# University Of Technology
## Building and Construction Eng. Dept.
## Final Exam-First Attempt–2014/2015

**Branch :Sanitary & Environ. Eng.** **Class: Third**
**subject : Chemistry& Microbiology** **Time : 3 Hours**
**Examiner : Dr.Aumar ALnakeeb** **Date : 13/6/2015**
**Lec. Rana J.Kadhim**

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**Answer Four questions only**

**Q1:-A/** Wastewater is diluted by factor 1/8 using seeded control water. DO levels in the sample and control bottles are shown in table below. Determine $BOD_5$ value if one milliliter of seed material is added directly to diluted sample and two milliliter to control bottles.

| Time (day) | Dissolved oxygen, mg/L | |
|---|---|---|
| | (1*ml*) Diluted sample | (2*ml*) Seeded Control |
| 0 | 5.94 | 7.03 |
| 1 | 5.65 | 6.33 |
| 2 | 5.36 | 6.12 |
| 3 | 5.12 | 6.01 |
| 4 | 4.63 | 5.90 |
| 5 | 4.42 | 5.78 |
| 6 | 4.13 | 5.41 |
| 7 | 3.81 | 5.23 |

(13 marks)

**B/** 1-Describe with drawing Procaryotic and Eucaryotic cells.
2-State the Factors affecting dissolved oxygen concentration in Water.
(12marks)

**Q2:- A/** A 60 ml raw water samples were taken from river for BOD test by using 300 ml BOD bottles without seeding with four duplications. The initial dissolved oxygen concentrations found when taken are 6.43, 6.18, 6.84 and 6.22 mg/L respectively. After 5 days, the dissolved oxygen concentrations at 20°C incubation are 3.75, 2.83, 2.35 and 2.66 respectively. Find raw water $BOD_5$.

(13marks)

**B/** Explain briefly of the following terms:

1- Polar Molecules and Non Polar Molecules.
2- Hardness of water.
3- The types and sources of water impurities.

(12marks)

**Q3:- A/** Use Phelps law to find first – stage BOD when $t_0 = 0$ days, and Butts et al.'s equation to find first – stage BOD when $t_0 = 36$ hours according to wastewater sample data given below:

$BOD_5 = 283$ mg/L  power factor = 2.0  $k_1 = 0.14\ day^{-1}$

(13marks)

**B/ :-** Draw a sketch showing Bacterial growth curves based on (batch and continuous culture).

(12marks)

**Q4:- A/** The results of a water analysis are: calcium 40 mg/l, magnesium 10 mg/l, sodium 11.7 mg/l, potassium 7.0 mg/l, bicarbonate 110 mg/l, sulfate 67.2 mg/l, and chloride 11 mg/l. Draw a milliequivalents -per- liter bar graph and list the hypothetical combinations. Express the hardness and alkalinity in units of mg/l as $CaCO_3$.

(13 marks)

**B/** Write short notes on the following terms:-

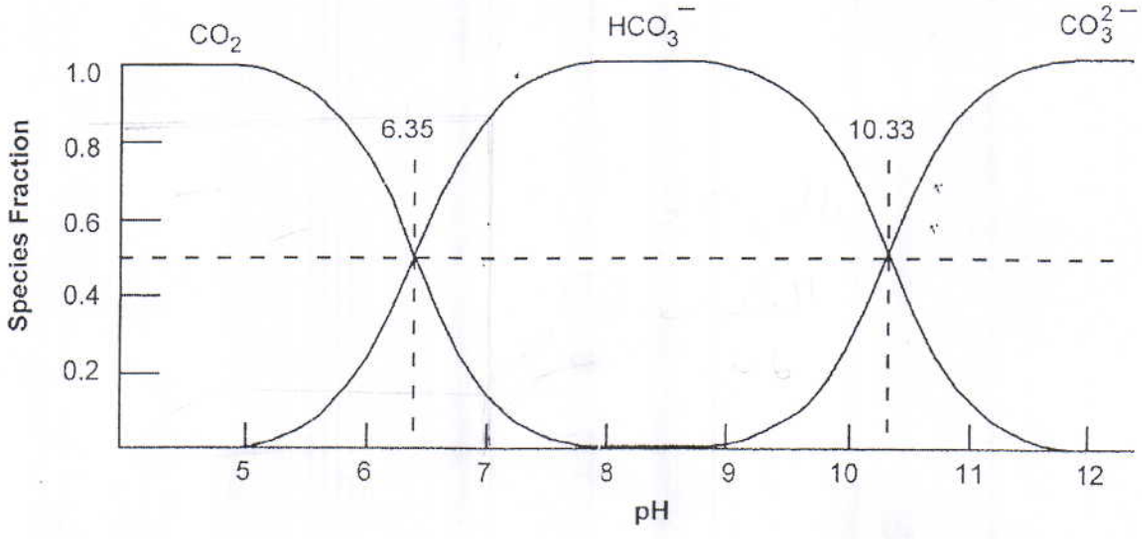
**1-** Phosphorus compounds.

