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

Branch :Structural Eng. **Class: Third**
subject : Sanitary Engineering **Time : 3 Hours**
Examiner : Lec. Rana J. Kadhim **Date : 15 /6/2016**

Note:- Answer Four questions only

Q1:-A/ Determine the maximum daily consumption and fire demand in (l/c/d) for a community of 22000 capita, has an average Consumption is 600 l/c/d and fire flow dictated by a 6 story ordinary construction building of a floor area of $1000m^2$/story.

(12.5 marks)

B/ Explain briefly the following terms:

1- The types and sources of water impurities.
2- The characteristics of sand and gravel used in filter media.
3- The methods used for population forecasting.
4- The common methods used for disinfection of water.
5- Physical characteristics of sewage

(12.5marks)

Q2:- A/ The following data was obtained in a chlorination experiment. Plot the data and determine the break point dosage.

Dosage (mg/l)	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Residual(mg/l)	0.8	1.55	1.95	1.25	0.5	0.85	1.95

What dosage is required to provide a free residual of (1) mg/l.

(12.5marks)

B/ Define only the following terms:

1- Trickling filters.
2- Coagulation and Flocculation.
3- Biochemical oxygen demand.
4- Surface overflow rate.
5- Breakpoint chlorination.

(12.5marks)

Q3:-A/ A stream has a flow of 0.5 m^3/s, BOD concentration is 3 mg/l , temperature 22°C and DO 8 mg/l , a waste water spilled into the river with a flow of 15000 m^3/d , BOD concentration 40 mg/l, temperature25°C and DO 2 mg/l. at 20°C, k_1 for the mixture 0.23 /d , k_2 for the river 0.4 /d. Find Critical dissolved oxygen deficit and the distance it happens if the average velocity of flow is 0.2 m/s.(saturated level of oxygen is 8.7 mg/l).

(12.5marks)

B/ Draw a sketch showing the method of filtration and back washing of filters (R.S.F.)

(12.5 marks)

Q4:- A/ A treatment plant uses 12 R.S.F. of a capacity of 4000 m^3 /d for each filter. The filtration rate is 160 m/d and the backwash rate is 864m /d. Each filter is designed with two troughs of a square cross Section find:-

1- Dimensions of each filter.

2- Dimensions of each trough.

(12.5marks)

B/ State only the following terms:-

1- The factors that affect the coagulation process.

2- The Factors that must be considered in the location of water intakes.

3- Types of settling tanks.

4- The physical factors affect process of self- purification of stream.

5- The Factors affecting water consumption.

(12.5marks)

Q5:-A/ A rectangular sedimentation tank, L=30m, W=16m and H=4m is designed to treat 12000 m^3/d, the effluent weir length=60m. Find:-

1- Detention time.

2- Weir loading.

3- Surface over flow rate.

4- Settling velocity of a particle entering at the top and reaching the bottom at mid length of tank.

(12.5marks)

B/ 1- Draw a sketch showing bacterial growth curves based on (number and mass of organisms).

2- Draw a sketch showing (units) of conventional water treatment plant.

(12.5marks)

Useful information:-

$$D_t = \frac{k1\ la}{k2-k1}\ (10^{-K1*t} - 10^{-K2*t}) + D_a\ 10^{-K2*t}$$

$$T_c = \frac{1}{k_2 - k1} \log\{ \frac{k_2}{k_1} (1 - \frac{D_a\ (k_2-k1)}{k_1\ La})\}$$

$$D_c = \frac{k_1}{k_2} L_a * 10^{-k1\ Tc}$$

$$XV = \frac{Y\ Q\ (S_o - s)\theta_c}{1+K_d\ \theta_c}$$

$$\frac{dX}{dt} = \frac{xV}{\theta_c}$$

$$O_{2\ demand} = 1.47\ (S_o - S)\ Q - 1.14\ X_r\ Q_w$$

$$Q_r = \frac{Q_x}{X_r - X}$$

$$r = \frac{Q_r}{Q}$$

$$G = (\frac{P}{\mu\ V})^{0.5}$$

$$y = 1.73 \sqrt[3]{\frac{Q_b^2}{g\ b^2}}$$

$$\text{vol. of air required} = \frac{wt.of\ O_2}{\%\ O_2 \times \rho_{air}}$$

حلول أسئلة الامتحان النهائي - الدور الأول العام 2015/2016
فرع الهندسة المدنية
المرحلة: الثالثة
المادة: الهندسة الصحية

Q1:- A/ sol.

