11-12-17

DOON UNIVERSITY, DEHRADUN
End Semester Examination, December 2017
School of Physical Sciences
Inorganic Chemistry I: Atomic Structure & Chemical Bonding
Course: CYC–101

Time Allowed: 2 Hours. ***Maximum Marks: 30***

Section: A *(Attempt **all** questions)* ***(Marks: 10 Q × 1= 10)***

1. Which of the following molecules violate octet rule:
(i) BF_3 (ii) PF_5 (iii) CCl_4 (iv) CO_2 (v) SF_6.

2. Explain why CO_2 and CCl_4 molecules are non polar while $CHCl_3$ molecule is polar?

3. Which is more polar, H_2S or H_2O and why?

4. What is resonance? Discuss by taking an example of CO_3^{2-} and BF_3.

5. Why do the molecules have definite geometry? In which of the following types of geometry, all the bond angles are not the same:

(i) Octahedral (ii) Tetrahedral (iii) Trigonal planar (iv) Trigonal bipyramidal.

6. Comment on the basicity order of the hydrides of group 15 elements (NH_3, PH_3, AsH_3 and SbH_3).

7. Give reason for the following:

i) Electron affinity of fluorine atom is less than that of chlorine atom.

ii) Ionization energies of C, N and O follow the order: C < N > O.

8. When phosphorus reacts with excess Cl_2 gas, the compound phosphorus pentachloride (PCl_5) is formed. In the gaseous and liquid states, this substance consists of PCl_5 molecules, but in the solid state it consists of a 1:1 mixture of PCl_4^+ and PCl_6^- ions.

Predict the geometric structures of PCl_5, PCl_4^+ and PCl_6^-.

9. How do you expect the bond type to change for the chlorides of the third period elements, NaCl, $MgCl_2$, $AlCl_3$, $SiCl_4$, PCl_5, SCl_2 and Cl_2, going from left to right? Explain the change in the bond type.

10. What do you understand by dual character of matter? Derive de Broglie equation.

Section: B *(Attempt any **four** questions)* ***(Marks: 4Q × 2= 8)***

11. Discuss the structure of the following molecules using VSEPR theory:
(i) ClF_3 (ii) XeF_6 (iii) I_3^- (iv) $SnCl_3^-$.

12. Write a short note on (i) *Slater's* rule (ii) *Bohr's* postulates.

13. (i) How does the Bohr's theory of hydrogen atom differ from that of Schrodinger?
(ii) Write down the general form of the Schrodinger equation and define each of the terms in it.

14. What do you understand by polar and non-polar molecules? Is it possible for the non-polar molecules to have polar bonds? Justify your answer with examples.

15. Calculate the short and long wavelength limits of *Lyman* series in the spectrum of hydrogen. Given $R_H = 109{,}691\ cm^{-1}$.

Section: C *(Attempt any **three** questions)* ***(Marks: 3Q × 4= 12)***

16. What is meant by metallic bond? Illustrate the nature of metallic bond on the basis of
(i) Electron sea model (ii) Valence bond model.

17. Draw MO diagrams for CO and HF molecules on the basis of s-p mixing of orbitals.

18. Explain the following terms in details: (i) Bent's rule (ii) Lattice energy (iii) Sigma and pi bonds.

19. Explain on the basis of molecular orbital (MO) theory:
(i) Oxygen molecule is paramagnetic while N_2 is diamagnetic.
(ii) The bond order in O_2^- is less than that in O_2 which, in turn is less than that in O_2^+.
(iii) The bond energy of NO^+ is higher than that of NO.
(iv) Hydrogen forms diatomic molecule while He remains monoatomic.