jisim bendalir

(4 marks/ *4 markah*)

ii. Specific weight of fluid

Berat tentu bendalir

(3 marks/ *3 markah*)

iii. Specific volume of fluid

Isipadu tentu bendalir

(3 marks/ *3 markah*)

QUESTION 2/ *SOALAN 2*

a) A U tube manometer in **Figure 1** measures the pressure difference between the two points which are point A and B in a liquid. The U tube contains mercury and water. Calculate the pressure difference if h= 1.5 m, h_2= 0.75 m, h_1 = 0.5 m. The liquid at A and B is water. Given the specific gravity of mercury is 13.6.

*Tiub U manometer dalam **Rajah 1** adalah untuk mengukur perbezaan tekanan pada cecair antara dua titik A dan B. Tiub U mengandungi cecair merkuri dan air. Kirakan perbezaan tekanan jika h = 1.5 m, h_2 = 0.75 m, h_1 = 0.5 m. Cecair di A dan B adalah air. Diberi spesifik graviti bagi merkuri ialah 13.6.*

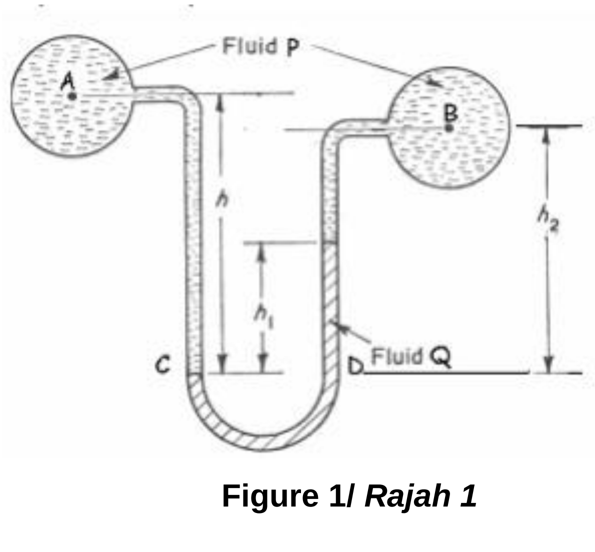


Figure 1/ *Rajah 1*

(5 marks/*markah*)

b) A basketball floats in a pool of water. The ball has a mass of 0.7 kg and a diameter of 25 cm.

Sebiji bola keranjang terapung di kolam air. Bola itu berjisim 0.7 kg dan berdiameter 25 cm.

i. What is the buoyant force for basketball?

Apakah daya apung bagi bola keranjang itu?

(4 marks/*markah*)

ii. What is the volume of water displaced by the ball?

Berapakah isi padu air yang dikeluarkan oleh bola?

(3 marks/*markah*)

iii. What is the average density of the basketball?

Berapakah ketumpatan purata bola keranjang?

(3 marks/*markah*)

QUESTION 3/ *SOALAN 3*

a) Consider a device with one inlet and one outlet. If the volume flow rates at the inlet and at the outlet are the same, is the flow through this device necessarily steady?Explain?

Sebuah peranti dengan satu saluran masuk dan satu saluran keluar. Jika isipadu kadar alir pada saluran masuk dan saluran keluar adalah sama, adakah aliran di dalam peranti itu stabil? Terangkan?

(5 marks/*markah*)

b) Oil flows through a pipe at a velocity of 2.12 m/s. The diameter of the pipe is 80 mm. Given specific gravity of oil is S_G = 0.85.

Minyak mengalir melalui sebuah paip pada halaju 2.12 m / s. Diameter paip ialah 80 mm. Diberi graviti tentu minyak ialah $S_G = 0.85$

i. Calculate the volume flow rate for oil.

Hitung kadar aliran isipadu bagi minyak.

(2 marks/*markah*)

ii. Calculate the mass flow rate of oil.
Kadar alir jisim minyak.

