

PRACTICE PAPER
SUBJECT: CHEMISTRY
SET 5

ALLOTTED TIME: 3Hours
MM:70

General Instructions :

Read the following instructions carefully and follow them :

- (i) This question paper contains 33 questions. All questions are compulsory.
- (ii) This question paper is divided into five sections – Section A, B, C, D and E.
- (iii) Section A – questions number 1 to 16 are multiple choice type questions. Each question carries 1 mark.
- (iv) Section B – questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.
- (v) Section C – questions number 22 to 28 are short answer type questions. Each question carries 3 marks.
- (vi) Section D – questions number 29 and 30 are case-based questions. Each question carries 4 marks.
- (vii) Section E – questions number 31 to 33 are long answer type questions. Each question carries 5 marks.
- (viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the sections except Section A.
- (ix) Use of calculator is not allowed.

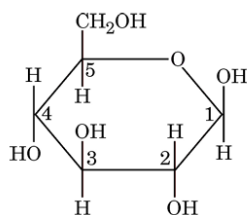
SECTION-A

Questions no. 1 to 16 are Multiple Choice type Questions, carrying 1 mark each.

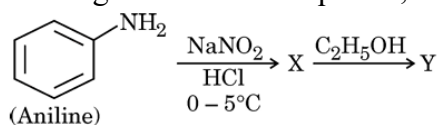
[1×16=16]

- 1. $\text{CH}_3\text{CH}_2\text{CHO}$ and $\text{CH}_3\text{CH}_2\text{COOH}$ can be distinguished by :
 - (a) Sodium bicarbonate test
 - (b) Hinsberg test
 - (c) Iodoform test
 - (d) Lucas test
 - 2. While doing qualitative analysis in chemistry lab, Abhishek added yellow coloured potassium chromate solution into a test tube. He was surprised to see the colour of the solution changing immediately to orange. He realised that the test tube was not clean and contained a few drops of some liquid. Which of the following substances will be the most likely liquid to be present in the test tube before adding potassium chromate solution ?
 - (a) Sodium hydrogen carbonate solution
 - (b) Methyl orange solution
 - (c) Sodium hydroxide solution
 - (d) HCl solution
 - 3. The role of a catalyst is to change :
 - (a) equilibrium constant
 - (b) enthalpy of reaction
 - (c) Gibbs energy of reaction
 - (d) activation energy of reaction
 - 4. Out of Fe^{3+} , Sc^{3+} , Cr^{3+} and Co^{3+} ions, the one which is colourless in aqueous solution is:
 - (a) Sc^{3+}
 - (b) Cr^{3+}
 - (c) Fe^{3+}
 - (d) Co^{3+}
- [Atomic number : Fe = 26, Sc = 21, Cr = 24, Co = 27]

5. The number of moles of AgCl precipitated when excess AgNO₃ solution is mixed with one mole of [Co(NH₃)₃Cl₃] is :
 (a) 0 (b) 1 (c) 2 (d) 3
6. In the Haworth structure of the following carbohydrate, various carbon atoms have been numbered. The anomeric carbon is numbered as :



- (a) 1 (b) 2 (c) 3 (d) 5
7. The value of Henry's constant K_H is :
 (a) greater for gases with higher solubility
 (b) greater for gases with lower solubility
 (c) constant for all gases
 (d) not related to the solubility of gases
8. An archaeologist found that the percentage of carbon-14 in a wooden artifact was 20% of what carbon-14 would have been in the wood when it was cut from the tree. What would be the approximate age of this wooden artifact? (Given the half-life of carbon-14 = 5730 years)
 (a) 5,790 years (b) 12,060 years
 (c) 13,300 years (d) 38,000 years
9. In the given reaction sequence, the structure of Y would be :



- (A) (B)
 (C) (D)

10. A solution of acetone in ethanol :
 (a) obeys Raoult's law.
 (b) forms an ideal solution.
 (c) shows a positive deviation from Raoult's law.
 (d) shows a negative deviation from Raoult's law.
11. What amount of electric charge is required for the reduction of 1 mole of MnO₄ into Mn²⁺?
 (a) 1 F (b) 4 F (c) 5 F (d) 6 F
12. Alkenes are formed by heating alcohols with conc. H₂SO₄. The first step in the reaction is :
 (a) formation of carbocation (b) formation of ester
 (c) protonation of alcohol molecule (d) elimination of water

For Questions number 13 to 16, two statements are given — one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

- (c) Assertion (A) is true, but Reason (R) is false.
 (d) Assertion (A) is false, but Reason (R) is true.
13. Assertion (A) : Electrolysis of aqueous NaCl gives H₂ at cathode and Cl₂ at anode.
 Reason (R) : Chlorine has higher oxidation potential than H₂O.
14. Assertion (A) : Cuprous salts are diamagnetic.
 Reason (R) : Cuprous ion has completely filled 3d-orbitals.
15. Assertion (A) : Acetanilide is less basic than aniline.
 Reason (R) : Acetylation of aniline results in decrease of electron density on nitrogen.
16. Assertion (A) : Vitamin K can be stored in our body.
 Reason (R) : Vitamin K is a water soluble vitamin.

