UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : CIVIL*
SUBJECT	:	**WATER & SEWERAGE RETICULATION 3A**
CODE	:	**CEW3A21**
DATE	:	SSA EXAMINATION 12 JANUARY, 2017
DURATION	:	(SESSION 1) 08:00 - 10:00
WEIGHT	:	40 : 60
TOTAL MARKS	:	90

ASSESSOR	:	MR. L F SHIRLEY
MODERATOR	:	MR. J DATELING
NUMBER OF PAGES	:	3 PAGES, 1 FORMULA SHEET AND 3 ANNEXURES.

2296

INSTRUCTIONS	:	THIS IS A CLOSED BOOK EXAMINATION.
REQUIREMENTS	:	ANY TYPE OF POCKET CALCULATOR PERMITTED. : ONE SHEET SIZE A4 GRAPH PAPER.

INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

Two reservoirs have water levels differing by 12m. The reservoirs are connected by a pipeline of which the first 500m is a pipe of diameter 200mm. The pipe then splits into two parallel pipes of diameter 150mm 1km long and 100mm 750m long which are connected to the lower reservoir. Assume the friction factor f in the d'Arcy-Weisbach formula = 0,0060 for all pipes and calculate :

1.1 The flow rate from the one reservoir to the other; (10)

1.2 The flow rate in the 150mm diameter pipe. (10)

[20]

QUESTION 2

The invert of a 1000mm diameter manhole is fitted with a 150mm diameter straight half-round. The half-round falls through 50mm inside the manhole.

2.1 What is the depth of flow in the half-round if the flow through the manhole is 12ℓ/s? (7)

2.2 What is the flow velocity in the half-round? (3)

Make use of Annexure 1 to solve the above problem.
Take Manning's n = 0,0130.

[10]

QUESTION 3

Water is discharged from a tank through a 15mm diameter commercial steel pipe 10m long as shown in Annexure 2. The inlet to the pipe is sharp with a shock loss coefficient k = 0,5 and the valve is half-open with a shock loss coefficient k = 6,0.

3.1 Determine the flow rate from the tank taking both friction and shock losses into account. Use Moody's diagram (See Annexure 2) to determine f making an initial calculated estimation of f followed by at least one iteration. Take the kinematic viscosity ν of water as 1×10^{-6} m^2/s.

[15]

QUESTION 4

Annexure 3 shows a simple water reticulation network ABCD. Inflow at A is 20ℓ/s and outflow at C is 20ℓ/s. All the pipes have the same Hazen-Williams coefficient $C_H = 130$.

4.1 Using the Hazen-Williams formula for estimating friction losses, calculate the flow in branches ABC and ADC. Ignore minor energy (shock) losses; (9)

4.2 If the residual pressure at node A is 300kPa, what is the residual pressure at node C? (6)

[15]

QUESTION 5

Reservoir A is connected to reservoir C by means of a pipeline ABC. Pipeline ABC consists of pipeline AB of length 1000m, diameter 150mm and friction factor f = 0,0040 followed by pipeline BC of length 1 500m, diameter 100mm and f = 0,0050. The difference in water level between the two reservoirs is 15m.

5.1 Using the d'Arcy-Weisbach formula for evaluation friction losses, calculate the flow from reservoir A to reservoir C. Ignore minor energy (shock) losses

[10]

QUESTION 6

The characteristic curves of a certain centrifugal pump can be plotted from the following test results:

Q (m^3/s)	0,0	0,010	0,020	0,030	0,040
H (m)	22,5	21,0	18,0	12,5	3,0
η (%)	0	66	81	70	20

The pump is connected to a water piping system of system head:

$$H_{sys} = 16{,}50 + 11\ 550\ Q^2 \text{ with H in m and Q in m}^3\text{/s.}$$

6.1 On the graph paper provided determine graphically the flow rate and power required if a single pump is connected in the system.

[20]

[TOTAL = 90]

