ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
B.Sc. CHEMISTRY: I SEMESTER
MID-SEMESTER TEST: AUGUST 2018
CH 118 : CHEMISTRY- I

TIME: 1 HOUR   **MAXIMUM MARKS: 30**

PART A

Answer any **FOUR** of the following: 4 X 2 = 8 Marks

1. Write de-Broglie's equation and explain the terms.

2. Write Hamiltonian operator in Cartesian coordinates.

3. Identify the operator, eigenvalue and eigenfunction in the equation given below,

$$\frac{d^2(\sin 3x)}{dx^2} = -9\sin 3x$$

4. Define covalent radius.

5. Give the reason for metallic character of s-block elements.

6. Write the general outer electronic configuration of d-block elements.

PART B

Answer any **THREE** of the following: 3 X 6 = 18 Marks

7. Derive the expression for the allowed energy levels for a particle in one dimensional box. Diagrammatically represent the energy levels for values of n from 1 to 4.

8. a) Give any two postulates of quantum mechanics.

   b) Draw the radial distribution curve of the orbital with $n=2$ and $l=1$.

   c) Sketch $d_{x^2-y^2}$ and d_{xz} orbitals.

9. Aluminium sulphide hydrolyses in the presence of moisture to liberate hydrogen sulphide gas according to the reaction, $Al_2S_3 + 6 H_2O \rightarrow 2 Al(OH)_3 + 3H_2S$. In an experiment 15 g of Al_2S_3 and 10 g of H_2O reacted until the limiting reagent is used up. Answer the following,

   a) Identify the limiting reagent with proper explanation.

   b) What is the maximum mass of H_2S which can be formed from this reaction?

   c) How much excess reagent remains after the reaction is complete?

(Atomic weights of $Al = 27$, $S = 32$, $H = 1$, $O = 16$ g/mol)

10. A piece of metallic iron (10 mol) was dissolved in conc. HCl. The products formed are H_2 and $FeCl_2$. Calculate,

   a) The amount of $FeCl_2$ formed,

   b) The amount of HCl used and

   c)The volume of H_2 liberated at STP.

   (Atomic weights of Fe $= 56$, Cl $= 35$, H $= 1$ g/mol)

11. a) Write Born-Lande' equation and explain the terms.

b) Calculate the lattice energy of NaCl crystal from the following data:

$$M = 1.7476; r_0 = 2.814 \, A°; \quad n = 8; \quad \varepsilon_0 = 8.854 \times 10^{-12} C^2 N^{-1} m^{-2}$$

PART C

Answer any **ONE** of the following: $1 \times 4 = 4$ Marks

12. Give reason for each:

   a) Ionisation energy of oxygen (Z=8) is less than that of nitrogen (Z=7).

   b) Electron affinity of fluorine (Z=9) is less than that of chlorine (Z=17).

   c) Radius of Mg^{2+}(Z= 12) is less than that of Mg^{+}.

   d) Radius of N^{3-}(Z=7) is greater than that of O^{2-}(Z=8) even though they are isoelectronic ions.

13. Find out in which case the quantisation of energy levels is observable by calculating the spacing between 1st and 2nd energy levels for,

   a) An electron (mass $\sim 10^{-30}$ kg) in 1D box of $1A°$ lengthand

   b) A ball (mass $\sim$ 1g) in a 1D box of 10 cm length($h = 6.63 \times 10^{-34}$Js).