**2-** pH-value.

**3-** Oxidation- Reduction potential.

(12marks)

**Q5:-A/** Calculate the carbonate alkalinity as $CaCO_3$ of industrial water sample contains 260 mg/l of bicarbonate at pH = 7.0.




(13marks)

**B/** Define the following terms:-

**1-**Bacteria  2- Fungi  3-Protozoa  4-Amoeba

(12marks)

Useful information:-

Atomic weights, H=1, O=16, C=12, Ca= 40, Mg= 24.4, Na= 23, K= 39.1, Cl= 35.5, S= 32

$$\frac{C}{C_o} = e^{-(Q/V)t}$$

$$C_f = \frac{Q_1C_1 + Q_2C_2}{Q_1 + Q_2}$$

$$\ln \frac{C_A}{C_{A0}} = -kt \quad or \quad \frac{C_A}{C_{A0}} = e^{-kt}$$

$$t_0 = \frac{1}{k_1} \log_{10} C$$

$$X = \frac{\Sigma(D_1 - D_2)}{n}$$

$$y = L_a[1 - 10^{-k_1 \Delta t}]$$

$$\text{BOD, mg/L} = \frac{D_1 - D_2}{P}$$

$$K_1 = k_1 \times 2.3026$$

$$\text{BOD, mg/L} = \frac{(D_i - D_e) - (B_i - B_c)f}{P}$$

$$\frac{C_3}{C_o} = \left(\frac{C_3}{C_2}\right)\left(\frac{C_2}{C_1}\right)\left(\frac{C_1}{C_0}\right) = \left(\frac{1}{1 + k_3\tau_3}\right)\left(\frac{1}{1 + k_2\tau_2}\right)\left(\frac{1}{1 + k_1\tau_1}\right)$$

$$\frac{C_3}{C_o} = \left(\frac{C_3}{C_2}\right)\left(\frac{C_2}{C_1}\right)\left(\frac{C_1}{C_0}\right) = (e^{-k_3\tau_3})(e^{-k_2\tau_2})(e^{-k_1\tau_1}) = e^{-(k_1\tau_1 + k_2\tau_2 + k_3\tau_3)}$$

$$y = L_a\left[1 - e^{-k_1(t - t_0)^m}\right]$$

حلول اسئلة الامتحان النهائي - الدور الاول
2014-2015
فرع الهندسة الطبية والبيئية المرحلة : الثالثة
المادة : كيمياء وميكروبايولوجيا الماء

Q1/A/ sol.

