أسئلة وحلول / شبكات المياه / فرع البيئة الصحية / المرحلة الثالثة

University Of Technology
Building and Construction Eng. Dept.
Final Exam – 1st Attempt – 2015/2016

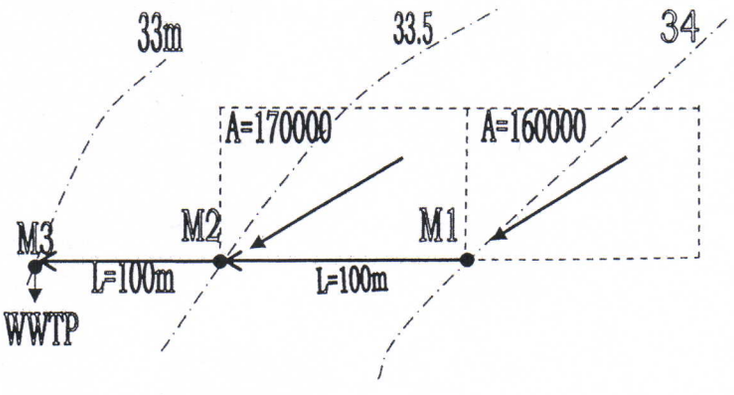
Branch : San. & Env. Eng. Class: 3rd
subject : Networks of Water Time : 3 hr
Examiner : S.A. Al-Bayati, Ph.D. Date : 7/6/ 2016

ملاحظات: ١.أجب عن **خمسة** أسئلة. ٢.الدرجات موزعة بالتساوي على الاسئلة.

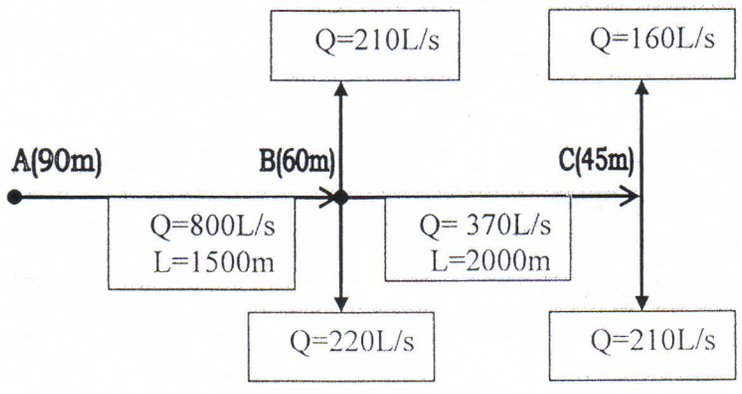
٣.تعاد الأسئلة والمرفقات كافة(دون كتابة عليها) وسط الدفتر الامتحاني. **الاسم:**

Q.1 Design a sanitary sewer system (2- pipelines) for the residential area shown below (M=manhole, A=area (m^2) & L=pipe length between two manholes). The conditions are:

1. min. sewer size = **200mm**.
2. roughness coefficient, n = 0.013
3. min. velocity = **0.6m/s**
4. min. allowable cover over the crown = **1.8 m**
5. max. population density = **11000p /km^2**.
6. max. rate of sewage flow + infiltration = **1900 L/day.capita** [20%]

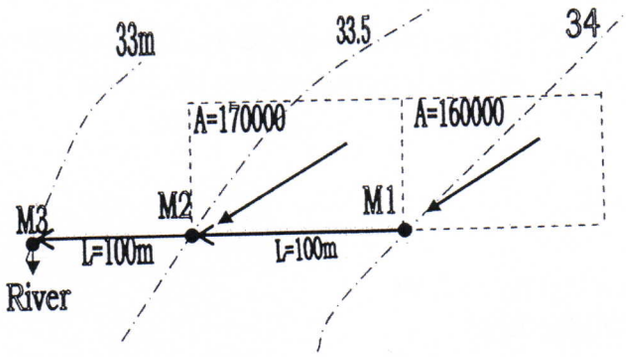


Q.2. Design the following water supply pipelines (AB, & BC). The elevations are given in brackets. The minimum pressure must be **33**m of water in points **A &B** and **44**m of water at point **C**. The piezometric head at A is **220**m & n = **0.013**.[20%]



