



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE & APPLIED SCIENCES
OCTOBER/ NOVEMBER 2019_2 EXAMINATION

COURSE CODE: CHM 307

COURSE TITLE: ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY

CREDIT: 3 UNIT

TIME ALLOWED: 3 HOURS

Instruction: Answer question 1 and any other four questions.

QUESTION 1 (22 marks)

- A(i).** State the theory of rotational spectroscopy **(2 marks)**
- A(ii)** State the requirements for rotational spectrum from a molecule (to first order) **(2 marks)**
- b.** Give the differences between valence bond theory and molecular orbital theory **(4 marks)**
- c.** Define the following terms:
- i. valence bond theory **(2 marks)**
 - ii. Resonance **(2 marks)**
 - iii. Angular momentum **(2 marks)**
 - iv. Bond order **(2 marks)**
- d.** What is the wavelength of a 100eV electron **(2 marks)?**
- e** Explain the trend for the variation of atomic radius and ionization energy in the periodic table **(2 marks)**
- f.** Explain the difference between bonding and antibonding orbitals **(2 marks)**

QUESTION 2 (12 marks)

- a.** Discuss the shortcomings of the Aufbau Principle **(4 marks)**
- b.** Write out the electronic configuration of four out of the following transition metals **(8 marks)**
- i. Cerium (Atomic No: 58)
 - ii. Thorium (Atomic No: 90)
 - iii. Gold (Atomic No: 79)
 - iv. Mercury (Atomic No: 80)

v. Silver (Atomic No: 47)

QUESTION 3 (12 marks)

a. Copy and complete the table below (7 marks):

Series	n_2	n_1	Region in electromagnetic spectrum	Wavelength (nm)
.....	1	2,3,4,5...	.....	.....
.....	2	.....	Visible	.....
.....	3	4,5,6,7...	.....	.....
.....	4	.....	.....	4051
.....	5	6,7,8,9 ...	Infrared	.....

b. State the steps you would take in writing resonance structures

5 marks)

QUESTION 4

a. Write out the ground state electron configurations of the following elements in orbital box notation showing electron spins **(6 marks).**

- Carbon
- Nitrogen
- Oxygen
- Fluorine
- Chlorine

b. Explain the trend of atomic radius and ionization energy in the periodic table

(3 marks)

c. State Hund's Rule

(3 marks)

QUESTION 5

ai. List all different types of quantum numbers

(2 marks)

ii. Write a short note on three of these types of quantum numbers

(6 marks)

b. Write out the hybrid orbitals and shapes of four of the following molecules

(4 marks)

- i. CH_3Cl ii. BF_3 iii. PF_5 iv. BeF_2 v. IOF_5

QUESTION 6

a. Write short note on four of the following

(8 marks):

- molecular orbital

- ii. atomic spectra
- iii. heat capacity
- iv. Russell-Saunders (or L - S) coupling
- v. J-J coupling

b. Write out the properties of molecular orbital

(2 marks)

c. Give any five appropriate combinations of atomic orbitals

(5 marks)