NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CGHEMISTRY

END OF FIRST SEMESTER EXAMINATIONS – APRIL/MAY 2009

INORGANIC CHEMISTRY I - SCH 1101

TIME : THREE (3) HOURS

INSTRUCTIONS TO CANDIDATES:

1. **ANSWER *ALL QUESTIONS* FROM *SECTION A* AND *ANY THREE* FROM *SECTION B.* SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS. MARKS ARE ALLOCATED IS INDICATED IN BRACKET.**

2. **START EACH QUESTION ON A NEW PAGE.**

3. **PERIODIC TABLE WILL BE PROVIDED ON REQUEST.**

TOTAL MARKS = 100

THIS QUESTION PAPER CONSISTS OF *THREE PRINTED PAGES* (ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.

SECTION A:

1. (a) state (i) Pauli's excusion principle.
(ii) Aufbau Principle
(iii) Hund's rule.

(2 x 3 Marks)

(b) How many electrons are there in a shell of Principal quantum number n?

(2 Marks)

(c) Draw the hybrid orbitals formed and their corresponding geometries for an atom having only s and p orbitals in its valence shell. Use carbon as an example.

(3 Marks)

(d) Write Schrödinger equation based on wave-particle duality.

(5 Marks)

(e) Which group has an ns^2np^3 electron configuration?

(2 Marks)

(f) With the aid of electron configuration explain Kernal electrons, octet electrons and valence electrons?

(6 Marks)

(g) According to De Broglie, how is the wave-length associated to the mass and the velocity of particles of a matter?

(2 Marks)

(h) What the following quantum numbers indicates
(i) Princilal quantum number
(ii) Azimuthal quantum number
(iii) Magnetic quantum number and
(iv) Spin quantum number

(2 x 4 Marks)

(i) What type of orbital is occupied by an electron with quantum number $n = 5$ and $l = 0$. How many orbitals of this type are found and what are they called?

(3 marks)

(j) Write Lewis structures for H_2O, CH_4, CO_2.

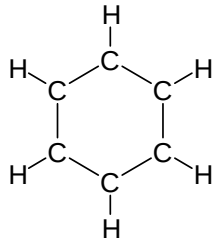
(3 Marks)

SECTION B:

2. (a) With the aid of a labelled diagram describe the experiment that provides evidence for the quantization of energy.

(7 Marks)

(b) Draw valence bond structure for benzene, C_6H_6. This molecule has a planar hexagonal geometry.



(5 Marks)

(c) How can you explain the electrical conductivity of a metal?

(3 Marks)

(d) State Heisenberg's uncertainty principle.

(5 Marks)

3. Describe and explain Bohr's atomic theory.
   (i) Use hydrogen atom as an example,
   (ii) Use assumption and line spectra for your explanation.

(20 Marks)

4. (a) What is the electron configuration of Zn and Zn^{2+}? What is the quantum number that is lost by an atom of Zn when it forms Zn^{2+}?

(6 Marks)

(b) Calculate the wave-length of light that must be emitted by the hydrogen atom from the Principal quantum number 2 to 1.

(6 Marks)

(c) Use the valence bond theory to account for the bonding and planar structure of the NO_3^- ion.

(6 Marks)

(d) Why is De Broglie's equation of greatest importance when applied to the least massive particle such as electron?

(2 Marks)

5. (a) Draw the molecular orbital diagram for fluorine molecule F_2. Use 1s, 2s and 2p electrons.

(5 marks)

(b) From the experimental data given below, draw Born-Haber cycle and calculate lattice energy of CsCl.

The enthalpy of atomization of caesium: $\Delta H_1 = +79$ kJ/mol

The enthalpy of atomization of chlorine: $\Delta H_2 = +121$ kJ/mol

The ionization energy of caesium: $\Delta H_3 = +376$ kJ/mol

The electron affinity of chlorine: $\Delta H_4 = -348$ kJ/mol

The lattice energy of caesium chloride to be calculated: ΔH_5

The standard enthalpy of formation of caesium chloride : $\Delta H_6 = -411$ kJ/mol

(10 Marks)

(c) Lattice energy can not be measured directly but it can be calculated. From the lattice energy expression, calculate lattice energy for caesium chloride.

The Avogadro constant: 6.022 x 1023 mol^{-1}

The electronic charge: 1.6022 x 10^{-19} C or J

The permittivity of a vacuum: 8.854 x 10^{-12} F m^{-1}

The Madelung constant: 1.763

The compressibility of crystal: 1.1005

Ionic radii of Cs = 0.169 nm; Cl = 0.181 nm

Comment on the experimental and calculated lattice energy.

(5 marks)

End of Question Paper!!!