KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION

COURSE NAME	:	**FLUID MECHANICS**
COURSE CODE	:	**DKM 2122**
EXAMINATION	:	**APRIL 2019**
DURATION	:	**2 HOURS**

INSTRUCTION TO CANDIDATES

1. This examintaion paper consists **FIVE (5)** questions.
   Answer **FOUR (4)** questions only.

2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator.

3. Please check to make sure that this examination pack consist of:
   i. Question Paper
   ii. Answer Booklet

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This examination paper consists of 14 printed pages including front page

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*

a) A pipe carrying 0.02 m^3/s of water. Solve the head losses in pipe due to diameter changing below:
   i. 20 cm to 35 cm
   ii. 50 cm to 15 cm

   Sebatang paip membawa 0.02 m^3/s air. Hitungkan kehilangan turus pada paip yang disebabkan mengikut perubahan diameter di bawah:
   i. *20 cm kepada 35 cm*
   ii. *50 cm kepada 15 cm*

(5 marks/ markah)

b) Two reservoirs in **Figure 1** are connected by a pipeline which is 150 mm long. There is a sharp entrance to the pipe and the diameter is 80 mm for the first 175 mm. The pipe then enlarges suddenly to 150 mm in diameter for the remaining of its length. The flow rate of water entering the pipes is 0.005 m^3/s. Given f = 0.01 (Darcy Formula), calculate the losses of head which occur and solve the rate of flows in m^3/s.
   *Dua tangki takungan dalam **Rajah 1** disambungkan dengan saliran paip yang panjangnya 150 mm. Mempunyai bentuk tajam pada bahagian masuk berdiameter 80 mm pada panjang pertama 175 mm. Paip kemudiannya membesar dengan diameter 150 mm dengan baki panjangnnya. Kemasukkan kadar alir. melalui paip 0.005 m^3/s. Diberi f = 0.01 (Darcy Formula), kirakan kehilangan turus dan kadar alir dalam unit m^3/s.*

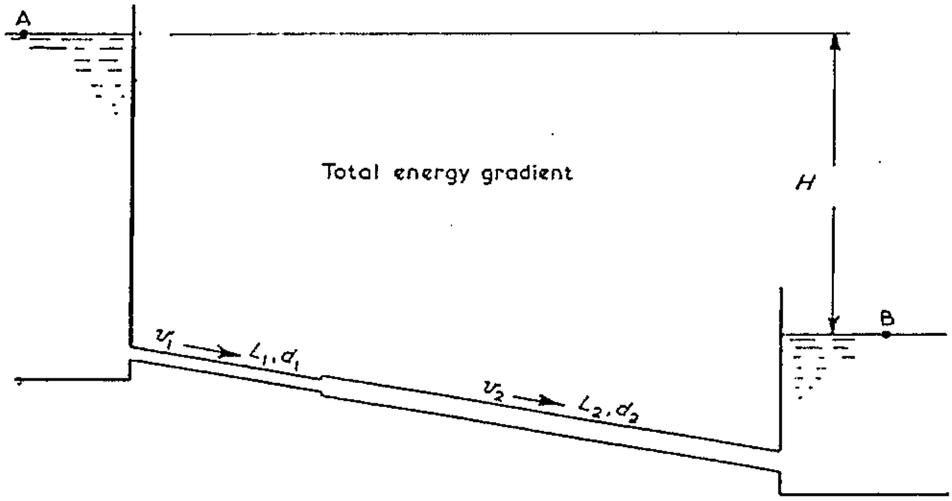


Figure 1/ *Rajah 1*

(10 marks/ markah)

QUESTION 2/ *SOALAN 2*

a) List **four (4)** application of Bernoulli's Theorem.
*Senaraikan **empat (4)** penggunaan Teori Bernouilli.*

(4 marks/ *markah*)

b) Oil flows through a pipe at velocity of 2.12 m/s. The diameter of the pipe is 80mm. Calculate flow rate and mass flow rate of oil. Assume specific gravity of oil, s_{oil} = 0.85.
Minyak mengalir melalui paip dengan halaju 2.12 m/s. Diameter paip ialah 80 mm. Kirakan kadar alir dan kadar alir jisim bagi minyak. Anggapkan graviti tentu bagi minyak ialah, s_{oil} = 0.85.

