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**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2019/2020 ACADEMIC YEAR TWO**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF PURE AND APPLIED SCIENCES**

**FOR THE DEGREE OF BACHELOR OF EDUCATION**

**COURSE CODE: CHE 210**

**COURSE TITLE: ATOMIC STRUCTURE AND BONDING**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 14/02/2020 TIME: 09.00-11.00 AM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of FOUR (4) printed pages *please turn over***

**(Useful constants:** c = 3.0 x 108 m/s, h = 6.625 x 10-34 Js, Avogadro’s constant = 6.0 x 1023

particles/mole R= 1.097×107 M-1 **)**

**QUESTION ONE (COMPULSORY)**

1. Briefly describe the meaning of the following terms; **[5 marks]**
2. Bond order
3. Hamiltonian operator
4. Probability density function
5. Photoelectric effect
6. Degenerate orbitals
7. Arrange the following molecular orbitals in order of decreasing energy **[2 marks]**

σs , σs\*, πx\* , πy , σz\* , πx , πy \* , σz

1. Which of the following molecules would be expected to have zero dipole moment O2, HCl, CO2, CCl4, FBr, NH3, H2S and BeCl2  **[4 marks]**
2. State Heisenberg uncertainty principle?  **[2 marks]**
3. Suggest whether the following statements are true or false **[6 marks]**
4. In Uncertainty principle, when we try to gain precise information about the position of the particle, its momentum becomes uncertain.
5. Ψ must be finite and single valued for all the values of the coordinates
6. Electron with same spins can also lead to bonding
7. An atom with a large electronegativity has a small tendency to attract electrons
8. sp hybrid orbitals have equal s and p character
9. ∫ ψ2 dτ must be finite when the integration is carried out over the whole space , of which is dτ small volume of element

(f) Calculate

1. The frequency of red light of wavelength 6.50 × 102 n.m **[3 marks]**
2. The wavelength of radiation emitted by hydrogen atom upon electron transitions from n=6 to n=2 **[5 marks]**

(f) State the following rules that govern electron configuration in an element **[3 marks]**

1. Aufbau principle
2. Hund’s rule
3. Pauli Exclusion principle

**QUESTION TWO**

1. Write down the ground state electron configuration for:

(i) Copper atomic number is 29

(ii) Bismuth atomic number is 83 **[6 marks]**

1. What is meant by the expression "**effective nuclear charge**" and how does it affect orbital energies within a particular principle energy level? **[4 marks]**
2. Define isotopes **[1 mark]**
3. Calculate the atomic mass of naturally occurring chlorine if 75.77% of chlorine atoms are chlorine-35 and 24.23% of chlorine atoms are chlorine-37 **[3 marks]**
4. A discharge lamp produces 5.0J of energy per second in the blue region of spectrum. Calculate the number of photons of blue (470 n.m) light would the lamp generate if it were left on for 8.5 s **[6 marks]**

**QUESTION THREE**

1. Name the four quantum numbers and describe the importance of each quantum number in describing the behavior of electrons in atoms **[8 marks]**
2. State the THREE non-derivable fundamental postulates upon which quantum mechanics is based in the treatment of the atomic electron **[6 marks]**
3. Write down the Schrondinger wave equation? Explain the significance of the terms involved **[6 marks]**

**QUESTION FOUR**

1. Explain any three postulates upon which Bohr model is based on **[3 marks]**
2. Using postulates of the Bohr Theory derive an expression to show that the Bohr orbits are quantised. **[7 marks]**
3. Define
   1. Resonance **[2 marks]**
   2. Hybridization  **[2 marks]**
   3. Draw the resonance structures of the following ion and molecule; NO2- and C6H6

**[6 marks]**

**QUESTION FIVE**

1. Using VSEPR model, predict the geometrical structures and electron pair geometry of
   1. H3O+
   2. XeF4

(H=1, O = 8 Xe= 54, F=9) **[10 marks]**

1. Using a molecular orbital energy level diagram, predict if the following molecules exists
2. He2 **[4 marks]**
3. N2 **[6 marks]**