SECTION B

[2×5=10]

17. (a) Calculate the elevation of boiling point of a solution when 3 g of CaCl₂ (Molar mass = 111 g mol⁻¹) was dissolved in 260 g of water, assuming that CaCl₂ undergoes complete dissociation. (K_b for water = 0.52 K kg mol⁻¹)

OR

- (b) Liquids 'X' and 'Y' form an ideal solution. The vapour pressure of pure 'X' and pure 'Y' are 120 mm Hg and 160 mm Hg respectively. Calculate the vapour pressure of the solution containing equal moles of 'X' and 'Y'.
18. What is meant by essential amino acids ? Why are amino acids amphoteric in nature?
19. PdCl₂ . 2KCl does not give precipitate of AgCl with AgNO₃ solution. Write the structural formula and IUPAC name of the complex.
20. Reactant 'A' underwent a decomposition reaction. The concentration of 'A' was measured periodically and recorded in the table given below :

Time / Hours	[A]/M
0	0.88
1	0.44
2	0.22
3	0.11

Based on the above data, predict the order of the reaction and write the expression for the rate law.

21. (a) What happens when phenol is treated with the following ?
 (i) Br₂ water (ii) Conc. HNO₃
- (b) Why do phenols not undergo reactions involving cleavage of C – OH bond ?

SECTION C

[3×7=21]

22. (a) Write the name of the cell which is generally used in inverters. Write the reactions taking place at anode and cathode of this cell, when it is in use.

OR

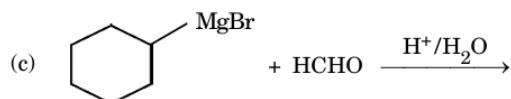
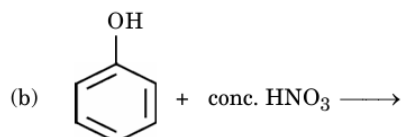
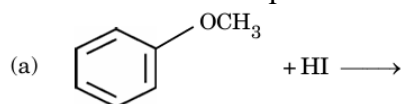
- (b) Explain why electrolysis of an aqueous solution of NaCl gives H₂ gas at cathode and Cl₂ gas at anode ? Write overall reaction.

(Given : E°_{Na⁺/Na} = - 2.71 V, E°_{H₂O/H₂} = - 0.83 V,

E°_{Cl₂/2Cl⁻} = + 1.36 V, E°_{H⁺/O₂/H₂O} = + 1.23 V)

23. A compound (A) with molecular formula C₄H₉I which is a primary alkyl halide, reacts with alcoholic KOH to give compound (B). Compound (B) reacts with HI to give (C) which is an isomer of (A). When (A) reacts with Na metal in the presence of dry ether, it gives a compound (D), C₈H₁₈, which is different from the compound formed when n-butyl iodide reacts with sodium. Write the structures of (A), (B), (C) and (D). Write the chemical equation when compound (A) is reacted with alcoholic KOH.

24. Write structure of the products of the following reactions :



25. Give reasons for the following : (a) (b) (c) Benzoic acid does not undergo Friedel-Crafts reaction.

HCHO is more reactive than CH_3CHO towards addition of HCN . Vinyl group directly attached with carboxylic acid should decrease the acidity of corresponding carboxylic acid due to resonance, but on the contrary it increases the acidity.

26. Write the reaction of D-Glucose with the following :

(a) HCN (b) Br_2 water (c) $(\text{CH}_3\text{CO})_2\text{O}$

27. Account for the following :

- (i) Allyl chloride is hydrolysed more readily than n-propyl chloride
- (ii) Isocyanides are formed when alkyl halides are treated with silver cyanide.
- (iii) Methyl chloride reacts faster with $-\text{OH}^-$ ion in $\text{S}_\text{N}2$ reaction than t-butyl chloride.

28. (a) Suman took two glasses of water from a water filter. She cools one glass in a fridge and warms the other glass on a stove. Which glass of water will hold more dissolved oxygen? Explain using Henry's law.

(b) 'Colligative properties help in determining the molar masses of the solutes.' The method based on which colligative property is preferred over others for determining molar masses of biomolecules and why?

SECTION D

[2×4=8]

The following questions are case-based questions. Read the case carefully and answer the questions that follow.

29. Amines are usually formed from amides, imides, halides, nitro compounds, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and H-bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. Alkyl amines are found to be stronger bases than ammonia. Amines being basic in nature, react with acids to form salts. Aryldiazonium salts, undergo replacement of the diazonium group with a variety of nucleophiles to produce aryl halides, cyanides, phenols and arenes. Answer the following questions :

(a) How can you convert the following ?

