CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

THIRD YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 344: ENVIRONMENTAL CHEMISTRY I

STREAMS: **TIME: 2 HOURS**

DAY/DATE: TUESDAY 30/03/2021 **2.30 P.M – 4.30 P.M**

INSTRUCTIONS:

Answer question one and any other two questions

QUESTION ONE (30 MARKS)

(a) (i) Sketch the temperature profile showing how the atmospheric temperature varies with altitude and indicate the major regions of the atmosphere and the boundaries between them. [3 marks]

(ii) State the respective altitudes of the major regions of the atmosphere. What are the characteristics and important chemical species in each region? [3 marks]

(b) (i) Briefly explain why temperature decreases with altitude in the troposphere, nut increases with altitude in the stratosphere. [3 marks]

(ii) Rank the following constituents of the troposphere in increasing order of concentration: $O_{2,}\, CO, CO_2 \wedge CH_4$? [1 mark]

(iii) List the names, the chemical formulae and sources of any three major gaseous pollutants present in the troposphere. [4 marks]

(iv) Discuss the impacts of the pollutants in (i) above in the environment. [3 marks]

(c) (i) With the help of chemical equations, explain how ozone is formed and depleted in the atmosphere. [3 marks]

(ii) Explain the role of ozone in the upper atmosphere. [1mark]

(iii) What are the consequences of the depletion of O_3 layer in the atmosphere? [2 marks]

(iv) The atmosphere plays an essential role as a protective shield. Briefly describe how this is achieved. [2 marks]

(d) (i) Distinguish between photodissociation and photoionization. [2 marks]

(ii) Given that the bond energy is oxygen is 495KJ mol^{-1}. What is the maximum wave length of light in nanometers (nm) that has enough energy per photon to dissociate the oxygen molecule?

[Planck's constant h= 6.626 x 10^{-34} J-s Avogadro's number N= 6.022 x 10^{23}/mol, speed of light, c = 3.0 x 10^{8} m/s. [3 marks]

QUESTION TWO (20 MARKS)

(a) (i) With help of relevant equations, give a detailed explanation on how photochemical smog is formed. [3 marks]

(ii) What are the environmental conditions required to form photochemical smog? [1 mark]

(iii) What are harmful effects of photochemical smog and how can they be controlled? [3 marks]

(b) (i) $N_{2,}O_2$ and O absorb photons in the upper atmosphere. Explain why these processes don't completely protect us from UV radiation.

[2 marks]

(ii) Write the chemical reactions that describe the cycling of NO and NO_2 to maintain their relative concentrations in the atmosphere assuming no hydrocarbons are present. [2 marks]

(c) (i) Explain in details what greenhouse effect is and how it affects the global climate. [4 marks]

(ii) With respect to absorption of radiant energy, what distinguishes a green house gas from non- green house gas? [2 marks]

(iii) Explain using molecular structure of CO_2 why it is a green house gas but Ar is not . Name any other two green house gases. [3 marks]

QUESTION THREE (20 MARKS)

(a) (i) What are CFCs chemicals? What properties of CFCs make them ideal for various commercial applications but also make them a long term problem in the stratosphere? [3 marks]

(ii) Using CF_2CL_2 as an example, show how CFCs reactions are involved in ozone depletion in the stratosphere. [2 marks]

(b) (i) What are hydrofluorocarbon? Why are these compounds potentially less harmful to the ozone layer than CFCs. [3 marks]

(c) (i) Describe acid rain? [2 marks]

(ii) Name and give sources of the pollutants responsible for causing acid rain. [3 marks]

(iii) Explain how acid rain harmful to the environment? Mention any three practical ways that can mitigate the problem of acid rain. [4 marks]

QUESTION FOUR

(a) Distinguish between the following pairs: [2 marks]

(i) Pollutants and contaminant

(ii) Primary pollutants and secondary pollutants

(b) (i) What are the major primary air pollutants produced by human activity? What are their sources? [4 marks]

(ii)Briefly discuss the impact of air pollution on human health and by giving examples where necessary, highlight on three major health impacts of air pollutants. [4 marks]

(c) (i) Briefly explain the major causes of water pollution. [3 marks]

(ii)Name two common methods of secondary treatment of sewage. Briefly describe each of these two methods. [4 marks]

(d) Explain the meaning of green chemistry? How will it help in decreasing? Environmental pollution? [3 marks]