Average domestic demand = 22000 * 600 = $13.2 * 10^6$ l/d

Maximum daily demand = 1.8 * ave. = $23.76 * 10^6$ l/d

$F = 18C\sqrt{A}$

$= 18 * 1 * \sqrt{1000 * 10.76 * 6}$ = 4574 gpm = 17288 l/min

$= 24.89 * 10^6$ l/d

Maximum Rate = $23.76 * 10^6 + 24.89 * 10^6$

$= 48.65 * 10^6$ l/d = 2211 l/c/d for 10hrs

the total flow required during this day would be:-

$23.76 + 24.89 * \frac{10}{24} = 34.13 * 10^6$ l = 1551 l/c/d

Comparative method

Ratio and Correlation method.

$$\frac{P_f}{P_f'} = \frac{P_i}{P_i'} = k \text{ (constant)}$$

Q1) B

1/

Impurities of water

- Suspended
  - Bacteria
  - Algae
  - Protozoa
  - Viruses
  - Silt, clay
  - colloids
- dissolved
  - Salts
    - cations: Ca^{+2}, Mg^{+2}, Fe^{+2}, Mn^{+}
    - anions: HCO_3^-, $CO_3^{=}$, $SO_4^{=}$, Cl^-
  - organics: color, odor, taste, toxicity
  - Gases: O_2, CO_2, H_2S

Q1/B

2/

خصائص الرمل والكول

الرمل : أرضية مادة كوسط للترشيح ، خالي من الأوساخ ، صلب ، مقاوم بلوري ، لا يفقد أكثر من 5٪ من الوزن بعد وضعه في حامض HCl بنسبة 4٪ لمدة 24 ساعة ، حجم الرمل 60 - 70 سم مكعب متر 0.45 - 0.55 mm عامل التجانس لا يتجاوز $1.2 \leq U.C \leq 1.7$

الكول : يوضع الحصو بخمسة أو ستة طبقات حيث تكون الطبقات العليا حاوية على حجم الجسم ، صلب ، متدور ، مقاوم ، الوزن التقريبي 1600 كغم خالي من الشوائب ، غير حاوي على الطين ، الرمال ، تربة عضوية ، مقاوم أو مواد غريبة ، حجم 400 - 600 mm

Q1:- B/

3-

Graphical method, Arithmetic method

$$\frac{dp}{dt} = k_a$$

$$dp = k_a dt$$

$$p_f = p_i + k_a (t_f - t_i)$$

$$\therefore k_a = \frac{p_f - p_i}{t_f - t_i}$$

Geometrical method $\frac{dp}{dt} = k_g p$

4-/ وسائل التعقيم ① الطرق الفيزيائية وتضم المعالجة بالحرارة

وترفع درجة الحرارة الى 100م ولمدة 15 - 20 دقيقة لقتل الجراثيم

- استخدام الاشعة فوق البنفسجية حيث تمر المياه بغرفة تعرض فيها الاشعة فوق البنفسجية لطول موجة 200 - 360 نانومتر
- استخدام ايونات المعادن مثل الفضة والنحاس
- اشعة الشمس

② الطرق الكيميائية: وتضم المواد الكيميائية المؤكسدة (مركبات تستقبل الالكترونات لتطهير المياه، ومثل ذلك غاز الكلور ومركبات الكلور، الاوزون اليود، برمنغنات البوتاسيوم لتطهير المياه)

