MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2015/2016

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

MAIN CAMPUS

NES 305: PRACTICAL ENVIRONMENTAL CHEMISTRY

Date: 12th January, 2016 Time: 8.30 - 10.30 am

INSTRUCTIONS:

- Answer Question ONE and any other TWO Questions.

NES 305 PRACTICAL ENVIRONMENTAL CHEMISTRY

Time: 2hrs

Answer question ONE and any other TWO

1. Discuss the mechanism of the following;
   a) Hydroxyl and hydroperoxyl radical formation in the atmosphere. **(8mks)**
   b) Oxygen radical formation in the atmosphere. **(8mks)**
   c) Assume the following statistics for CFC-12 (CF_2C1_2):
      Atmospheric residence time = 150 yr
      1985 emission rate = 0.44×10^{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? **(7mks)**
   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? **(7mks)**

2. From the following data of volumetric analysis.

Sample 100 ml	*Total ml of titrant to reach end point*	
	Phenolphthalei	*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 **(6mks)**
ii) carbonate **(7mks)**
iii) bicarbonate **(7mks)**

3. Discuss the mechanisms involved in stratospheric ozone destruction.**(20mks)**

4. A municipal wastewater treatment plant serving a city of 200 000 discharge $1.10 m^3/s$ 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. **(10mks)**

   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. **(10mks)**

5. 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, **(7mks)**
ii) carbonate hardness **(7mks)**
iii) non-carbonate hardness in mg/l **(6mks)**

6. 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.

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

   b) Find the minimum value of DO. **(10mks)**