ST. XAVIER'S SENIOR SECONDARY SCHOOL, DELHI – 110 054

Std. 11 **Time : 3 hrs.**

20-2-2024 **Final Examination in CHEMISTRY** **Max. Marks : 70**

General Instructions:

(a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

Section – A

The following questions are multiple-choice questions with one correct answer.
Each question carries 1 mark. There is no internal choice in this section.

1. Which of the following is a nucleophile?
   a) H_3O^+ b) NH_3 c) $AlCl_3$ d) NO_2^+ 1

2. The conjugate acid of NH_2^- is:
   a) NH_3 b) NH_2OH c) NH_2 d) N_2H_4 1

3. Heating a mixture of sodium benzoate and soda lime gives:
   a) Methane b) Benzene
   c) Sodium benzoate d) Calcium benzoate 1

4. Transition metals have the general electronic configuration:
   a) $ns^2\ nd^{1-10}$ b) $ns^2\ np^1\ (n-1)d^{1-10}$
   c) $ns^{1,2}\ (n-1)d^{1-10}$ d) $ns^2\ np^6\ (n-1)d^{1-10}$ 1

5. In the hydrocarbon $CH_3 – CH = CH-CH_2-C \equiv CH$, the state of hybridization of C_1 , C_3 and C_5 are in the following sequence:
   a) sp, sp^3, sp^2 b) sp, sp^2, sp^3
   c) sp^3, sp^2, sp d) sp^2, sp, sp^3 1

6. Select the correct order of arrangement based on the property indicated:
   a) HI > HBr > HCl >HF (bond length)
   b) $H_2O > CH_4 > BF_3 > NH_3$ (bond angle)
   c) $Cl_2 > O_2 > N_2 > F_2$ (bond strength)
   d) F>Cl >Br > I (electron gain enthalpy) 1

7. Which of the following combinations involves the formation of coordinate covalent bond?
   a) $H_2 + I_2$ b) $Mg + O_2$
   c) Cl + Cl d) $H^+ + H_2O$ 1

8. Identify the correct order of size of the following isoelectronic species?
   (At. No : Ca = 20, K = 19, Ar = 18, Cl = 17, S = 16)
   a) $Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$ b) $Ar < Ca^{2+} < K^+ < Cl^- < S^{2-}$
   c) $Ca^{2+} < Ar < K^+ < Cl^- < S^{2-}$ d) $Ca^{2+} < K^+ < Ar < S^{2-} < Cl^-$ 1

9. Arrange the following in decreasing order of their boiling points.
   i) n-butane ii) 2- Methylbutane
   iii) n-pentane iv) 2,2-Dimethylpropane
   a) (i) > (ii) > (iii) > (iv) b) (ii) > (iii) > (iv) > (i)
   c) (iv) > (iii) > (ii) > (i) d) (iii) > (ii) > (iv) > (i) 1

10. An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. IUPAC name of the alkene 'A' is:
    a) 3- Ethylpent-3-ene b) 3- Ethylpent-2-ene
    c) 2,2-dimethylpent-2-ene d) 2- Ethylpent-3-ene 1

11. Which of the following statements is true for the Daniel cell?
    a) Current flows from zinc electrode to copper electrode.
    b) Electrons flow from copper electrode to zinc electrode.
    c) Cations from the salt bridge move towards copper electrode.
    d) Cations from the salt bridge move towards zinc electrode. 1

12. Cyclohexanol on heating with conc.H_2SO_4 at 445 K gives:
    a) cyclohexene b) Hex-1-ene
    c) cyclohexen-1-ol d) hexane-1,2-diol 1

In questions 13-16 a statement of assertion (A) followed by a statement of reason(R) is given. Choose the correct answer out of the following choices.
a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

13. Assertion: Zinc reacts with sulphuric acid to give hydrogen gas but copper does not.
    Reason: Zinc has higher reduction potential than copper. 1

14. Assertion: Bond energy has order like C - C < C = C < C ≡ C.
    Reason: Bond energy increases with increase in bond order. 1

15. Assertion: Shielding effect increases as we go down the group.
    Reason: More is the number of electrons in the penultimate shell, more is shielding effect. 1

16. Assertion: For any chemical reaction at a particular temperature, the equilibrium constant is fixed and is a characteristic property.
    Reason: Equilibrium constant is independent of temperature. 1

Section – B

This section contains very short answer type questions and carry 2 marks each.

