

Note : Answer Five questions only

Q<sub>1</sub>: Connect between the sentences in the left column with the suitable and compatible sentences in the right column. (20 Marks)

No.	Left Column	No.	Right Column
1	At a given section of a channel the depth of flow does not change with distance	A	$y_2=4y_1$
2	Rivers and streams	B	Steady jump
3	Prismatic channels	C	One half of square
4	Most economical rectangular channel	D	Rapidly varied flow
5	For a rectangular channel, $V=3\text{m/sec}$ and $y=0.6\text{m}$	E	Lining of channel
6	For hydraulic jump in rectangular channel, $Fr_1=3.1623$	F	Artificial channels
7	Normal depth ( $y_n$ ) > Critical depth ( $y_c$ )	G	Uniform flow
8	Hydraulic jump	H	Mild slope
9	Increasing the canal capacity	I	Super critical flow
10	$Fr = 5$	J	Natural channels

Q<sub>2</sub>: For a trapezoidal channel of bed width (B) (4m), the depth of flow (y) is (1.2m), the bed slope (S) is (1 in 2000), the side slope (Z) is 1.5(H):1(V) and Manning's coefficient (n) is (0.015). It is desired to increase the discharge to a maximum value by changing the dimensions of the section with keeping the same value of the cross section area, bed slope, and roughness coefficient. Find the new dimensions of this channel and then find the increasing in the discharge. (20 Marks)

Q<sub>3</sub>: Water flow in a rectangular canal of bed width ( $B_1$ ) equal to (2.4m) and depth of flow ( $y_1$ ) equal to (1m). At a given section the bed width of this canal was reduced to ( $B_2$ ) equal to (1.3m) and the depth of flow ( $y_2$ ) is (0.85m). When a hump with depth (h) equal to (0.2m) is fixed at the throat section (section 2), a critical depth ( $y_c$ ) occurred over the hump. Find the normal depth at (section 1) after fixing the hump. (20 Marks)

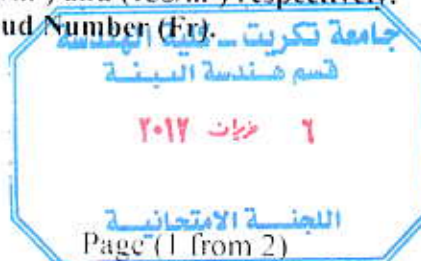
Q<sub>4</sub>: The optimum bed width (B) of a non erodible channel is equal to (2.2m). The discharge of this channel is ( $12\text{m}^3/\text{sec}$ ), Manning's (n) is (0.025), Bed slope (S) equal to (0.0005) and  $V_{\min}$  is (0.5 m/sec).

a- Determine the cost of 1km of this channel if the cost of excavation, lining and land purchasing are ( $10.5\$/\text{m}^3$ ), ( $18\$/\text{m}^2$ ) and ( $15\$/\text{m}^2$ ) respectively. (12 Marks)

b- Find critical depth ( $y_c$ ) and Froud Number (Fr). (8 Marks)

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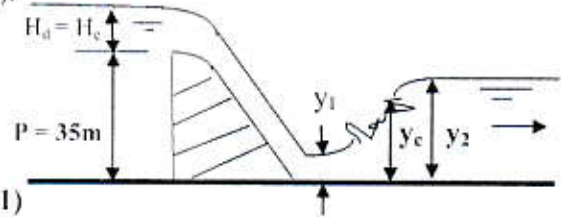
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Q<sub>5</sub>: A hydraulic jump occurred at the end of Ogee spillway. For this jump, the critical depth ( $y_c = 2.5\text{m}$ ). The height ( $P$ ) of the spillway is equal to (35m).

The crest of the spillway consists of (8) spans having clear width of (10m) each, the thickness of each pier is (2m).

$K_p = 0.01$  ;  $K_a = 0.1$  ;  $C = 2.2$  ; assume  $H_d = H_c$



a- Find the D/S crest coordinates of this spillway, where the downstream sloping of this spillway is (0.8:1)

(10 Marks)

b- Find energy losses ( $\Delta E$ ) in this jump.