Formulae

$$d-W:\quad h_f = \frac{4fL}{d}\frac{v^2}{2g} = \frac{fLQ^2}{3{,}03d^5}$$

$$H-W:\quad h_f = \frac{10{,}67LQ^{1{,}85}}{C_H{}^{1{,}85}d^{4{,}87}}$$

$$h_s = k\frac{v^2}{2g}$$

$$v = \frac{1}{n}m^{\frac{2}{3}}i^{\frac{1}{2}} \qquad m = \frac{A}{P}$$

$$\Theta = \cos^{-1}\frac{r-h}{r}$$

$$P = 2r\Theta$$

$$A = \frac{1}{2}r^2\left(2\Theta - \sin 2\Theta\right)$$

$$Q = av$$

$$p = \rho gh = \gamma h$$

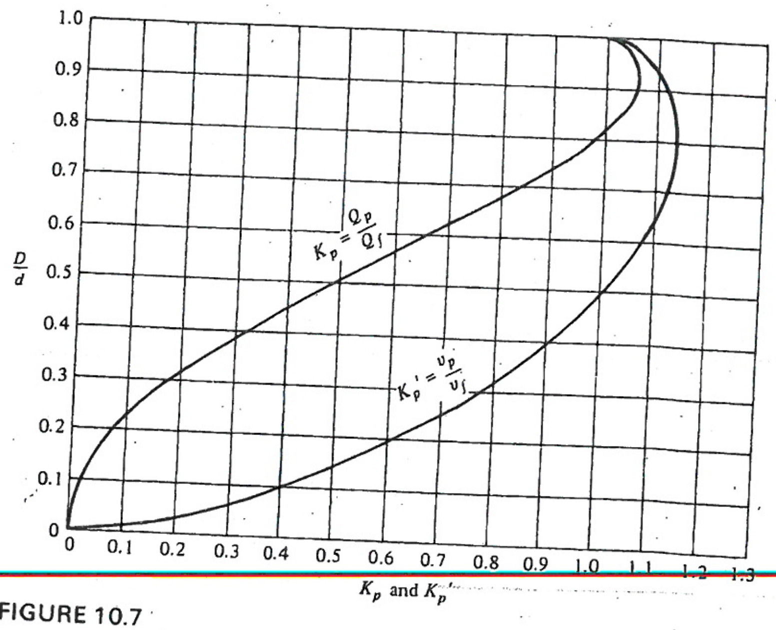
$$H_{sys} = H_{stat} + H_f + H_v$$

$$z_1 + \frac{p_1}{\rho g} + \frac{v_1{}^2}{2g} + h_p = z_2 + \frac{p_2}{\rho g} + \frac{v_2{}^2}{2g} + \sum h_f + \sum h_s$$

$$P = \frac{\gamma QH}{\eta}$$

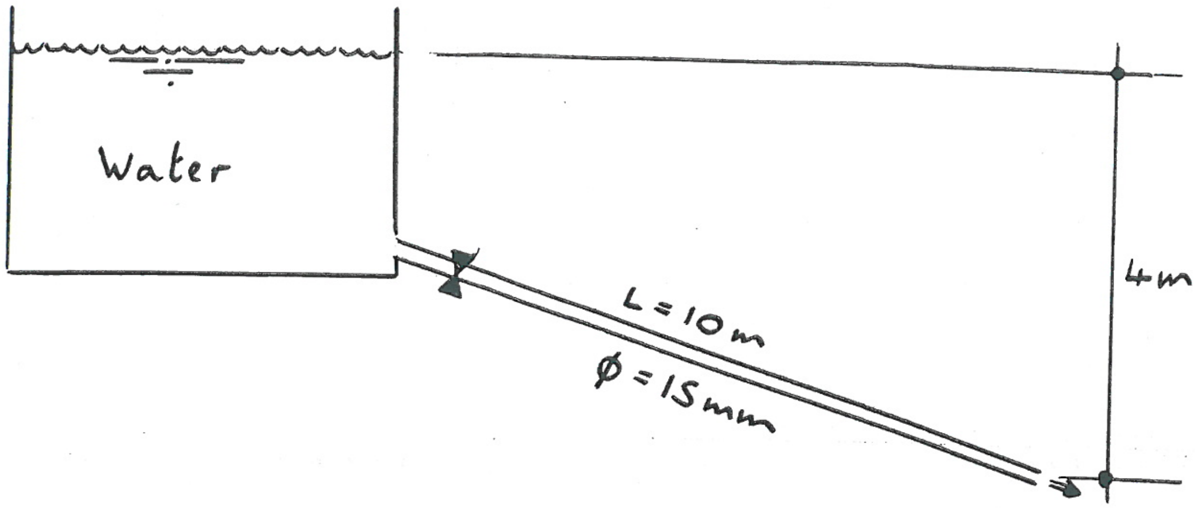
$$L_e = \frac{d_e^5}{f_e}\left(\frac{f_1 L_1}{d_1^5} + \frac{f_2 L_2}{d_2^5} + \frac{f_3 L_3}{d_3^5}\right)$$

$$\left(\frac{d_e^5}{f_e L_e}\right)^{.5} = \left(\frac{d_1^5}{f_1 L_1}\right)^{.5} + \left(\frac{d_2^5}{f_2 L_2}\right)^{.5} + \left(\frac{d_3^5}{f_3 L_3}\right)^{.5}$$



1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
D/d
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3
K_p and K_p'
$K_p = \frac{Q_p}{Q_f}$
$K_p' = \frac{v_p}{v_f}$

