

Seat No. : \_\_\_\_\_

# MA-123

March-2019

M.Sc., Sem.-I

## 401 : CHEMISTRY (INORGANIC CHEMISTRY)

Time : 2:30 Hours]

[Max. Marks : 70

1. (A) Explain step-up and step-down operators of angular momentum. Prove that  $L_+$  and  $L_-$  are not but  $L_+L_-$  and  $L_-L_+$  are Hermitian operators. 14

OR

- (i) Find out commutator value of the angular momentum operators  $L_z$  and  $L_y$ . 7
- (ii) In Perturbation theory, show that if  $H$  and  $H^0$  are Hermitian operators then perturbed Hamiltonian operator  $H'$  is also Hermitian. 7
- (B) Answer any **four** questions in **one** or **two** lines from the following : 4
- (1) What is the importance of calculating delocalization energy ?
- (2) In HMO theory, which molecule is used for the calculation of free valency  $N_{\max}$  ?
- (3) For Helium atom, after perturbation, what is the value of  $E_{1s^2}$  in atomic unit ?
- (4) State the second postulate of the quantum chemistry.
- (5) If  $a$  is an amplitude of vibration and  $k$  is a constant, then what is the value of total energy ?
- (6) Prove that commutator  $[A, B] = -[B, A]$ .

2. (A) If  $A$ ,  $B$  and  $C$  are all matrices of order  $3 \times 3$  and all the elements of each of them are real numbers, by taking a suitable examples, calculate the following properties of the matrices : 14
- (a)  $A \times B = B \times A$  (b)  $A \times B \neq B \times A$  and (c)  $A(B \times C) = (A \times B) \times C$ .

OR

- (i) Discuss the four area of the character table. 7
- (ii) Determine the irreducible representations in direct product representation for  $E + T_1 + T_2$  in  $T_d$ . 7

- (B) Answer any **four** questions in **one** or **two** lines from the following : 4
- (1) What is the  $\chi (S_3)$  value ?
  - (2) What should be the criteria of the matrix multiplication for the two matrices A & B ?
  - (3) State any one 'General Rule' from 'The Great Orthogonality' theorem.
  - (4) What clarification can be given for  $A_2$  Mulliken symbol for  $C_{3v}$  point group ?
  - (5) Write the reduction formula for making the representation irreducible.
  - (6) What is the application of similarity transformation ?
3. (A) Write a note on Pascal's Constant. Calculate the value of  $\chi_M$  (dia) for (a)  $[Cu_2(CH_3COO)_4(H_2O)_2]$  and (b) Pyridine. 14
- (Given :  $\chi_{Cu^{2+}} = -11 \times 10^{-4}$  emu mol<sup>-1</sup>,  $\chi_{OAc} = -31.5 \times 10^{-6}$  emu mol<sup>-1</sup>,  $\chi_{H_2O} = -11 \times 10^{-6}$  emu mol<sup>-1</sup>,  $\chi_{AC^*} = -6.2 \times 10^{-6}$  emu mol<sup>-1</sup>,  $\chi_{AH} = -4.6 \times 10^{-6}$  emu mol<sup>-1</sup>,  $\chi_{AN^*} = -6.2 \times 10^{-6}$  emu mol<sup>-1</sup>)
- OR**
- (i) Explain the terms ferromagnetism and antiferromagnetism. Distinguish between the properties of the compounds exhibiting such phenomenon. 7
  - (ii) Derive the equation for spin magnetic moment and the value of Bohr Magnetron. 7
- (B) Answer any **three** questions in **one** or **two** lines from the following : 3
- (1) Give examples of molecules for intermolecular antiferromagnetism.
  - (2) Define Permeability.
  - (3) What is Magnetic induction ?
  - (4) What is Neel Temperature ?
  - (5) What is pole strength ?
4. (A) Discuss in detail myoglobin and cytochromes. 14
- OR**
- (i) Discuss 'In Vitro' nitrogen fixation. 7
  - (ii) Discuss the role of gold complexes in rheumatoid arthritis. 7
- (B) Answer any **three** questions in **one** or **two** lines from the following : 3
- (1) What is the bond energy of  $N_2$  ?
  - (2) What is the biological function of Manganese ?
  - (3) Define Enzymes.
  - (4) Why light is avoided in the preparation of cis-platin ?
  - (5) Give examples of molecules for intermolecular antiferromagnetism.