

**NATIONAL OPEN UNVERSITY OF NIGERIA**

PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA

**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE & APPLIED SCIENCES**

**2018\_2 EXAMINATION QUESTIONS**

**COURSE CODE: CHM 307**

**COURSE TITLE: ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY**

**INSTRUCTION: ANSWER QUESTION 1 AND ANY OTHER FOUR QUESTIONS**

**COURSE UNIT: 3**

**TIME ALLOWED: 2 ½ HOURS**.

**QUESTION 1**

. ai) State the Hund’s Rule **(1 mark)**

**(aii)** What is paramagnetic substance **(2 marks)**

(aiii) Define quantum Chemistry **(1 mark)**

(aiv) Discuss the Pouli’s exclusion principle **(3 marks)**

(av) Write short note on the effect of vibration on rotation spectroscopy. **(2 marks)**

(bi) Write short notes on the following:

1. spin-spin coupling. **(2 marks)**

1. orbit-orbit coupling. **(2 marks)**

3. JJ coupling. **(2 marks)**

(bii) Discuss two postulates of quantum mechanics. **(4 marks)**

(biii) What is a center atom? **(3 marks)**

**QUESTION2**

**(a)i** Define molecular orbital theory (**2 marks)**

**(ii)** Sketch the energy level diagram in a hydrogen molecule **(3 marks)**

**(b)i** Calculate wave length of 100 ev electron. **(5 marks)**

(ii) Define bond order and give the formula (**2 marks)**

**QUESTION 3**

1. Determine the bond order for O2 and use that to determine its stability **(6 marks)**
2. i. Give the Schrodinga wave equation for 3 dimentional (3D) box**. (1 mark)**

ii. What are the requirements and principles of rotational spectrum? **(5 marks)**

**QUESTION 4**

1. State the relationship between
2. Bond length and bond order. **1 mark**
3. Bond order and bond dissociation energy **1 mark**
4. Force constant and bond order **1 mark**
5. Bond energy and bond strength **1 mark**
6. Using the algebra vector, discuss the vector analogy of a resonance**. (4 marks)**

(ii) highlight on the applications of valence bond theory. **(3 marks)**

(ii) Write an expression for orthogonal wave function. **(1 mark)**

**QUESTION 5**

1. Explain what you understand by the term (i) Commutation of operation **(4 marks)**

(ii) Describe the properties of molecular orbitals. **(2 marks)**

1. Write short note on heat capacity. **(2 mark)**

(ii) Derive an expression for following thermodynamics variables:

1. Heat capacity at constant volume Cv **(2 marks)**
2. Heat capacity at constant volume Cp. **(2 marks)**

**QUESTION 6**

1. Write short note on resonance energy of benzene. **(3 marks)**

(ii) Give the resonance structures of the following:

1. Ozone. **(1 mark)**
2. Alkyl cation. **(1 mark)**
3. Give the equation for dimensionless heat capacity of a material and what do those materials stand for? **(4 marks)**

(ii) What is molecular orbital? **(3 marks)**