Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

BTAC 12S / BTAC 13S

ACH 4207: ENVIRONMENTAL CHEMISTRY

SEMESTER EXAMINATION

DECEMBER 2013 SERIES 2 HOURS

Instructions to candidates:

This paper consist of FIVE questions
Answer question ONE (compulsory) and any other TWO questions

QUESTION ONE

a) To study environmental chemistry , one needs a strong background knowledge in environmental sciences

(i) Differentiate environmental science from environmental chemistry **(5 marks)**

(ii) Explain how the study of chemistry plays a key role in environmental protection and improvement **(2 marks)**

(iii) Sustainable development is a goal environmental chemistry intends to achieve. Explain how? **(3 marks)**

b) Pollution is one of the main issues studied in environmental chemistry

(i) Define the term pollution and differentiate it from the term contaminat **(4 marks)**

(ii) The term pollution can be diffuse. Explain this statement with two examples **(3 marks)**

(iii) Time and place determine what may be called a pollutant. Give an example that

explains this statement **(2 marks)**

c) Carbon monoxide is a primary pollutant in the environment

(i) State its main natural source and its main anthropogenic source, giving the relevant chemical equations **(4 marks)**

(ii) What is the average amount of carbon monoxide in the atmosphere? State how this average amount is maintained. **(3 marks)**

(iii) State the main effect of carbon monoxide poisoning, and explain what heightens its danger. **(4 marks)**

QUESTION TWO

a) Nitrogen dioxide (NO_2) is the major NO(x) pollutant in the atmosphere

(i) With relevant equations, show how it is formed from an anthropogenic source **(5 marks)**

(ii) Describe the fate of atmosphenix NO(x) **(8 marks)**

b) In a series of equations, show how the use of catalytic converters in the internal combustion engine of automobiles has reduced the release of NO_2, CO and HCs **(7 marks)**

QUESTION THREE

a) The atmosphere contains particles that are released to it either naturally or through anthropogenic activities

(i) Give TWO examples from each source **(4 marks)**

(ii) Describe how total suspended matter is measured in air **(6 marks)**

b) Describe the 'bag filtration' and the 'cyclone separation' methods that industry uses to control particulate emission in the environment. **(10 marks)**

QUESTION FOUR

a) Two types of smog can be found in the atmosphere

(i) What are they? **(2 marks)**

(ii) Differentiate them **(4 marks)**

b) Hydroxyl radicals are very reactive species responsible for many of the photochemical reactions that take place in the environment.

(i) Show how 2 hydroxyl radicals from , starting with NO_2 **(5 marks)**

c) Aldehdes are one of the products generated by the attach of hydroxyl radicals on hydrocarbons

(i) From the above statement, show how PAN is formed **(3 marks)**
(ii) Give the structure of PAN **(1 mark)**
(iii) State the characteristics of PAN **(5 marks)**

QUESTION FIVE

a) Over time, a steady-state is established where the energy that the earth absorbs from the sun equals the energy it re-radiates

(i) From the statement above, derive the equation

$$T = \left[\frac{(1-A)Fs}{4S_b}\right]^{1/4}$$ **(5 marks)**

(ii) Given $S_b = 5.67 \times 10^{-8} Wm^{-2}K^{-4}$, Calculate T **(2 marks)**
(iii) Why is the calculated value of T lower than the experimentally measured value **(3 marks)**

b) Chlorofluorocarbons when released to, and enter the stratosphere, destroy the ozone layer.

(i) Show this photochemical process **(7 marks)**
(ii) Explain the mechanism that CFC substitutes use to prevent this **(3 marks)**