



**INDIAN SCHOOL SOHAR**  
**TERM II EXAMINATION (2022-2023)**  
**CHEMISTRY (043)**

Class : XI  
Date : 21.02.23

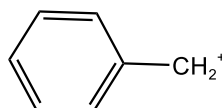
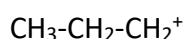
Maximum marks: 70  
Time allowed : 3 hours

**General Instructions:**

- (a) There are 35 questions in this question paper with internal choice.
- (b) Section A consists of 18 multiple-choice questions carrying 1 mark each.
- (c) Section B consists of 7 very short answer questions carrying 2 marks each.
- (d) Section C consists of short answer questions carrying 3 marks each.
- (e) Section D consists of 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.**

*Following questions are Multiple Choice Questions with one correct answer. Each question carries 1 mark each. There is no internal choice in this section.*

1.  $K_a$  for  $\text{CH}_3\text{COOH}$  is  $1.8 \times 10^{-5}$  and  $K_b$  for  $\text{NH}_4\text{OH}$  is  $1.8 \times 10^{-5}$ . The pH of ammonium acetate will be:  
(a) 7.005 (b) 4.75  
(c) 7.0 (d) Between 6 and 7
2. Which of the following is not a cyclic compound?  
(a) Anthracene (b) pyrrole  
(c) phenol (d) Neopentane
3. The five successive ionization enthalpies of an element are 801, 2427, 3638, 25024 and 32824  $\text{kJ mol}^{-1}$  respectively. The number of valence electrons of the atom of the element is:  
(a) 5 (b) 3  
(c) 2 (d) 4
4. The IUPAC name of the compound is:  
$$\text{HOOC}-\text{CH}_2\text{CH}_2-\underset{\text{COOH}}{\text{CH}}-\text{CH}_2\text{CH}_2\text{COOH}$$
  
(a) 4-Carboxyheptanedioic acid (b) 1,3,5-Heptanetricioic acid  
(c) Pentane-1,3,5-tricarboxylic acid (d) 3-Carboxyheptanedioic acid
5. Which of the following is not correct?  
(a)  $\Delta G$  is zero for a reversible reaction (b)  $\Delta G$  is positive for a spontaneous reaction  
(c)  $\Delta G$  is negative for a spontaneous reaction (d)  $\Delta G$  is positive for a non-spontaneous reaction
6. The order of stability of the following carbocations is:



- (a) III > I > II (b) III > II > I
- (c) II > III > I (d) I > II > III

7. The correct ground state configuration of chromium atom (Z=24) is:

- (a) [Ar] 3d<sup>5</sup> 4s<sup>1</sup> (b) [Ar] 3d<sup>4</sup> 4s<sup>2</sup>  
(c) [Ar] 3d<sup>6</sup> 4s<sup>0</sup> (d) [Ar] 4s<sup>1</sup> 4p<sup>5</sup>

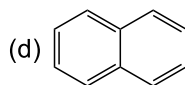
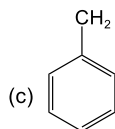
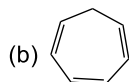
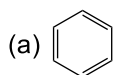
8. Which of the following has lowest boiling point?

- (a) HF (b) HCl  
(c) HI (d) HBr

9. 20 kg of N<sub>2</sub>(g) and 3.0 kg of H<sub>2</sub>(g) are mixed to produce NH<sub>3</sub>(g). The amount of NH<sub>3</sub>(g) formed is:

- (a) 17 kg (b) 51 kg  
(c) 60 kg (d) 34 kg

10. Which of the following does not obey Huckel rule?



11. Identify the disproportionation reaction:

- (a)  $\text{CH}_4 + 2\text{O}_2 \longrightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  (b)  $\text{CH}_4 + 4\text{Cl}_2 \longrightarrow \text{CCl}_4 + 4\text{HCl}$   
(c)  $2\text{F}_2 + 2\text{OH}^- \longrightarrow 2\text{F}^- + \text{OF}_2 + \text{H}_2\text{O}$  (d)  $2\text{NO}_2 + 2\text{OH}^- \longrightarrow \text{NO}_2^- + \text{NO}_3^- + \text{H}_2\text{O}$

