SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE CHEMISTRY

SCH 205: GROUP THEORY AND ITS CHEMICAL APPLICATIONS

6TH DECEMBER, 2016 **TIME: 10.30-12.30 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) The Character Table is provided

QUESTION 1 (30 MARKS)

a) Determine the symmetry elements of the following orbitals

i. an *s* orbital,
ii. a dz^2 orbital

(10 marks)

.b) Determine the symmetry point groups for the following molecules

i. SF_6
ii. Ethane (eclipsed)

iii. PCl_5
iv. SO_4^{2-}
v. decacarbonyldimanganese(0)
vi. chlorotris(triphenylphosphine)rhodium(I)
vii. ferrocene (staggered)
viii. *cis* 1,2-Dichlorocyclobutane
ix. Cyclohexane (boat)

(20 marks)

QUESTION 2 (20 MARKS)

a) Derive the irreducible representations for the s, p, and d orbitals for SF_4. Show your work. Confirm that your answers match those given in the character table. (15 marks)

b) Find the irreducible representations for the σ bonds in NH_3. (5 marks)

QUESTION 3 (20 MARKS)

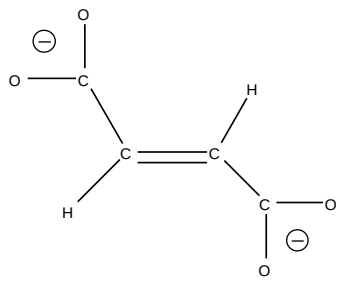
Set up the correlation diagram for the BH_3 molecule. Consider the atomic orbitals of boron with combination group orbitals of the three H (20 marks)

QUESTION 4 (20 MARKS)

Find the hybrid orbital's of a central atom in trichloroborane suitable for forming a set of δ bonds. (20 marks)

QUESTION 5 (20 MARKS)

Find the number, and symmetry species, of the Raman and infrared active vibrations of the fumarate ion (C_{2h}). The ion lies in the xy plane. C_2 axis is the z axis.



(20 marks)