(2 marks/*markah*)

c) Water flows through a pipe in **Figure 2** with a diameter of 50 mm. Then the split into two, one of the pipes has a diameter 25 mm with the velocity of flow 0.4 m/s and the other one has a diameter 15 mm with the velocity 0.6 m/s. Calculate the velocity in the main pipe.

*Air mengalir melalui paip seperti **Rajah 2** dengan diameter 50 mm. Kemudian terpisah kepada dua bahagian, satu bahagian paip berdiameter 25 mm dengan aliran halaju 0.4 m/s dan satu bahagian berdiameter 15 mm dengan halaju 0.6 m/s. Kirakan halaju paip utama.*

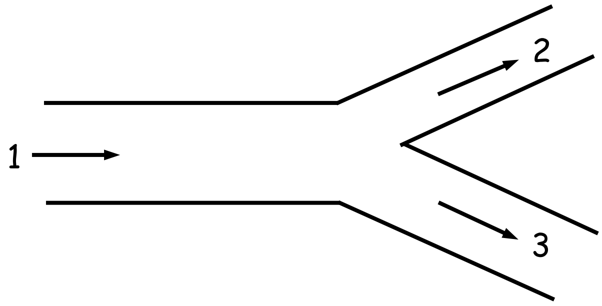


Figure 2/ *Rajah 2*

(6 marks/ *markah*)

QUESTION 4/ *SOALAN 4*

a) Consider a person walking first in air and then in water at the same speed. Estimate which motion will the Reynolds number be higher?
Pertimbangkan seseorang yang berjalan pada mulanya di udara dan kemudian di air dengan kelajuan yang sama. Anggarkan gerakan yang manakah mempunyai nombor Reynolds yang lebih tinggi?

(3 marks/*markah*)

b) Water at 5°C (ρ= 1000 kg/m³) and μ= 1.519 x 10^{-3} kg/m.s) is flowing steadily in a 0.3 cm diameter 9 m long horizontal pipe at an average velocity of 0.9 m/s as shown in **Figure 3**.

Air pada 5°C (p=1000 kg/m³) dan (μ= 1.519 *x* 10^{-3} *kg/m.s) mengalir berterusan di dalam paip yang melintang berdiameter 0.3 cm sepanjang 9 m, mempunyai halaju purata 0.9 m/s seperti* ***Rajah 3****.*

i. Determine the head loss for this pipe.
Tentukan kehilangan turus bagi paip itu.

(6 marks/ markah)

ii. Calculate the pressure drop, and the required pumping power input to overcome this pressure drop.
Kirakan kehilangan tekanan dan kuasa pam masukan yang diperlukan bagi mengatasi kehilangan tekanan itu.

(6 marks/ markah)

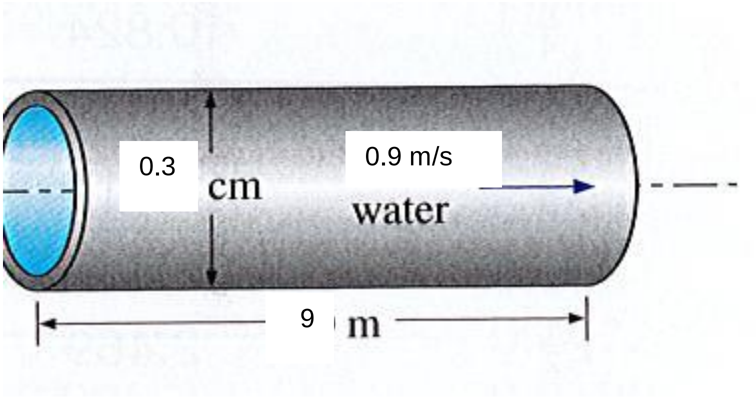


Figure 3/ *Rajah 3*

QUESTION 5/ *SOALAN 5*

a) Define incompressible flow and compressible flow.