12. Benzene reacts with CH<sub>3</sub>Cl in the presence of anhydrous AlCl<sub>3</sub> to form:

- (a) Chlorobenzene (b) Benzyl chloride  
(c) Toluene (d) Xylene

13. The moles of sodium chloride in 250 cm<sup>3</sup> of 0.50 M NaCl are:

- (a) 0.250 mol (b) 2 mol  
(c) 0.125 mol (d) 1.0 mol

14. In PO<sub>4</sub><sup>3-</sup> ion the formal charge on the oxygen atom of P-O bond is:

- (a) +1 (b) -1  
(c) -0.75 (d) +0.75

In the following questions (Q. No. 15 to 18) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices:

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.  
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.  
(c) Assertion is correct statement but reason is wrong statement.  
(d) Assertion is wrong statement but reason is correct statement

15. **Assertion** : All the C-C bond lengths in benzene are equivalent.  
**Reason** : The resonance energy of benzene is about 150.6 kJ.
16. **Assertion** : All the carbon atoms in CH<sub>2</sub>=C=CH<sub>2</sub> are sp<sup>2</sup> hybridized.  
**Reason** : In this molecule, all the carbon atoms are attached to each other by double bonds.
17. **Assertion** : Potassium and caesium are useful as electrodes in photoelectric cells.  
**Reason** : Potassium and caesium, when irradiated with light, the light energy absorbed is sufficient to eject out the electron from an atom.
18. **Assertion** : Among isomeric pentanes, 2,2-dimethylpentane has highest boiling point.  
**Reason** : Branching does not affect the boiling point.

## SECTION – B

*This section contains 7 questions with internal choice in two questions. The following questions are very short type and carry 2 marks each.*

19. (a) State law of multiple proportions.  
(b) Balance the equation:  $\text{CaF}_2 + \text{H}_2\text{SO}_4 + \text{H}_3\text{BO}_3 \longrightarrow \text{CaSO}_4 + \text{BF}_3 + \text{H}_2\text{O}$
20. Calculate the percent ionization of 0.2 M solution of hydrocyanic acid, HCN.  $K_a$  for HCN =  $4.9 \times 10^{-10}$ .

OR

- (a) Classify the following into acids and bases according to Lewis concepts:  
(i)  $\text{S}^{2-}$  (ii)  $\text{F}^-$  (iii)  $\text{H}^+$  (iv)  $\text{Ni}^{2+}$
- (b) Arrange in the decreasing order of basic strength of the following conjugate bases:  
 $\text{OH}^-$ ,  $\text{RO}^-$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{Cl}^-$
21. On the basis of hybridization discuss the structure of  $\text{PCl}_5$ .

OR

- (a) Sketch the shape of MOs obtained by the sideways overlap of two p-orbitals.  
(b) Which of the two molecules OCS and  $\text{CS}_2$  has a higher dipole moment and why?
22. Calculate the enthalpy of formation of  $\text{KOH(s)}$  from the following data:
- $$\text{K(s)} + \text{H}_2\text{O(l)} + (\text{aq}) \longrightarrow \text{KOH(aq)} + \frac{1}{2} \text{H}_2(\text{g}); \quad \Delta_r H^0 = -200.8 \text{ kJ}$$
- $$\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \longrightarrow \text{H}_2\text{O(l)}; \quad \Delta_r H^0 = -286.3 \text{ kJ}$$
- $$\text{KOH(s)} + (\text{aq}) \longrightarrow \text{KOH(aq)}; \quad \Delta_r H^0 = -58.6 \text{ kJ}$$

23. Write one chemical equation for each, to illustrate the following reaction:  
(a) Wurtz reaction  
(b) Friedel Crafts Alkylation
24. (a) What is an electromagnetic spectrum?  
(b) Arrange the following types of radiations in increasing order of frequency:  
(i) radiation from microwave (ii) amber light from traffic signal  
(iii) radiation from FM radio (iv) cosmic rays from outer space (v) X-rays
25. (a) Draw the Newman's projection formula of the staggered form of 1,2-dichloro ethane.  
(b) Which salt on treatment with soda lime gives ethane? Give the reaction.

