

Read the Instructions Carefully:

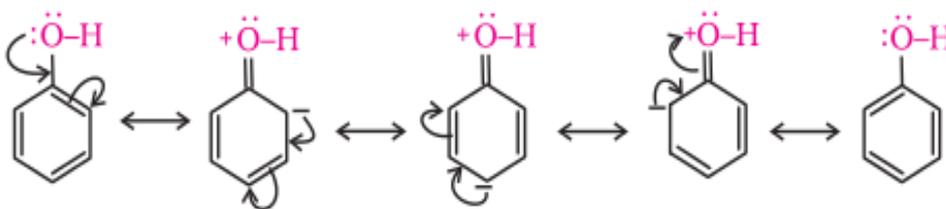
1. There are 33 questions in this question paper. All questions are compulsory.
2. Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage-based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
3. Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
4. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
5. Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
6. There is no overall choice. However, internal choices have been provided.
7. Use of calculators and log tables is not permitted.

SECTION - A

1. **Read the passage given below and answer the following questions:**

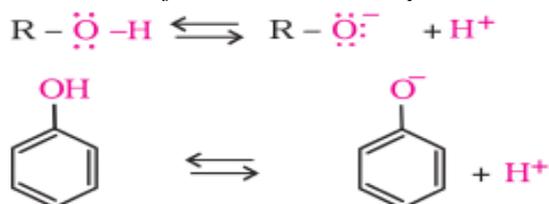
(4)

“Acidity of phenols: The reactions of phenol with metals (e.g., sodium, aluminium) and sodium hydroxide indicate its acidic nature. The hydroxyl group, in phenol is directly attached to the sp^2 hybridised carbon of benzene ring which acts as an electron withdrawing group. Due to this, the charge distribution in phenol molecule, as depicted in its resonance structures, causes the oxygen of $-OH$ group to be positive.



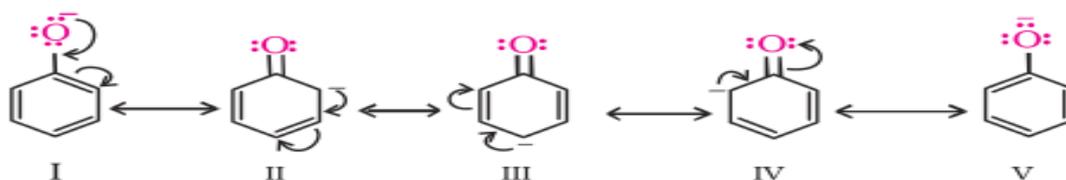
The reaction of phenol with aqueous sodium hydroxide indicates that phenols are stronger acids than alcohols and water. Let us examine how a compound in which hydroxyl group attached to an aromatic ring is more acidic than the one in which hydroxyl group is attached to an alkyl group.

The ionisation of an alcohol and a phenol takes place as follows:



Due to the higher electronegativity of sp^2 hybridised carbon of phenol to which $-OH$ is attached, electron density decreases on oxygen. This increases the polarity of $O-H$ bond and results in an increase in ionisation of phenols than that of alcohols. Now let us examine the stabilities of alkoxide and phenoxide ions. In alkoxide ion, the negative charge is localised on

oxygen while in phenoxide ion, the charge is delocalised. The delocalisation of negative charge (structures I-V) makes phenoxide ion more stable and favours the ionisation of phenol. Although there is also charge delocalisation in phenol, its resonance structures have charge separation due to which the phenol molecule is less stable than phenoxide ion.



In substituted phenols, the presence of electron withdrawing groups such as nitro group, enhances the acidic strength of phenol. This effect is more pronounced when such a group is present at ortho and para positions. It is due to the effective delocalisation of negative charge in phenoxide ion. On the other hand, electron releasing groups, such as alkyl groups, in general, do not favour the formation of phenoxide ion resulting in decrease in acid strength. Cresols, for example, are less acidic than phenol.