Nyatakan aliran mampatan dan aliran tidak mampat

(3 marks / *markah)*

b) Convert the temperature below according to the specified scales:

Tukarkan suhu di bawah mengikut skala tertentu.

i. 250°K to Rankine (°R)

250°K kepada Rankine (°R)

(2 marks/ *2 markah*)

ii. 250°F to Rankine (°R)

250°F kepada Rankine (°R)

(2 marks/ *2 markah*)

iii. 250ºC to Kelvin (°K)

250ºC kepada Kelvin (°K)

(2 marks/ *2 markah*)

c) Explain about Archimedes principle and the function in buoyant force

Terangkan Prinsip Archimedes dan kegunaannya pada daya keapungan.

(6 marks / 6 *markah*)

[60 MARKS/ *60 MARKAH*]

END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*

FORMULA AND TABLE

FORMULAR DAN JADUAL

Density :

$\rho = m/v$

Pressure :

$P = F / A$

$P = \rho gh$

$P = P_0 - \rho gh$

$P_{gage} = P_{abs} - P_{atm}$

$P_{vac} = P_{atm} - P_{abs}$

$P_{abs} = P_{gage} – P_{atm}$

Specific Gravity : $\gamma_{substance} / \gamma_{water}$

Specific Weight,W : ρg

Heat, Q : $C_p\, m\, dT$

Langarian and Eularian :

$$\vec{a} = \frac{d\vec{V}}{dt} = \frac{\partial\vec{V}}{\partial t}\frac{dt}{dt} + \frac{\partial\vec{V}}{\partial x}\frac{dx}{dt} + \frac{\partial\vec{V}}{\partial y}\frac{dy}{dt} + \frac{\partial\vec{V}}{\partial z}\frac{dz}{dt}$$

$$= \frac{\partial\vec{V}}{\partial t}(1) + \frac{\partial\vec{V}}{\partial x}(u) + \frac{\partial\vec{V}}{\partial y}(v) + \frac{\partial\vec{V}}{\partial z}(w)$$

$$= \frac{\partial\vec{V}}{\partial t} + u\frac{\partial\vec{V}}{\partial x} + v\frac{\partial\vec{V}}{\partial y} + w\frac{\partial\vec{V}}{\partial z}$$

Fluid dynamics :

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

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

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

Energy losses in pipes :

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

$$h_i=0.5\frac{v_2^2}{2g}$$

$$h_F=\frac{4fl}{d}\frac{v^2}{2g}$$

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

Nozzle :

$$\frac{P_c}{P_1}=\left(\frac{2}{\gamma+1}\right)^{\frac{\gamma}{\gamma+1}}$$

$$\frac{T_C}{T_1}=\frac{2}{\gamma+1}$$

$$\frac{T_1}{T_2}=\left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$$

$$V_C=\frac{RT_C}{P_C} \quad A_C=\frac{\dot{m}V_C}{C_C}$$

Coefficient of Volume Expansion

Constant : P / ρ

Specific heat at constant pressure, k : C_p/C_v

Absolute Viscosity : (F/A) / (v/y)