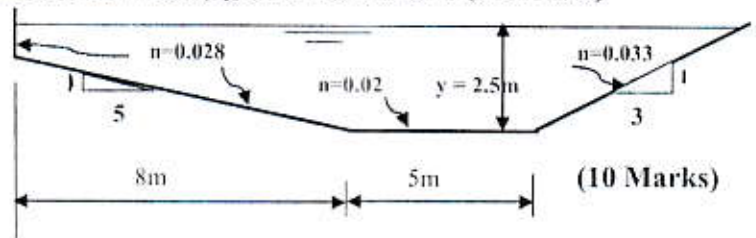
(10 Marks)

Q<sub>6</sub>: For the compound channel shown in the figure, the flow rate ( $Q$ ) of this channel is ( $30 \text{ m}^3/\text{sec}$ ).

Determine the bed slope ( $S_o$ ) using:

a- Compound section method

$$Q = \left[ \left( \frac{A_1}{n_1} \right) R_1^{\frac{2}{3}} + \left( \frac{A_2}{n_2} \right) R_2^{\frac{2}{3}} + \dots \right] (S_o)^{\frac{1}{2}}$$



(10 Marks)

b- Manning equation with equivalent roughness coefficient

$$n_e = \frac{PR^{\frac{2}{3}}}{\sum_{i=1}^M \left( \frac{P_i R_i^{\frac{2}{3}}}{n_i} \right)}$$

(10 Marks)

The following formula may be helpful:

$$Q = \frac{1}{n} AR^{\frac{2}{3}} S_o^{\frac{1}{2}} ; Q = \frac{1.49}{n} AR^{\frac{2}{3}} S_o^{\frac{1}{2}} ; A = By + Zy^2 ; P = B + 2y\sqrt{1+Z^2} ; R = \frac{A}{P} ; T = B + 2Zy$$

$$y_c = \left( \frac{q^2}{g} \right)^{\frac{1}{3}} ; E_{min} = 1.5 y_c ; Fr = \frac{V}{\sqrt{gy}} ; \frac{Q^2}{g} = \frac{A^3}{T} ; Fr = \frac{V}{\sqrt{gy_b}} ; E = y + \frac{V^2}{2g}$$

$$\frac{B+2Zy}{2} = y\sqrt{1+Z^2} ; R = \frac{y}{2}$$

$$\frac{y_2}{y_1} = \frac{1}{2} \left[ \sqrt{1+8Fr_1^2} - 1 \right] ; \frac{y_1}{y_2} = \frac{1}{2} \left[ \sqrt{1+8Fr_2^2} - 1 \right] ; \Delta E = \frac{(y_2 - y_1)^3}{4y_1 y_2}$$

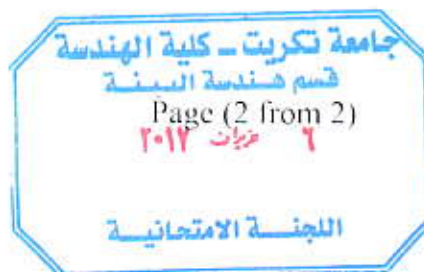
$$Q = \frac{(B_1 y_1)(B_2 y_2)\sqrt{2g}}{\sqrt{(B_1 y_1)^2 - (B_2 y_2)^2}} \sqrt{y_1 - y_2} ; Q = B_2 y_2 \sqrt{2g} \sqrt{E - y_2} ; Q_{max} = 1.705 B_2 E^{\frac{3}{2}}$$

$$Q = B_2 y_2 \sqrt{2g} \sqrt{E - y_2 - h} ; Q_{max} = 1.705 B_2 (E - h)^{\frac{3}{2}} ; AR^{\frac{2}{3}} = \frac{nQ}{S_o^{\frac{1}{2}}} ; y_1 = y + f ; f = 0.2(1 + y)$$

$$Q = CL_c H_c^{\frac{3}{2}} ; L_c = L - 2(K_p + N + K_a)H_c ; X^{1.85} = 2H_d^{0.85} y$$

