PWANI UNIVERSITY COLLEGE

A CONSTITUENT COLLEGE OF KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2008/2009 ACADEMIC YEAR

2ND YEAR 1ST SEMESTER EXAMINATION FOR THE DEGREE OF

STREAM: BACHELOR OF EDUCATION (SCIENCE) & BACHELOR OF EDUCATION

SCH 200: ATOMIC STRUCTURE & CHEMICAL BONDING

END SEMESTER: I **TIME: 3 HOURS**

DAY: WEDNESDAY 8.00 TO 11,00A.M. **DATE: 25/02/2009**

INSTRUCTIONS

1. *All questions have equal marks*
2. *Answer question **ONE (COMPULSORY)** and any other **FOUR** questions*
3. *electronic calculators may be used*
4. *Show all your working **CLEARLY***
5. *Marks are indicated in brackets ( )*

LIST OF CONSTANTS

Planck's Constant,	h	=	6.626×10^{-34} j.S
Electronic Mass,	m_e	=	9.1094×10^{-31} Kg
Electronic charge,	e	=	1.6022×10^{19} C
Permittivity constant	$\sum_o$	=	$8.854 \times 10^{-12} CJ^{-1}m^{-1}$
Speed of Light	C	=	3.0×10^{8} mls
Reduced Planck's Constant,	$\hbar$	=	1.05457×10^{-34} J.s

QUESTION ONE - COMPULSORY

Q.1) a) Using the sine and cosine function
Ψ = A sin (Kx) + Bcos(Kx)
Derive the solution of the Schrödinger equation for a particle in a box.
Take $K = (2mE)^{1/2}\ \hbar^{-1}$ (12 mks)

b) Find the Transition energy of the light emitted when a 1 x -27 g particle in 34 one-dimensional box goes from the n = 2 to the n = 1 level (2 mks)

Q.2) a) Distinguish between an orbital and electronic charge density (2 mks)

b) Draw the charge cloud diagram for (2 mks)
i) 25 – orbital

ii) 35 – orbital

c) State three properties of a well behaved wave function. (3 mks)

d) i) Calculate the De Broglie wavelength associated with the electron in the hydrogen atom. (3 mks)

ii) According to Schrödinger, what does each of the following quantum numbers describe Principal quantum number, Angular momention quantism number and magnetic quantum number (4 mks)

Q.3) a) Diatomic Molecule for Neon, Ne_2 does not exist. Explain using the Molecular orbital theory. (3 mks)

b) i) Draw the molecular orbital energy level diagram for the ground state of the oxygen molecule 0_2 and write the electronic configuration. (5 mks)

ii) State and explain the number of sigma , δ and Pi, π bonds in a 0_2 molecule (3 mks)

iii) is the Oxygen-Oxygen bond a single, double or Triple bond? (1 mk)

iv) What is the bond order of the oxygen-oxygen bond? (2 mks)

Q.4) a) i) Use the abbreviated electron configurations to show the formation of the ionic compound. Magnesium Fluoride form magnesium atoms and Fluorine atoms. (2 mks)

ii) What is the formula for magnesium Fluoride? (1 mk)

b) Define the term Lattice Energy (2 mks)

c) i) Given the information below, use a Born-Haber cycle to calculate the Energy change associated with the reaction. (5 mks)

$$K^+_{(g)} + Br^-_{(g)} \longrightarrow KBr_{(s)} .$$

1) $K_{(s)} \longrightarrow K_{(g)}$ $\Delta H^o_1 = 77Kj$

2) $Br_{2(1)} \longrightarrow Br_{2(g)}$ $\Delta H^o_2 = 30\ Kj$

3) $Br_{2(g)} \longrightarrow 2Br_{(g)}$ $\Delta H^o_3 = 194Kj$

4) $K_{(g)} \longrightarrow K^+_{(g)} + e^-$ $\Delta H^o_4 = 419Kj$

5) $Br_{(g)} + e^- \longrightarrow Br^-_{(g)}$ $\Delta H^o_5 = 324\ Kj$

6) $2\ K_{(s)} + Br_{2(1)} \longrightarrow 2KBr_{(s)}$ $\Delta H^o_6 = 788\ Kj$

ii) Determine the Lattice energy for solid KBr. (2 mks)

iii) Explain the source of energy that separates the oppositely charged ions in a Crystal of an Ionic Solid from each other when dissolving. (2 mks)

Q.5) a) Calculate the third (rd) ionization potential for Lithiom (Li = 3) (3 mks)

b) Given that the allowed bound stake Energy levels of Hydrogen-Like atoms is given by:

$$E = \frac{-Z^2 Me^4}{32\pi^2 \sum^2 \hbar^2} \cdot \frac{1}{\prod^2}$$

Calculate the total energy of two electrons in the n = 2 level of Hydrogen atom (5 mks)

c) i) The S-orbital does not have the Angular momentum, in other words, the S-orbital does not depend on the angular co-ordinates. Explain (2 mks)

ii) A sodium atom, Na is larger than a sodium ion, Na^+ while a chloride ion, Cl^- is larger than a chlorine atom, Cl. Explain (2 mks)

iii) An aqueous solution of $AlCl_3$ is acidic . Explain (2 mks)

Q.6) a) i) Give the Lewis definition for Acids and bases (1 mk)

ii) Distinguish between a complex ion and a Ligard (2 mks)

b) Picture the formation of HCO_3^- as a Lewis acid-base reaction between OH^- and CO_2 (2 mks)

c) Briefly describe any TWO properties of Ionic compounds and explain how ionic bonding accounts for these properties. (2 mks)

d) Use the bond energies indicated to estimate (Kr) $\Delta H_{s\,x\,n}$ at 25°C for the reaction: (3 mks)

$$CO_{(g)} + OH_{(g)} \longrightarrow CO_{2(g)} + H_{(g)}$$

Bond Energies, Kj/Nol	1075		464	799

e) Explain the following observations

i) The electrical conductivity of metals decreases with increased temperature. (2 mks)

ii) Metals have a characteristic shinny appearance (2 mks)