# UNIVERSITY OF SWAZILAND
## Faculty of Health Sciences
## Department of Environmental Health Sciences

**BSc Environmental Health**

## MAIN EXAMINATION PAPER DECEMBER 2012

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|---|---|---|
| **TITLE OF PAPER** | : | WATER DISTRIBUTION |
| **COURSE CODE** | : | EHS:586 |
| **DURATION** | : | 2 HOURS |
| **MARKS** | : | 100 |
| **INSTRUCTIONS** | : | THERE ARE FIVE QUESTIONS IN THIS EXAM |
| | : | ANSWER ANY FOUR OF THE FIVE QUESTIONS |
| | : | EACH QUESTION CARRIES 25 MARKS |
| | : | NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM |

EHS 586
DECEMBER 2012

**QUESTION ONE** (25 Marks)

The tank containing air, oil and water shown in Figure Q1 below is partly open to the atmosphere and partly closed. The specific gravity of the oil is 0.9 as indicated in the figure.

**A.** Calculate the pressure in KPa at A. .....[ 5 Marks ]

**B.** Calculate the pressure in KPa at B. .....[ 5 Marks ]

**C.** Calculate the pressure in KPa at C. .....[ 5 Marks ]

**D.** Calculate the pressure in KPa at D. .....[ 5 Marks ]

**E.** What will be the pressure at C if the water level at A rises by 1m from its present position due to increase in the atmospheric pressure at the open end of tank ?

.....[ 5 Marks ]

