



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi - Abuja**  
**Faculty of Science**

**JULY 2017 Examination**

**COURSE TITLE: Atomic and Molecular Structure and Symmetry**

**COURSE CODE: CHM 307**

**COURSE UNIT: 3 Units**

**INSTRUCTION: Answer question ONE and any other FOUR questions**

**TIME: 2 ½ Hours**

- 1a) State the modern form of the Aufbau principle. **(4½ marks)**
- 1b) Fill the orbitals of Manganese according to Pauli's Exclusion Principle. **(1½ marks)**
- 1c) Use the following listed elements to answer the questions that follow.
- Li, Mg, P, Na, Cl, Be, N, K, Al, Ca, Si, C, S, B, O, Ar, F, Ne.
- i. Arrange the elements into groups of the periodic table. **(3 marks)**
- ii. Show the order of decreasing atomic radius in your arrangement. **(1 mark)**
- iii. Show the order of decreasing atomic radius in your arrangement. **(1 mark)**
- 1d) Explain the formation of molecular orbital (MO) in a homonuclear diatomic molecule. **(8 marks)**
- 1e) Discuss the energy ordering of molecular orbitals. **(3 marks)**
- 2a ) Highlight the characteristics of Molecular orbitals. **(5 marks)**
- 2b) Illustrate Huckel theory using ethene as example. **(7 marks)**
- 3a) Explain how continuous radiation spectrum and discrete spectrum are formed.  
**(4 marks)**
- 3b) write the fundamental formula of spectroscopy. **(1 mark)**

- 3c) Explain what the formula written in (3b) above means. **(2 marks)**
- 3d) Give the explanation given by Niel Bohr on spectrum of atomic hydrogen. **(5 marks)**
- 4a) Define the heat capacity of a compressible body. **(8 marks)**
- 4b) Using equation and diagram, explain the dimensionless heat capacity as a function of temperature as predicted by the Debye model and by Einstein's model. **(4 marks)**
- 5a) List the hybrid orbitals. **(1 mark)**
- 5b) Write on any three of the listed hybrid orbitals in (5a) above. **(9 marks)**
- 5c) Explain the application of Valence Bond Theory. **(2 marks)**
- 6a) Write on the principal coupling schemes. **(7 marks)**
- 6b) Use equation to explain Orthogonal and Orthonormal Wave Function. **(5 marks)**