



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)

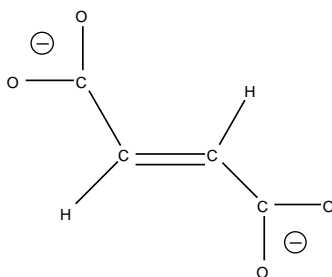
Set up the correlation diagram for the BH_3 molecule. Consider the atomic orbitals of boron with combination group orbitals of the three H (20 marks)

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)