Kinematic Viscosity, V : μ / ρ

Hydraulic : $F_1 / A_1 = F_2 / A_2$

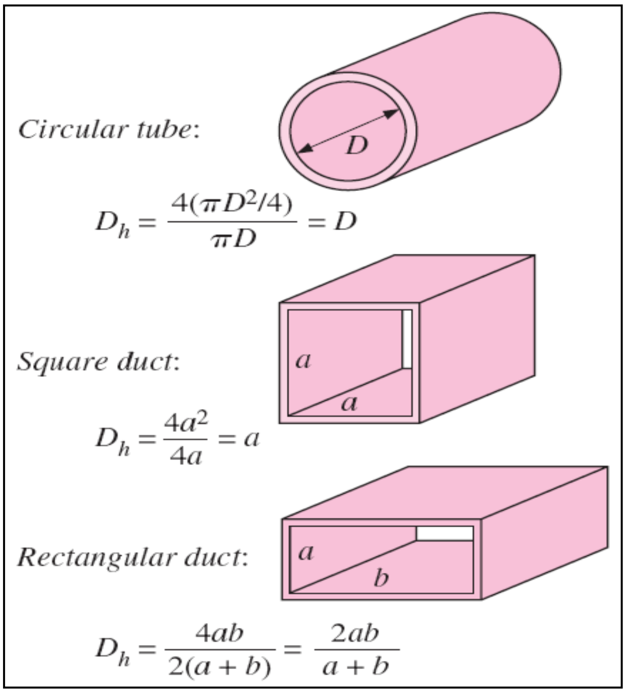
$F_2 / A_2 = A_2 / A_1$

$P_1 = P_2$

Buoyancy : Momen inertia from surface / volume of water displaced

Bernoulli :