compute f & p

$f = \frac{1\ ml}{2\ ml} = 0.5$

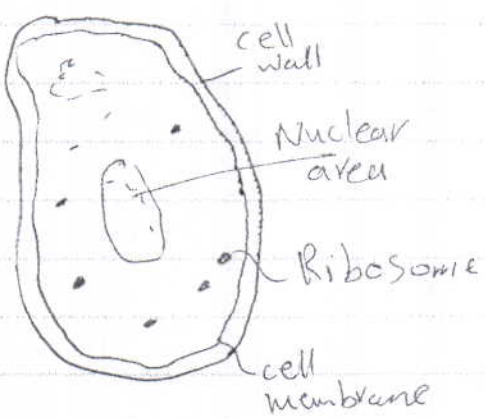
$p = \frac{1}{8} = 0.125$

$BOD_{only\ 5} = \frac{(D_i - D_e) - (B_i - B_e) f}{p}$

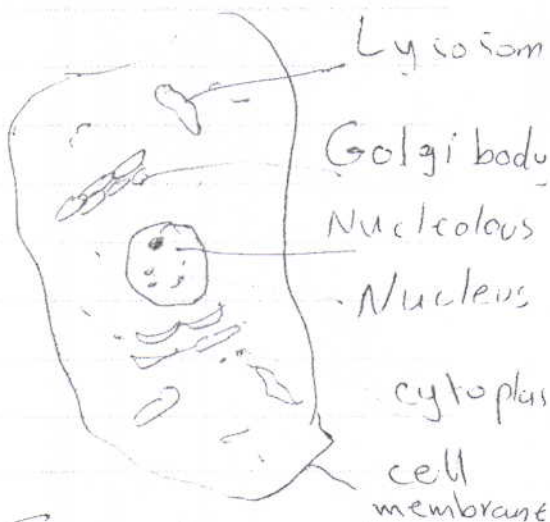
$= \frac{(5.94 - 4.42) - (7.03 - 5.78) \times 0.5}{0.125}$

