MACHAKOS UNIVERSITY

UNIVERSITY EXAMINATIONS 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SUPPLEMENTARY EXAMINATION FOR

EDUCATION SCIENCE

SCH 300: CHEMISTRY OF S AND P BLOCK ELEMENTS

DATE: 26/7/2019 **TIME: 2:00 – 4:00 PM AM**

INSTRUCTIONS:

ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED.

ANSWER QUESTION ONE [COMPULSORY] AND ANY OTHER TWO QUESTIONS.

QUESTION ONE (THIRTY MARKS)

a. Draw 13-crown-4, 14-crown-4, 15-crown-4, and 16-crown-4. Suggest a reason why 14-crown-4, can catalyse reactions of $LiCH_3$ in organic solvents. (4 marks)

b. Compare the bonding in 'BH_3' and BCl_3. Why is BCl_3 monomeric and 'BH_3' dimeric? (4 marks)

c. What is the order of acid strength for the following: HClO, $HClO_2$, $HClO_3$ and $HClO_4$. Explain (4 marks)

d. Carbon disulphide readily undergoes insertion reactions. Using an example, show how this happens. (4 marks)

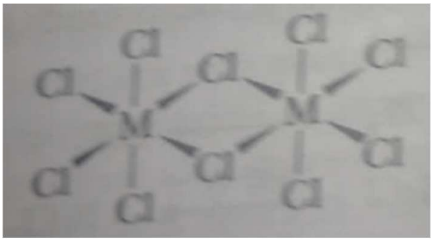
e. Hydrolysis of most phosphate esters involves two possibilities. Name them. Indicate the relevant equations (6 marks)

f. Describe the equilibria of SO_2 in water (4 marks)

g. Show how xenon hexafluoride is prepared (4 marks)

QUESTION TWO (TWENTY MARKS)

a) Describe the three-centre, four electron (3c-4e) bond system of the molecular halide M_2Cl_{10}



(6 marks)

b) Describe, with relevant examples, how each of the following oxygen compound acts as a ligand (6 marks)

a. Dioxygen
b. Water
c. Oxo-ligands

c) Using clear schemes show i) a one-step and ii) the two-step mechanism for the aquation of IO_4^- to $IO_2(OH)_4^-$ clearly show the hydrogen bonds.

(8 marks)

QUESTION THREE (TWENTY MARKS)

a) Carbon chemistry differs uniquely from that of other group 14 members. It exists in allotropy with the third and most recent allotrope being the fullerene which has been extensively studied, infinite chemical research on it notwithstanding. For example, among the remarkable compounds of fullerene is the Osmium compound, which is the first derivative of C_{60} which was a form of *osmylation*. Worth noting is the fact that C_{60} behaves as an alkene towards transition metals.

a. Describe 3 ways in which carbon chemistry differs from that of other group 14 members. (6 marks)

b. Using appropriate equations show how C60 acts as an alkene

(6 marks)

b) Write short notes on each of the following sulphur compounds (describe the processes in the brackets) (8 marks)

i. Dioxides (complex formation and aqueous chemistry)

ii. Polythionates (synthesis and stability)

QUESTION FOUR (TWENTY MARKS)

a) All reactions of S_8 must involve initial ring opening to give sulfur chains or chain compounds. Explain this concept using relevant nucleophilic reactants. (8 marks)

b) Describe laboratory routes used to obtain (12 marks)

i. Phosphine (PH_3)

ii. Phosphorous acid

iii. Diborane (B_2H_6)

QUESTION FIVE (TWENTY MARKS)

a) Among group IIIB elements, the chemistry of Boron stands out. Boron has only but a few features in common with Al. However, there exists a few resemblances to Silicon. Discuss, with examples and equations whenever necessary, the characteristic resemblances of Boron to Silicon and the differences from the more metallic Al. 6 marks)

b) Discuss the excited state chemistry of oxygen. Clearly show the three electronic states arising from the $(\pi^*)^2$ electron configuration of molecular oxygen (5 marks)

c) Describe any 3 methods of preparing organo-fluorine compounds

(9marks)