FIGURE 10.7



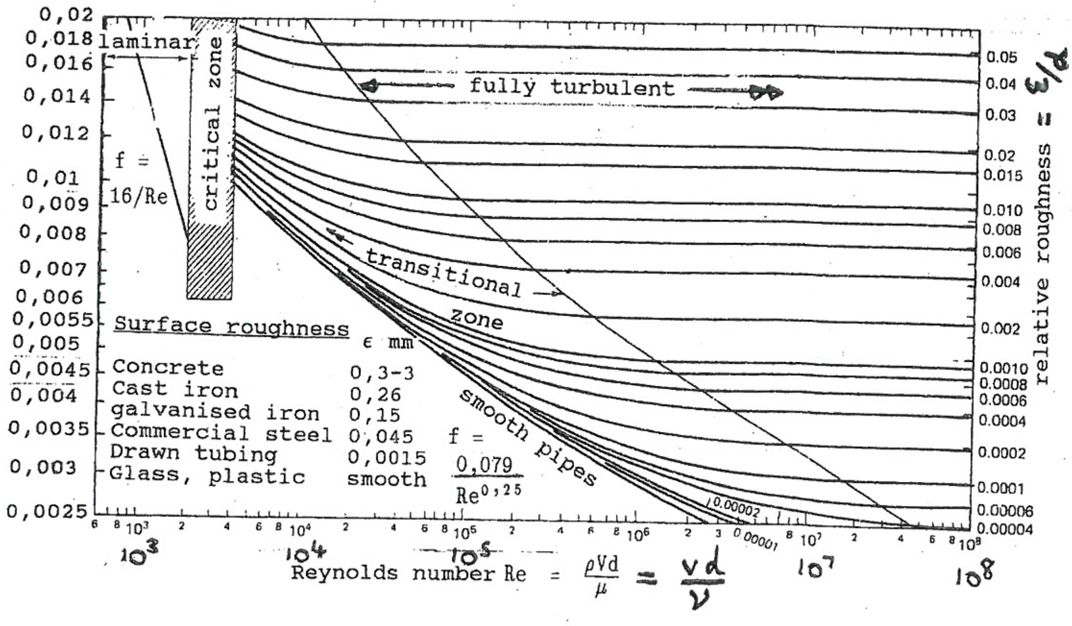
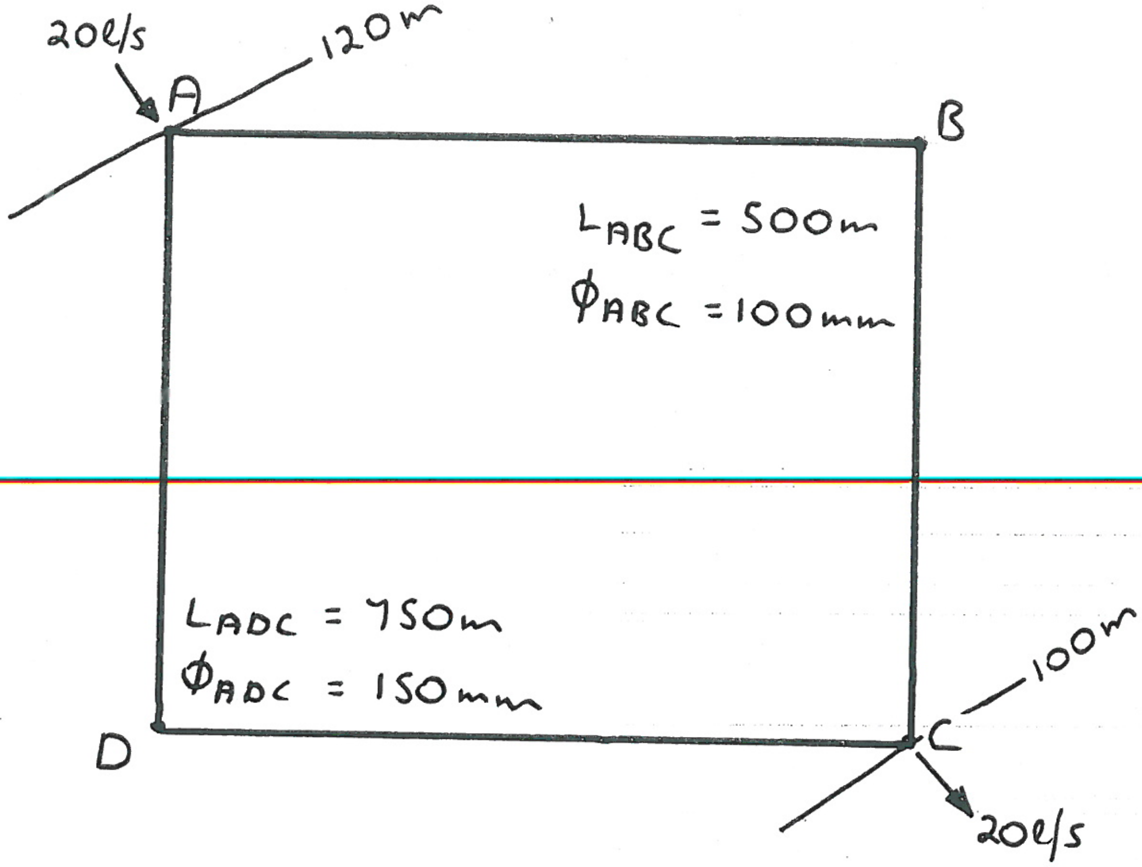


Figure 7.7 Moody-diagram



100m
Contour with elevation above datum