



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

OPEN, DISTANCE AND E-LEARNING EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION

SCH 200: ATOMIC STRUCTURE AND CHEMICAL BONDING.

DATE: Monday 4th July 2011

TIME: 8.00a.m – 10.00a.m

INSTRUCTIONS: Attempt All the questions

You do not need a periodic table.

- 1) a) Briefly explain what you understand with the following concepts in regard to Quantum theory.
 - i) Dual nature
 - ii) Heisenberg Uncertainty Principle
 - iii) Quantization [9marks]
- b) Explain which and how the three concepts in 1 (a) above
 - i) Defy or support the Bohr atomic model
 - ii) Contribute to the current understanding of atomic orbitals. [8marks]
- c) State one experiment that supports both the ‘dual nature’ and “quantization” concepts and with aid of a relevant diagram explain
 - i) The experimental set-up
 - ii) Observations
 - iii) And conclusions made based on the observations. [12marks]

- 2) The Schrödinger equation for a particle moving in three dimensions under a potential V can be given as follows:

$$\left[\frac{-h^2}{8\pi^2m} \left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} \right) + V(x, y, z) \right] \psi(x, y, z) = E \psi(x, y, z)$$

- a) Define all the terms used in the equation above. [6marks]
- b) State the properties that a wave function must have to be and acceptable solution to this equation. [4marks]
- c) List all the quantum numbers that are obtained when Schrödinger equation is solved and state what each determines and what values it can have. [12marks]

- 3) Oxygen molecule, O_2 , is known to be attracted by magnet. (atomic number of O is 8).

- a) What term is used to describe molecules of species with such properties [2marks]
- b) Draw the molecular orbital diagram of O_2 and [4marks]
 - i) Explain how it supports the above property. [2marks]
 - ii) Calculate the bond order. [2marks]

- 4) The following are thermo chemical data for calcium difluoride solid, $CaF_{2(s)}$,

Enthalpy of atomization of calcium, $\Delta H_{at} = 193 \text{ kJ/mole}$

First ionization energy for Ca, $\Delta H_I = 590 \text{ kJ/mole}$

Second ionization energy for Ca, $\Delta H_{II} = 1146 \text{ kJ/mole}$

Dissociation Energy for $D(F-F) = 158.2 \text{ kJ/mole}$

Electron affinity for fluorine, $E_{a(F)} = -342 \text{ kJ/mole}$

Enthalpies of formation, $\Delta H_f CaF_2, -1219.64 \text{ kJ/mole}$

- a) Use the data to calculate the lattice energies for $CaF_{2(s)}$. [7marks]
- b) Briefly explain why most fluorides are insoluble. [2marks]