$= 7.16\ mg/l$

Q1--B/ 1-

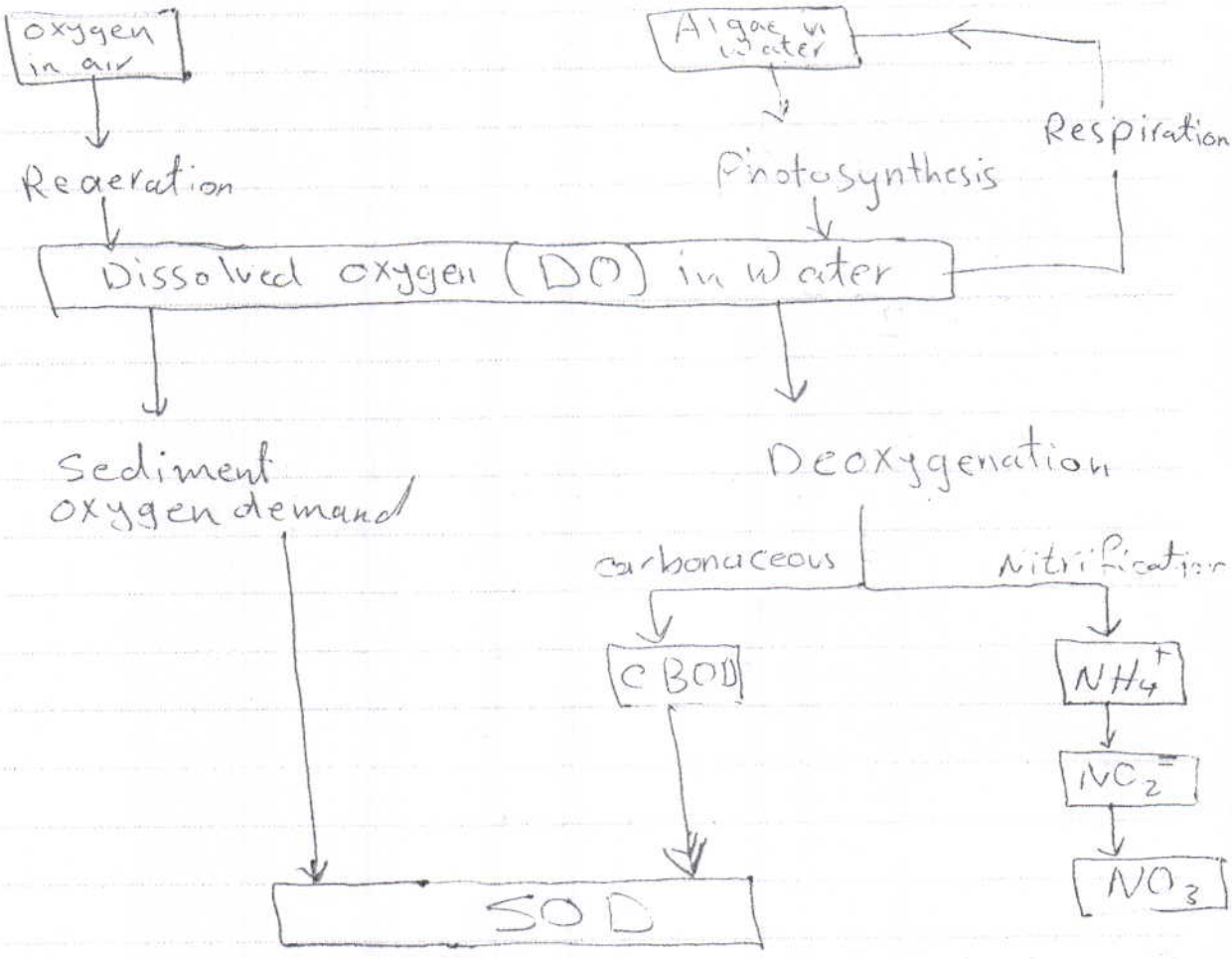


Procaryptic cell



Eucaryntic cell

Q1: B/ 2-


oxygen in air
Algae in water
Respiration
Reaeration
Photosynthesis
Dissolved oxygen (DO) in water
Sediment oxygen demand
Deoxygenation
carbonaceous
Nitrification
CBOD
$NH_4^+$
$NO_2^-$
$NO_3$
SOD

Q2 -- A / sol.

compute $X = \frac{\Sigma(D_1 - D_2)}{n}$

$$X = \frac{(6.43 - 3.75) + (6.18 - 2.83) + (6.84 - 2.35) + (6.22 - 2.66)}{4}$$

$$= 3.52$$

$$P = \frac{6c}{300} = 0.2$$

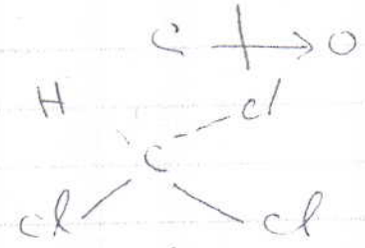
$$BOD_5 = \frac{X}{P} = \frac{3.52}{0.2} = 17.6 \text{ mg/l}$$

Q2 - B / 1 -

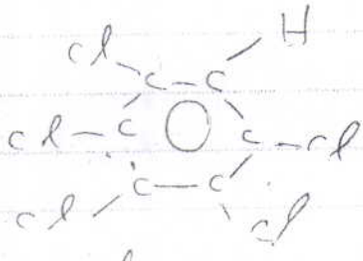
Polar Molecules

① carbon monoxide

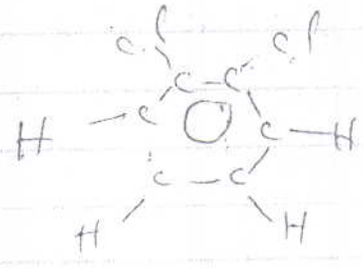
② carbon trichloride $CHCl_3$



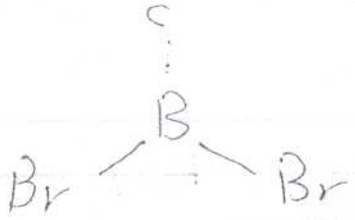
③ pentachlorobenzene



④ ortho-dichlorobenzene



(5) Boron dibromochloride



(6) Water

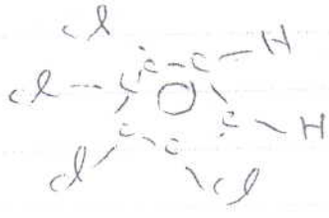
Non polar =

(1) carbon dioxide

(2) carbon tetrachloride

(3) Hexachlorobenzene

(4) para-dichlorobenzene



(5) Boron tribromide

(2) Hardness

Water hardness was a measure of the ability of water soap. It was measured by the amount of soap needed for adequate lathering and served also indicator of the rate of scale formation, hardness is a property of cations ($Ca^{+2}$, $Mg^{+2}$)