Table 11.3: pK_a values of some Phenols and Ethanol

Compound	Formula	pK_a
<i>o</i> -Nitrophenol	<i>o</i> -O ₂ N-C ₆ H ₄ -OH	7.2
<i>m</i> -Nitrophenol	<i>m</i> -O ₂ N-C ₆ H ₄ -OH	8.3
<i>p</i> -Nitrophenol	<i>p</i> -O ₂ N-C ₆ H ₄ -OH	7.1
Phenol	C ₆ H ₅ -OH	10.0
<i>o</i> -Cresol	<i>o</i> -CH ₃ -C ₆ H ₄ -OH	10.2
<i>m</i> -Cresol	<i>m</i> -CH ₃ -C ₆ H ₄ -OH	10.1
<i>p</i> -Cresol	<i>p</i> -CH ₃ -C ₆ H ₄ -OH	10.2
Ethanol	C ₂ H ₅ OH	15.9

From the above data, phenol is million times more acidic than ethanol” (Source: NCERT)

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) Choose the correct arrangement in increasing order of acidic strength:

- (a) *p*-nitrophenol > *p*-cresol > Phenol > Ethanol
- (b) Ethanol > *p*-cresol > *o*-cresol > *p*-nitrophenol
- (c) *m*-nitrophenol > Phenol > *o*-cresol > Ethanol
- (d) Ethanol > *o*-cresol > Phenol > *m*-nitrophenol

(ii) The hybridization of the carbon in benzene ring of phenol which is attached to hydroxyl group is:

- (a) sp²
- (b) sp³
- (c) sp
- (d) sp³d

(iii) Phenol is more acidic than cresol due to

- (a) effective localization of negative charge on phenoxide ion than cresol
- (b) effective delocalization of negative charge on phenoxide ion than cresol
- (c) Electron releasing group favours acidity
- (d) Electron withdrawing group like NO₂ attached to cresol

(iv) Choose the correct arrangement in increasing order of acidic strength

- (a) *o*-nitrophenol > *m*-nitrophenol > *p*-nitrophenol > phenol
- (b) *m*-nitrophenol > *p*-nitrophenol > *o*-nitrophenol > phenol

- (c) phenol > p-nitrophenol > m-nitrophenol > o-nitrophenol
 (d) p-nitrophenol > o-nitrophenol > m-nitrophenol > phenol

OR

- (iv) Phenol is _____ times more acidic than alcohol
 (a) 10000
 (b) 1000000
 (c) 10
 (d) 1000

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

(4)

“Charge on colloidal particles: Colloidal particles always carry an electric charge. The nature of this charge is the same on all the particles in a given colloidal solution and may be either positive or negative. A list of some common sols with the nature of charge on their particles is given below:

Positively charged sols	Negatively charged sols
Hydrated metallic oxides, e.g., $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, $\text{CrO}_3 \cdot x\text{H}_2\text{O}$ and $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, etc.	Metals, e.g., copper, silver, gold sols.
Basic dye stuffs, e.g., methylene blue sol.	Metallic sulphides, e.g., As_2S_3 , Sb_2S_3 , CdS sols.
Haemoglobin (blood)	Acid dye stuffs, e.g., eosin, congo red sols.
Oxides, e.g., TiO_2 sol.	Sols of starch, gum, gelatin, clay, charcoal, etc.

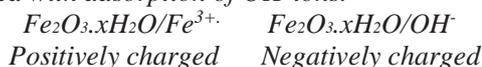
The charge on the sol particles is due to one or more reasons, viz., due to electron capture by sol particles during electrodispersion of metals, due to preferential adsorption of ions from solution and/or due to formulation of electrical double layer.

Preferential adsorption of ions is the most accepted reason. The sol particles acquire positive or negative charge by preferential adsorption of +ve or -ve ions. When two or more ions are present in the dispersion medium, preferential adsorption of the ion common to the colloidal particle usually takes place. This can be explained by taking the following examples:

(a) When silver nitrate solution is added to potassium iodide solution, the precipitated silver iodide adsorbs iodide ions from the dispersion medium and negatively charged colloidal solution results. However, when KI solution is added to AgNO_3 solution, positively charged sol results due to adsorption of Ag^+ ions from dispersion medium.



(b) If FeCl_3 is added to excess of hot water, a positively charged sol of hydrated ferric oxide is formed due to adsorption of Fe^{3+} ions. However, when ferric chloride is added to NaOH a negatively charged sol is obtained with adsorption of OH^- ions.



Having acquired a positive or a negative charge by selective adsorption on the surface of a colloidal particle as stated above, this layer attracts counter ions from the medium forming a second layer, as shown below.