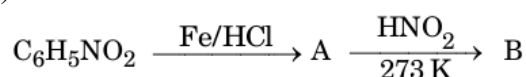
- (i) Ethanoic acid to methanamine
- (ii) Propanenitrile to 1-aminopropane

(b) Why is pK_b value of aniline more than that of methylamine ?

(c) (i) Arrange the following in increasing order of their basic strength in aqueous solution : CH_3-NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$

OR

(c) (ii) Give the structures of A and B in the following reaction :



30. The Crystal Field Theory (CFT) of coordination compounds is based on the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. In tetrahedral coordination entity formation, the d-orbital splitting is smaller as compared to the octahedral entity.

Answer the following questions :

- (a) On the basis of CFT, explain why $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$ complex is coloured ? What happens on heating the complex $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$? Give reason. [Atomic no. : Ti = 22]
 (b) (i) What is crystal field splitting energy ?

OR

- (b) (ii) On the basis of Δ_o and P (pairing energy), how can you differentiate between a strong field ligand and a weak field ligand ?
 (c) Why are low spin tetrahedral complexes rarely observed?

SECTION E

[3×5=15]

31. (i) Account for the following :

- (I) Orange colour of $\text{Cr}_2\text{O}_7^{2-}$ ion changes to yellow when treated with an alkali.
 (II) Zn, Cd and Hg are non-transition elements.
 (III) E^0 value for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is highly positive (+1.57 V) as compared to $\text{Cr}^{3+}/\text{Cr}^{2+}$.
 (ii) What happens when :
 (I) Manganate ion undergoes disproportionation reaction in acidic medium ?
 (II) KMnO_4 is heated ?

OR.

Answer the following questions :

- (i) What is 'Misch metal' ? Give its one use.
 (ii) Write the formula of an oxoanion of chromium in which it shows the oxidation state equal to its group number.
 (iii) Why does Vanadium pentoxide (V_2O_5) act as a catalyst ?
 (iv) Why do transition elements have high enthalpies of atomisation ?
 (v) How do you prepare $\text{Na}_2\text{Cr}_2\text{O}_7$ from Na_2CrO_4 ?
 32. (a) (i) Calculate the emf of the following cell at 25°C :
 $\text{Zn(s)} | \text{Zn}^{2+} (0.1 \text{ M}) || \text{H}^+ (0.01 \text{ M}) | \text{H}_2(\text{g}) (1 \text{ bar}), \text{Pt(s)}$
 [Given : $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$, $E^\circ_{2\text{H}^+/\text{H}_2} = 0.00 \text{ V}$, $\log 10 = 1$]
 (ii) State Faraday's second law of electrolysis. How much electricity is required in terms of Faraday for the reduction of 1 mol of $\text{Cr}_2\text{O}_7^{2-}$ to Cr^{3+} ?

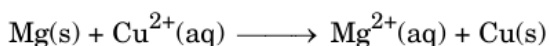
OR

- (b) Answer the following questions :

- (i) The conductivity of 0.20 M solution of KCl is $2.48 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation (α).

$$\begin{aligned} \text{[Given : } \lambda^\circ_{(\text{K}^+)} &= 73.5 \text{ S cm}^2 \text{ mol}^{-1} \\ \lambda^\circ_{(\text{Cl}^-)} &= 76.5 \text{ S cm}^2 \text{ mol}^{-1}] \end{aligned}$$

- (ii) Calculate $\Delta_r G^\circ$ of the following cell :



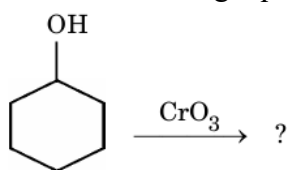
$$\begin{aligned} \text{[Given : } E^\circ_{\text{Mg}^{2+}/\text{Mg}} &= -2.37 \text{ V, } E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V} \\ 1 \text{ F} &= 96500 \text{ C mol}^{-1}] \end{aligned}$$

(iii) What type of cell is mercury cell ? Why is it more advantageous than dry cell ?

33. (a) (i) An organic compound (X) having molecular formula $C_5H_{10}O$ can show various properties depending on its structures. Draw each of the structures if it :
- (I) shows Cannizzaro reaction.
 - (II) reduces Tollens' reagent and has a chiral carbon.
 - (III) gives positive iodoform test.
- (ii) Write the reaction involved in the following :
- (I) Clemmensen reduction
 - (II) Etard reaction

OR

- (b) Answer the following questions :
- (i) Draw structure of the methyl hemiacetal of methanal.
 - (ii) There are two $-NH_2$ groups in semicarbazide. However only one is involved in the formation of semicarbazones. Give reason.
 - (iii) How will you convert ethanol to 3-hydroxybutanal ?
 - (iv) Complete the following equation :



- (v) Write the final product formed when phthalic acid is treated with NH_3 followed by strong heating.