NATIONAL OPEN UNIVERSITY OF NIGERIA

DEPARTMENT OF PURE AND APPLIED SCIENCES

2021_2 EXAMINATION 45678

COURSE CODE: CHM 307 **CREDIT UNIT:** 3
COURSE TITLE: Atomic and Molecular Structure and Symmetry **TIME:** 3 HRS
INSTRUCTION: Answer question 1 and any other 4 questions

QUESTION 1

1a) Discuss molecular orbital theory of heteronuclear diatomic molecules **(3 Marks)**

i. As we go down any group on the periodic table, the atoms get larger. Why? **(½ Mark)**

1bi) Write the electronic configuration of C^{4-}, Sn^{2+}, N^{3-}, Pb^{4+} **(2 Marks)**

1c. complete the table below **(3 Marks)**

Table: The Series in the Spectrum of Atomic Hydrogen

Series	n_2	n_1	Region in electromagnetic spectrum	Wavelength (nm)
• Lyman	1	2,3,4,5 …	--------	121.6
-------	2	3,4,5,6 …	---------	656.3
• Paschen	3	4,5,6,7 …	Infrared	1875
----	4	5,6,7,8 …	-------	4051
• Pfund	5	6,7,8,9 …	--------	7458

1cii) State the application of valence bond theory? **(½ Mark)**

iii) Draw the energy level in hydrogen molecule **(3 Marks)**

1biv) Explain the effect of vibration on rotation **(3 Marks)**

1bv) What are the shortcomings of the Aufbau Principle? **(7 Marks)**

QUESTION 2

2a) State what you understand by the following

i) Commutation of operators (4Marks)

ii) Linearity of an operator (2 Marks)

2bi) What are the importance of quantum field theory to a chemist? (2 Marks)

bii) What is the wavelength of a 100eV electron? (4 Marks)

QUESTION 3

3ai) List the steps on writing Resonance (5 Marks)

3aii). Define of Angular Momentum Coupling (1Mark)

3aiii). Angular momentum is a property of a physical system that is a constant of motion in two situations, name the situations. (2Marks)

3b) Explain the example of first situation of the angular momentum (4Marks)

QUESTION 4

4a) Explain L-S coupling (5Marks)

4b) Explain J-J coupling (4Marks)

4c) Explain the term spin-spin coupling (3Marks)

QUESTION 5

5ai) What is bond order? (2Marks)

5aii). How do you determine bond order of a molecule (2Marks)

iii). Define bond length (2Marks)

5bi) Briefly explain bond energy (3Marks)

ii) Describe bond dissociation energy (3 Marks)

QUESTION 6

a) State Hund's Rule and the Pauli's Exclusion Principle (4 Marks)
b) Briefly describe principle quantum number (6 Marks)
c) What is atomic spectrum (2 Marks)