Q1:- B/

5/ Physical characteristics

sewage is 99.9% water, but the remaining material has very significant effects fresh domestic sewage

slightly soapy

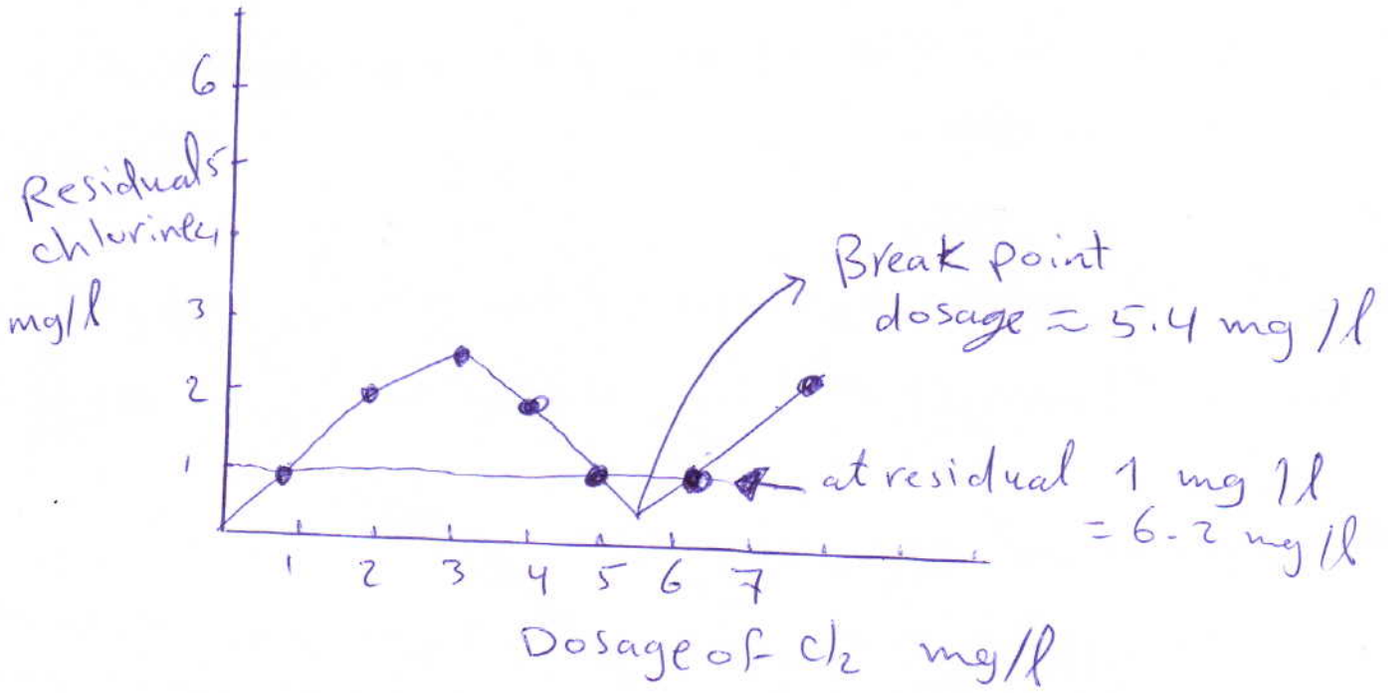
oily odor

cloudy, contains recognizable solids, a considerable size

state sewge, has a pronounced odor of H_2S

dark grey, contains smaller but occasionally recognizable suspended solids.

Q2:- A/ sol.



Q2 :- B/ define only:

1- Zeta potential : when acharged is placed in an electric field, it will migrate to the pole of opposite charge. this movement is called electrophoresis, the electric potential between the shear plane and the bulk solution is called Zeta