$P_1 / \rho + V_1^2 / 2 + gz_1 = P_2 / \rho + V_2^2 + gz_2$

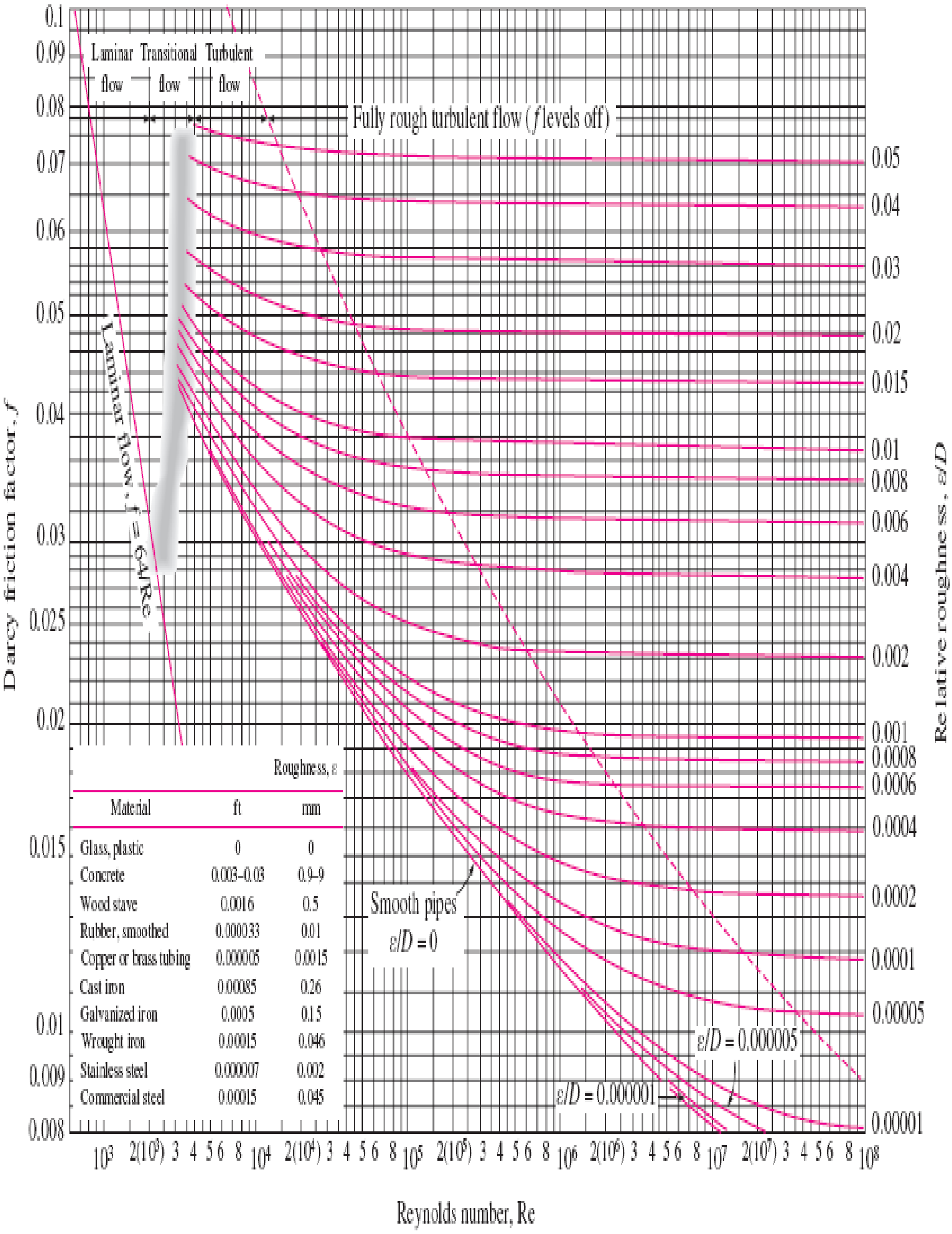


Relative Roughness, ε/D	Friction Factor, f
0.0*	0.0119
0.00001	0.0119
0.0001	0.0134
0.0005	0.0172
0.001	0.0199
0.005	0.0305
0.01	0.0380
0.05	0.0716

* Smooth surface. All values are for Re = 10^6 and are calculated from the Colebrook equation.

Equivalent roughness values for new commercial pipes*

Material	Roughness, ε ft	Roughness, ε mm
Glass, plastic	0 (smooth)	
Concrete	0.003–0.03	0.9–9
Wood stave	0.0016	0.5
Rubber, smoothed	0.000033	0.01
Copper or brass tubing	0.000005	0.0015
Cast iron	0.00085	0.26
Galvanized iron	0.0005	0.15
Wrought iron	0.00015	0.046
Stainless steel	0.000007	0.002
Commercial steel	0.00015	0.045



	Roughness, ε	
Material	ft	mm
Glass, plastic	0	0
Concrete	0.003–0.03	0.9–9
Wood stave	0.0016	0.5
Rubber, smoothed	0.000033	0.01
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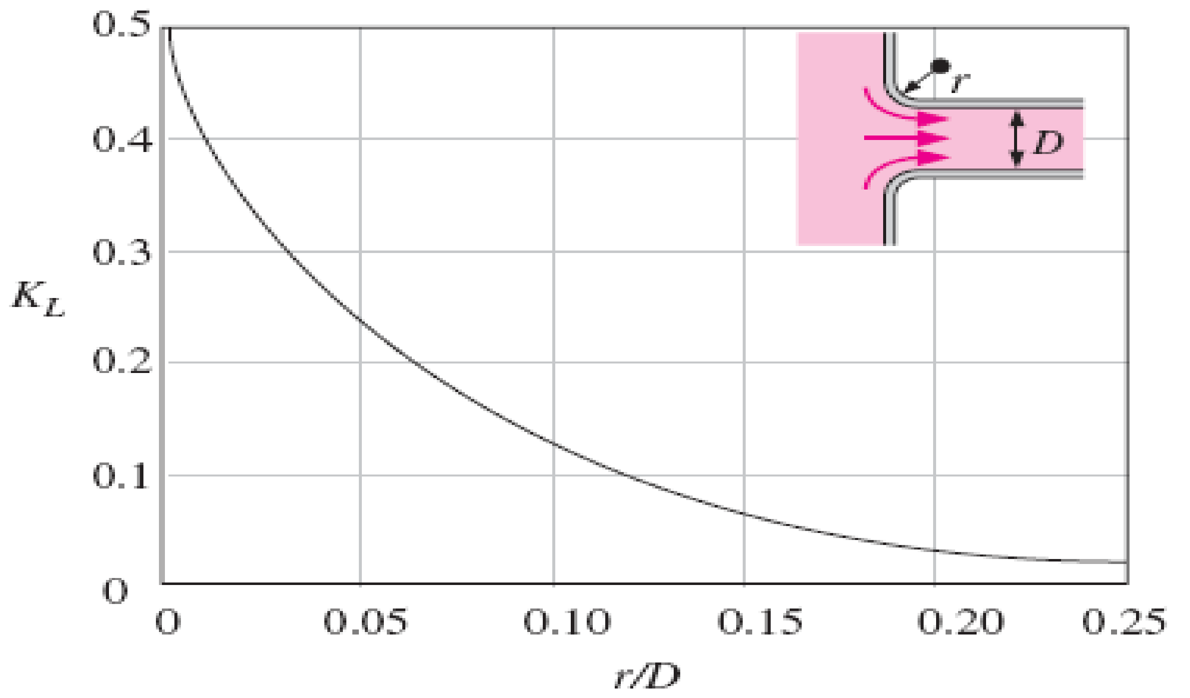
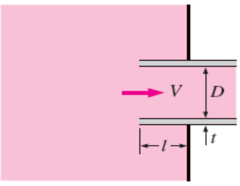


