

COURSE CODE: CHM 307

COURSE TITLE: Atomic and Molecular Structure and Symmetry

INSTRUCTION: Answer question 1 and any other 4 questions

CREDIT UNIT: 3

TIME: 3 HRS

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

- Commutation of operators (4Marks)
- 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

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