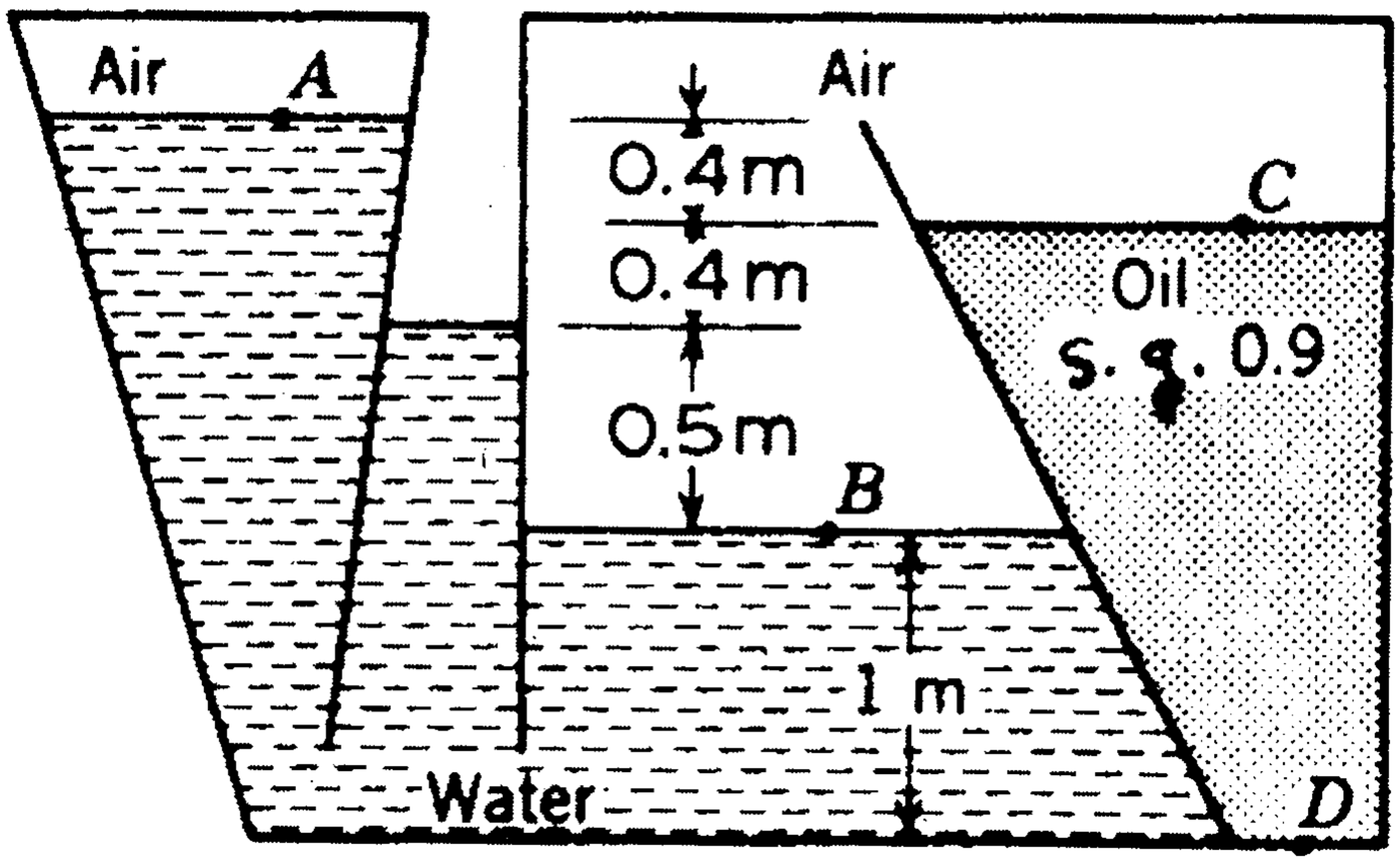



**Fig Q1**

**QUESTION TWO** (25 Marks)

**A.** Calculate the resultant force on the triangular surface ABC as a result of water pressure shown in Figure Q2. .....[ 13 Marks]

**B.** Locate the center of pressure (line of action of the resultant force) measured from the top water surface. .....[ 12 Marks]

The moment of inertia of a triangular surface about its centroid is given by:

$$I_{BC} = \frac{bh^3}{36}$$

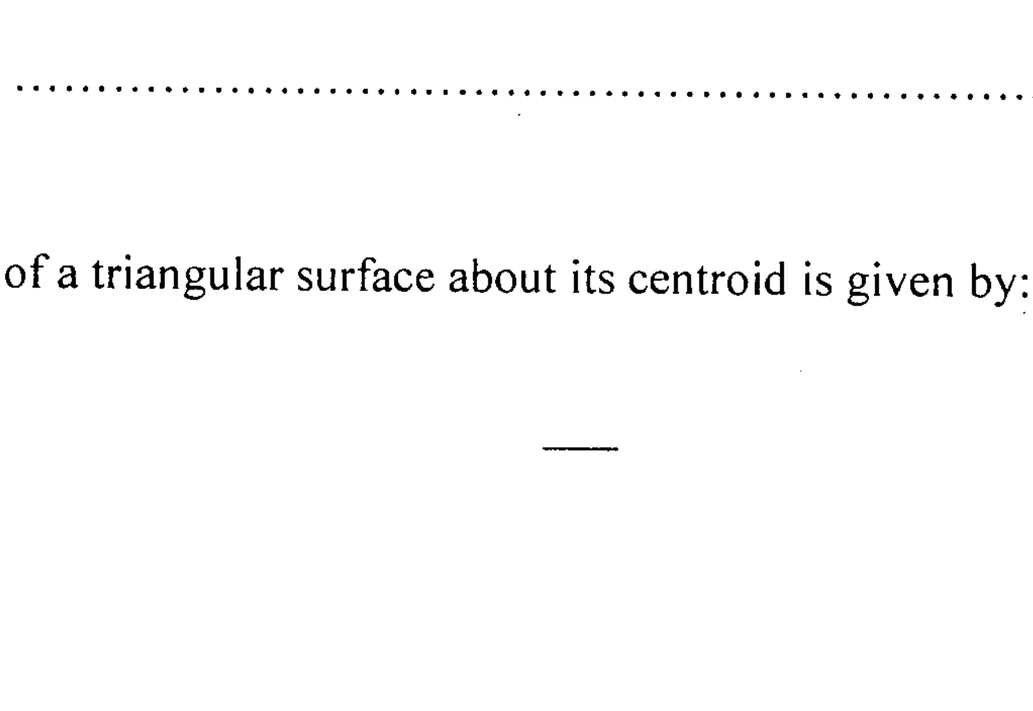



Fig. Q2

**QUESTION THREE** (25 Marks)

Water is pumped from a sump (see Fig. Q3 below) to a higher elevation by installing a hydraulic pump with the data:

Discharge of water = 6.9 $m^3$/min

Diameter of suction pipe = 150 mm

Diameter of delivery pipe = 100 mm

Energy supplied by the pump = 25 kW

I. Determine the pressure in $KN/m^2$ at points A and B neglecting all losses. ...[13 Marks]

II. If the actual pressure at B is 25 $KN/m^2$ determine the total energy loss in KW between the sump and the point B. .....[12 Marks]

