

1- a- Given a short notes with neat sketches for the different types of sedimentation tank according to direction of flow and shape of tank . (4Marks)

b- If the concentration of suspended solids is 100 mg/L and removal ratio in sedimentation tank is 90 % , what would be the accumulated sludge volume per day if the design flow 3000 m³/hr and the plant working 16 hrs/day . Determine the diameter of sludge pipe if sludge is withdrawal twice daily . (5Marks)

c- Design the required rectangular sedimentation tanks for a flow of 60000 m³/d and volume 2000 m³ for each tank . The surface loading rate is 40 m/d and depth 4.0 m .Check all dimensions of the tank and draw the plan of each tank showing the outlet weir . (8Marks)

2- a- Discuss briefly the following :

- Purposes of filtration in water purification .
- Purpose of supplying air under pressure to rapid sand filter just before backwashing .
- Functions of wash water gutters during washing period .
- Function of rate controller valve in rapid sand filter . (8Marks)

b- A rapid sand filter plant consists of 10 filters treats 50000m³/d .If water alone is used in washing the beds and the wash water is supplied from an elevated storage tank. What should be the capacity of tank if two filters are to be washed simultaneously and design the wash water gutters for each filter . (filtration rate=125 m/d , backwashing rate = 750 m/d and T_b = 15 min) (5Marks)

c- A rapid sand filter unit 6x8 m. After filtering 5000 m³/d in a 24 hr period, the filter is backwashed at a rate 500 m/d for 12min . Calculate the rate of filtration and the settling velocity if the sand depth during backwash 1.5 time the initial depth . (e =0.35,dp= 0.4mm and specific gravity = 2.65) (5Marks)

3- a- Discuss briefly the following :

- Mode of chlorination .
- Purposes of ground storage tank .
- The operation of elevated storage tank with respect to the distribution system and draw the sectional elevation of the tank showing all pipes and valves . (6Marks)

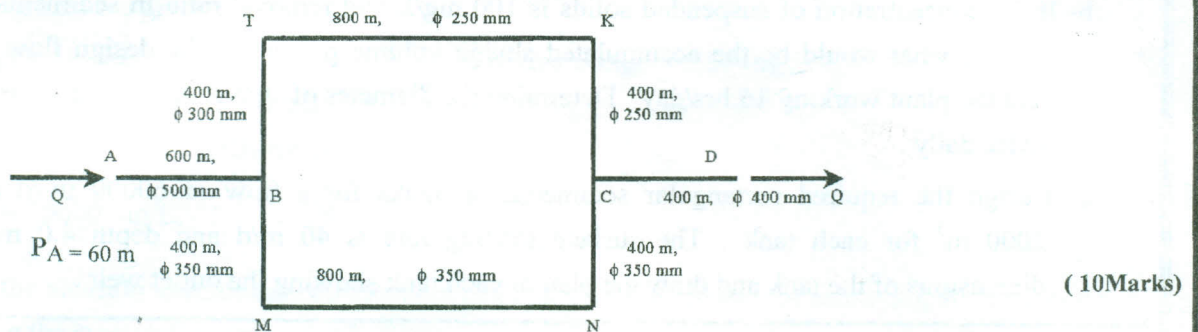
b- Determine the minimum capacity of elevated storage required for a town of population 200000 capita and daily consumption of 180 L/c/d , if the high lift pump working 16 hrs/day with uniform rate .

Time	Consumption (lit /hr)	Time	Consumption (lit /hr)
12 N – 2	1.0	12 N – 2	14.0
2 – 4	2.0	2 – 4	12.0
4 – 6	4.0	4 – 6	10.0
6 – 8	5.0	6 – 8	6.0
8 – 10	14.0	8 – 10	5.0
10 – 12 M.N	15.0	10 – 12 M.N	2.0

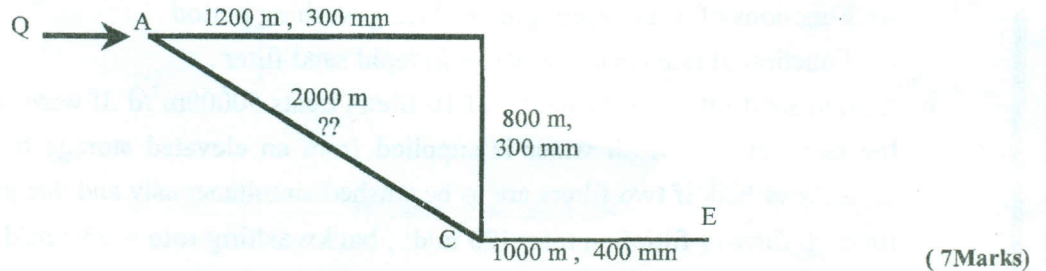
(9Marks)

4- a- State using sketches the different layouts of distribution systems stating the advantages and disadvantages of each system . (3Marks)

b- The value of the discharge Q, in the shown network of a distribution system , is increased from 250 L/S to 350 L/S . To the maintain the pressure at D equal its original value , it is suggested to put the pump on point C . What would be the head of the pump ?



c- Determine the diameter of pipeline AC in the shown network distribution system , if $Q = 150 \text{ L/sec}$, $P_A = 50 \text{ m}$ and $P_E = \text{minimum pressure}$.