The combination of the two layers of opposite charges around the colloidal particle is called Helmholtz electrical double layer. According to modern views, the first layer of ions is firmly held and is termed fixed layer while the second layer is mobile which is termed diffused layer.

Since separation of charge is a seat of potential, the charges of opposite signs on the fixed and diffused parts of the double layer results in a difference in potential between these layers. This potential difference between the fixed layer and the diffused layer of opposite charges is called the electrokinetic potential or zeta potential.

The presence of equal and similar charges on colloidal particles is largely responsible in providing stability to the colloidal solution, because the repulsive forces between charged particles having same charge prevent them from coalescing or aggregating when they come closer to one another.” (SOURCE: NCERT)

In these questions (Q numbers (i) to (iv)), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(i) Assertion: Colloidal particles always carry a charge.

Reason: Charge on a colloidal particle is always due to electron capture by sol particles

(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.

(ii) Assertion: Metallic sulphides are usually positively charged sols

Reason: Charge on colloidal particle may be due to formulation of electrical double layer

(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.

(iii) Assertion: The potential difference between the fixed layer and the diffused layer of opposite charges is called zeta potential

Reason: First layer of ions is firmly held and termed fixed layer while the second layer is mobile which is termed diffused layer.

(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.

(iv) Assertion: If FeCl_3 is added to excess of hot water, a positively charged sol of hydrated ferric oxide is formed.

Reason: Adsorption of Fe^{3+} ions on hydrated ferric oxide leads to positively charged sol.

(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.

OR

(iv) Assertion: When silver nitrate solution is added to potassium iodide solution, negatively charged colloidal solution results

Reason: Precipitated Silver iodide adsorbs iodide ions from the dispersion medium

(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.

3. Cell reaction is spontaneous when:

(a) E_{red}° is negative

(b) E_{red}° is positive

(1)

- (c) ΔG° is negative
- (d) ΔG° is positive

4. Usually Amino acids are: (1)
- (a) acidic
 - (b) basic
 - (c) amphoteric
 - (d) non-polar

OR

Nucleotides are composed of:

- (a) a nitrogenous base and a pentose sugar
- (b) a pentose sugar and phosphoric acid
- (c) a nitrogenous base and phosphoric acid
- (d) a nitrogenous base, a pentose sugar and phosphoric acid.

5. The osmotic pressure of equimolar solutions of glucose, sodium chloride and barium chloride will be in the order: (1)
- (a) $\text{BaCl}_2 > \text{NaCl} > \text{glucose}$
 - (b) $\text{BaCl}_2 > \text{glucose} > \text{NaCl}$
 - (c) $\text{glucose} > \text{BaCl}_2 > \text{NaCl}$
 - (d) $\text{NaCl} > \text{BaCl}_2 > \text{glucose}$
6. d block elements form large number of complex compounds due to (1)
- (i) comparatively smaller size of the metal ions (ii) high ionic charge (iii) availability of d orbitals
 - (a) (i), (ii) & (iii)
 - (b) (i) & (iii)
 - (c) only (iii)
 - (d) (i) & (ii)

OR

Oxidation state of Ni and Fe in $\text{Ni}(\text{CO})_4$ and $\text{Fe}(\text{CO})_5$ are

- (a) 4 and 5
- (b) 8 and 10
- (c) 2 and 2.5
- (d) both are zero

7. pK_b value of Aniline is **9.38** and that of methanamine is **3.38** Reason for the lower basicity of Aniline is: (1)
- (a) Unshared electron pair on nitrogen atom to be in conjugation with the benzene ring.
 - (b) Unshared electron pair on nitrogen atom is not in conjugation with the benzene ring.
 - (c) High electron cloud on benzene ring.
 - (d) Steric effect due to bulky benzene ring.