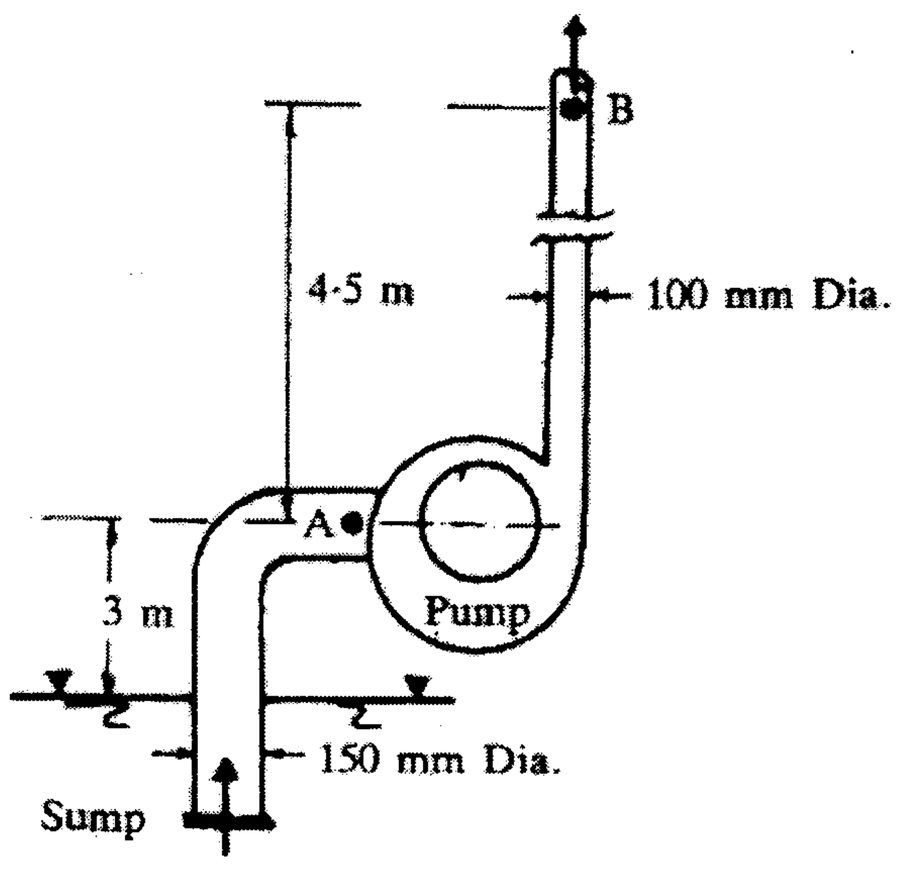



**Fig. Q3**

**QUESTION FOUR** (25 Marks)

Water is flowing from a 1.6m high column at section 1 to a 0.3m high water column at section 2 as shown in Figure Q4 below. The pipe connecting the two points (1 and 2) has a length of 10m and diameter of 150mm. Taking the kinematic viscosity, $\nu = 0.114 * 10^{-5}$ $m^2/sec.$ , roughness $\varepsilon = 0.0000442m$ and using the Moody diagram provided below:

**A.** Determine the discharge through pipe. .....[17 Marks]

**B.** Indicate whether the flow is laminar, transitional or turbulent and state the dominant force that determines the fluid flow characteristics. .....[8 Marks]