(5 marks/ *markah*)

c) Water flows through a pipe in **Figure 2** with 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.*

(6 marks/ *markah*)

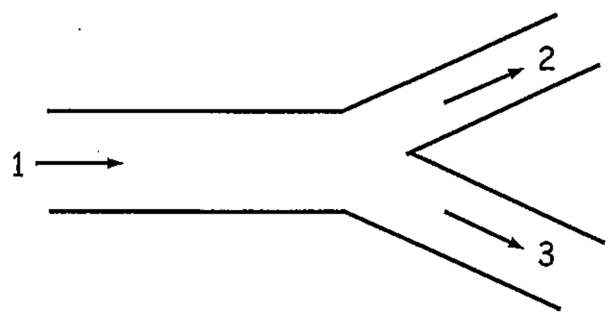


Figure 2/ *Rajah 2*

QUESTION 3/ *SOALAN 3*

a) Define Buoyant force.
Takrifkan daya apungan.

(2 marks/ *markah*)

b) A wooden block has density of 500 kg/m^3 and a mass of 0.8 kg when floated in a liquid of density 1000 kg/m^3 . Calculate the buayant force acting on the wooden block.
Blok kayu mempunyai ketumpatan 500 kg/m^3 dan jisim 0.8 kg apabila terapung di dalam bendalir yang berketumpatan 1000 kg/m^3. Kirakan daya apungan yang bertindak pada blok kayu.

(3 marks/ *markah*)

c) An inverted U- tube manometer in **Figure 3** is filled with mercury in a u-tube and water in pipe A and B. Calculate the pressure difference A and B if h= 80 cm, h_1= 70 cm and h_2= 165 cm. Given the s_{HG} = 13.6
*Sebuah manometer u-tiub terbalik seperti **Rajah 3** di isi dengan merkuri pada u-tiub dan air pada paip A dan B. Kirakan perbezaan tekanan A dan B jika h = 80 cm, h_1= 70 cm dan h_2= 165 cm. Diberi s_{HG} = 13.6.*

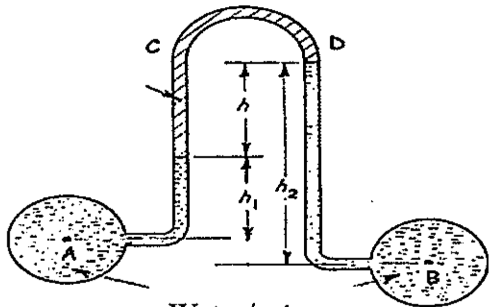


Figure 3/ *Rajah 3*

(5 marks/ *markah*)

d) A force, F of 850 N is applied to the smaller cylinder of a hydraulic jack in **Figure 4**. The diameter of a small cylinder is 2.5 cm while the area, A of a larger cylinder is 80 cm^2. What load can be lifted on the larger cylinder if the small cylinder is 0.5 m below the larger cylinder? Assume ρ = 1000 kg/m^3 .

Daya, F 850 N dikenakan pada silinder kecil pada jack hidraulik dalam ***Rajah 4.*** *Diemater silinder kecil 2.5 cm manakala luas, A silinder besar ialah 80 cm^2.* *Apakah beban yang boleh diangkat pada silinder besar jika silinder kecil 0.5 bawah daripada silinder besar? Anggap*kan ρ = 1000 kg/m^3 .

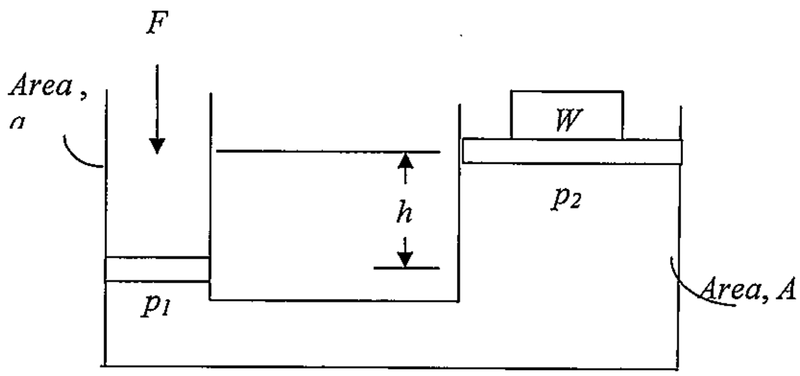


Figure 4/ ***Rajah 4***

(5 marks/ *markah*)