5- a- Write brief notes with neat sketches on the following :-

- Location of manholes in the sewerage system .
- Types of pumping station .
- Location of wastewater treatment plant .
- Purposes of primary treatment .

(8Marks)

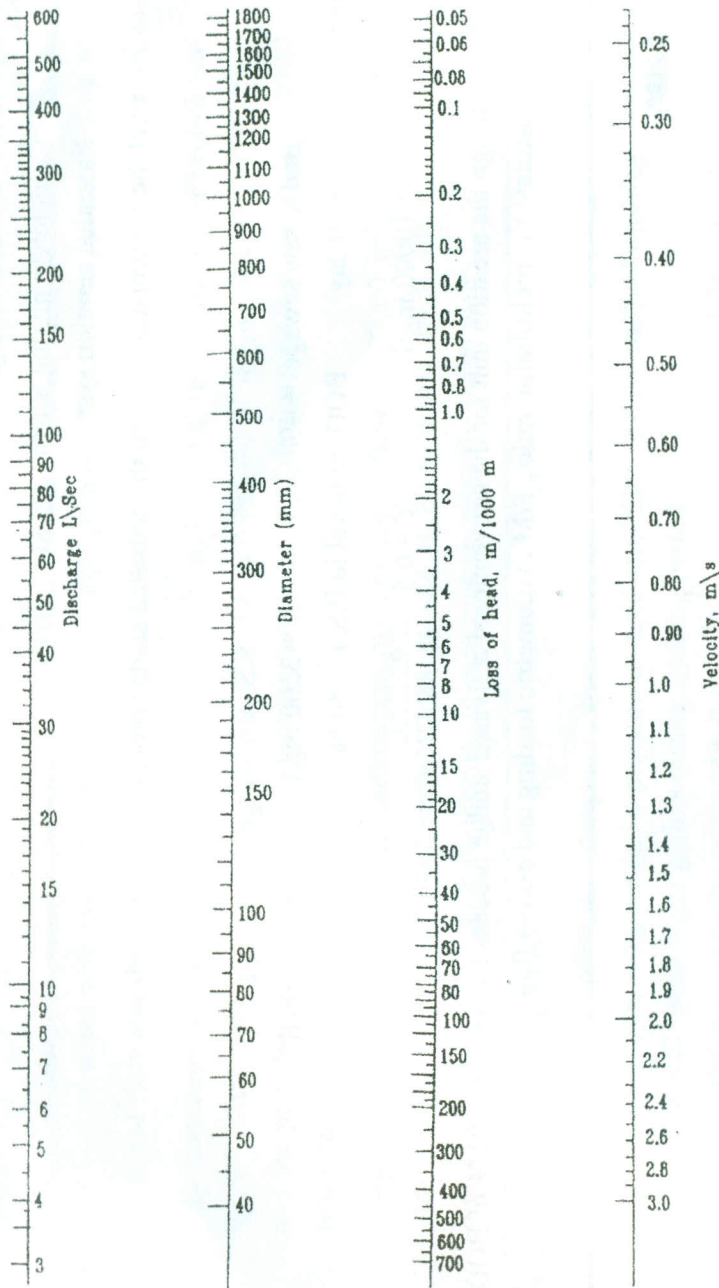
b- A main collector sewer pipeline is to carry $0.163 \text{ m}^3/\text{sec}$ where $\frac{d_{\text{max}}}{\phi} = 2/3$ at max. flow and $0.066 \text{ m}^3/\text{sec}$ at min flow . IF the velocity at the min . flow should not be less than 0.5 m/sec . Determine the diameter , the minimum slope of sewer ,the velocity and depth of sewage a max. and min. flows . Calculate the diameter of wet well pumping station and draw the cross sectional elevation of the wet well if the ground level and invert level of inlet pipe are (10.00) and (5.00) respectively .

(10Marks)

