KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: SCH 214

COURSE TITLE: ATOMIC STRUCTURE AND CHEMICAL BONDING

DURATION: 2 HOURS

DATE: 12/02/21 **TIME:** 11-1 Pm

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **4** printed pages. Please Turn Over

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The following constants may be used

h = 6.6 x 10^{-34}J.S

C = 3.08 x10^{8} m/s

Charge on electron, e = 1.602 x 10^{-19}C

Mass of electron, m = 9.10939 x 10^{-31}kg

ε_o =8.854 x 10^{-12} $Kg^{-1}m^{-1}A^2$

QUESTION ONE

a. Based on Rutherford's observations, explain THREE main conclusions about the structure of the atom. **(3mks)**

b. Distinguish between the ground state and an excited state of an atom. **(2mks)**

c. Determine the energy in Joules of a photon whose frequency is 3.55 x 10^{17} Hz (*Planks* constant =6.63 x 10^{-34}) **(2mks)**

d. Electron energy in hydrogen atom is given by $E_n = (-2.18 \times 10^{-18})/n^2$ J. Calculate the energy required to remove an electron completely from the $n = 2$ orbit. What is the longest wavelength of light in cm that can be used to cause this transition? **(3mks)**

e. Using $r = \varepsilon_o n^2h^2/\pi me^2z$, calculate the radii of the first and second orbits for hydrogen atom. **(3mks)**

f. State three limitations of Bohrs theory of atomic structure of hydrogen. **(3mks)**

g. State Heisnberg's uncertainty principal **(1mk)**

h. What is an orbital. **(1mk)**

i. Give the names of four quantum numbers associated with the hydrogen atom and state the significance of each. **(4mks)**

j. Draw and name the shapes of *s* and *p* orbital. **(3mks)**

k. Distinguish between radial and angular nodes of orbitals **(2mks)**

l. Determine each of the following for 4f orbital **(3mks)**

i. total number of nodes ;

ii. the angular nodes;

iii. the radial nodes;

QUESTION TWO

a) State Paulis exclusion principle. **(1mk)**

b) Chloride ion (Cl^-), Chromium (23), Copper (29) and Zinc (30) are some of the transition elements.

i. Write the electronic configuration of the elements. **(4 marks)**

ii. State four characteristics commonly exhibited by the transition elements. **(4 marks)**

c) The table below gives single bond covalent radii (*all in Å*) for some atoms of main group elements.

Element	H	F	Cl	Br	I
Atomic radii *Å*	0.37	0.72	0.99	1.14	1.33
Electronegativity	2.20	4.10	2.83	2.74	2.21

Use it to answer questions that follow

(i) Given inter nuclear distance $d_{A\text{-}B} = r_A + r_B$ calculate the inter nuclear distance for the atoms in the following molecules. **(2mks)**

-HF = 1.09 Å

-HBr = 1.51 Å

(ii) Explain the trend in

I. atomic radii down the halogen group (from F to I). **(2mks)**

II. electronegativity among the halogens (from F to I). **(2mks)**

(d) Distinguish between electronegativity and electron affinity. **(2mks)**

(e) State three factors affecting ionization energy. **(3mks)**

QUESTION THREE

a) Write the significance of octet rule. **(1mk)**

b) Explain the formation of $CaCl_2$ according to kossel concept. **(3mks)**

c) List three rules for the linear combination of atomic orbitals LCAO. **(3mks)**

d) State five differences between sigma and pi-bonds. **(5mks)**

e) Explain the different types of s - bond formation. **(6mks)**

f) Distinguish between bonding molecular orbital and antibonding molecular orbital. **(2mks)**

QUESTION FOUR

a) Define bond order. (1mk)

b) i) Construct a Molecular Orbital diagram of He_2^+ and diatomic oxygen molecule, O_2. **(4mks)**

Use the diagram to determine the bond orders and magnetic properties of NO^+ and O_2 **(4mks)**

i. Explain why Helium atoms do not combine to give He_2 but helium atom can bond to helium ion to give He_2^+ **(2 marks)**

c) Determine the shapes correlated with the sp^2, sp^3, sp^3d, hybridization. **(3 mks)**

d) Discuss the shape of the following molecules using the VSEPR model: **(6mks)**

$BeCl_2$, H_2S, PH_3

QUESTION FIVE

a) Define hydrogen bonding. **(1mk)**

b) Explain two factors affecting the strength of dispersion forces. **(4mks)**

c) Using van der Waals concept, explain the following; **(4 marks)**

i. Butane and 2-methylpropane have the same relative molecular mass but very different boiling points, -0.5 °C and -11.7 °C respectively

ii. The boiling point of Ethane is 184.5° K while flouro methane is 194.7° K.

d) Give the coordination number of the ions and describe the crystal structure of sodium chloride in terms of close packing and occupancy of the holes. **(5mks)**

e) Explain the following using the band theory **(6mks)**

i. Conductors

ii. Insulators

iii. semiconductors