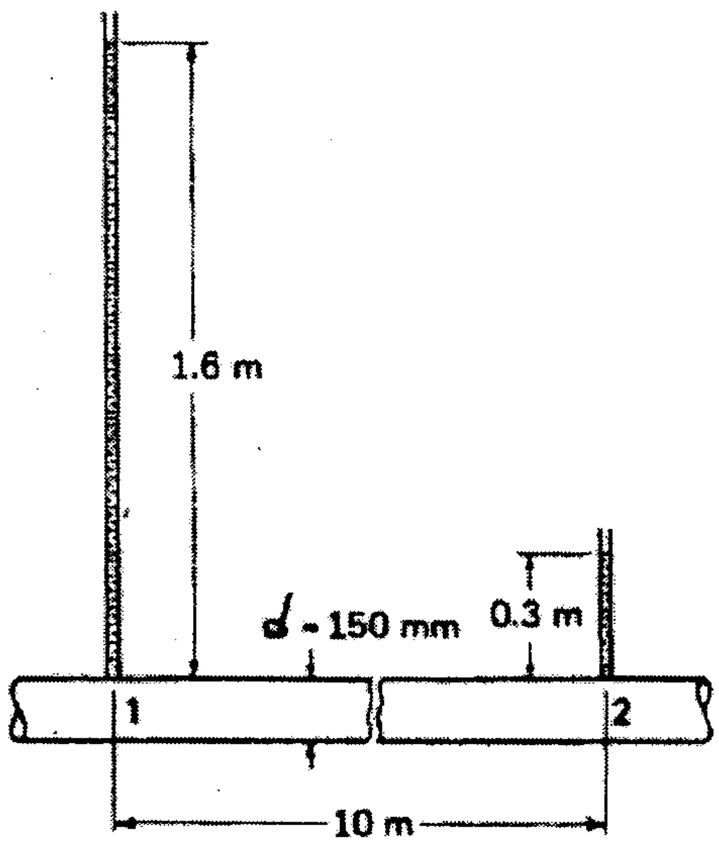
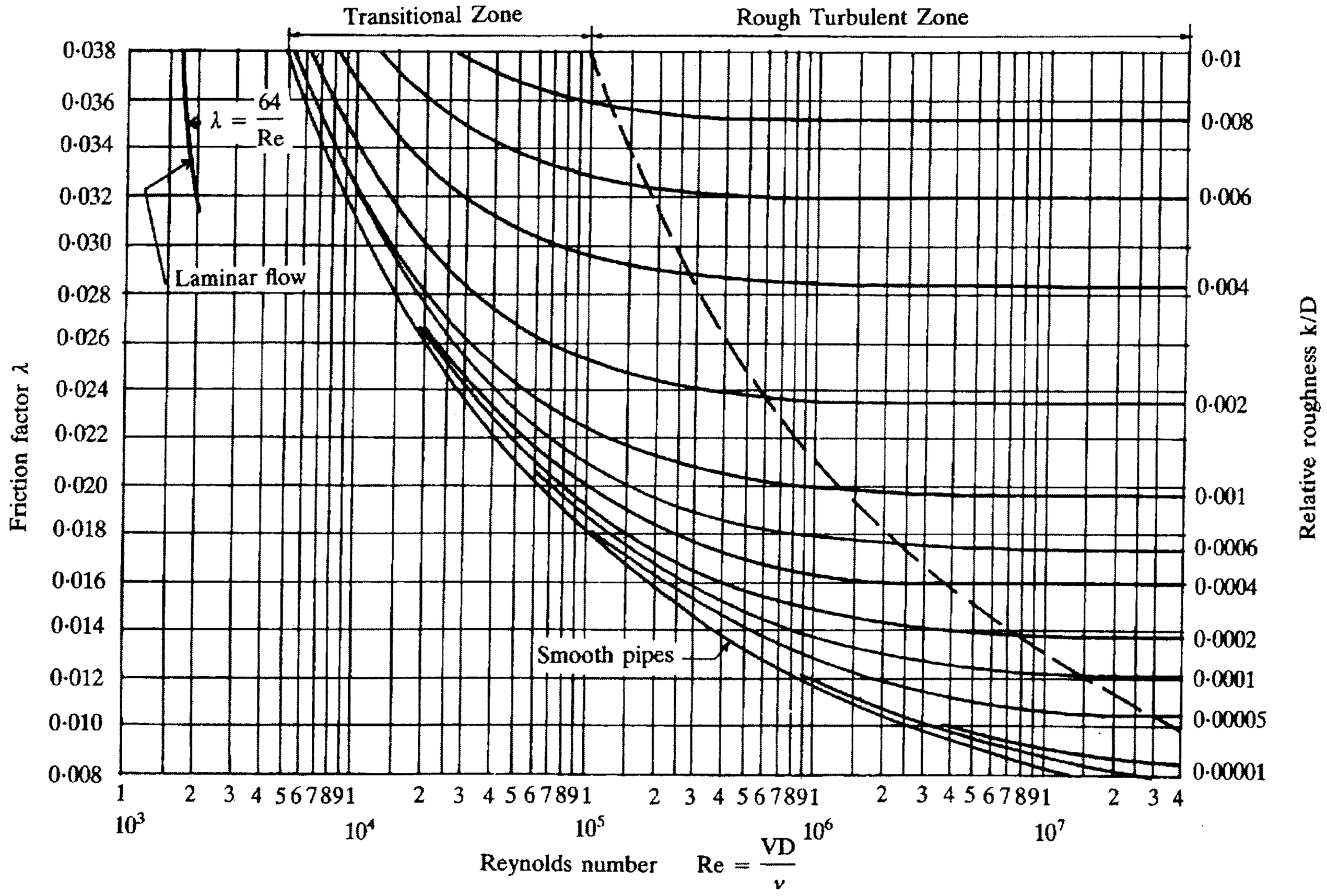



