

Library

09/04/15 B.Sc (VI)  
\* Physical & Inorg. Chemistry

QP Code : 14567

(2 ½ Hours)

[ Total Marks :75

- N.B. : (1) All questions are compulsory.  
(2) Figures to the right indicate full marks.  
(3) Use of logarithmic tables/ Non programmable calculator is allowed  
(4) Answers to the two sections must be written in two separate answer books and tied together.

Physical Constants

$$N = 6.022 \times 10^{23}$$

$$k = 1.38 \times 10^{-23} \text{ J/K}$$

$$F = 96500 \text{ C}$$

$$R = 8.314 \text{ J/mol/K}$$

$$h = 6.626 \times 10^{-34} \text{ J/s}$$

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$\pi = 3.142$$

$$\frac{2.303 RT}{F} = 0.0592 \text{ at } 298 \text{ K}$$

$$1 \text{ a.m.u} = 1.66 \times 10^{-27} \text{ kg} = 931 \text{ MeV}$$

Section -I

1. Attempt any three of the following :-
- (a) Explain the effect of presence of isotopes on the rotational spectra. 5
  - (b) Define dipole moment and induced dipole moment. How does dipole moment study help in differentiating between linear and non-linear molecules? 5
  - (c) What is Raman shift? Explain the origin of stokes and anti-stokes lines in Raman spectra. 5
  - (d) Define force constant. The vibrational frequency of a diatomic molecule is  $3.33 \times 10^5 \text{ m}^{-1}$ . Calculate the force constant of the bond, if the reduced mass of the molecule is  $1.2 \times 10^{-27} \text{ kg}$ . 5
  - (e) Show that the frequency separation of successive lines in rotational spectrum of a diatomic molecule is given by  $2B$ , where  $B$  is rotational constant. 5
  - (f) Derive expression for P and R branch lines in vibrational-rotational spectra. 5
2. Attempt any three of the following :-
- (a) With respect to Lithium ion cell, explain cathode, anode and electrolytes used in the cell. 5
  - (b) With respect to NMR, explain following terms. 5
    - (1) Spin-spin relaxation
    - (2) Spin-lattice relaxation.

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- (c) Distinguish between low resolution spectra of ethyl alcohol and methyl alcohol. 5  
 (d) Explain the construction, working and electrode reactions of Bacon's  $H_2-O_2$  fuel cell. 5  
 (e) Explain Lindemann's theory of unimolecular reactions. 5  
 (f) On the basis of rate of reactions, classify chemical reactions. State suitable example for each class. 5

3. Attempt any seven from the following :- 7

- (1) \_\_\_\_\_ molecule shows rotational spectra.  
 (a) HCl (b)  $O_2$  (c)  $H_2$
- (2) The number of modes of vibration for a non-linear molecule are given by formula \_\_\_\_\_  
 (a)  $3n-5$  (b)  $3n-6$  (c)  $3n-4$
- (3) Dipole moment is zero if the same substituents are at \_\_\_\_\_ position in a molecule  
 (a) meta (b) para (c) ortho
- (4) When for a molecule \_\_\_\_\_, the molecule is said to obey selection rule for rotational spectra.  
 (a)  $\Delta J = \pm 2$  (b)  $\Delta J = 0$  (c)  $\Delta J = \pm 1$
- (5) The energy required for stretching vibrations is \_\_\_\_\_ that for bending vibrations.  
 (a) more than (b) less than (c) equal to.
- (6) Zero point energy is the energy molecule possesses at \_\_\_\_\_ K.  
 (a) 306 (b) 298 (c) 273
- (7) Solar cells work on the basis of \_\_\_\_\_  
 (a) Photoelectric effect  
 (b) Photovoltaic effect  
 (c) Compton effect.
- (8) Hydrogen is considered as the promising fuel of future because of its \_\_\_\_\_ resource.  
 (a) diminishing (b) renewable (c) polluting



- (9) Tetramethyl silane has \_\_\_\_\_ equivalent protons in it and is used as reference in NMR.  
 (a) 10 (b) 12 (c) 8
- (10) The unit for chemical shift in NMR is \_\_\_\_\_  
 (a)  $\text{mol}^{-1} \text{dm}^{-3}$  (b)  $\text{mol}.\text{dm}^{-3}$  (c) ppm
- (11) Effective collisions are collisions which take place between \_\_\_\_\_ molecules  
 (a) disoriented (b) oriented (c) deactivated
- (12) Ultra-fast reactions can be studied using \_\_\_\_\_ method  
 (a) continuous -flow (b) stop-flow (c) non-flow.

### Section -II

4. Answer any three of the following :-

- (a) Explain the effect of crystal field splitting on lattice energy. 5
- (b) Explain Russell Saender's coupling scheme. 5
- (c) Draw a labelled molecular orbital energy level diagram for hexa fluoro ferrate (II) ion comment on its magnetic properties. 5
- (d) Write any three merits and two demerits of crystal field theory. 5
- (e) Explain crystal field splitting in square planar complexes. 5
- (f) Explain the effect of  $\Pi$  - bonding on the value of  $10 Dq$  in case of cyano complexes. 5

5. Answer any three of the following :-

- (a) Explain the principles involved in aerobic and anaerobic processes. 5
- (b) Write notes on the following :- 5
- (i) Coagulation (ii) TOC
- (c) Write notes on 5
- (i) Calamine and its uses
- (ii)  $\text{KMnO}_4$  and its uses.
- (d) Discuss the structure and bonding involved in borazine. 5
- (e) What are nanomaterials? Discuss the two dimensional nanoparticles. 5
- (f) Describe in detail the colloidal route method for preparation of nanomaterials. 5

6. Write the most appropriate answer from those given for the following 8

(Answer any Eight)

- (1) d-d electron repulsions are \_\_\_\_\_ in a complexes metal ion than in a free metal ion.  
 (a) more (b) less (c) twice



- (2) The ground term has the \_\_\_\_\_ spin multiplicity  
(a) highest (b) lowest (c) zero
- (3)  $^2D$  is the ground state term for \_\_\_\_\_ configuration.  
(a)  $d^1$  (b)  $d^4$  (c)  $d^8$
- (4)  $10 Dq$  value for tetrahedral complexes is \_\_\_\_\_ of that for octahedral complexes.  
(a)  $\frac{6}{9}$  (b)  $-\frac{4}{9}$  (c)  $-\frac{3}{8}$
- (5) The number of microstates in  $P^2$  configuration is \_\_\_\_\_.  
(a) 10 (b) 20 (c) 15
- (6) The terms for  $d^1$  configuration are the same as that for \_\_\_\_\_ configuration.  
(a)  $d^7$  (b)  $d^2$  (c)  $d^9$
- (7) Oxygen demanding waste in water leads to \_\_\_\_\_ of dissolved  $O_2$ .  
(a) depletion (b) increase (c) no change
- (8) Removal of inorganic salts from the effluents can be done by \_\_\_\_\_ process.  
(a) osmosis (b) precipitation (c) electrodialysis
- (9) 'BOD' is often expressed in \_\_\_\_\_ of  $O_2$  required per litre of waste.  
(a) nano grams (b) milligrams (c) grams
- (10) The most widely used flocculent in effluent treatment is \_\_\_\_\_.  
(a) Alum (b) Boric acid (c)  $Na_2CO_3$
- (11) The B-N bond in borazine is \_\_\_\_\_.  
(a) polar (b) non polar (c) metallic
- (12) The polymers that have atoms of only one element in their backbone are called \_\_\_\_\_.  
(a) homo atomic (b) subatomic (c) hetero atomic.