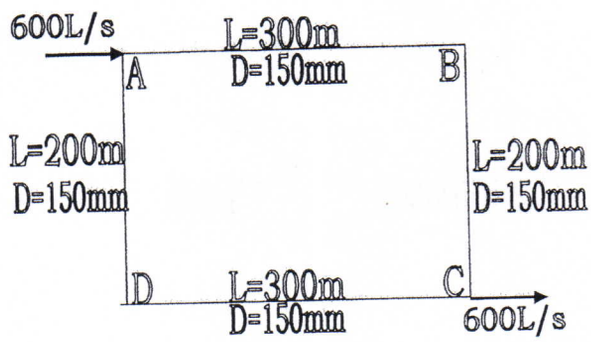
Q.3- a Design a storm sewer system (2- pipelines) for the residential area shown below (M=manhole, A=area (m^2) & L=pipe length between two manholes). The conditions are

1. min. sewer size = **305**mm.
2. roughness coefficient = **0.013**
3. min. velocity = **0.75**m/s
4. min. allowable cover over the crown = **1.8** m
5. runoff coefficient = **0.5**
6. rainfall intensity = **3110/(t + 15)**. [18%]



Q.3-b Explain the unlined open well. [2%]

Q.4 Determine the distribution of flow in the pipe network shown in the Fig. below if f = **0.02**. Use Hardy Cross method with **two** cycles. [20%]



Q.5

a) If the flow rate of a pump is 2.5 m^3/min with a motor power of 25 kW, and head for the pump system is 45m. Find efficiency of the motor of pump. Take efficiency of pump = 80%. [10%]

b) Compare among CCTV, PPS, and line lamping (5 items). [10%]

Q.6

a) A circular orifice with **20** cm diameter in a canal, discharge is **80** L/s, & discharge coefficient is **0.72**. Find the difference in elevation between water surface and center of orifice. [10%]

b) Explain the following: chemical grouting process, gate valve, & centrifugal pump. [10%]

مع التوفيق

Q 1

1 of

Line No.	From MH	To MH	L m	Inc. A m^2	Inc. population person	Total trib. population person	Sewage flow l/d
1	1	2	100	160 000	1760	1760	3168 000
2	2	3	100	170 000	1870	3630	6 534 000

Sewage flow m^3/min	G.E upper end	G.E lower end	Dia. mm	Grade of sewer	Fall of sewer m	V_f m/s	Q_f m^3/min	Q/Q_f	V/V_f
2.2	34	33.5	200	0.013	1.3	1.2	2.3	0.96	1.24
4.54	33.5	33	305	0.005	0.6	1.1	4.8	0.95	1.1

V m/s	Inv. El. Upper end	Inv. El. Lower end
1.49	32.0	30.70
1.21	30.60	30.00

Q.2

Min. pressure at endpoint, A = 33+90 = 123 m

B = 33+60 = 93 m

C = 44+45 = 89 m

AB

At B available head = 220 − 93 = 127 m

headloss /100 $= 100\left(\frac{127}{1500}\right) = 8.5$ m

$Q_{AB} = 0.8\ m^3/s$ & D = 610 mm or 533 mm

$$f_{AB} = \left[\frac{0.013 * 0.8}{\frac{\pi}{4}(0.533)^2\left(\frac{0.533}{4}\right)^{2/3}}\right]^2 = 0.032 = \frac{3.2}{100} < 8.5\ m \quad \text{ok}$$

Total H_L in AB $= 3.2\left(\frac{1500}{100}\right) = 48$ m

piezometric head at B = 220 − 48 = 172 m > 93 m ok.

BC

av. head at C = 172 − 89 = 83 m

H_L /100 $= 100\left(\frac{83}{2000}\right) = 4.15$ m

$Q_{BC} = 0.370\ m^3/s$, D = 381 mm

$$f_{BC} = \left[\frac{0.013\ (0.37)}{\frac{\pi}{4}(0.381)^2\left(\frac{0.381}{4}\right)^{2/3}}\right]^2 = 0.041 = \frac{4.1}{100} < 4.15\ m \quad \text{ok}$$

T. H_L in BC $= 4.1\ \left(\frac{2000}{100}\right) = 8.2$ m

piez. head at C = 172 − 82 = 90 m > 89 m ok

1>t

Q.3-a

line No.	From MH	To MH	Inc. of area m^2	C	Eq. Area (CA) m^2	Total A ΣCA m^2	Time of Conc. min
1	1	2	160 000	0.5	80 000	80000	10
2	2	3	170 000		85 000	165 000	10.53

