

**JARAMOGI OGINGA ODINGA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY  
JANUARY – APRIL SESSION  
EXAMINATIONS  
SCH 3211 INORGANIC CHEMISTRY**



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY  
SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES  
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE  
in.....  
2<sup>ND</sup> YEAR 1<sup>ST</sup> SEMESTER 2016/2017 ACADEMIC YEAR  
MAIN CAMPUS**

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**COURSE CODE: SCH 321I**

**COURSE TITLE: INORGANIC CHEMISTRY**

**EXAM VENUE:                      STREAM: (BSc.)**

**DATE:                                      EXAM SESSION:**

**TIME: 2 HOURS**

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**Instructions:**

- 1. Answer question 1 (compulsory) and ANY other 2 questions.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room**

**Question one (compulsory) 30 marks**

1. (a)(i) Distinguish between an absorption spectrum and an emission spectrum (2 mks)  
(ii) Which spectrum did Bohr use for his work? Explain (2 mks)  
(iii) Explain which of these transitions correspond to absorption of energy and which to emission?  
(I)  $n = 2$  to  $n = 4$  (2 mks)  
(II)  $n = 3$  to  $n = 1$  (2 mks)
- (b)(i) Write the electronic configurations for the following atoms and ions  
 ${}_{25}\text{Mn}^{2+}$ ,  ${}_{13}\text{Al}$ ,  ${}_{35}\text{Br}^-$  (3 mks)  
(ii) Using hybridization theory explain the shapes of the following molecules  
(I)  $\text{BF}_3$  (3 mks)  
(II)  $\text{CCl}_4$  (3 mks)
- (c) Distinguish between the following  
(i) Orbit and orbital (2 mks)  
(ii) Radial function and angular function (2 mks)
- (d)(i) Give the set of quantum numbers for all the orbitals with the energy level,  $n=3$  (3 mks)  
(iii) Draw the shapes of the d orbitals (6 mks)

**Question two (20 marks)**

2. (a)(i) State the exclusion principle (2 mks)  
(ii) Explain the distinction between sublevel energies in one-electron species such as hydrogen atom and those in many-electron species such as carbon atom (3 mks)  
(iii) Explain the meaning of the following terms  
(I) Shielding effect (2 mks)  
(II) Effective nuclear charge (2 mks)  
(iii) Explain the relationship shielding effect and effective nuclear charge (2 mks)
- (b)(i) What is penetration effect? (2 mks)  
(ii) How is it related to shielding effect? (2 mks)  
(iii) Use the penetration effect to explain the difference in relative orbital energies of a 3p electron and a 3d in the same atom (3 mks)
- (c) Why do covalent substances melt and boil at low temperatures (2 mks)

**Question three (20 marks)**

3. (a) Explain the type of bonding in the following compounds  
(i)  $\text{ICl}_3$  (2 mks)  
(ii)  $\text{N}_2\text{O}$  (2 mks)  
(iii)  $\text{LiCl}$  (2 mks)
- (b) Using partial orbital diagrams and Lewis symbols depict the bond formation in the following compounds ( $\text{Na} = 11$ ,  $\text{O} = 16$ ,  $\text{H} = 1$ )  
(i)  $\text{Na}_2\text{O}$  (2 mks)  
(ii)  $\text{C}_2\text{H}_4$  (2 mks)
- (c)(i) Explain the relationship between the trends in atomic size and in ionization energy within the main group elements (2 mks)  
(ii) Why do successive ionization energies of a given element always increase? (2 mks)

- (c)(i) State Coulomb's law of electrostatic attraction (1 mks)  
(ii) Coulomb's law is a fundamental aspect of ionic bonding. Explain this statement (3 mks)
- (d) Draw the molecular shapes of the following (2 mks)  
(i)  $\text{BF}_3$   
(ii)  $\text{SO}_4^{2-}$

**Question four (20 marks)**

4. (a)(i) State the periodic law (1 mks)  
(ii) Explain its relation to electron configuration (2 mks)  
(iii) State Hund's rule and show its application in the orbital diagram of the nitrogen atom (3 mks)  
(iv) State Aufbau principle and its connection with periodic law (3 mks)
- (b)(i) Why could the Bohr model not predict line spectra atoms other than hydrogen? (3 mks)  
(ii) What was the theoretical basis from which Bohr made this assumption (2 mks)  
(iii) How is  $n_l$  in the Rydberg equation related to the quantum number  $n$  in Bohr model? (2 mks)
- (c) Draw the shapes of the following ionic solids and indicate their coordinate arrangement  
(i) Cesium Chloride (2 mks)  
(ii) Nickel Arsenide (2 mks)

**Question five (20 marks)**

5. (a) How does each of the following atomic properties influence the metallic character of the main-group elements in a period  
(i) Ionization Energy (2 mks)  
(ii) Atomic Radius (2 mks)  
(iii) Number of outer electrons (2 mks)  
(iv) Effective nuclear charge (2 mks)
- (b)(i) Distinguish between covalent and dative bonds (2 mks)  
(ii) State three rules that are necessary for the linear combination of atomic orbitals (3 mks)  
(iii) Compare and contrast the valence bond theory (VBT) and the molecular orbital theory (3 mks)
- (c) Draw and name the shapes of the following  
(i)  $\text{PF}_5$  (2 mks)  
(ii)  $[\text{CoCl}_4]^-$  (2 mks)