17. a) Write the favorable factors for the formation of ionic bond.
    b) The dipole moment of hydrogen halides decreases from HF to HI. Explain 2

18. Balance the redox reaction :
    $I_2 + NO_3^- + H^+ \rightarrow NO_2 + IO_3^- + H_2O$ (acidic medium) 2

19. Calculate the mole fraction of benzene in a solution containing 30% by mass of it in carbon tetrachloride.
    (Molar mass of benzene = 78 g mol^{-1}, CCl_4 = 154 g mol^{-1}) 2

20. a) Write expression for solubility product of calcium phosphate.
    b) In qualitative analysis, NH_4Cl is added before adding NH_4OH for testing group III cations. Why? 2

21. a) Define electrode potential.
    b) Differentiate between oxidation number and valency. 2

Section – C

This section contains 7 short answer type questions with internal choice in one question and carry 3 marks each.

22. a) Define normality.
    b) A solution of oxalic acid, $(COOH)_2$. $2H_2O$ is prepared by dissolving 0.63 g of the acid in 250 cm^3 of the solution. Calculate the molarity of the solution.
    (Molar mass of oxalic acid = 126 g mol^{-1}) 3

23. a) Write the IUPAC name of the following:
        i) $CH_3 - C(Cl) = CHCOOCH_3$ ii) $(CH_3)_2CH - CH(OH) - CH_2 - COOH$
    b) Draw the structure of the organic compound:
        4-Hydroxy-3-methoxybenzaldehyde 3

24. a) Give chemical equation and mechanism for the nitration of benzene.
    b) Give a chemical test to distinguish between but-1-yne and but-2-yne. 3

25. a) What is meant by metamerism? Give an example.
    b) Give one chemical equation to illustrate.
        i) Wurtz reaction.
        ii) Free radical substitution reaction. 3

26. a) Can a solution of 1 M copper sulphate be stored in a vessel made of Nickel metal? Given : $E^0_{Ni^{2+}/Ni}$ = -0.25V, $E^0_{Cu^{2+}/Cu}$ = +0.34V.
b) Given the standard electrode potentials: K^+/K = -2.93 V, Ag^+/Ag = 0.80 V, Hg^{2+}/Hg = 0.79 V, Mg^{2+}/Mg = -2.37 V, Cr^{3+}/Cr = -0.74 V. Arrange these metals in their increasing order of reducing power. 3

27. An electrochemical cell is set up between zinc rod dipped in zinc sulphate solution and cadmium rod in cadmium sulphate solution.
Given that $E^0_{Zn^{2+}/zn}$ = -0.76 V and $E^0_{Cd^{2+}/Cd}$ = -0.40 V.
i) Name the positive electrode.
ii) Write the cell representation.
iii) What will be the overall reaction?
iv) Calculate the E.M.F of the cell. 3

28. The value of K_c for the reaction, $2HI_{(g)} \rightleftharpoons H_{2\ (g)} + I_{2\ (g)}$ is 1×10^{-4}. At a given time, the composition of reaction mixture is [HI] = 2×10^{-5} mol L^{-1}, [H_2] = 1×10^{-5} mol L^{-1} and [I_2] = 1×10^{-5} mol L^{-1}. Is this reaction at equilibrium? If not, in which direction does the reaction tend to proceed to reach equilibrium?

(OR)

a) Write any two characteristics of chemical equilibrium.
b) Using Le Chatelier's principle, predict the effect of increasing pressure and decreasing the temperature on the equilibrium: $N_{2\ (g)} + O_{2\ (g)} \rightleftharpoons 2\ NO_{(g)}$ + heat. 3

Section – D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each.

29. Read the passage given below and answer the following questions:

In an organic reaction, the organic compound called the substrate reacts with a suitable attacking reagent, which may be either electron-deficient or electron-rich. But most of the substrate molecules as a whole are electrically neutral. Evidently, the reagent can attack the substrate molecule successfully only if the substrate possesses oppositively charged centres. Bond cleavage of carbon-carbon covalent bonds occurs either homolytically or heterolytically This is possible only if the displacement of bonding electrons occurs either partially or completely creating centres of low and high electron density in the substrate molecule. Such factors are called electron displacements. These are of the following four types: (i) inductive effect, (ii) electromeric effect, (iii) resonance or Mesomeric effect and (iv) hyperconjugation effect. These factors play a vital role in determining the reactivity of any substrate molecule in a given reaction.

a) What is meant by heterolytic fission of a covalent bond?
b) Explain electromeric effect.
c) What are carbocations? Discuss the stability of carbocations on the basis of inductive effect.