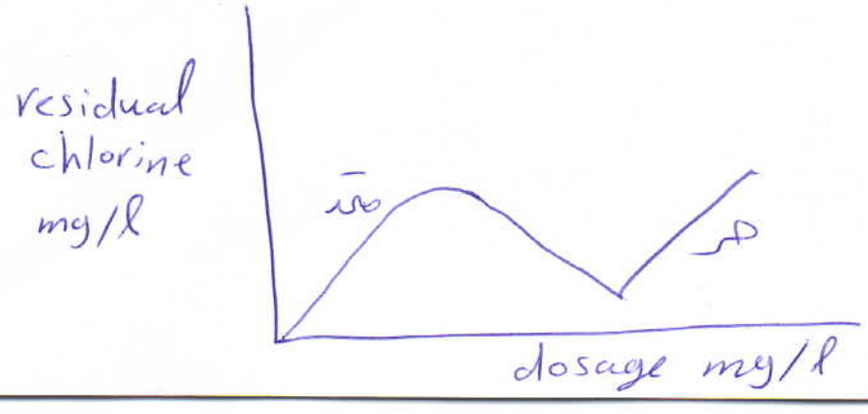
2- Coagulation: Destabilization colloids
Flocculation: Aggregation of destabilized colloids

3- BOD: Bacteria placed in contact with organic material will utilize it as a food source. the organic matter will be oxidized to stable end product such as CO_2 and water.

4- SOR: Physically represent the settling velocity of the smallest (slowest) settling particle which is 100% removed.

5- Break-point chlorination.

هي النقطة التي يتفاعل بها الكلور الحر وبعدها يبقى كلور حر متبقي في حالة وجود مواد عضوية كثيرة في الماء وطالبة المتبقية منه.



Q3:- A/ sol.

$Q_w = 15000\ m^3/d = 0.17\ m^3/s$

$Q_{mix} = 0.17 + 0.5 = 0.67\ m^3/s$

$$BOD_5)_{mix} = \frac{40(0.17) + 3(0.5)}{0.67} = 12.4\ mg/l$$

$$L_a = \frac{BOD_5)_{mix}}{1 - 10^{-k_1 t}} = \frac{12.4}{1 - 10^{-0.23 \times 5}} = 13.3\ mg/l$$

