SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (CHEMISTRY)

SCH 205: GROUP THEORY AND ITS CHEMICAL APPLICATIONS

DATE: 12TH APRIL, 2017 **TIME: 4.00-6.00 P.M**

INSTRUCTIONS TO CANDIDATES

(a) Answer question One and any other Two questions

(b) Question 1 carries 30 marks while the other questions carry 20 marks each

(c) Illustrate your answers with well labeled diagrams where appropriate

(d) No written materials allowed.

(e) Write all answers in the booklet provided.

(f) Do not forget to write your Registration Number.

(g) Do not write any answers on this question paper

(h) A table of group theory operations and their contributions is provided

(i) The Character Table is provided

QUESTION 1 (30 MARKS)

a) Determine the symmetry elements of the following orbitals
   i. p_x orbital,
   ii. dxy orbital

(10 marks)

b) Determine the symmetry point groups for the following molecules
   i. *cis*-$Pt(NH_3)_2Cl_2$
   ii. *trans*-$Pt(NH_3)_2Br_2$
   iii. CF_2CH_2
   iv. SO_4^{2-}
   v. SO_3

vi. tetrachloroallene

(10 marks)

c) For the trans-1,2-dichloroethylene of the C_{2h} symmetry,

i. List all symmetry operations for the molecule

ii. Write a set of transformation matrices that describe the effect of each symmetry operation in C_{2h} point group on the set of co-ordinates *x*,*y*,*z* for a point

iii. Using the terms along the diagonal, obtain as many irreducible representations as possible from the transformation matrices.

(10 marks)

QUESTION 2 (20 MARKS)

What are *s*, *p*, and *d* orbitals of a central atom can be used to form δ hybrid orbitals for an AB_8 molecule having a square antiprism structure. (20 marks)

QUESTION 3 (20 MARKS)

Set up the correlation diagram for the CH_4 molecule. Consider the 2s and 2p orbitals of carbon and the 1s orbital of each hydrogen atom. (20 marks)

QUESTION 4 (20 MARKS)

Find the hybrid orbitals of a central atom in ammonia suitable for forming a set of δ bonds.

(20 marks)

QUESTION 5 (20 MARKS)

The molecule with simple formula N_2F_2 has several isomers; two of these isomers have central nitrogen's, with terminal fluorine on each nitrogen.

a) Draw the isomers clearly using the Lewis dot diagram.

b) Determine the symmetry point group of each of the isomers.

c) For the *cis* isomer determine the number and symmetry species of the Raman and infrared active vibrations. (20 marks)

GROUP THEORY OPERATIONS AND THEIR CONTRIBUTIONS

OPERATION	E	δ	i	C_2	C_3	C_4	C_5	C_6	S_3	S_4	S_5	S_6	S_8
F(R)	3	1	-3	-1	**0**	**1**	**1.618**	**2**	**-2**	**-1**	**0.382**	**0**	**0.414**

For any C_n, f(R)=$1+2\cos\frac{2\pi}{n}$

For any S_n, f(R)= $-1+2\cos\frac{2\pi}{n}$