## SECTION – C

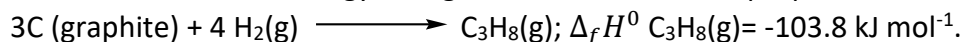
*This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.*

26. Draw the molecular orbital energy level diagram for nitrogen molecule. Also predict its bond order, type of bond and magnetic property.
27. The compound adrenaline is released in the human body in times of stress. It was found by experiment to have the composition 56.8% C, 6.5% H, 28.4 % O and 8.28% N. What is the empirical formula of adrenaline?
28. (a) What is electromeric effect? Give an example for negative electromeric effect.  
(b) Draw the structures of all isomeric ethers corresponding to molecular formula  $\text{C}_5\text{H}_{12}\text{O}$ .

OR

- (a) Draw the resonating structure for  $\text{C}_6\text{H}_5\text{OH}$ .  
(b) Which of the following compounds show geometrical isomerism? Draw the geometrical isomers of the respective compound.  
(i) Pent-1-ene (ii) 2-Methylbut-2-ene (iii) But-2-ene
- (c) Give the bond line formula for 2,3-dibromo-1-phenylpentane.

29. Calculate the standard Gibbs energy change for the formation of propane at 298 K:

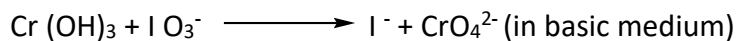


(Given:  $S_m^0[\text{C}_3\text{H}_8(\text{g})] = 270.2 \text{ JK}^{-1}\text{mol}^{-1}$ ,  $S_m^0[\text{graphite}] = 5.70 \text{ JK}^{-1}\text{mol}^{-1}$ ,  $S_m^0[\text{H}_2(\text{g})] = 130.7 \text{ JK}^{-1}\text{mol}^{-1}$ )

OR

Calculate  $\Delta U$ ,  $q$ , and  $w$  when 2.0 mol of an ideal gas at 25°C are compressed isothermally and reversibly from 1.0 bar to 10.0 bar. (Given  $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$ )

30. (a) Balance the following equation either by oxidation number method or ion-electron method:



(b)  $\text{HNO}_3$  acts only as an oxidising agent while  $\text{HNO}_2$  can act both as reducing and oxidising agent.

#### SECTION -D

**The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.**

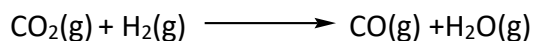
31. Enthalpy is a thermodynamic property that gives the quantity of heat energy that is being absorbed or evolved during the progression of a chemical reaction. It is a state function and is equal to the sum of the internal energy and the product of the pressure and volume work. In practice, a change in enthalpy is the preferred expression for measurements, at constant pressure. The enthalpy change of reaction remains the same irrespective of number of steps is Hess's law of heat summation. Hess's law can be applied to calculate enthalpies of reactions that are difficult to measure like enthalpy of formation, combustion and other enthalpy changes. Hess's law is important as it demonstrates, chemically, the law of conservation of energy.

**Answer the following questions:**

(a) What is the basis of Hess's law of heat summation?

(b) We can determine  $\Delta H_{lattice}$  with the help of cycle. Name the cycle.

(c) Calculate the heat of reaction:



Given that the  $\Delta_f H^0 \text{CO}(\text{g}) = -110.5 \text{ kJ mol}^{-1}$ ,  $\Delta_f H^0 \text{CO}_2(\text{g}) = -393.8 \text{ kJ mol}^{-1}$ ,  $\Delta_f H^0 \text{H}_2\text{O}(\text{g}) = -241.8 \text{ kJ mol}^{-1}$  respectively.

OR

If the enthalpy of fusion and enthalpy of vaporization of sodium metal are 2.6 and 98.2  $\text{kJ mol}^{-1}$  respectively, what is the enthalpy of sublimation of sodium? Is the reaction exothermic or endothermic?