TABLE 14–3

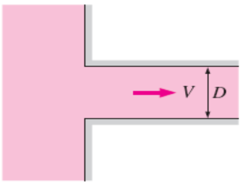
Loss coefficients K_L of various pipe components for turbulent flow (for use in the relation $h_L = K_L V^2/(2g)$, where V is the average velocity in the pipe that contains the component)*

Pipe Inlet

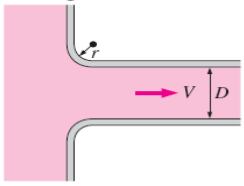
Reentrant: $K_L = 0.80$
($t \ll D$ and $l \approx 0.1D$)



Sharp-edged: $K_L = 0.50$

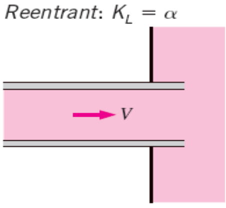


Well-rounded ($r/D > 0.2$): $K_L = 0.03$
Slightly rounded ($r/D = 0.1$): $K_L = 0.12$
(see Fig. 14–27)

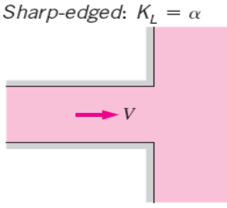


Pipe Exit

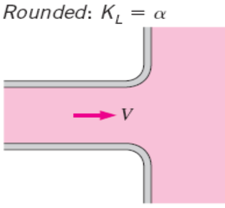
Reentrant: $K_L = \alpha$



Sharp-edged: $K_L = \alpha$



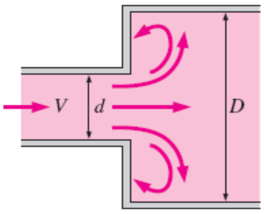
Rounded: $K_L = \alpha$



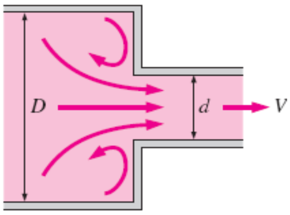
Note: The kinetic energy correction factor is $\alpha = 2$ for fully developed laminar flow, and $\alpha \approx 1.05$ for fully developed turbulent flow.