OR

Gabriel Phthalimide is used for the preparation of

- (a) Primary amines
- (b) Secondary amines
- (c) Tertiary amines
- (d) Quaternary amines

8. The colour the complex $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is due to : (1)
- (a) d-s transition
 - (b) d-p transition
 - (c) p-p transition
 - (d) d-d transition

OR

Metals present in chlorophyll, hemoglobin and vitamin B₁₂ are:

- (a) Magnesium, Iron and Cobalt
 - (b) Cobalt, Iron and Magnesium
 - (c) Iron, Magnesium and Cobalt
 - (d) Magnesium, Cobalt and Iron
9. Which among the transition elements having positive E° value for M^{2+}/M (1)
- (a) Cu
 - (b) Sn
 - (c) Zn
 - (d) Mn
10. The correct increasing order of boiling points of the following compounds is: (1)
- (a) bromobenzene < 1-bromobutane < 1-bromopropane < 1-bromoethane
 - (b) bromobenzene < 1-bromoethane < 1-bromopropane < 1-bromobutane
 - (c) 1-bromopropane < 1-bromobutane < 1-bromoethane < bromobenzene
 - (d) 1-bromoethane < 1-bromopropane < 1-bromobutane < bromobenzene
11. A compound is formed by two elements X & Y. Atoms of the element Y (as anions) make ccp (1) and those of the element X (as cations) occupy all the octahedral voids. What is the formula of the compound?
- (a) XY
 - (b) XY₂
 - (c) X₂Y
 - (d) X₂Y
12. **Assertion:** D (+) – Glucose is dextrorotatory in nature. (1)
Reason: 'D' represents its dextrorotatory nature
- (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.
13. **Assertion:** Xenon forms fluorides (1)
Reason: Because, 5d-orbitals are available for valence shell expansion.
- (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.
14. **Assertion:** The sum of mole fractions of all components of a solution is unity. (1)
Reason: Mole fraction is independent of temperature.

- (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

OR

Assertion: Relative lowering of vapour pressure is a colligative property.

Reason: Relative lowering of vapour pressure is equal to mole fraction of the solute.

- (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:** Cannizzaro reaction is given by formaldehyde and benzaldehyde. (1)

Reason: Both the compounds lack of α – hydrogen atom.

- (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

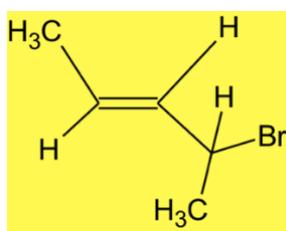
16. **Assertion:** p-nitrophenol is more acidic than phenol. (1)

Reason: Nitro group helps in the stabilization of the phenoxide ion by dispersal of negative charge due to resonance.

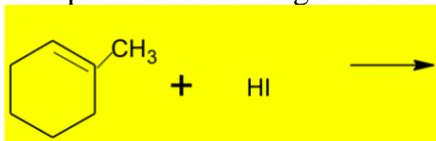
- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
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SECTION - B

17. (a) Give the IUPAC name of the following: (2)

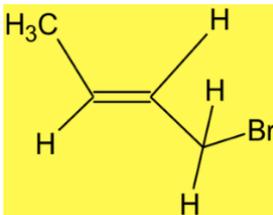


(a) Complete the following reaction:



OR

(a) Give the IUPAC name of the following:



(b) Complete the following reaction:



18. (a) Define an ideal solution and write one of its characteristics (2)
(b) State Raoult's law

19. (a) What is the IUPAC name of the complex [Ni(NH₃)₆]Cl₂ (2)
(b) What do you understand by denticity of a ligand?

OR

(a) What is meant by crystal field splitting energy? How does the magnitude of splitting decide the actual configuration of d-orbital in an octahedral field for a coordination entity?

20. (a) For a reaction $A + B \rightarrow P$, the rate law is given by $r = k[A]^{1/2}[B]^2$. What is the order of this reaction? (2)
(b) List two factors that affect the rate of reaction.

OR

(a) Define half-life of a reaction ($t_{1/2}$)
(b) A first order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14} \text{ s}^{-1}$. Find the half-life of the reaction.

21. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the reaction will be completed. [$\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6020$] (2)

22. How will you convert. (2)
(a) propene to propan-1-ol
(b) propan-2-ol to propanone

23. (a) Draw the structure of BrF₃ (2)
(b) Complete the following reaction equation:
 $\text{NaOH (hot and conc)} + \text{Cl}_2 \rightarrow$

24. Account for the following: (2)
(a) The C-Cl bond length in chlorobenzene is shorter than that of CH₃-Cl
(b) Grignard reagent should be prepared under anhydrous conditions

25. Define the following: (2)
(a) Schottky defect

(b) Express the relationship between atomic radius (r) and the edge length (a) in the fcc unit cell

SECTION - C

26. Assign suitable reasons for the following: (3)
- The transition metals generally form coloured compounds.
 - The Mn^{2+} compounds are more stable than Fe^{2+} towards oxidation to their +3 state.
 - Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured.