QUESTION 4/ *SOALAN 4*

a. Define the following pressure :

Takrifkan tekanan dibawah:

i. Atmospheric Pressure (p_{atm})

Tekanan Atmosfera (p_{atm})

ii. Gauge Pressure (p_G)

Tekanan Tolok (p_G)

iii. Absolute Pressure (p_A)

Tekanan Mutlak (p_A)

(3 marks/ *markah*)

b. Identify the pressure gauge of air in the cylinder if the atmospheric gauge is 101.3 kN/m^2 and absolute pressure is 460 kN/m^2?

Kenalpasti tekanan tolok bagi udara di dalam silinder jika tekanan atmosfera ialah 101.3 kN/m^2 dan tekanan mutlak 460 kN/m^2?

(2 marks/ *markah*)

c. The weight of lubricant oil is 38.75 kN and the volume is 4.5 m^3. Calculate the following.

i. Mass density
ii. Specific weight
iii. Specific volume
iv. Specific gravity of lubricant oil

Berat bendalir minyak ialah 38.75 kN dan mempunyai isipadu 4.5 m^3. Kirakan.

i. Ketumpatan jisim
ii. Berat tentu
iii. Ispadu tentu
iv. Gravity tentu bagi minyak

(8 marks/ markah)

d. Define the meaning of viscosity and give **two (2)** types of viscosity.

*Berikan maksud kelikatan dan berikan **dua (2)** jenis kelikatan.*

(2 marks/ markah)

QUESTION 5/ *SOALAN 5*

a. By using a diagram, briefly describe and sketch the types of flow below.

   i. Steady flow
   ii. Uniform flow
   iii. Turbulent flow
   iv. Laminar flow

   Dengan menggunakan gambarajah, huraikan dengan ringkas jenis- jenis aliran di bawah.

   i. Aliran tenang
   ii. Aliran sekata
   iii. Aliran Tubulent
   iv. Aliran Laminar

(4 marks/ *markah*)

b. Give **four (4)** physical properties of fluid.
   Berikan ***empat (4)*** *sifat fizikal bagi bendalir.*

(2 marks/ *markah*)

c. Draw the presure diagram.
   Lukiskan diagram tekanan

(3 marks/ *markah*)

d. Give **three (3)** differences between gases and liquid.
   Berikan ***tiga (3)*** *perbezaan di antara gas dan cecair.*

(6 marks/ *markah*)

[60 MARKS/ MARKAH]

END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*

FORMULA

Density :

$\rho = m/v$

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

Specific Weight,W : ρg

Heat, Q : $C_p m\, dT$

Pressure :

$P = F / A$

$P = \rho g h$

$P = P_0 - \rho g h$

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

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

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

Langarian and Eularian :

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

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

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

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 :

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

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

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

$$V_C = \frac{RT_C}{P_C} \qquad A_C = \frac{\dot{m}V_C}{C_c}$$

Coefficient of Volume Expansion

Constant : P / p

Specific heat at constant pressure, k : C_p/C_v

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

Kinematic Viscosity, V : μ / p

Hydraulic : $F_1 / A_1 = F_2 / A_2$

$F_2 / A_2 = A_2 / A_1$

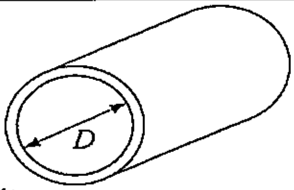
$P_1 = P_2$

Buoyancy : Momen inertia from surface / volume of water displaced

Bernoulli :

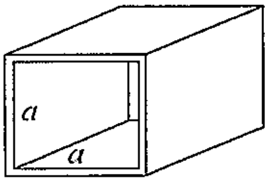
$P_1 / p + V_1^2 / 2 + gz_1 = P_2 /p + V_2^2 + gz_2$

Circular tube:



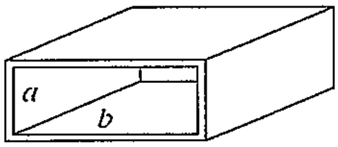
$$D_h = \frac{4(\pi D^2/4)}{\pi D} = D$$

Square duct:



$$D_h = \frac{4a^2}{4a} = a$$

Rectangular duct:



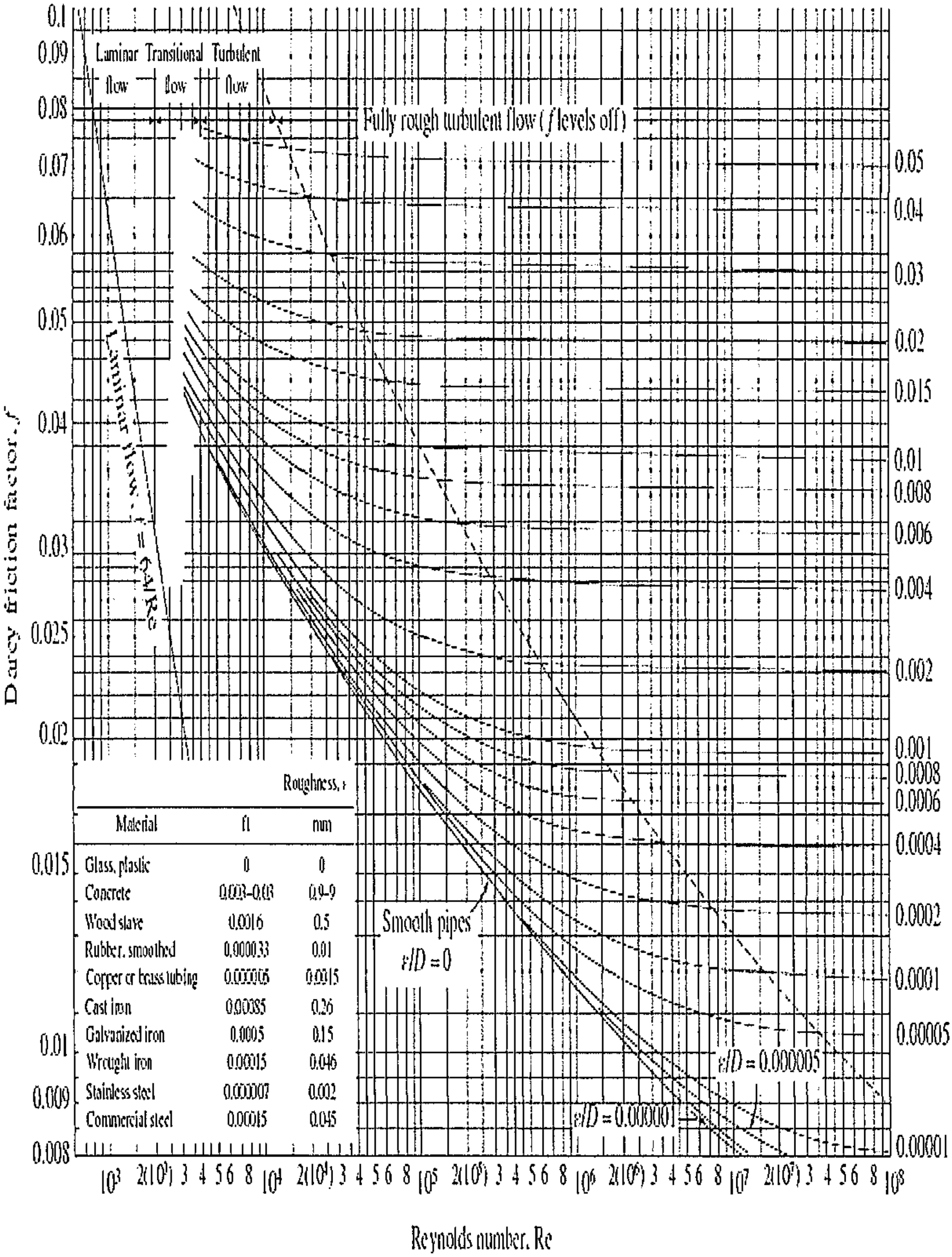
$$D_h = \frac{4ab}{2(a+b)} = \frac{2ab}{a+b}$$

