

**MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**P.O. Box 972-60200 – Meru-Kenya.**

**Tel: 020-2069349, 061-2309217. 064-30320 Cell phone: +254 712524293, +254 789151411**

**Fax: 064-30321**

**Website:** [**www.must.ac.ke**](http://www.must.ac.ke) **Email:** **info@must.ac.ke**

**University Examinations 2015/2016**

THIRD YEAR, FIRST SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN CHEMISTRY

**SCH 2300: ATOMIC STRUCTURE & BONDING**

**DATE: NOVEMBER, 2015 TIME:** $2$**HOURS**

**INSTRUCTIONS:** *Answer question* ***one Compulsory*** *and any other* ***two*** *questions.*

* ***Useful data and constants.***

***Quantity Symbol Value and units***

***speed of light C 2.998 x*** $10^{8}ms^{-1}$

***Plank’s constant h 6.626 x*** $10^{-34}J.S$

***Mass of electron m 9.109 x***$10^{-31}$***kg***

***elementary change e 1.602 x***$10^{-19}$***C***

***vacume permittivity*** $ε\_{0}$ ***8.854 x***$10^{-12}JC^{2}m^{-1}$

***Avogadro constant NA 6.022 x*** $10^{23}mol^{-1}$

***1J = 1kg***$m^{2}s^{-2}$***,***$π=3.14$

**QUESTION ONE – (30 MARKS)**

1. What type of atomic orbitals do the following quantum numbers describe? (3 Marks)
2. n = 2, l = 0
3. n=3, l = 1
4. n=4, l=2
5. Why is the ground state electron configuration of copper (z=29) is $\left\{Ar\right\}$ $4s^{'}$ $3d^{10}$and not $\left\{Ar\right\} 4s^{2}3d^{9}$ while that of Cr (z = 24) is $\left\{Ar\right\}$4$s^{'}$3$d^{s}$ and not $\left\{Ar\right\} 4s^{2}3d^{4}$ (3 Marks)
6. Write down the Schrondiger equation and explain the significance of the terms involved. (5 Marks)
7. How can electro negativities of elements be used to predict the kind of bonds formed between elements? give examples. (3 Marks)
8. State what were the draw backs of Rutherford’s model of atom. How are these connected by Bohr’s theory? (2 Marks)
9. Given that the centrifugal force of the electron, $MV^{2}$is equal and opposite to the electrostatic attraction between the nucleus and electron $\frac{-ze^{2}}{4πε\_{0}r^{2}}$ that is

 $\frac{ze^{2}}{4πε\_{0}r^{2}}$ = $\frac{MV^{2}}{r}$

1. Show that r = $\frac{ε\_{0} n^{2}h^{2}}{πme^{2}z}$ (4 Marks)
2. Calculate the radius of the first Bohr’s orbit for hydrogenic atom. (2 Marks)
3. Give the moleculer orbital diagram for the following diatomic molecules. Calculate the bond order in each case. (6 Marks)
4. N2
5. F2
6. Li2
7. On the molecular orbital diagram of N2 in (I above show Lumo and Homo. (2 Marks)

**QUESTION TWO (20 MARKS)**

1. What is photoelectric effect? Light of wavelength 400 nm strikes a certain metal which has a photoelectric work function of 2.13 ev. Calculate:
2. The energy of the photon. (3 Marks)
3. The kinetic energy of the most energetic electron in (1J = 6.24 x $10^{18}ev)$(3 Marks)
4. Velocity of the ejected electrons. (3 Marks)
5. The stopping potential. (3 Marks)
6. What is Compton effect?

A monochromatic x-ray bean of wavelength 0.0558nm is scattered through an angle of 460.What is the wavelength of the scattered beam? (3 Marks)

1. Calculate the wavelength of the first spectral line in the Balmer series of He+ ion.

(R = 1.09722 x $10^{7}m^{-1})$ (3 Marks)

1. What is meant by quantization of energy? How has this concept been helpful in explaining the existence of different lines in hydrogen spectrum? (2 Marks)

**QUESTION THREE (20 MARKS)**

1. State two Bohr’s postulate of atomic structure. (2 Marks)
2. What are the limitations of Bohr’s theory of atomic structure? (2 Marks)
3. The ionization potential of hydrogen atom is 13.6 ev. Calculate the ionization potential of He+, that is the energy for the process (R= 1.096778x $10^{7} m^{-1}$)

He+ $\rightarrow $ He 2+ +$ e^{-}$ (3 Marks)

1. Explain why the first ionization potential of Al (z =13) is less than that of Mg(z = 12)

(3 Marks)

1. State the de Broglie hypothesis. (1 Mark)

The $∝$- particles emitted from radium have an energy of 4.8 Mev. What is the de Broglie wavelength of these $∝ $- particles. (3 Marks)

1. Write short notes in each of the following;
2. Uncertainty principle (2 Marks)
3. Electron affinity (2 Marks)
4. Screening effect (2 Marks)

**QUESTION FOUR (20 MARKS)**

1. Distinguish the following; (6 Marks)
2. Atomic orbital from molecular orbital
3. A polar covalent bond from a non-polar covalent bond
4. A pi bond from a sigma bond.
5. With aid of molecular energy level diagram, write down the molecular orbital configuration of O2,$O\_{2}^{-}$ and O2+  which one of these species is the most stable and why. Which one would you expect to be paramagnetic and why? (10 Marks)
6. Write the resonating structures for; (4 Marks)
7. 
8. $SCN^{-}$