Uva Wellassa University, Sri Lanka
End Semester Examination – March 2010
SCT 131-1 Chemistry I

Time: One (01) hour

Total five (05) questions
Answer all questions in part A
Answer two (02) questions from part B

Universal gas constant, $R = 8.314\ J\ K^{-1}\ mol^{-1}$
Plank's Constant, $h = 6.626 \times 10^{-34}\ m^2\ kg\ s^{-1}$
Rydberg constant, $R = 1.096 \times 10^7\ m^{-1}$
Velocity of light $= 3 \times 10^8\ m\ s^{-1}$
Mass of electron $= 9.109 \times 10^{-31}$ kg

Part A

01) a. State the Bohr model for a hydrogen atom. State two drawbacks of the model.

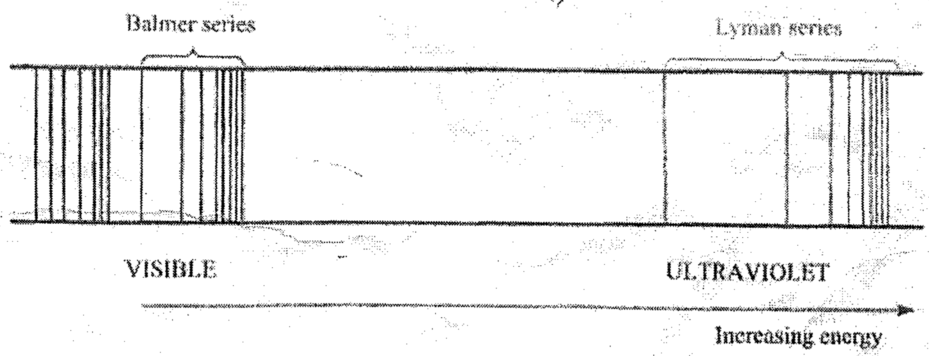
(09 marks)

b. In 1885 Balmer showed that the wave number $\bar{v}$ of any line in the visible spectrum of atomic hydrogen could be given by a simple empirical formula. State the formula. Identify all terms therein.

(06 marks)

c. For a one-electron atom of unknown atomic number Z, a series of emission lines, all terminate at the second-excited level of the atom was obsreved. In this series of lines, the wavelengths of the first three lines are (in decreasing order): 4690 Å, 3210 Å and 2750 Å.

Calculate the value of the shortest wavelength for a line in this series. Show your working clearly.



(10 marks)

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02) Answer **either** part (a) or (b) bellow.

a. i. Draw the shapes of the following molecular orbitals for the overlap of two p atomic orbitals. Show the nodal planes clearly.

(1) Direct overlap of the p orbitals along z axis forming σ (bonding orbital) and σ^* (antibonding orbital).

(2) Sideways overlap of the p_x atomic orbitals forming π (bonding orbital) and π^* (antibonding orbital).

(11 marks)

ii. Draw the orbital interaction diagrams (molecular orbital diagram) for any two of the following molecules.

(1) Li_2

(2) C_2

(3) O_2

(14 marks)

03) b. i. How many atomic orbitals make up the set with n=4 and l=3? What label is given to this set of orbitals? Write down a set of quantum numbers that defines each orbital in the set.

(10 marks)

ii. Use the VSEPR theory to predict any three of the followings:

(1) $[BH_4]^-$

(2) $[H_3O]^+$

(3) SO_3

(4) PF_5

(5) SF_4

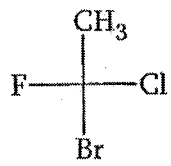
(15 marks)

Part B

1. a. Draw the structure of (E)-2-chloro-2-butene.

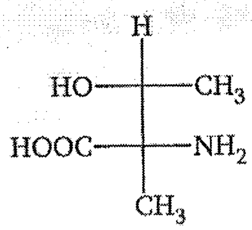
(5 marks)

b. Draw the corresponding dash and wedge projection for the given fisher projection with the relevant optical isomerism.



(5marks)

c. Consider the Fisher projection given below. Specify the configuration at each chiral center using R or S nomenclature.



(10 marks)

d. Define the term "Meso compounds".

(5 marks)

2. a. "Carbon-carbon single bonds undergo rotation about the bond with only a small energy barrier, but carbon-carbon double bonds do not undergo rotation under normal conditions." Explain.

(10 marks)

b. Draw the structure corresponding to N-Methylcyclohexylamine

(5 marks)

c. Draw the staggered conformations of 2,3-dimethylbutane in the order of increasing energy.

(10 marks)

3. a. Give the structural formula and names of the three isomers of dimethylcyclopropane

(9 marks)

b. Consider 1,2-dimethylcyclohexane

i. Draw the most stable chair conformation for *cis*-1,2-dimethylcyclohexane and for *trans*--1,2-dimethylcyclohexane?

(8 marks)

ii. Draw the most stable configurational isomer of 1,4-dimethylcyclohexane. Give reason.

(5 marks)

iii. State whether *trans*-1,2-dimethylcyclohexane is chiral or achiral.

(3 marks)

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