(OR)

c) What are free radicals? Give example for primary, secondary and tertiary free radicals and arrange them in the increasing order of stability. 4

30. Read the passage given below and answer the following questions:

Lewis concept is unable to explain the shapes of molecules. To explain the shapes of molecules, 'Valence Shell Electron Pair Repulsion (VSEPR) Theory' was put forward by Sidgwick and Powell in 1940. The theory suggests that the central atom of a molecule is surrounded by bond pairs and lone pairs of electrons which repel each other and move so far apart that there are no further repulsions. Direction of the electron pairs decides the shape of molecule. The shape may be regular or distorted depending upon the groups attached and presence of lone pairs. VSEPR theory was able to explain only the shapes of simple molecules. Hence, another theory called 'Valence Bond (VB) Theory' was put forward by Heitler and London orbitals in 1927. One simple approach to this theory suggests that when two atoms approach each other, there are new forces of attraction and repulsions between the nuclei and electrons of the approaching atoms. A bond is formed if new forces of attraction are greater than new forces of repulsion. Four important characteristics generally studied about the chemical bonds are their bond length, bond enthalpy, bond angle and bond order.
In order to explain the characteristic geometrical shapes of polyatomic molecules, Pauling introduced the concept of 'hybridization'. According to him, the combining atomic orbitals combine to form a new set of equivalent orbitals known as hybrid orbitals. Depending upon the orbitals mixed, we have sp, sp^2, sp^3, dsp^2, d^2sp^3 etc. different types of hybridization.

a) How does valence bond theory explains the non-formation of He_2?
b) Why sigma bonds are stronger than pi bonds?
c) Describe the hybridization of PCl_5. Why are the axial bonds longer than equatorial bonds?

(OR)

c) Explain sp^3d^2 hybridization with the help of an example. 4

Section – E

The following questions are long answer type and carry 5 marks each.
All questions have an internal choice.

31. Attempt **any five** of the following :
Explain why:
a) Electronegativity of elements increases on moving from left to right in the periodic table.
b) Na and Mg^+ have same number of electrons but removal of electron from Mg^+ requires more energy.
c) The reactivity of halogens decreases down the group but of alkali metal increases down the group.
d) Beryllium has higher ionization enthalpy than Boron.
e) Elements of same group have same chemical properties.
f) Define covalent radius.
g) Write any two characteristics of s-block elements. 5

32. a) Give reason for the following:
i) Alkenes are more reactive than alkynes towards electrophilic addition reaction.
ii) Halogens are ortho-para directing, but deactivating in haloarenes.
b) How the following conversions can be carried out?
i) Benzene to p-Nitrotoluene
ii) 1-bromopropane into 2-Bromopropane
iii) Ethyne to but-1-yne

(OR)

a) Give reason for the following:
i) Ethyne is more acidic than ethene.
ii) Arenes are less reactive towards addition reactions even though they contain double bonds.
b) –OH group in phenol is ortho-para directing and activating. Explain with the help of resonance structures.
c) Predict the product:
i) $CH_3\text{-}CH_2\text{-}CH_2Br + Mg \xrightarrow{ether} A \xrightarrow{H_2O} B$
ii) $(CH_3)_3C\text{-}Br \xrightarrow{KOH\ (alc)} A \xrightarrow{HBr/peroxide} B$ 5

33. a) Which of the following are Lewis acids?
H_2O, BF_3, H^+, NH_4^+
b) The hydrogen ion concentration on a sample of vinegar is 1.3×10^{-5} M. Calculate its pH (log 1.3 = 0.1139).
c) For the equilibrium, $2\ NOCl_{(g)} \rightleftarrows 2\ NO_{(g)} + Cl_{2\ (g)}$, the value of equilibrium constant, Kc is 3.75×10^{-6} at 1000 K. Calculate Kp for the reaction at the same temperature. ($R = 0.0821\ L\ atm\ K^{-1}\ mol^{-1}$)
d) The ionization constant of HF is 3.2×10^{-4}. Calculate the degree of dissociation of HF in its 0.02M solution. Calculate the concentration of H_3O^+ ions.

(OR)

a) Differentiate between reversible and irreversible reaction.
b) What are strong electrolytes? Give example.
c) Calculate the hydrogen ion and hydroxyl ion concentration in 0.005M NaOH.
d) The ionization constant of HF is 3.2×10^{-4}. Calculate the degree of dissociation of HF in its 0.02M solution. Calculate the concentration of F^- ions. 5

-x-x-x-x-x-x-