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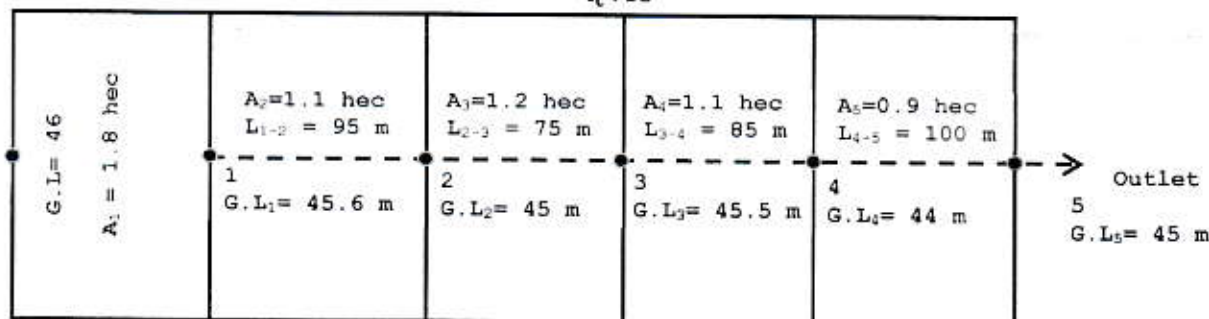
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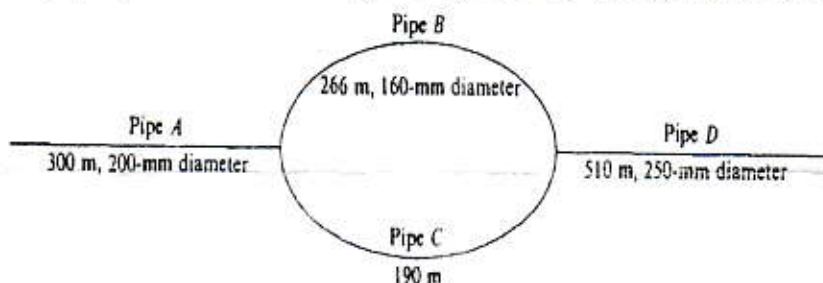


Note : Answer Only Five Questions and assume any reasonable value if you needed.

Q1: Design the Storm Sewer Network that shown in figure with following data: ( $C = 0.5$ ), ( $n = 0.014$ ), Concentration Time ( $t_c = 10$  min) and ( $i = \frac{2600}{t_c + 18}$ ). (12 Mks.)

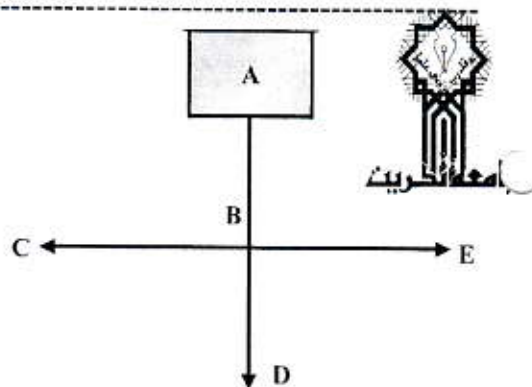


Q2: If the flow rate of water through the pipe system shown in figure is ( $0.05 \text{ m}^3/\text{sec}$ ) under total head loss of ( $9 \text{ m}$ ), determine the diameter of pipe (C), if the Hazen-William's coefficient ( $C = 120$ ) for all pipes, then what will be the length of the equivalent pipe ( $D = 300$  mm,  $C = 90$ ) for the parallel pipe system. (12 Mks.)



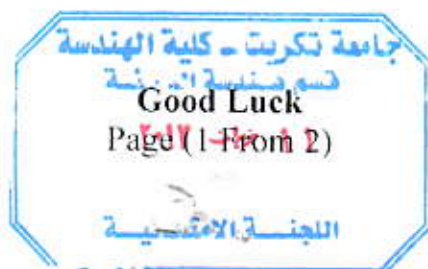
Q3: What will be the elevation of water in tank (A) that shown in figure with conditions in table to satisfy a minimum head pressure ( $35 \text{ m}$ ) in all points, if the demand rate is ( $625 \text{ Lpd}$ ) and ( $n = 0.013$ ). (12 Mks.)

Pipe	L (m)	D (mm)	Population	Elevs. (m)
AB	2500	400	16000	55 at B
BC	900	200	5000	45 at C
BD	600	150	3500	40 at D
BE	1000	250	7500	47 at E



Q4: (A):- Explain the (Gutter and Inlets), then sketch the Grate and Curb Inlets in details. (6Mks.)  
(B):- How did you estimate the storage capacity in elevated tanks? (6 Mks.)