I mm/hr	Q m^3/min	Grade	Dia. mm	V_f m/s	L m	Time of flow min	Q m^3/min	G.E	
								upper end	lower end
124.4	165.87	0.009	1070	3.15	100	0.53	170	34	33.5
121.8	335	0.012	1370	3.95	100	0.42	350	33.5	33

Inv. EL	
upper end	lower end
31.13	30.23
29.93	28.73

Q.3-b Explain the unlined open well

well dug for temporary purposes, depth ≤ 6.5 m

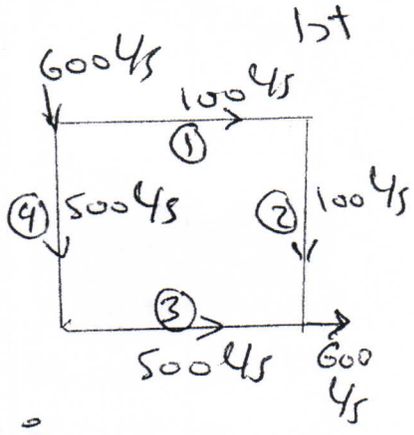
Q.4

$$k_1 = 8\left[\frac{0.02(300)}{9.81(0.15)^5\pi^2}\right] = 6528.9$$

$$k_2 = 8\left[\frac{0.02(200)}{9.81(0.15)^5\pi^2}\right] = 4352.6$$

$$k_3 = 8\left[\quad\right] = 6528.9$$

$$k_4 = 8\left[\quad\right] = 4352.6$$



1st cycle :

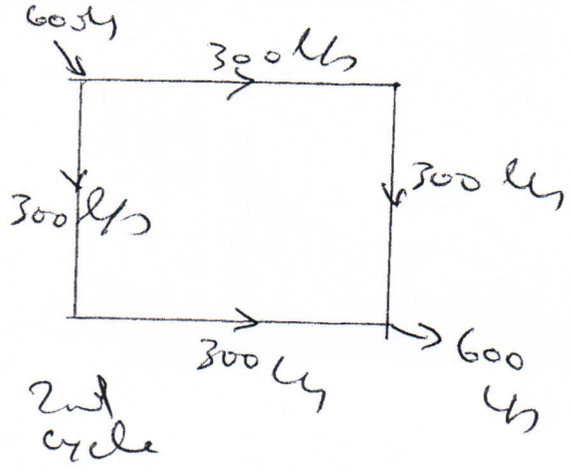
	KQ^2	$2KQ$
1	65.29	1305.79
2	43.53	870.52
3	-1632.23	6528.93
4	-1088.15	4352.62
	Σ -2611.57	13057.85

$$\Delta Q = \frac{-2611.57}{13057.85} = -0.2$$

2nd cycle :

	KQ^2	$2KQ$
1	587.6	3917.4
2	391.7	2611.6
3	-587.6	3917.4
4	-391.7	2611.6
	0	0

$\Delta Q = 0$ Ok



after 2nd cycle

Q.5-a

$$P_w = KQH = 0.163 \times 2.5 \times 45\,m = 18.3\,kW$$

$$P_p = \frac{P_w}{e} = \frac{18.3}{0.8} = 22.9\,kW$$

$$e_1 = P_p / P_m = 22.9/25 = 0.92$$

Q.5.b Compare among CCTV, PPS, & line lamping. (5 items)

	CCTV	PPS	L.lampy
cost	high	high	low
effectiveness	high	high	low
device Technology	high	high	low
accuracy	high	high	low
limitation	no water	in water	no water
store data	good	good	no

Q.6 a

$$H = \left[\frac{Q}{C_d A}\right]^2 \frac{1}{2g} = \left[\frac{0.08}{0.7\left(\frac{\pi}{4}\right)(0.2)^2}\right]^2 \frac{1}{19.62}$$

$$= 0.64 \text{ m}$$

Q.6 b Explain the following: Chemical grouting process, gate valve, & centrifugal pump.

Ch. grouting process: acrylamide grout is pressure injected into a crack & joint in a sewer. A remotely operated grout packer is used. Close pipe area, inject grout & clean remaining grout.

Gate valve: Free flow through it, control flow & shutt off water for repairing, widely used in water supply, placed at intersection.

Centrifugal p.: contains volute & impeller. convert some of velocity into pressure, gives high head