$$DO)_{mix} = \frac{8(0.5) + 2(0.17)}{0.67} = 6.5\ mg/l$$

$$T)_{mix} = \frac{22(0.5) + 25(0.17)}{0.67} = 22.8\ ^\circ C$$

$$k_1(22.8) = k_1(20^\circ c) * 1.047^{(22.8-20)} = 0.26/d$$

$$k_2(22.8) = k_2(20^\circ c) * 1.016^{(22.8-20)} = 0.42/d$$

$$D_a = C_s - C = 8.7 - 6.5 = 2.2\ mg/l$$

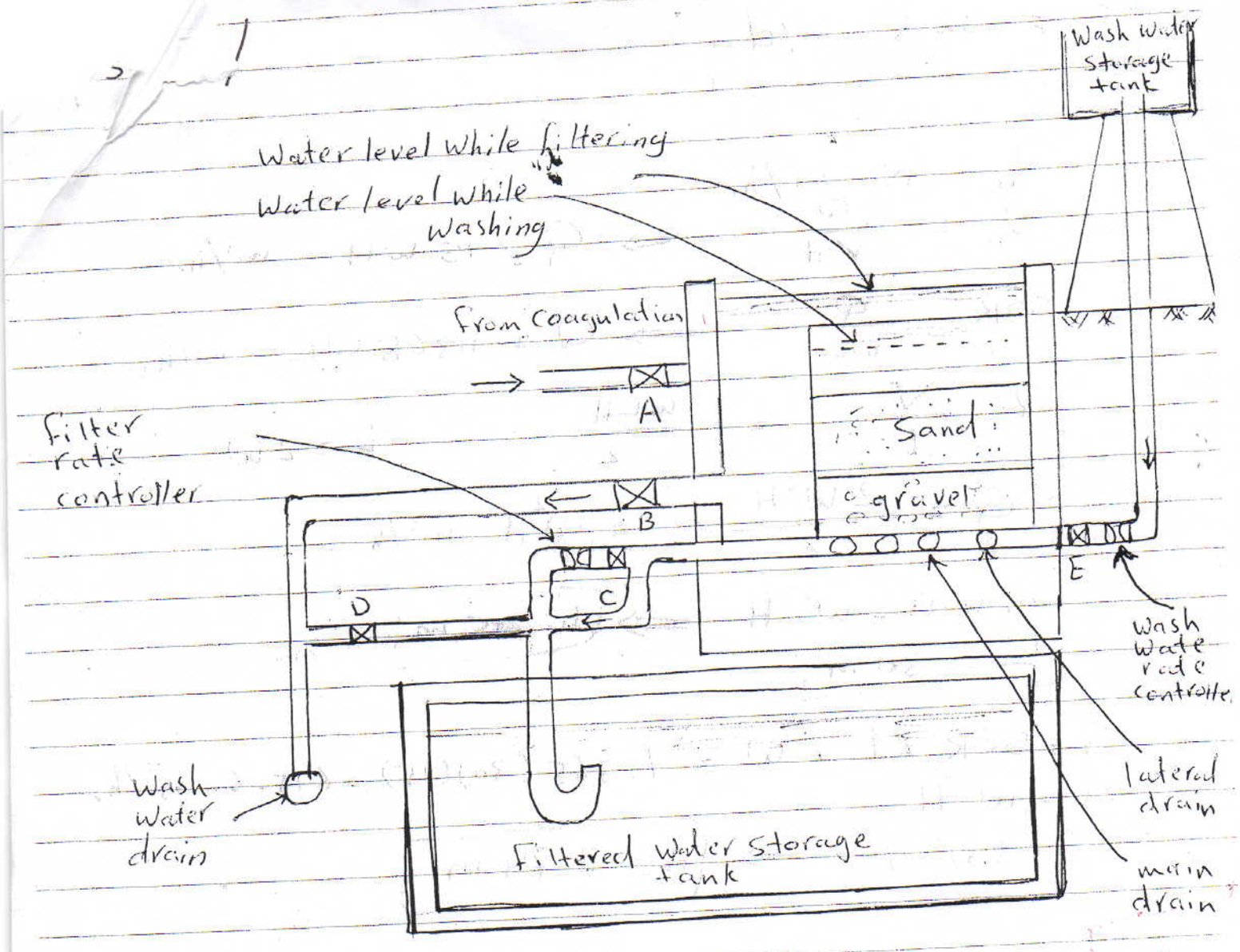
$$t_c = \frac{1}{k_2 - k_1} \log\left\{\frac{k_2}{k_1}\left(1 - D_a \frac{k_2 - k_1}{k_1 L_a}\right)\right\}$$

$t_c = 1.01$ day

$D_c = 4.470\ mg/l$

$$\text{distance}(X) = 0.2\ \frac{m}{s} * 1.01 * 86400$$

$$= 17.6\ Km$$


Wash water storage tank
Water level while filtering
Water level while washing
From coagulation
A
Filter rate controller
Sand
gravel
B
C
D
E
Wash water rate controller
Wash water drain
Filtered water storage tank
lateral drain
main drain

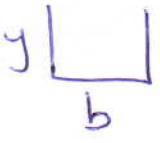
Q4 :- A/ Sol.

assume $W = 4\ m$

$$A_s = L * W = \frac{Q_f}{V_f} = \frac{4000}{160} = 25\ m^2$$

$$\therefore L = \frac{25}{4} = 6.25\ m$$

ملاحظة بحكي كيف W ص
معرف عدد السواقي
2 trough



$$y = b$$

$$y = 1.73 \sqrt[3]{\frac{Q_b^2}{g b^2}}$$

$$Q_b = \frac{864 * 25}{24 * 60 * 60 * 2} = 0.125\ m^3/s$$

$$\therefore y^3 = 1.73^3 * \frac{0.125^2}{9.8 * y^2}$$

$$y^5 = \frac{1.73^3 * 0.125^2}{9.8}$$

$$\therefore y = 0.38\ m = b$$

Q4:- / B state

1-

١- نوعية الماء
٢- كمية وخواص المواد الغروية
٣- PH Value
٤- الخط السريع وفترة الترسيب وسرعة الجاذبية
٥- درجة الحرارة
٦- القاعدية
٧- خواص الايونات في الماء

2-

1- The intake should be located in a place no fast curren
2- The ground near the intake should be stable.
3- The approach to the intake should be free from obstacles
4- The inlet should be below the surface of the water and above the bottom of the water body.
5- should be located at some distance from the bank
6- intake should be located on the upstream of the town
7- The low water level and max. water level should be consid

3- settling Tanks

1- horizontal, vertical, radial flow
2- circular, rectangular, square
3- Detention time, 4- continuous flow
fill and withdraw
4- Plain Sedimentation (without chemical)

Q4:- / B

4-

1- Dilution -
2- Currents -
3- Sedimentation.
4- Bottom deposits and runoff.
5- Sunlight.
6- Temperature.