**Fig. Q4**


Transitional Zone
Rough Turbulent Zone
0·038
0·036
0·034
0·032
0·030
0·028
0·026
0·024
0·022
0·020
0·018
0·016
0·014
0·012
0·010
0·008
$\lambda = \frac{64}{Re}$
Laminar flow
Smooth pipes
0·01
0·008
0·006
0·004
0·002
0·001
0·0006
0·0004
0·0002
0·0001
0·00005
0·00001
Relative roughness k/D
Friction factor λ
1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4
$10^3$ $10^4$ $10^5$ $10^6$ $10^7$
Reynolds number $Re = \frac{VD}{\nu}$

**QUESTION FIVE** (25 Marks)

For the pipe loop shown in Fig. Q5 below, determine the flows in each of the pipes using the Hardy-Cross method. Use the head loss formula $H_L = Kq^2$ where the K values are indicated in the figure for each pipe. Start with flow magnitudes and directions indicated for each pipe in the figure.

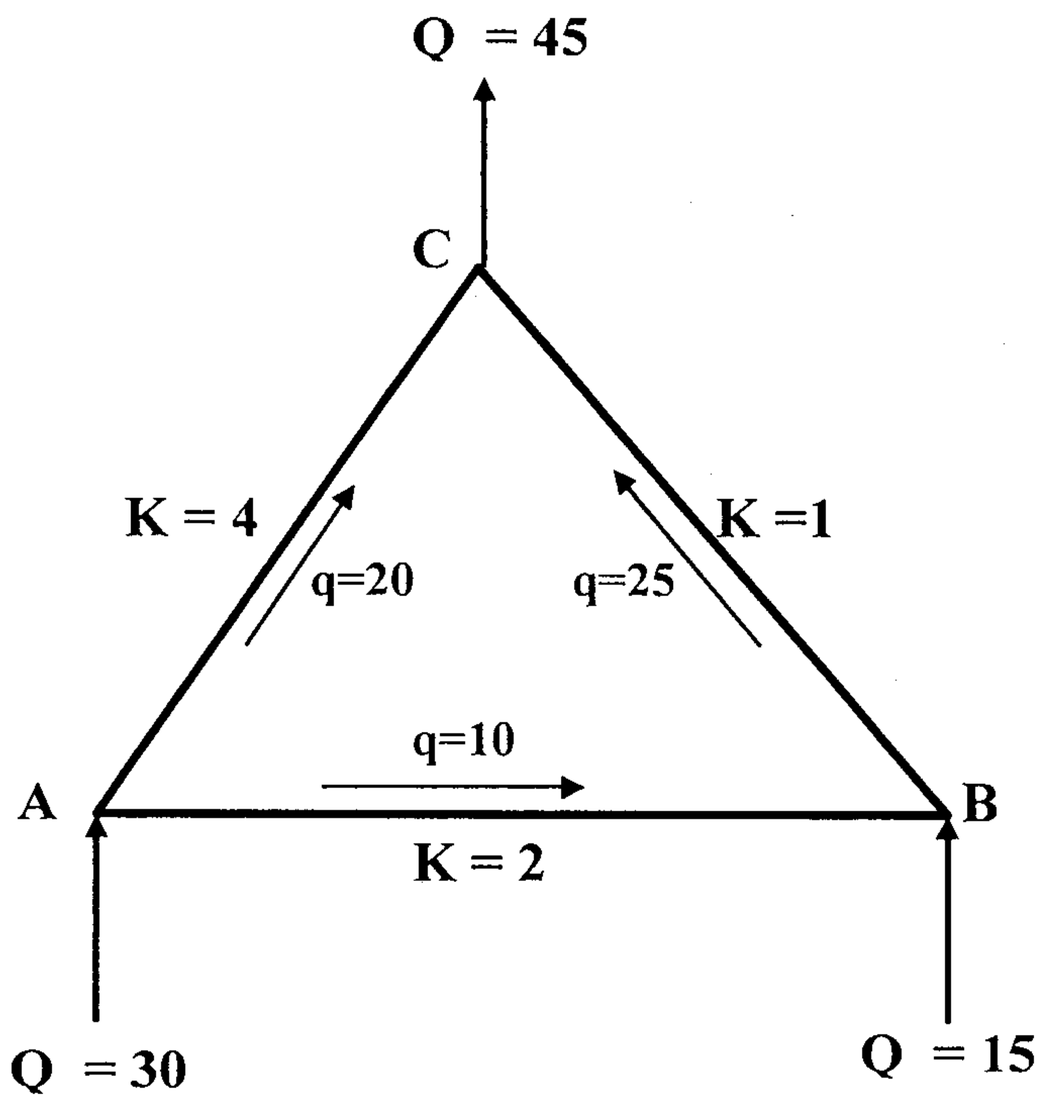



**Fig. Q5**