1. An electron is in one of the 3d orbitals. Give possible values of $n$, $l$ and $m$ for the electron.

2. An unpaired electron in Al (at. no. – 13) and Si (at. no. – 14) are present in 3p orbitals. Which electron will experience more effective nuclear charge from the nucleus?

3. How are $d_{xy}$ and $d_{z^2-r^2}$ orbitals related to each other?

4. Mention the state of hybridization of all the carbon atoms present in the molecule

$$\text{CH}_2 = \text{CH} – \text{CH} = \text{CH}_2$$

5. Predict the dipole moment of a molecule type $AX_5$ and $AX_6$ having trigonal bipyramidal geometry and octahedral geometry.

6. B.pt. of ethyl alcohol is less than water. Explain.

7. Plot a graph between $V$ and $1/P$ at constant $T$.

8. $\text{AlCl}_3$ is an acid according to which concept? \hspace{1cm} \text{(1 x 8 = 8)}

9. Calculate the volume of 36 M and 1 M $\text{H}_2\text{SO}_4$ required to mix to get 11/6 M $\text{H}_2\text{SO}_4$.

10. Calculate the molarity of 30 ml 0.5 M $\text{H}_2\text{SO}_4$ diluted to 500 ml.

11. (a) What are the limitations of the Bohr’s theory?
    (b) Derive an expression for the de Broglie relationship.

12. Define the terms:
    (a) Ionization enthalpy.
    (b) Electron gain enthalpy.

13. Explain:
    (a) $\text{H}_2\text{O}$ is polar but $\text{CO}_2$ is non-polar.
    (b) Dipole moment of $\text{NH}_3$ is more than $\text{NF}_3$. 

P.T.O.
14. Explain:
   (a) PCl₅ exists but NOCl₅ does not.
   (b) Bond angle of NH₃ is more than PH₃.

15. Volume of a gas becomes zero at −273°C. Explain it with the help of a graph.

16. Explain the terms:
   (a) Critical temperature and critical pressure.
   (b) Compressibility factor Z.

17. NH₃ is a Lewis as well as Bronsted base but not Arrhenius base. Explain.

18. Write the conjugate base of the following NH₃, HF, H₃PO₄ and HS⁻.

19. P and Q are two elements which form P₂Q₃ and PQ₂ molecules. If 0.15 mole of each weighs 15.9 gm and 9.3 gm respectively, then calculate the atomic masses of the elements P and Q?

20. 3.0 gm H₂ react with 29.0 gm O₂ to yield H₂O:
   (a) Find out the limiting reagent.
   (b) Calculate the amount of H₂O formed.
   (c) Find out the amount of reagent left.

21. Explain:
   (a) Three electrons present in 2p sub-shell of nitrogen remain unpaired.
   (b) In K (at. no.=19) the 19th electron enters the 4s sub-shell instead of 3d sub-shell.
   (c) Cr (at. no.=24) has configuration 3d⁶ 4s¹ and not 3d⁴ 4s².

22. Explain:
   (a) Radius of cation is less than that of the atom.
   (b) IE₂ value of an element is always more than its IE₁ value.
   (c) IE₁ of oxygen is less than nitrogen.

23. Write the molecular orbital configuration of O₂, O₂⁻ and O₂²⁻. Arrange them in increasing order of:
   (a) Bond order.
   (b) Bond dissociation energy.

24. At 0°C the density of a gaseous oxide at 2 bar is the same as that of nitrogen at 5 bar. What is the molecular mass of the oxide?

25. (a) Chemical equilibrium is a dynamic process explain.
   (b) In a reaction Qₑ=Kₑ. What does it indicate?
(c) Write the relation between \( K_p \) and \( K_c \) for the reactions.

(i) \( \text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \)

(ii) \( \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) \)

26. State and explain Le Chatelier's Principle. Discuss the effect of temperature, pressure and concentration on the equilibrium.

27. \( K_c \) for the reaction

\[ 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}) \]

Calculate \( K_p \) and \( K_c \) for the reaction given below:

\[ \text{SO}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{SO}_3(\text{g}) \text{ at 29^\circ C.} \]

\( 9 \times 3 = 27 \)

28. (i) An education trip was arranged for school children of class X to visit a coal mine in Dhanbad. They went inside the mine in a group of five to six. Few students were feeling uncomfortable and suffocated inside the mine.

(a) Should the entire team cancel the visit or continue without the affected students?

(b) What are the remedial measures can you provide to your friends?

(c) What is the reason for uneasiness?

(ii) Write the postulates of kinetic theory of gases. \( 3 + 2 \)

29. (a) An electron and proton are possessing the same amount of kinetic energy. Which of the two has greater wave length and why?

(b) The \( \lambda \) of the 1st line in the Balmer series is 656 nm. Calculate the wave length of the 2nd line in Balmer series. \( 3 + 2 \)

30. Define hybridization. Discuss the orbital structures of the following molecules on the basis of hybridization:

(i) \( \text{NH}_3 \)  
(ii) \( \text{C}_2\text{H}_2 \)  
(iii) \( \text{CO}_2 \)  
(iv) \( \text{PCl}_3 \)  

\( 1 \times 4 \)