Answer any 4 questions from 1 to 5. Each carries 1 score. **(4 × 1 = 4)**

1. Identify the limiting reagent in the reaction $2A + 4B \rightarrow 3C + 4D$, when 5 moles of A react with 6 moles of B.

2. Which of the following elements will gain one electron more readily ?

   (a) S (g) (b) Na (g)

   (c) O (g) (d) Cl (g)

3. Analyse the following statements and choose the correct option :

   Statement I : Sodium chloride formed by the action of chlorine gas on sodium metal is a stable compound.

   Statement II : This is because sodium and chloride ions acquire octet in sodium chloride formation.

   (a) Both statement I and statement II are true and statement II is the correct explanation of statement I.

   (b) Both statement I and statement II are true but statement II is not the correct explanation of statement I.

   (c) Statement I is true but statement II is false.

   (d) Both statement I and statement II are false.

4. The conjugate base of H_2O is _____ .

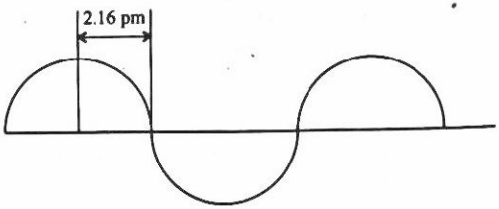
5. How many σ bonds are present in the following molecule ?

   $HC{\equiv}CCH{=}C\overset{\cdot}{H}CH_3^-$

Answer any 8 questions from 6 to 15. Each carries 2 scores. **(8 × 2 = 16)**

6. Define the law of multiple proportions. Explain it with one example.

7. Define wavelength and find out the wavelength of electromagnetic wave shown below :



8. Draw the boundary surface diagram of s and p orbitals.

9. Match the following :

Column – I	Column – II
(i) CH_4	(a) sp^3d
(ii) PCl_5	(b) sp^3d^2
(iii) BeF_2	(c) sp^3
(iv) SF_6	(d) sp^2
	(e) sp

10. Identify the state functions and path functions out of the following :
enthalpy, heat, work, free energy.

11. What are buffer solutions? Give an example.

12. Arrange the following compounds in the increasing order of oxidation number of chlorine :

$NaClO$, $KClO_2$, Cl_2, ClO_2

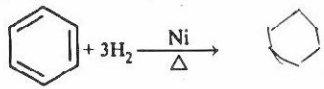
13. Write the IUPAC names of the following compounds and identify the type of isomerism shown by them :

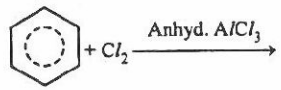
(i) CH_3COCH_3

(ii) CH_3CH_2CHO

14. What are the products obtained when propene undergoes ozonolysis ?

15. Complete the following reactions:

(i) 

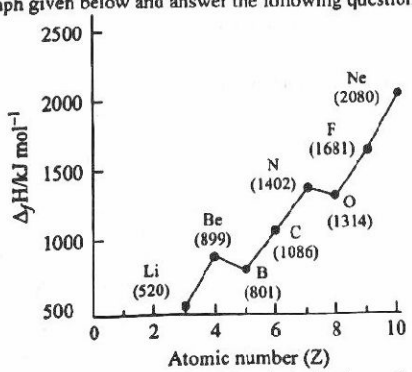
(ii) 

Answer any 8 questions from 16 to 26. Each carries 3 scores. **(8 × 3 = 24)**

16. (i) What is the mass percent of carbon in carbon dioxide ? (1)
(ii) Which of the following solutions have the same concentration ? (2)
(a) 20 g of NaOH in 200 ml of solution
(b) 0.5 mol of KCl in 200 ml of solution
(c) 40 g of NaOH in 100 ml of solution
(d) 20 g of KOH in 200 ml of solution

17. (i) An atomic orbital has n = 2. What are the possible values of l and m_l ? (2)
(ii) Which of the following orbitals are possible ? (1)
2s, 2p, 2d and 3f

18. Analyse the graph given below and answer the following questions :



(i) Identify the elements showing deviation in ionisation enthalpy from the general trend. (1)
(ii) Explain the reason for deviation in each case. (2)

19. (i) Define covalent radius. (1)

(ii) Explain why cations are smaller and anions larger in radii than their parent atoms ? (2)

20. (i) Discuss the significance of dipole moment. (1)

(ii) Represent diagrammatically the bond moments and the resultant dipole moment in CO_2 and NF_3. (2)

21. At 298 K, K_p for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is 0.98. Calculate the change in standard free energy and predict whether the reaction is spontaneous or not.

22. (i) On the basis of Le Chatelier principle explain how temperature and pressure can be adjusted to increase the yield of ammonia in the following reaction :

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), \Delta H = -92.38 \text{ kJ mol}^{-1}$ (2)

(ii) What will be the effect of addition of argon to the above reaction mixture at constant volume ? (1)

23. Balance the following ionic equation :

$Cr_2O_7^{2-} + Fe^{2+} + H^+ \longrightarrow Cr^{3+} + Fe^{3+} + H_2O$

24. (i) Explain the terms Inductive and Electromeric effects. (2)

(ii) Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids ?

$Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$ (1)

25. Draw Newman projections for the eclipsed and staggered conformations of ethane. Which of these conformations is more stable ?

26. Identify the products formed in the following reactions :

(i) $CH_2 = CH_2 + Br - Br \xrightarrow{CCl_4}$ (1)

(ii) $CH_3 - CH = CH_2 + H - Br \longrightarrow$ (2)

Answer any 4 questions from 27 to 31. Each carries 4 scores. **(4 × 4 = 16)**

27. (i) Write the statement and significance of Heisenberg's uncertainty principle. (2)

(ii) An electron in an atom can be located within a distance of 0.1 Å. What is the uncertainty involved in the measurement of its velocity ? (mass of electron = 9.1×10^{-31} kg) (2)

28. Write the molecular orbital configurations N_2, Ne_2 and show that N_2 has a triple bond in between nitrogen atoms while Ne_2 does not exist.

29. (i) State Hess's Law of Constant Heat Summation. (1)

(ii) Construct an enthalpy diagram (Born-Haber cycle) to calculate the lattice enthalpy of Na^+Cl^-(s). (3)

30. (i) What is meant by heterogeneous equilibrium? Give an example. (2)

(ii) The value of K_c for the reaction $2A \rightleftharpoons B + C$ is 2×10^{-3}. At a given time, the composition of the reaction mixture is [A] = [B] = [C] = 3×10^{-4} M. Calculate reaction quotient(Q_c) and predict in which direction will the reaction proceed ? (2)

31. Explain the detection of N, S, Cl and Br using sodium fusion extract.