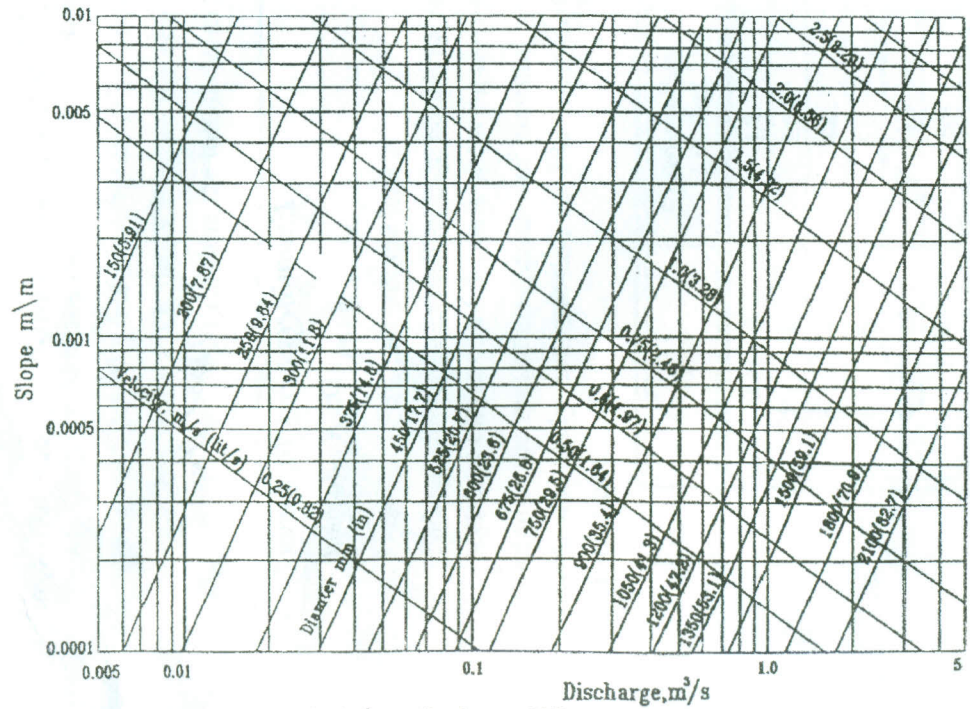
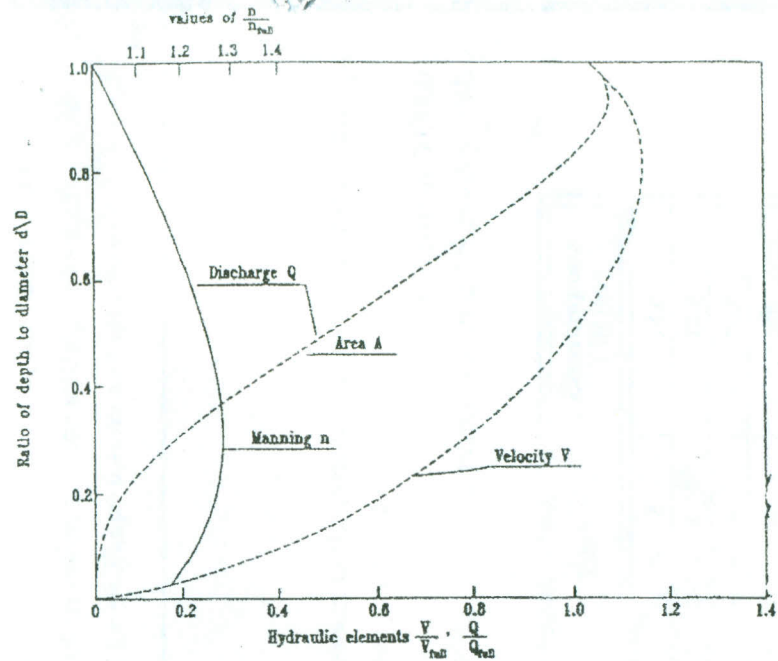
c- For a wastewater treatment plant processing average flow of $25000 \text{ m}^3/\text{d}$ with peak and minimum factors of 2.0 and 0.5 respectively . Its required to design :

- The approach channel. ($V = 0.9 \text{ m/s}$. at average flow) .
- The screen chambers. ($S = 3.0 \text{ cm}$, $a = 2.0 \text{ cm}$, $\theta = 60^\circ$) .
- The grit removal tanks. ($V_h = 0.3 \text{ m/s}$, $T = 60 \text{ sec}$) .

(12Marks)



Nomograph of Hazen-Williams equation



Nomograph for solution of Manning's equation for $n = 0.013$

6- a- Draw the flow diagram for the following :-

- Completely mixing activated sludge system .
- Extended aeration system .

(4Marks)

b- Find the recirculation ratio in the activated sludge process .

(4Marks)

c- following data are given :

- $Q_{av} = 10000 \text{ m}^3/\text{d}$
- S.S. raw swage = 550 mg/L
- $BOD_5 \text{ raw sewage} = 400 \text{ mg/L}$
- $X = 3500 \text{ mg/L}$
- $K_d = 0.06 \text{ d}^{-1}$
- $\theta_c = 10 \text{ day}$
- $BOD_5 \text{ removal in P.S.T} = 30 \%$
- $X_u = 10000 \text{ mg/L}$
- $Y = 0.5 \frac{KgBOD_5}{Kg MLSS}$

Design the aeration unit for the conventional activated sludge process for removing 90 % of BOD_5 .

Calculate the recirculation ratio , F/M , volumetric loading and excess flow .

(12Marks)

Notes:

$$e_{fb} = \left(\frac{V_B}{V_t} \right)^{0.22}$$

$$V_t^2 = \frac{4}{3} \frac{g(\rho_p - \rho_w)d_p}{C_d \rho_w}$$

$$\mu = 1.002 \times 10^{-3} \text{ N.S/m}^2$$

$$Re = \frac{\rho_w V d_p}{\mu}$$

$$V = \frac{QY\theta_c(S - S_e)}{X(1 + k_d\theta_c)} \text{ (volume of aeration tank)}$$

$$\rho_w = 1000 \text{ kg/m}^3$$

Good Luck

Examiners : Prof. Dr. Ahmed Fadel

Dr. R. Barakat