MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2017/2018

THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCE WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

NES 305: PRACTICAL ENVIRONMENTAL CHEMISTRY

Date: 14ᵗʰ February, 2018   Time: 3.30 - 6.30pm

INSTRUCTIONS:

- Answer Question ONE and any other THREE.

1. a) Discuss the mechanism of the following;
   i) Hydroxyl and hydroperoxyl radical formation in the atmosphere.
   (10marks)
   (5marks)

   ii) Oxygen radical formation in the atmosphere.
   b) Just below the point where a continuous discharge of pollution mixes with a river, the BOD is 10.9 mg/L and DO is 7.6 mg/L. The river and waste mixture has a temperature of 20°C, a deoxygenation constant of 0.20/day, an average flow speed of 0.30m/s, and an average depth of 3.0m.

   i) Find the time and distance downstream at which the oxygen deficit is a maximum.
   (10marks)

   (5marks)

   ii) Find the minimum value of DO.

2. Assume the following statistics for CFC-12 (CF_2Cl_2):
   Atmospheric residence time = 150 yr
   1985 emission rate = 0.44 x 10^{12} g/yr
   1985 atmospheric concentration = 0.40 ppb

   Suppose the emission rate of CFC-12 is instantaneously reduced to 50 percent of its 1985 value and held constant thereafter:
   i) What would be the final, steady-state atmospheric concentration of CFC-12?
   (8marks)

   ii) What cut in the emission rate would be required for CFC-12 concentrations to remain constant at its 1985 level of 0.40 ppb?
   (7marks)

3. From the following data of volumetric analysis.

Sample 100 ml	Total ml of titrant to reach end point	
	Phenolphthalein	Methyl orange
A	10	15.5
B	14.4	38.6
C	83	8.4
D	0	12.7

Calculate the alkalinities of:
i)   hydroxide   (4marks)
ii) carbonate   (5marks)
iii) bicarbonate   (6marks)

4. Discuss the mechanisms involved in stratospheric ozone destruction.(15marks)

5. A municipal wastewater treatment plant serving a city of 200 000 discharge $1.10m^3/s$ of treated effluent having an ultimate BOD of 50.0 mg/L into a stream that has a flow of 8.70 m^3/s and a BOD of its own equal to 6.0 mg/L. The deoxygenation constant k_d is 0.20/day.

a) Assuming complete and instantaneous mixing, calculate the ultimate BOD of the river just downstream from the outfall.   (8marks)

b) If the stream has constant cross section so that it flows at a fixed speed equal to 0.30 m/s, estimate the BOD of the stream at a distance 30 000m downstream.   (7marks)

6. The analysis of a sample of water shows the following results in mgll:

Na =20   Cl = 40
K =30   HCO$_3$ = 67
Ca = 5   SO$_4$ = 5
Mg = 10   NO$_3$ = 10

The concentration of stroncium (Sr) is equivalent to a hardness of 2.29 mgll and the carbonate alkalinity in this water is zero. Calculate as $CaCO_3$
   i)   the total hardness,   (5marks)
   ii) carbonate hardness   (6marks)
   iii) non-carbonate hardness in mg/l   (4marks)