32. Equilibrium can be established for both physical as well as chemical processes and at equilibrium rate of forward reaction is equal to rate of backward reaction. Equilibrium constant ( $K_C$ ) is ratio of product of molar concentration of products, to the product of molar concentrations of reactants, raised to the power of their stoichiometric coefficient.  $K_C$  has fixed value at a particular temperature. At equilibrium, concentration, pressure etc. become constant.  $K_P$  is equilibrium constant in terms of partial pressure of the gases or vapours. The direction of equilibrium can be determined with the help of  $Q_C$  or  $Q_P$  (reaction quotient).  $Q_C = K_C$ ,  $Q_P = K_P$  at equilibrium. If  $Q_C < K_C$  or  $Q_P < K_P$ , reaction will proceed in forward direction and vice-versa. The suitable condition of temperature, pressure, concentration, catalyst is determined with the help of Le Chatelier's principle for manufacture of important chemicals involving equilibrium.

**Answer the following questions:**

(a) Write the expression for  $K_C$  for the reaction:

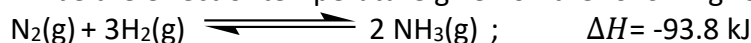


(b) If  $K_C = 1.06 \times 10^3$ ,  $Q_C = 2.04 \times 10^3$ , what will be direction of the reaction?

- (c) At 800 K, the equilibrium constant for the reaction:  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$  is  $6.02 \times 10^{-2} \text{ L}^2 \text{ mol}^{-2}$ . Calculate  $K_p$  for the reaction at the same temperature.

OR

What will be the effect of temperature given on the following reaction:



- (i) on increasing the temperature. (ii) on increasing the pressure.

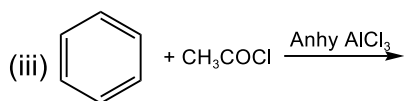
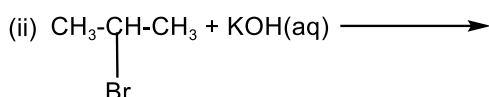
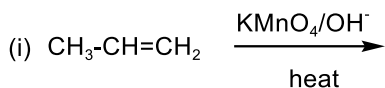
### SECTION – E

*The following questions are Long Answer Type and carrying 5 marks each. Two questions have an internal choice.*

33. (a) Explain the mechanism of chlorination of benzene.  
 (b) How can you convert the following:  
 (i) 2-Bromopropane to 1-bromopropane  
 (ii) Benzene to m-Nitrochlorobenzene

OR

- (a) Reductive ozonolysis of an alkene gave Butan-2-one and Pentane-2-one. Write the structure of alkene, its IUPAC name and the reactions involved.  
 (b) Complete the following reactions and identify the type of reaction.

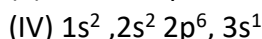
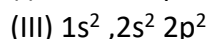
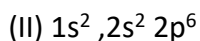
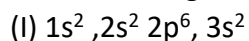


34. (a) How many orbitals are possible for a d-subshell? Name them.  
 (b) Draw the shapes of  $d_{xy}$  and  $d_{x^2-y^2}$  orbitals? What is the difference between these two orbitals?  
 (c) Name and draw a 3d orbital which has electron density along all the three axes.  
 (d) State Hund's rule of maximum multiplicity.

OR

- (a) Which transitions between Bohr orbits corresponds to  
 (i) second line in Balmer series and  
 (ii) First line in Brackett series of the hydrogen spectrum.  
 (b) Calculate the energy and frequency of the radiation emitted when an electron jumps from  $n=3$  to  $n=2$  in a hydrogen atom. (Given  $R_H = 109677 \text{ cm}^{-1}$ )  
 (c) What is the main difference between electromagnetic wave theory and Planck's quantum theory?

35. (a) The electronic configurations of some elements are given below:



Name the elements.

- (b) Give reason for the following:  
 (i) Chlorine has more negative electron gain enthalpy than F.  
 (ii) Anionic radius is always more than that of neutral atom.  
 (iii) O has lower ionization enthalpy than N.  
 (c) Predict the position of the element in the periodic table satisfying the electronic configuration  $(n-1)d^1 ns^2$  for  $n=4$ .