Time: 1 hour   Max.Marks:30

Part – A

Answer any 4 out of 6 questions. Each question carries 2 marks.   2x4=8

1. Calculate the total number of electrons with the same spin in all the orbitals with $n + l = 4$ in an atom.

2. Calculate the miniimum uncertainty in velocity of an object of mass 1.0g if its uncertainty in position is 5×10^{-26} m. Given, $h = 6.626 \times 10^{-34}$ Js .

3. Write the quantum mechanical operator for momentum.

4. Explain why Na (Z=11) has a greater second ionisation enthalpy than that of Mg (Z=12).

5. What are exact differentials? Give an example.

6. How many moles of He atoms are present in 6.46g of He? The molar mass of He is 4g.

Part – B

Answer any 3 out of 5 questions. Each question carries 6 marks.   3x6 = 18

7.a) Write i) mathematical expression for normalisation of wave function.

   ii) Schrodinger wave equation of H – atom in spherical polar coordinates.

   b) Explain the following: i) there cannot be more than two electrons in an orbital..

   ii) 4s orbital is lower in energy than 3d orbital.   (3 + 3)

8.a) Draw the radial distribution curves for 2s and 2p orbitals and indicate the node(s), if any.

   b) Set up the Born – Heber cycle for CaF_2 and arrive at an expression for lattice energy for the same.   (3 + 3)

9.a) Write an expression for the allowed energy levels for a particle in a three dimensional box and explain the terms. For this particle write the sets of qantum numbers of degenerate states corresponding to the energy state with total enrgy equal to $11h^2 / 8ma^2$.

   b) Define electron affinity. Explain why electron affinity of Cl is greater than the electron affinities of F and Br.   (3 + 3)

10. a) The bond dissociation energies of H – H , H – X and X – X are 436, 478 and 225 KJ/mol respectively. Assuming electronegativity of hydrogen to be 2.1, calculate

electronegativity of X.

b) Explain why are group I elements i) form univalent ions and ii) strong reducing agents?

$(3 + 3)$

11. a) Th depletion of ozone(O_3) in the stratosphere has been a matter of great concern among scientists in recent years. It is believed that ozone can react with NO that is discharged from the high altitude jet planes. The reaction is

$$O_3 + NO \rightarrow O_2 + NO_2$$
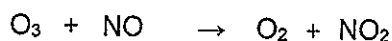
If 0.740g of ozone reacts with 0.670g of NO, how many grams of NO_2 will be produced. Which compound is the limiting reagent? Calculate the number of moles of the excess reagent remaining at the end of the reaction. Molar masses of O and N are 16g and 14g respectively.

(b) Disulphide dichloride (S_2Cl_2) is used in the vulcanization of rubber. It is prepared by heating sulphur in an atmosphere of chlorine.

$$S_8 + 4Cl_2 \rightarrow 4S_2Cl_2$$
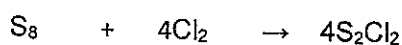
What is the theoretical yield of S_2Cl_2 in grams when 4.06g of S_8 are heated with 6.24g of Cl_2? If actual yield of S_2Cl_2 is 6.55g, what is the percent yield?

Note: Molar masses of Cl and S are 35.5g and 32g respectively. $(3 + 3)$

Part – C

Answer any 1 out of 2 questions. Each question carries 6 marks. $1x4 = 4$

12. Calclate the work done when 50g of iron react with hydrochloric acid in i) a closed vessel of fixed volume ; ii) an open beaker at 298K. Molar mass of Fe is 56g. Assume volume of Fe and HCl mixture is negligibly small compared to volume of H_2 released in the reaction:

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

$$R = 0.0821 LatmK^{-1} mol^{-1}$$

13. An electron is confined in a molecule of length $1x10^{-9}$ m. What is i) the minimum energy; ii) the minimum excitation energy from the minimum energy state? Mass of an electron is $9.1x10^{-31}$ kg..