5-

1- Size of city.
2- Presence of industries.
3- Quality of the water and cost.
4- the climate.
5- characteristics of the population.
6- Metering.

Q5:- A/ sol.

Vol. of the tank = 30 * 16 * 4

= 1920 m^3

1- detention time = $\frac{\text{Vol.}}{Q}$

= $\frac{1920\,(24)}{12\,000}$ = 3.84 hr

2- Weir load = $\frac{12000\ m^3/d}{60\ m} = \frac{Q}{\text{weir length}}$

= 200 m^2/d

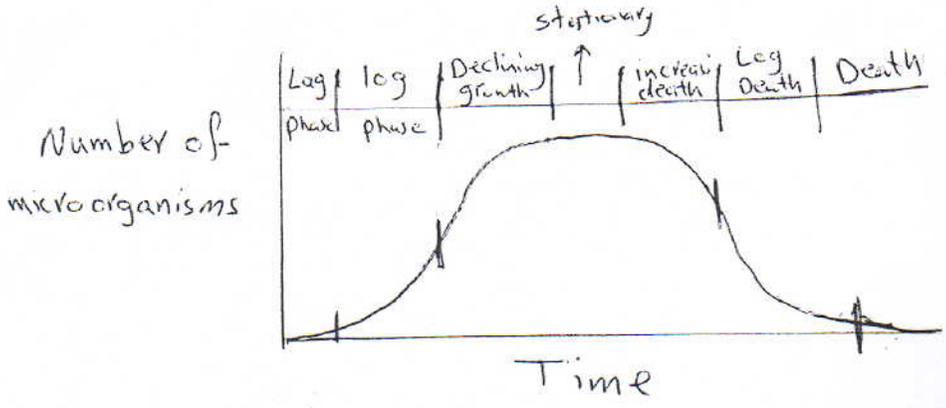
3- $A_s = L * W = 30 * 16 = 480\ m^2$

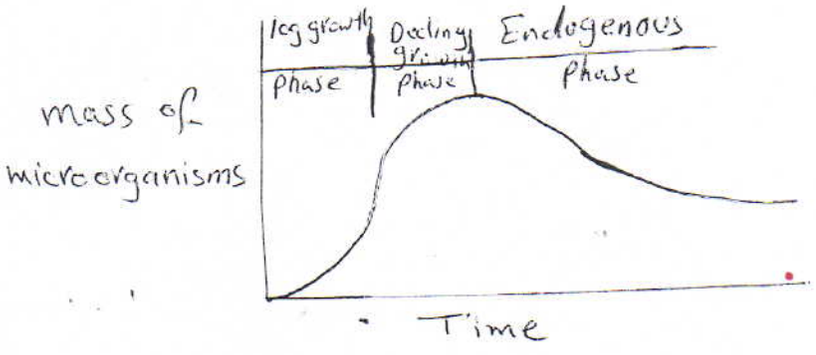
SOR = $\frac{Q}{A_s} = \frac{12000}{480}$ = 25 m/d

4- $\frac{V_{s1}}{V_{s2}} = \frac{h_1}{H} \longrightarrow \frac{25}{V_{s2}} = \frac{4/2}{24}$

