CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY

CHIN 451: AIR POLLUTION AND CONTROL

STREAMS: CHIN **TIME: 2 HOURS**

DAY/DATE: TUESDAY 21/09/2021 **2.30 P.M. – 4.30 P.M.**

INSTRUCTIONS: ANSWER QUESTION **ONE** AND ANY OTHER **TWO** QUESTIONS

[Planck's Constant h= 6.626 x 10^{-34} J-s, Avogadro's number N = 6.022x 10^{23}/mol, Velocity of light = 3.0 x 10^{8}m/s]

QUESTION ONE [30 MARKS]

(a). (i). Name and describe the four segments of the environment **[4 marks]**

(ii). Enumerate the role of the atmosphere in the environment **[3 marks]**

(iii). What is the primary basis for the division of the atmosphere into different regions? **[2 marks]**

(b).(i). Name the regions of the atmosphere**.** **[2 marks]**

(ii) 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**.** **[4 marks]**

(iii) State the respective altitudes and temperature ranges of the major regions of the atmosphere. What are the characteristics and important?

chemical species in each region? **[4 marks]**

(c.) (i). Briefly explain what you understand by the terms lapse rate **[2 marks]**

(ii) Give reasons why temperature decreases with altitude in the troposphere, but increases with altitude in the stratosphere**. [4 marks]**

(d). (i) Briefly discuss why the environmentalists are greatly concerned about pollution of the stratosphere**.** **[2 marks]**

(ii Why do environmental scientists call tropopause thermal layer or cold trap?

Explain its importance in the atmosphere **[3 marks]**

***QUESTION TWO*. [20marks]**

(a)(i). Describe the phenomenon 'Temperature inversion' and explain its significance in air pollution**.** **[2 marks]**

(ii) Using any three examples explain how temperature inversion occurs **[3 marks]**

(b. (i)With the help of chemical equations, explain the Chapman's cycle for the formation and destruction of ozone in the stratosphere**. [3 marks]**

(ii). What are the consequences of ozone destruction? **[2 marks]**

(c) (i). Name and distinguish the two most important chemical reactions that occur in the upper atmosphere. What conditions are necessary for these reactions to occur**?** **[3 marks]**

(ii). The dissociation energy of carbon- bromine bond is typically about 210kJ /mol. What is the maximum wavelength of photons that can cause C- Br bond to dissociate **[3 marks]**

(d)(i). With the help of chemical equations, describe the mechanism for catalytic destruction of ozone and mention possible chain carriers responsible for this process **[3 marks]**

(ii).Rank the following constituents of the troposphere in increasing order of concentration: O_3, CO, CO_2 N_2 O_2 and CH_4? **[1 mark]**

QUESTION THREE [20 marks]

(a). (i). Give three examples each of natural and anthropogenic air pollutants **[3 marks]**

(ii). What naturally occurring cleanser helps to remove pollutants from the Atmosphere? **[1 mark]**

(iii). Show how the cleanser in (i) above is formed in the troposphere and give any three examples of pollutants destroyed by this cleanser and their end products [**3 marks]**

(b). (i). Distinguish between a pollutant and contaminant**.** **[2 marks]**

(ii). What are primary pollutants? List three major primary air pollutants and their sources present in the troposphere **[3 marks]**

(iii). What are secondary pollutants and how are they formed. Give two examples of secondary pollutants **[3 marks]**

(c). (i). What impacts does air pollution have on human health? Give the three categories of impact and distinguish among them **[3 marks]**

(d). Name two basic approaches that are used for controlling air pollution and show how they can be achieved**.** **[3 marks]**

QUESTION FOUR [20 marks]

(a) (i). Distinguish between industrial smog and photochemical smog **[2 marks]**

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

(iii) What are the environmental conditions required to form photochemical smog? **[2 marks]**

(iv). What are harmful effects of photochemical smog and how can they be controlled**.** **[2 marks]**

(b).(i). What is acid rain? **[2 marks]**

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

(iii) Acid rain is known to contain some acids. Name these acids and by writing chemical equations show where they come from rain? **[3 marks]**

(iv). How is acid rain harmful to the environment? Explain three practical ways that can mitigate the problem of acid rain **[3 marks]**

QUESTION FIVE [20 marks]

a) (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 greenhouse gas from a non greenhouse gas? **[2 marks]**

(iii). Explain using molecular structure of $CO_{2,}$ why it is a greenhouse gas but Ar is not. Name any two other greenhouse gases **[3 marks]**

b) (i). What properties of CFCs make them ideal for various commercial applications but also make them a long term problem in the stratosphere?

[4 marks]

(ii). Using CF_2Cl_2 as an example, show how CFCs reactions are involved in ozone depletion in the stratosphere **[2 marks]**

c) (i). What is a hydrofluorocarbon? Why are these compounds potentially less

harmful to the ozone layer than CFCs **[3marks]**

(ii) What are halons? What are their commercial applications? **[2 marks]**

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