ALUPE UNIVERSITY COLLEGE

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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2019/2020 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHE 210

COURSE TITLE: ATOMIC STRUCTURE AND BONDING

DATE: 6TH DECEMBER, 2019   **TIME: 9.00AM – 12.00 NOON**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

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CHE 210: ATOMIC STRUCTURE AND BONDING

STREAM: BED (Science)   **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

   i.   *Answer **ALL** questions.*

  ii.   *Diagrams may be used whenever they serve to illustrate the answer*

Question One

a) Define the following terms.

   i.   Wave   (1 Mark)

  ii. Wave function   (1 Mark)

 iii. Stationary state   (1 Mark)

b) Derive the de Broglie's relationship.   (3.5 Marks)

c) Discuss the state of an atom according to Bohr model.   (3 Marks)

d) Discuss briefly the uncertainty principle.   (2 Marks)

e) Discuss the two consequences of the Heisenberg Uncertainty Principle.   (4 Marks)

f) Outline the three properties of a wave function.   (4.5 Marks)

Question Two

a) The main task of applying the Schrodinger equation to a given problem is

   two-fold. Discuss.   (4 Marks)

b) Highlight five conditions necessary for the Schrodinger equation.   (5 Marks)

c) Discuss briefly the shapes of s, p and d orbitals   (4 Marks)

d) The filling of orbitals with electrons is governed by three

   principles. Discuss.   (3 Marks)

e) The electron configuration of a carbon atom is $1s^2 2s^2 2p^2$. Illustrate the

   three possible arrangements for the electrons in p orbital.   (2 Marks)

Question Three

a) Calculate the effective nuclear charge on a 3d electron in a nickel atom.   (2 Marks)

b) Briefly discuss the three factors considered when describing Fajan's rule.   (3 Marks)

c) Outline the three statements that summarize valence bond theory.   (3 Marks)

d) Discuss the formation of F-F bond using valence bond theory.   (3 Marks)

e) i. Define the term hybridization.   (1 Mark)

  ii. State what happens when orbitals are hybridized.   (2 Marks)

  f) State two failures and one success of valence bond theory   (3 Marks)

Question Four

a) Define lattice enthalpy.   (1 Mark)

b) i. Draw a Born-Haber cycle for sodium chloride, naming each step.   (3 Marks)

  ii. Calculate the lattice enthalpy for sodium chloride given that;

    ΔH_f^0 (NaCl) = -411 kJmol^{-1}

    ΔH_{at}^θ (Na(g))= +107 kJmol^{-1}

    ΔH_{at}^θ ($\frac{1}{2}Cl_2$(g))= +121 kJmol^{-1}

    ΔH_{il}^θ (Na(g))= +496 kJmol^{-1}

    ΔH_{eal}^θ (Cl(g))= -348 kJmol^{-1} (3 Marks)

c) State two characteristics of ionic compounds.   (2 Marks)

d) For combination of the atomic orbitals to occur three conditions have to be met. Outline them.   (2 Marks)

e) Construct a molecular orbital picture for fluorine molecule and determine whether it is paramagnetic or diamagnetic.   (4 Marks)

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