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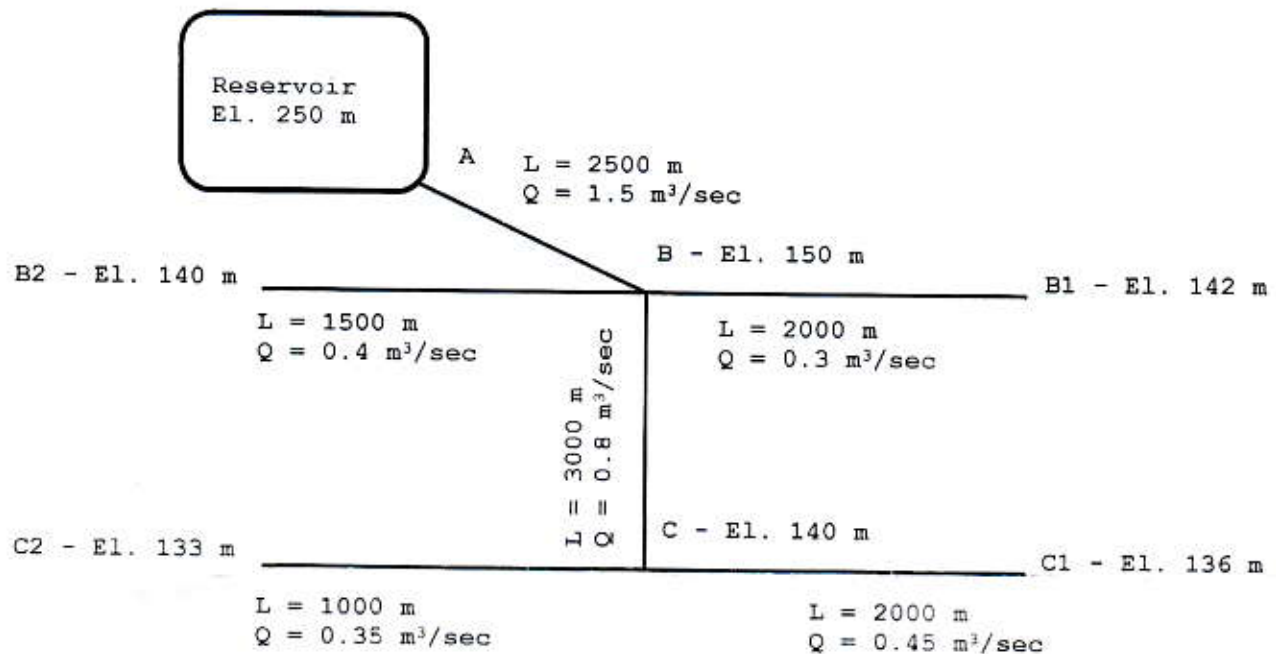


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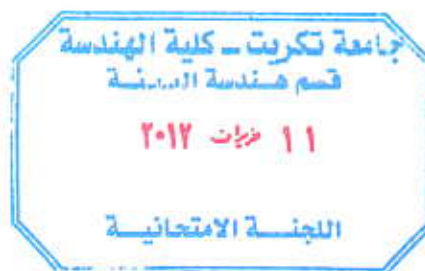


Note : Answer Only Five Questions and assume any reasonable value if you needed.

Q5: For the layout that shown in figure below, Design the pipelines (AB), (BB1) and (BC). Assume the minimum head pressure in all points is (20 m). Using Manning's roughness ( $n = 0.013$ ). (12 Mks.)



Q6: A building consist from wood frame with area ( $A_1$ ) and fire resistive part with area ( $A_2 = 0.3 A_1$ ). If the diameter of pipe which convey the total water quantity to firehouse is (500 mm) and the flow velocity under work is (1.12 m/sec). Find the building area ( $A_1, A_2$ ). (12 Mks.)



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**Note : Answer All Questions**

**Q1: Answer Four (4) Only**

**(20 mark)**

1. Determine the ponds of water that must be removed per 1000 lb of shredded , air- classified solid wastes if the initial moisture content is 25 percent and the final moisture content after drying is to be 10 percent . How much energy will be required to accomplish this?
2. Given that 100 tons/hr of M.S.W. with the composition shown in table below are applied to arotary screen for the removal of glass prior to shredding. Determine the recovery efficiency and effectiveness of the screen based on the following expermental data:
  - weight of glass in screen underflow = 9 ton/hr.
  - weight of underflow = 12 ton/hr.