OR

- Transition metals and their compounds generally exhibit a paramagnetic behavior
 - Zinc is not regarded as transition element.
 - Cu^+ ion is not known in aqueous solution
27. (a) Which of the two is more basic and why? (3)
- (b) Write the IUPAC name of the following compound:
 $\text{CH}_3\text{NHCH}(\text{CH}_3)_2$
- (c) Write equation for Gabriel Phthalimide reaction.

OR

- Out of $\text{CH}_3\text{-NH}_2$ and $(\text{CH}_3)_3\text{N}$, which one has higher boiling point?
 - Why does NH_3 act as a Lewis base?
 - Write equation for Hofmann bromamide reaction.
28. An element with molar mass 27 g mol^{-1} forms a cubic unit cell with edge length 4.05×10^{-8} cm. If its density is 2.7 g cm^{-3} . What is the nature of the cubic unit cell? (3)
29. What happens when D-glucose is treated with the following reagents? (3)
- HI
 - Br_2 water
 - HNO_3
30. (a) Helium is used in diving equipments. Justify (3)
- (b) XeF_2 is linear molecule without a bent. Justify
- (c) What happens when XeF_6 is hydrolysed?

SECTION - D

31. Account for the following: (5)
- Ozone is thermodynamically unstable.
 - The acidic strength of these compounds increases in the following order
 $\text{PH}_3 < \text{H}_2\text{S} < \text{HCl}$
 - Why are halogens strong oxidizing agents?
 - Reducing character decreases from SO_2 to TeO_2
 - HClO_4 is stronger acid than HClO

OR

- NF_3 is an exothermic compound whereas NCl_3 is not. Justify
 - The oxidizing power of oxoacids of chlorine follows the order:
 $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$ Justify
 - F_2 has lower bond dissociation enthalpy than Cl_2 . Why?
 - BiH_3 is the strongest reducing agent amongst all the hydrides of group 15
 - unlike xenon, no distinct chemical compound of helium is known.
32. (a) Draw the structure of p-Methylbenzaldehyde (5)
- (b) Account for the following: CH_3CHO is more reactive than CH_3COCH_3 towards reaction

with HCN.

- (c) Explain with the help of chemical equation : Wolff Kishner Reduction
- (d) Give a simple chemical test to distinguish between the pair of organic compounds: Ethanal and propanal
- (e) How to convert Butan-1-ol to Butanoic acid

OR

- (a) Draw the structure of 4-Methylpent-3-en-2-one
- (b) Account for the following: Carboxylic acid is stronger than Phenol
- (c) Explain with the help of chemical equation: Clemensen Reduction
- (d) Give a simple chemical test to distinguish between the pair of organic compounds: Benzaldehyde and benzoic acid
- (e) How to convert phenyl magnesium bromide to benzoic acid.

33. (a) What is the SI Unit of conductance (5)
- (b) Define Limiting molar conductivity
 - (c) Calculate the limiting molar conductivity of CaSO_4 (Limiting molar conductivity of calcium and sulphate ions are 119.0 and $160.0 \text{ S cm}^2 \text{ mol}^{-1}$ respectively)
 - (d) Calculate the emf of the following cell at 298 K :
 $\text{Fe (s)} \mid \text{Fe}^{2+} (0.001 \text{ M}) \parallel \text{H}^+ (1\text{M}) \mid \text{H}_2 (\text{g}) (1 \text{ bar}), \text{Pt (s)}$
[Given $E_{cell}^\ominus = +0.44 \text{ V}$ and $\text{Log } 10^n = n$]

OR

- (a) Name any one factor where the conductivity of ionic solution depends:
- (b) Define molar conductivity
- (c) Define Kohlrausch Law of independent migration
- (d) Calculate the emf of the following cell at 25°C
 $\text{Ag (s)} \mid \text{Ag}^+ (10^{-3} \text{ M}) \parallel \text{Cu}^{2+} (10^{-1} \text{ M}) \mid \text{Cu (s)}$ [Given $E_{cell}^\ominus = +0.46 \text{ V}$ and $\text{Log } 10^n = n$]

-END-