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
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

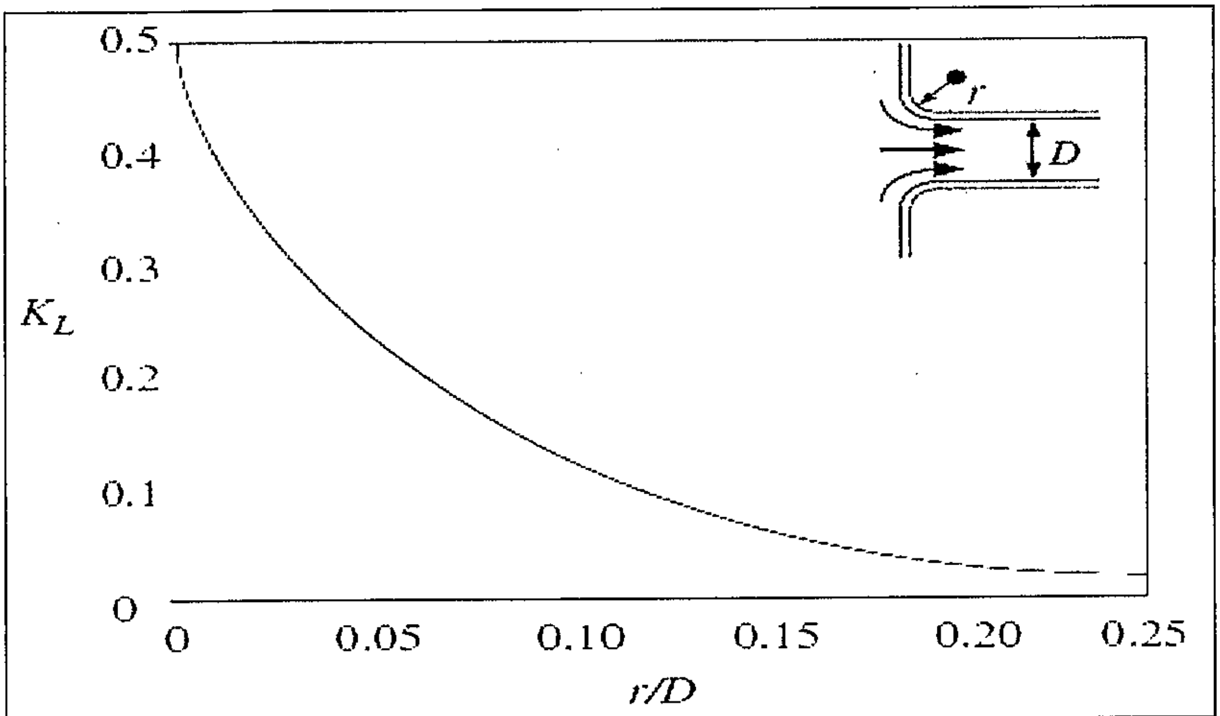
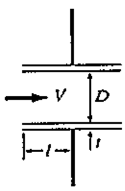


TABLE 14–3

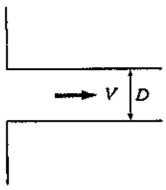
Loss coefficients K_L of various pipe components for turbulent flow (for use in the relation $h_L = K_L V^2/(2g)$, where V is the average velocity in the pipe that contains the component)*

Pipe Inlet

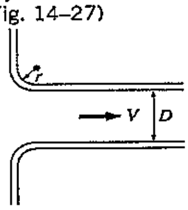
Reentrant: $K_L = 0.80$ ($t \ll D$ and $l \approx 0.1D$)



Sharp-edged: $K_L = 0.50$

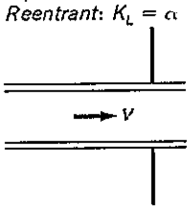


Well-rounded ($r/D > 0.2$): $K_L = 0.03$
Slightly rounded ($r/D = 0.1$): $K_L = 0.12$
(see Fig. 14–27)