Component	Weight , %
Food waste	25
Paper	40
Cardboard	15
Glass	16
Wood	4

3. Determine the area required for a new landfill site with a projected life of 30 years for a population of 250000 generating 2.02 kg/c.day. The density of the compacted waste is 470 kg/m<sup>3</sup>. The height of the landfill cannot exceed 15 m.
4. Calculate the volumetric flow rate of leachate through a compacted clay liner if the area of the landfill is 15 ha and the liner thickness is 1 m. The hydraulic conductivity is  $7.5 \times 10^{-10}$  m/s, Assume that the head of water is 0.6 m.
5. The mean concentration of TCA in a water supply is 2.5 µg/L. What is its carcinogenic risk for adult and child? Use the slope factor for TCA = 0.057 kg.d/mg, assume any parameters if needed.

**Q2: Answer Five (5) Only**

**(40 mark)**

1. What are the source of solid waste (list only)?
2. Explain with draw methods of landfilling for dry areas.
3. List factors that should be taken into consideration when layout routes.
4. What are the important topics that must be considered in an engineering report for design landfilling.
5. What are the major physical, chemical and biological characteristics of solid waste.
6. List only the major environmental laws for hazardous waste management.
7. List with draw types of vents used to control the lateral movement of gases in sanitary landfills.

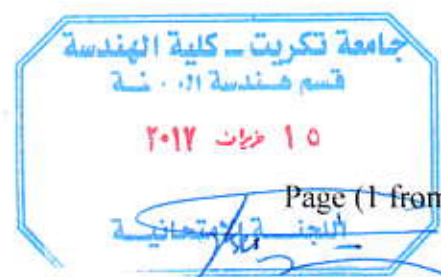


Q3 : A new residential area composed of 750 single-family dwelling. Assuming that either three person collection crew will be used or two person collection crew and crub collection, Desgin the collection system and compared the two alternatives. The following data are applicable:

- Average number of residents per service = 3.2
- Solid waste generation rate per capita = 2 lb/c.d.
- Density of solid waste (at containers)= 300 lb/yd<sup>3</sup>.
- Containers per service = three 32- gal. containers.
- Type of service = 25 percent alley.

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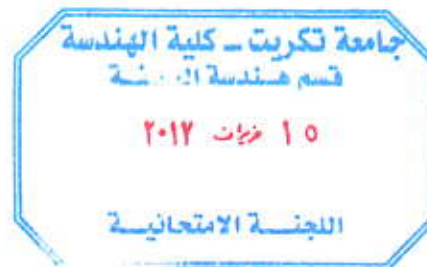
- Collection frequency = once per week.
- Rear- loaded compactor= 2.5.
- Round-trip-haul distance = 15mi.
- Trip per day = 2
- Constants for estimating haul time  $a = 0.016$  h/trip,  $b = 0.018$ mi/hr.
- Assume at site time per trip = 0.1 h/trip,  $W = 0.15$ ,  $H = 8$  hr.
- $t_p = 0.92$  collector -min /location.
- If necessary, use equation:  $t_p = 0.72 + 0.18 (Cn) + 0.014 (PRH)$ .

(20 mark)

**Q4:** Determine the energy content (Kj/Kg) and moisture content of the solid waste composition sample shown in the table below. Estimate the change in energy content if 35% of the paper, 75% of the cardboard and 8% of food waste are separated by the homeowner.

Component	Solid waste, lb	Energy, Btu/lb	Moisture content, %
Food waste	9.5	2200	70
Paper	33	7550	8
Cardboard	6	7100	5
Plastic	7	14500	2
Textile	2	7000	10
Rubber	1	11000	2
Leather	1	6000	10
Yard wastes	16	3200	2
Wood	3	7800	15
Glass	8	75	2
Tin cans	7	400	3
Aluminum	0.5	-----	-----
Other metals	3	500	2
Dirt, ashes, etc.	3	3800	8

(20 mark)



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Note : Answer Four questions only.

**Q1 ( 15 Marks)**

- 1- What is the water quality management , what are water quality management process, what are key action to address water quality management.
- 2- In agriculture operations , what are the water quality impacts and mismanagement of agriculture is the root cause.
- 3- Water resources types.
- 4- List the primary water-quality-related problems encountered in rivers and streams and what are the techniques that can be used in river and stream restoration.

