Civil Engineering Department	**Special Course of Sanitary Engineering**
Faculty Of Engineering	**Civil (2008-2009)**
Mansoura University	**Allowable Time: 3 Hours**

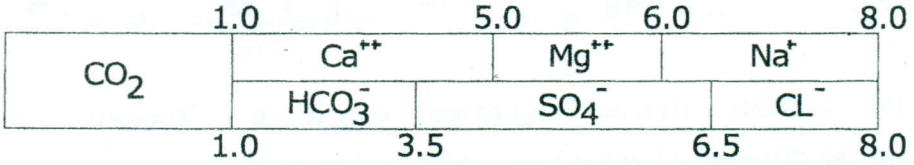
Part I:(27.5 marks)

Question 1 :

a- What is the equivalent expression for alkalinity ?

A water with an initial alkalinity of 30 mg/L is treated with 20 mg/L Na_2CO_3 with the resultant precipitation of 10 mg/L $CaCO_3$. All quantities are expressed as $CaCO_3$. What is the alkalinity of the settled effluent, assuming a perfect solids separation?

b- A water treatment plant process 1500 m^3/d of water with the following ionic concentration



Determine the quantity of chemicals required for softening for softening this water to minimum possible hardness by two stages lime soda ash softening. Also draw a bar diagram for the finished water.

Question 2 :

a- Define ion exchange process? What is its advantage and disadvantage ?

b- An ion- exchange system is to be used to soften a water has the following ionic constituents (mequiv./L) :

$Ca^{++} = 3.5$ $HCO_3^- = 3.0$ $Mg^{++} = 2.5$

$SO_4^{--} = 3.0$ $Na^+ = 3.0$ $CL^- = 2.8$ $CO_2 = 0.6$

The resin has exchange capacity of 95 Kg/m^3 when operated at a flow rate of 0.4 m^3/m^2.minute. Determine the volume of resin needed to treat 5000 m^3/d and the tank configuration ?

Question 3 :

a- A water has the following characteristics: alkalinity 60 mg/L, Calcium 45 mg/L, temperature 25^0c, pH 8.1, TDS 40mg/L. Chlorine and sulfates are negligible. You think the water is corrosive because the customers are complaining about "red water" and your distribution system is iron. Determine if this is so and see what kind of protection would be afforded by the addition of , say 5 mg/L $Ca(OH)_2$.

b- What is hardness and what hardness level indicates the need to soften at the treatment plant ?

c- A water has the following analysis : Mg 45, pH 10.8, temperature 25^0C, TDS 40 mg/L, What is the amount of $Mg(OH)_2$ will be precipitated?

Part II: (27.5 marks)

Any data missing can be reasonably assumed

1- a) Explain the oxidation of carbon (CBOD) and nitrogen (N BOD) by equations and sketches.

b) List three reasons why ammonia nitrogen is detrimental to a receiving body of water and its inhabitants.

c) The following data were obtained from an experiment to determine the BOD rate constant and ultimate BOD for an untreated wastewater using Thomas graphical method:

Day	0	1	2	4	6	8
BOD, mg/l	0	34	60	85	108	115

(7 marks)

2- a) Name the "limiting nutrients" and explain why it is a limiting nutrient.

b) Explain the difference between eutrophic and oligocrophic lakes in terms of productivity and water quality.

c)Design a stabilization pond system to treat 20,000 m^3/d of starch wastewater which has a BOD_5 of 400 mg/l. The design temperature is 20 $^{\circ}C$ and the required effluent standards are: BOD_5 <60 mg/l and FC 5000 /100 ml .

(7 marks)

3- The following sentences True or False (for false answer give the correct answer) :

a) The actual BOD less than BOD theoretical
b) The methane former consist s of facultative and anaerobic bacteria.
c) The BOD test is a direct measurement of organic matter.
d) Nitrogen serves as a vital nutrient for the growth of algae.

(6 marks)

4- a) List the major pollutant categories that are produced by each of the four principal sources of wastewater.

b) Assuming that the mixed oxygen deficit (D_a) is zero and the ultimate BOD (L_a) of the river above the wastewater fall is zero. Calculate the amount of ultimate BOD, in kg/d, that can be discharged if the DO must be kept at 4 mg/l at a point 8.05 km downstream. The stream deoxygenation rate (K_d) is 1.8 d^{-1} at 12°C, and the reaeration rate (K_r) is 2.2 d^{-1} at 12°C. The river temperature is 12°C. The river flow is 3.2 m^3/s with a speed of 0.3 m/s. DO saturation at 12°C =10.77 mg/l. The wastewater flow is 0.01 m^3/s.

(7.5 marks)

Given $D = \frac{K_d . L_a}{K_r - K_d}(10^{-K_d t} - 10^{-K_r t}) + D_a(10^{-K_r t})$.