KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
SUPPLENTARY/SPECIAL EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SCH 210

COURSE TITLE: ATOMIC STRUCTURE AND CHEMICAL BONDING

DURATION: 2 HOURS

DATE: 01/10/2018 **TIME: 8-10 AM**

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 **3** printed pages. Please Turn Over

SECTION A COMPULSORY QUESTION (30 MARKS)

(a) Given that the sublimation energy of a solid potassium is 90kJ/mol, dissociation energy of chlorine is 121.5kJ/mol, ionization energy of potassium is 420kJ/mol and the electron affinity -355KJ/mol. Lattice energy = - 703kJ/mol. Sketch the Born- Haber cycle for the formation of potassium chloride from which to determine the enthalpy of formation. [5marks]

(b) The lattice energies of some ionic compounds are given below:
NaCl = 600kJ/mol
LiF = 10400kJ/mol
$CaCl_2$ = 2200kJ/mol

(i) Define lattice of an ionic compound. [2marks]

(ii) Briefly explain why LiF has higher lattice energy than NaCl. [2marks]

(iii) The lattice of $CaCl_2$ is almost three times that of NaCl. [2marks]

(iv) Calculate the wave number if $n_1 = 3$ and $n_2 = 4$ and $n_1 = 2$ and $n_2 = 6.8899$ [2marks]

(c) Define the terms:

(i) Polar covalent bond. [1marks]

(ii) Hybrid orbitals. [$1^1/_2$ marks]

(iii) Molecular orbitals. [$1^1/_2$marks]

(d) Give the difference between

(i) A sigma bond and a π –bond. [2marks]

(ii) A diamagnetic and a paramagnetic substance. [2marks]

(e) Plot the shape of orbitals for which l = 1. [2marks]

(f) What is the characteristic wavelength of an electron with a velocity of 5.97×10^6m/s. [3marks]

(g) (i) Give the difference between valence bond theory and molecular bond theory. [2marks]

(ii)Differenciate between antibonding and bonding molecular orbitals. [2marks]

Question 2

(a) Formaldehyde, H_2CO, is a colourless pungent gas used to make plastics. Give the valence bond description of the formaldehyde molecule. (Bond hydrogen atoms are attached to the carbon atoms). [2marks]

(b) Solution to the equation above gives rise to four quantum numbers. State these numbers, give their acceptable values and what they determine. [2marks]

(c) Write down the electron configuration of the following elements and state the block of the periodic table in which they belong to. (Atomic numbers; Cr = 24, Sb = 51, Ce = 58).[3marks]

(d) IR light emitted from a TV remote control has a wavelength of 805nm.Calculate:

(i)The frequency of its photons. [3marks]

(ii)The energy of its photons. [2marks]

(e) Spectral line is produced when the hydrogen atom jumps from n = 3 to n = 2. Calculate;

(i)The wave number of the spectral line produced. [2marks]

(ii)The energy of the radiation produced. [2marks]

(f) (i)Define orbital hybridization. [1marks]

(ii)Complete the table below for hybridization in carbon. [6marks]

Hybridization state	Number of hybrid orbitals	Number of σ bonds	Number of π bonds	Geometry around carbon
SP^3	-	-	-	-
SP^2	-	-	-	-
SP	-	-	-	-

Question 3

(a) Explain the meaning of the following. [6marks]

(i)Photoelectron

(ii)Black body

(iii)Degenerate orbitals

(b) Outline the four postulates upon which Bohr's atomic model is based. [2marks]

(c) State the limitations of Bohr's theory. [2marks]

(d) Calculate the radius of Bohr's orbit for a hydrogen atom. [3marks]

Calculate the frequency of the radiation required to eject photoelectrons at a velocity of 9×10^5m/s from a sodium metal surface having a threshold frequency of 4.61×10^{14}Hz. [3marks]

(e) The speed of a 1.75g projectile is known to be within 1.0×10^{-6}m/s. Given that the Plank's constant, $h = 6.626 \times 10^{-34}$Js, calculate the minimum uncertainty in position for this particle. (Mass of electron = 9.11×10^{-31}kg). [2marks]

(f) Calculate the wavelength of the 12^{th} line in the Balmer series of hydrogen spectrum [2marks]

Question 4

(a) Define each of the following. [4marks]

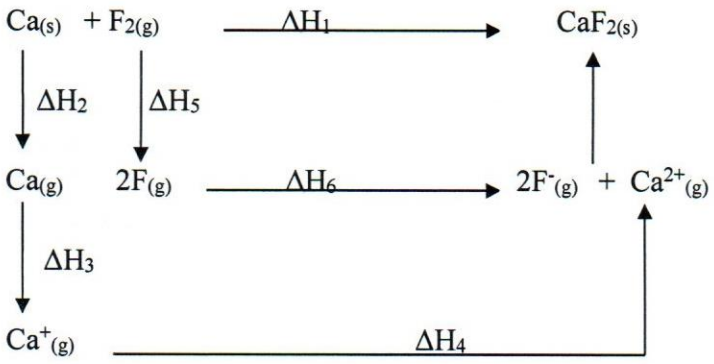
(i)Electro negativity

(ii)The standard enthalpy of formation

(iii)The standard enthalpy of atomization

(iv)Electron affinity

(b) Calculate the value of the lattice energy of CaF_2 from the following data. [2marks]



(c) (i) Briefly explain how a molecular orbital is a major factor in the formation of a metallic bond. [2marks]

(ii)Draw Lewis structures that represent an ionic bond that exists between Ca and Br^- ions. [2marks]

(iii)Write down the Schrödinger equation in three dimensions indicating what m,ψ, E, V stand for. [4marks]

(iv)Write down two possible sets of quantum numbers that describe an electron in a 2S atomic orbital. [2marks]

(d)Use the following data, which are in Kj/mol to calculate the lattice energy of Magnesium Bromide. [4marks]

Sublimation energy of Magnesium ..... +2187

Vaporization energy of $Br_{2(l)}$ ..... +31

Dissociation energy of Bromine gas..... +193

Electron affinity of Bromine gas ..... -331

Enthalpy of formation, ΔH_f ($MgBr_2$) ..... - 524

Question 5

The following table shows melting points and conductivity of five elements/ substances

Substance	Melting point/k	Conductivity in solid state	Conductivity in molten state
MgO	3173	Poor	Good
NaCl	1081	Poor	Good
Mg	923	Good	Good
CO_2	217	Poor	Poor
SiO_2	1883	poor	Poor

a) Explain why the conductivity of $MgO_{(l)}$ good whereas that of $MgO_{(s)}$ is poor. [2marks]
b) Explain why the melting point of MgO is much higher than that of NaCl even though both are ionic compounds. [2marks]
c) Why is the conductivity of Mg good both in solid and liquid states? [2marks]
d) By illustration using suitable examples, explain how the following bonds are formed; metallic bond and ionic bond [6marks]
e) Briefly describe the band theory and use it to differentiate between conductors, semi conductors and insulators. [8marks]