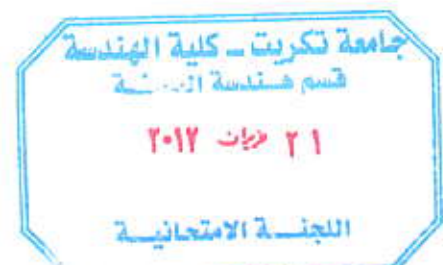
**Q2: Calculate DWQI for raw water, than determine class of water quality ? ( 15 Marks)**

Date	Turbidity (NTU)	pH	NO <sub>3</sub> (mg/l)	TDS (mg/l)	BOD(mg/l)
15/1/2017	5	7.25	3.4	295	6
15/2/2017	4	7.6	-	287	4.8
15/3/2017	56	9.2	4.1	355	9
15/4/2017	-	8.1	3	-	-
15/5/2017	23	6.1	3.3	388	17
Objetive	≤ 5	6.5-8.5	< 20	< 1000	< 3



**Q3: Answer four only ( 15 Marks)**

- 1- Talk about WQI?
- 2- Talk about surface water (River)?
- 3- Define the hydrology cycle with activities, and draw it?
- 4- The oxygen sag curve, there are two simplest model of the oxygen resources in a river, Talk about it, and write any equations.
- 5- What are the mass balance approach for DO & temperature with write the all questions and drawing?



**Q4:**

**( 15 Marks)**

A treatment plant effluent has following characteristics:

$$Q_{\text{plant}} = 15 \text{ ft}^3/\text{s}$$

$$\text{BOD}_5 \text{ at } 20^\circ\text{C} = 45 \text{ mg/l}$$

$$\text{DO} = 2.9 \text{ mg/l}$$

$$T = 24^\circ\text{C}$$

$$(k_1)_{20^\circ\text{C}} = 0.25 \text{ d}^{-1}$$

The water river has the following characteristics:

$$Q_{\text{river}} = 120 \text{ ft}^3/\text{s}$$

$$u = 0.55 \text{ ft/s}$$

$$\text{BOD}_5 \text{ at } 20^\circ\text{C} = 4 \text{ mg/l}$$

$$\text{DO} = 8.3 \text{ mg/l}$$

$$T = 16^\circ\text{C}$$

$$(k_2)_{20^\circ\text{C}} = 0.45 \text{ d}^{-1}$$

Determin (a) The distance downstream where the  $\text{O}_2$  level is at a minimum, and

(b) The minimum dissolved oxygen concentration.

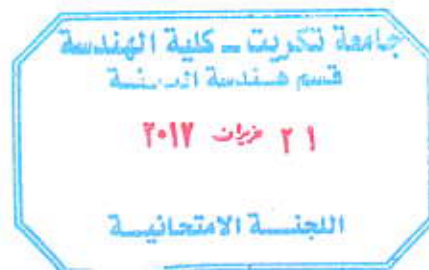
**Note:**

$$X_c = \frac{u}{(k_2 - k_1)} \ln \left( \frac{k_2}{k_1} \left( 1 - \frac{k_2 - k_1}{k_1} \right) * \frac{D_0}{L_0} \right)$$

$(K_1, k_2, D_0, L_0)$  calculate at  $T_{\text{mix}}$ .

$$(k_1)_{\text{at Temp.}} = (k_1)_{\text{at } 20^\circ\text{C}} * (1.35)^{T-20}$$

$$(k_2)_{\text{at Temp.}} = (k_2)_{\text{at } 20^\circ\text{C}} * (1.025)^{T-20}$$



**Q5: (A)**

**( 15 Marks)**

A municipality discharge wastewater to a stream that is (10 m) wide and (2 m) deep. The average flow velocity in the stream is (1.5m/s), and the friction factor is estimated to be (0.03).


Estimate the distance downstream to where the wastewater is well mixed across the stream if:

- (a) The wastewater is discharged from the side of a stream.
- (b) The wastewater is discharged from the center of the stream, and
- (c) The wastewater is discharged through a 5-m-long multiport diffuser placed in the middle of the stream.

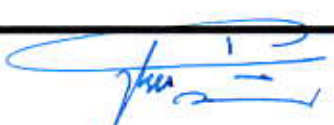
**Q5: (B)**

Just the downstream of the outfall from a point source of pollution the DO of a river is (6 mg/L), and the mix of river and wastes has a BOD of (20 mg/L). The saturation value of DO is (9 mg/L). The deoxygenation constant is ( $k_d = 0.2/\text{day}$ ).

- (a) Estimate the reaeration coefficient, assuming that the river speed is (0.25 m/s) and the average stream depth is (3m).
- (b) Find the critical time downstream at which minimum DO occurs.
- (c) Find the minimum DO downstream.
- (d) If the outfall is the only source of BOD, what percent removal of BOD would be needed to assure a minimum DO of (5 mg/L)?

  
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