V_{s2} = 50 m/d

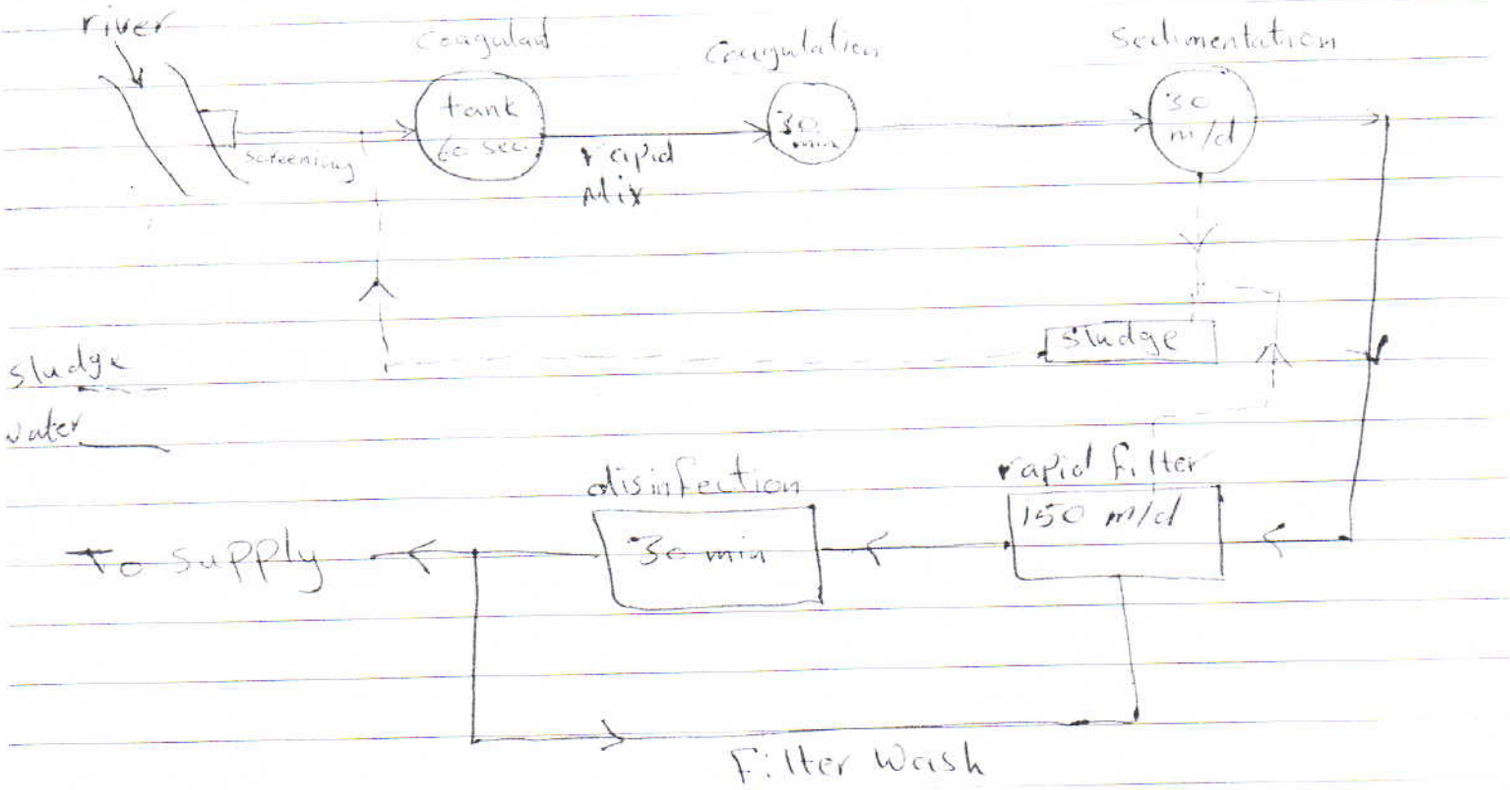
Q5 B/ 1-


Stationary
Lag phase
log phase
Declining growth
Log Death
Death
Number of microorganisms
Time


log growth phase
Declining growth phase
Endogenous phase
mass of microorganisms
Time

MEMO

Q5:- B/ 2-


river
Coagulant
tank
60 sec
Coagulation
30 min
Sedimentation
150 m/d
screening
rapid Mix
sludge
sludge
water
disinfection
30 min
rapid filter
150 m/d
To supply
Filter Wash