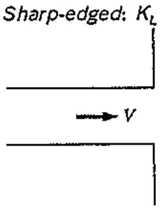


Pipe Exit

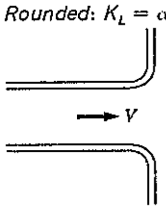
Reentrant: $K_L = \alpha$



Sharp-edged: $K_L = \alpha$



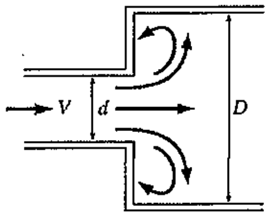
Rounded: $K_L = \alpha$



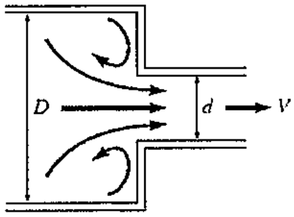
Note: The kinetic energy correction factor is $\alpha = 2$ for fully developed laminar flow, and $\alpha \approx 1.05$ for fully developed turbulent flow.

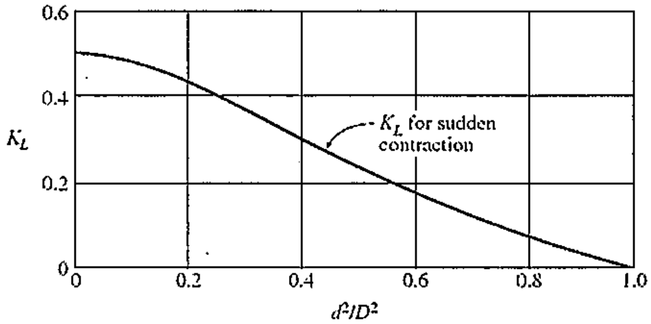
Sudden Expansion and Contraction (based on the velocity in the smaller-diameter pipe)

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



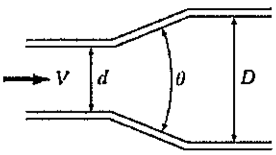
Sudden contraction: See chart.



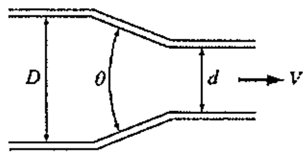


Gradual Expansion and Contraction (based on the velocity in the smaller-diameter pipe)

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 $d/D = 0.8$

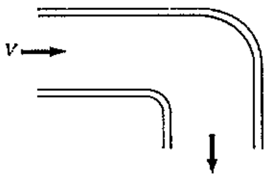


Contraction:
$K_L = 0.02$ for $\theta = 30°$
$K_L = 0.04$ for $\theta = 45°$
$K_L = 0.07$ for $\theta = 60°$

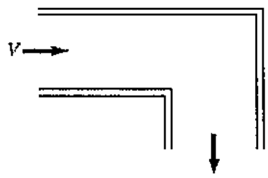


Bends and Branches

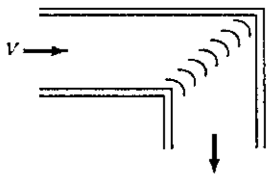
90° smooth bend:
Flanged: $K_L = 0.3$
Threaded: $K_L = 0.9$



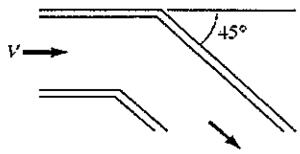
90° miter bend
(without vanes): $K_L = 1.1$



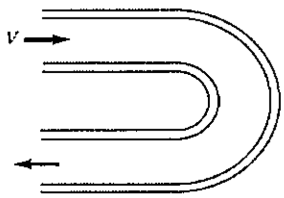
90° miter bend
(with vanes): $K_L = 0.2$



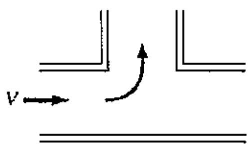
45° threaded elbow:
$K_L = 0.4$



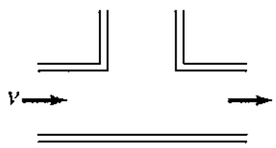
180° return bend:
Flanged: $K_L = 0.2$
Threaded: $K_L = 1.5$



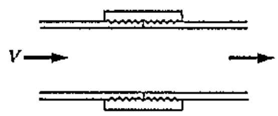
Tee (branch flow):
Flanged: $K_L = 1.0$
Threaded: $K_L = 2.0$



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.