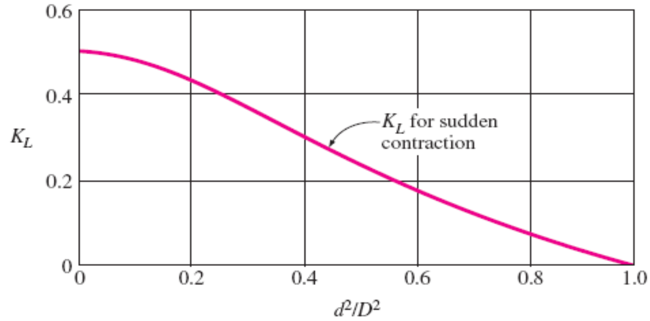
Sudden Expansion and Contraction (based on the velocity in the smaller-diameter pipe)

Sudden expansion: $K_L = \alpha\left(1 - \frac{d^2}{D^2}\right)^2$



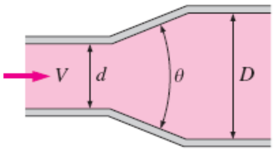
Sudden contraction: See chart.



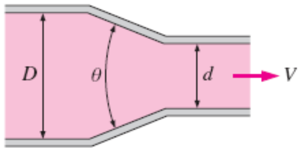


Gradual Expansion and Contraction (based on the velocity in the smaller-diameter pipe)

Expansion (for $\theta = 20°$):
$K_L = 0.30$ for $d/D = 0.2$
$K_L = 0.25$ for $d/D = 0.4$
$K_L = 0.15$ for $d/D = 0.6$
$K_L = 0.10$ for $d/D = 0.8$

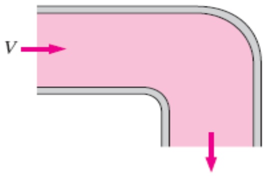


Contraction:
$K_L = 0.02$ for $\theta = 30°$
$K_L = 0.04$ for $\theta = 45°$
$K_L = 0.07$ for $\theta = 60°$

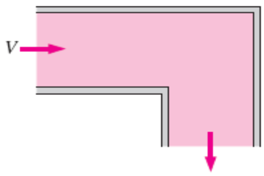


Bends and Branches

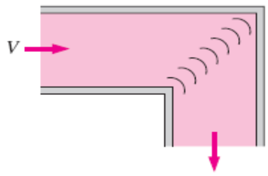
90° smooth bend:
Flanged: $K_L = 0.3$
Threaded: $K_L = 0.9$



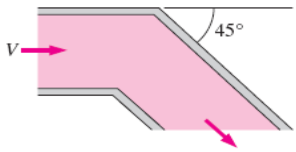
90° miter bend
(without vanes): $K_L = 1.1$



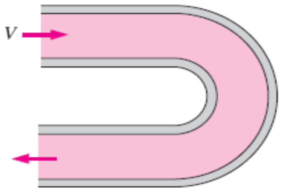
90° miter bend
(with vanes): $K_L = 0.2$



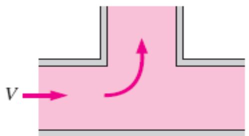
45° threaded elbow:
$K_L = 0.4$



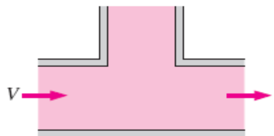
180° return bend:
Flanged: $K_L = 0.2$
Threaded: $K_L = 1.5$



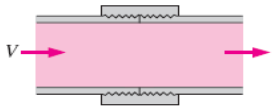
Tee (branch flow):
Flanged: $K_L = 1.0$
Threaded: $K_L = 2.0$



Tee (line flow):
Flanged: $K_L = 0.2$
Threaded: $K_L = 0.9$



Threaded union:
$K_L = 0.08$



Valves

Globe valve, fully open: $K_L = 10$
Angle valve, fully open: $K_L = 5$
Ball valve, fully open: $K_L = 0.05$
Swing check valve: $K_L = 2$

Gate valve, fully open: $K_L = 0.2$
$\frac{1}{4}$ closed: $K_L = 0.3$
$\frac{1}{2}$ closed: $K_L = 2.1$
$\frac{3}{4}$ closed: $K_L = 17$

* These are representative values for loss coefficients. Actual values strongly depend on the design and manufacture of the components and may differ from th given values considerably (especially for valves). Actual manufacturer's data should be used in the final design.