



RAJARATA UNIVERSITY OF SRI LANKA  
FACULTY OF APPLIED SCIENCES

B.Sc. First year Semester I Examination – September/October 2014  
CHE 1201 - General and Inorganic Chemistry

Answer question No. 1 (compulsory) and any other three questions.

Time: 02 hours.

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Electronic rest mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Proton rest mass	$m_p = 1.672 \times 10^{-27} \text{ kg}$
Neutron rest mass	$m_n = 1.675 \times 10^{-27} \text{ kg}$
Magnitude of the electron charge	$e = 1.60 \times 10^{-19} \text{ C}$
Universal gas constant	$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Planck constant	$h = 6.626 \times 10^{-34} \text{ J s}$
Avogadro number	$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
Speed of light	$c = 3.0 \times 10^8 \text{ m s}^{-1}$
Rydberg constant ,	$R = 1.097 \times 10^7 \text{ m}^{-1}$
Permittivity of vacuum	$\epsilon_0 = 8.85 \times 10^{-12} \text{ kg}^{-1} \text{ m}^{-3} \text{ A}^2$
1 atomic mass unit (amu)	$1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$
1 eV	$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$

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Use of non programmable calculator is permitted.

- Q1). (a) Calculate the wavelength in nanometers of an X-ray with a frequency of  $7.5 \times 10^{11} \text{ MHz}$ .  
 (b) What are the features of VSEPR theory? Why it is important?  
 (c) Two elements X and Y have atomic numbers 12 and 16 respectively. Write the electronic configuration for these elements. To which period of the modern periodic table do these two elements belong? What type of bond will be formed between them?

- (d) Indicate the hybridization of the following atoms:
- C in  $\text{CH}_2\text{I}_2$
  - Xe in  $\text{XeF}_4$
- (e) What is the difference between Aufbau and Pauli's exclusion principles?
- (f) Indicate the molecular geometry of the following compounds:
- $\text{SF}_4$
  - $\text{XeF}_4$
- (g) Write a short note on the following:
- Fajan's Rule.
  - Hydrogen Bond.
- (h) Write down the IUPAC name of the following compounds:
- $[\text{Cd}(\text{CN})_2(\text{en})_2]$
  - $[\text{CoCl}(\text{NH}_3)_5]\text{SO}_4$
- (i) Give the structures of the following compound:
- tetrachloridonickelate(II) ion
  - amminepentachloridocuprate(II) ion
- (j) Predict the number of unpaired electrons, the magnetic moments at  $25^\circ\text{C}$  for each of the following ions:
- $[\text{Fe}(\text{CN})_6]^{4-}$
  - $[\text{Cr}(\text{NH}_3)_6]^{2+}$

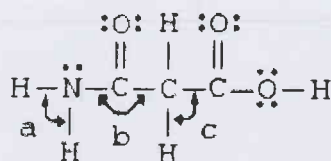
(10 x 13 marks = 130 marks)

- 2). (a) Write down the Lewis structure of guanidine has the chemical formula  $\text{CH}_5\text{N}_3$ .  
(25 marks)
- (b) Guanidine is a very good brønstead base. Addition of  $\text{H}^+$  to guanidine leads to the guanidinium ion,  $\text{CH}_6\text{N}_3^+$ . Complete the Lewis structure of the guanidinium ion  
(20 marks)
- (c) State the type of hybridization in each atom in guanidine.  
(15 marks)

- (d) Draw the resonance structures of  $\text{CH}_6\text{N}_3^+$ .

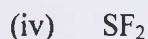
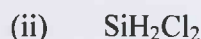
(30 marks)

3. (a) Give the bond angles marked a, b, and c in the molecule below. Explain your answers.



(30 marks)

- (b) Draw the molecular shapes of the following molecules.



(30 marks)

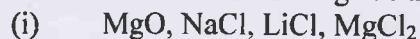
- (c) State, giving reasons whether the following molecules are polar or non polar:  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{SO}_3$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ .

(30 marks)

4. (a) Calculate the radii of the first two Bohr orbits for hydrogen. Derive the equation you have used in this calculations.

(30 marks)

- (b) Which one of the following has the greatest lattice energy? Explain your answers.



(20 marks)

- (c) Discuss the various experimental values of energy changes needed to calculate the lattice energy of a typical ionic salt.

(20 marks)

- (d) The theoretical and experimental lattice energy values of KI and AgI are given below. Comment on the values.

	Theoretical lattice energy ( $\text{kJ mol}^{-1}$ )	Experimental lattice energy ( $\text{kJ mol}^{-1}$ )
KI	- 630.9	- 631.8
AgI	- 735.9	- 865.4

(20 marks)

5. (a) Give the IUPAC name for the following compounds:

- (i)  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ .  
 (ii)  $\text{K}[\text{Au}(\text{CN})_2(\text{SCN})_2]$ .

(15 marks)

- (b) Write down the formula for the following compounds:

- (i)  $\text{Li}[\text{Ni}(\text{PF}_3)_3\text{I}_3]$ .  
 (ii)  $\text{K}_2[\text{CrCO}(\text{CN})_5]$ .

(15 marks)

- (c) Determine the configuration, the number of unpaired electrons, and the ligand field stabilization energy as a multiple of  $\Delta_o$  or  $\Delta_T$  for each of the following complexes.

- (i)  $[\text{Fe}(\text{OH}_2)_6]^{2+}$   
 (ii)  $[\text{Cr}(\text{NH}_3)_6]^{3+}$

(24 marks)

- (d) (i) How crystal field theory explains the colours of transition metal complexes?  
 (ii) Give biological importance of co-ordination compounds by giving two examples.

(20 marks)

- (e) Draw the structure of the following complexes:

- (i) *trans*-diaquadichloroplatinum(II)  
 (ii) diamminetetra(isothiocyanato)chromate(III)

(16 marks)