Question Paper 2008 Delhi Set-1

Class-12 Chemistry

Time Allowed: 3 Hours, Maximum Marks: 70

General Instructions

1. All questions are compulsory.
2. Marks for each question are indicated against it.
3. Question numbers 1 to 8 are very short-answer questions, carrying 1 mark each. Answer these in one word or about one sentence each.
4. Question numbers 9 to 18 are short-answer questions, carrying 2 marks each. Answer these in about 30 words each.
5. Question numbers 19 to 27 are short-answer questions of 3 marks each. Answer these in about 40 words each.
6. Question numbers 28 to 30 are long-answer questions of 5 marks each. Answer these in about 70 words each.
7. Use Log Tables, if necessary Use of calculators is not permitted.

1. What is the coordination number of each type of ions in a rock-salt type crystal structure? [1]

Ans. 6:6 or 6

2. Define the term 'order of reaction' for chemical reactions. [1]

Ans. The sum of powers of the concentration terms of the reactants in the rate law expression is called the order of that chemical reaction.

Or

rate = $rate = k[A]^p[B]^q$

Order of reaction = p + q

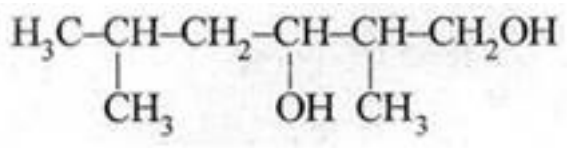
3. What causes Brownian movement in a colloidal solution? [1]

Ans. Due to unbalanced bombardment of the colloidal particles by the molecules of the dispersion medium.

4. In which one of the two structures, NO_2^+ and NO_2^- the bond angle has a higher value? [1]

Ans. NO_2^+

5. Write the IUPAC name of the following compound: [1]



Ans. 2,5-Dimethylhexane -1,3-diol.

6. Arrange the following compounds in an increasing order of their acid strengths: [1]

$(CH_3)_2CHCOOH$, $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$

Ans. $(CH_3)_2CHCOOH < CH_3CH(Br)CH_2COOH < CH_3CH_2CH(Br)COOH$

7. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt. [1]

Ans. $C_6H_5N_2^+Cl^- + KI \rightarrow C_6H_5I + KCl + N_2$

8. Name a substance that can be used as an antiseptic as well as a disinfectant. [1]

Ans. Phenol (or any other correct one)

9. Explain as to why haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions. [2]

OR

Which compound in each of the following pairs will react faster in SN_2 reaction with $-OH$? Why? [2]

(i) CH_3Br *or* CH_3I

(ii) $(CH_3)_3CCl$ *or* CH_3Cl

Ans. Aryl halides are less reactive towards nucleophilic substitution because of any of the following reasons with correct explanation:

(i) Resonance effect stabilization

(ii) sp^2 hybridization in haloarenes being more electronegative than sp^3 in haloalkanes.

(iii) Instability of phenyl cation which is not stabilized by resonance.

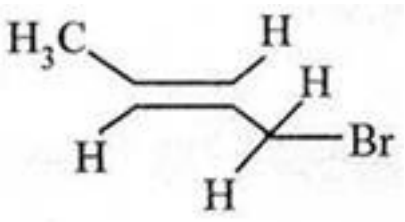
(iv) possible repulsion between electron rich nucleophile and electron rich arene. (at least two reasons to be given)

OR

(i) CH_3I, because iodine is a better leaving group due to its larger size.

(ii) CH_3Cl, the presence of bulky group on the carbon atom in $(CH_3)_2CCl$ has an inhibiting effect.

10. (a) State the IUPAC name of the following compound: [2]



(b) Complete the following chemical equation:

$$CH_3CH_2CH=CH_2 + HBr \xrightarrow{peroxide} \ldots$$

Ans. (a) 1-Bromobut-2-ene

(b) $CH_3CH_2CH_2CH_2Br$

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11. State Henry's law correlating the pressure of a gas and its solubility in a solvent and mention two applications for the law. [2]

Ans. Henry's law states that at a constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas over the solution.

Applications
(i) To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.
(ii) Scuba divers must cope with high concentrations of dissolved Nitrogen with breathing air at high pressure underwater. To avoid this air is diluted with He.
(iii) At high altitudes, the partial pressure of oxygen is less than that at the ground level. Low blood oxygen causes anoxia.
(any two)

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12. A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its $t_{1/2}$ value. [2]

Ans. $k = \frac{2.303}{t}\frac{\log[A_0]}{[A]}$

$$k = \frac{2.303}{40\,\text{min}}\frac{\log[A_0]}{[A]}$$

$$k = \frac{2.303}{40} \times 0.155 = 0.00892\,\text{min}^{-1}$$

$$t_{1/2} = \frac{0.693}{k}$$

$$t_{1/2} = \frac{0.693}{0.00892} \text{min}$$

$$t_{1/2} = 77.7 \text{min}$$

13. What is meant by the 'rate constant, k' of a reaction? If the concentration be expressed in $mol\ L^{-1}$ units and time in seconds, what would be the units for k
(i) for a zero-order reaction and
(ii) for a first order reaction? [2]

Ans. Rate constant 'k' of a reaction is defined as the rate of reaction when the concentration of the reactant(s) is unity. / or Rate constant is the proportionality factor in the rate law.
(i) Unit for 'k' for a zero-order reaction $= mol\ L^{-1}s^{-1}$
(ii) Unit for 'k' for a first order reaction $= s^{-1}$

14. Define the following terms in relation to proteins: [2]
(i) Peptide linkage
(ii) Denaturation

Ans. (i) Peptide linkage: Peptide linkage is an amide $(-CO-NH-)$ bond formed between $-COOH$ and $-NH_2$ group in protein formation.

(ii) Denaturation: When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, protein loses its biological activity. This is called denaturation of protein.

15. List the reactions of glucose which cannot be explained by its open chain structure. [2]

Ans. (i) Despite having the aldehyde group, glucose does not give 2,4-DNP test or Schiff's test.
(ii) It does not form the hydrogen sulphite addition product with $NaHSO_3$.
(iii) The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free $-CHO$ group. (any two)

16. Assign a reason for each of the following statements: [2]

(i) Ammonia is a stronger base than phosphine.

(ii) Sulphur in vapour state exhibits a paramagnetic behaviour.

Ans. (i)The lone pair of electrons on N atom in NH_3 is directed and not diffused / delocalized as it is in PH_3 due to larger size of P/ or due to availability of d-orbitals in P.

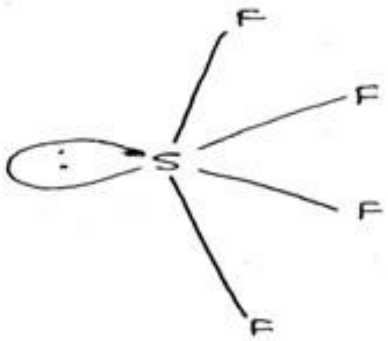
(ii) S_2 molecule like O_2, has two unpaired electrons in antibonding π^* orbitals.

17. Draw the structures of the following molecules: [2]

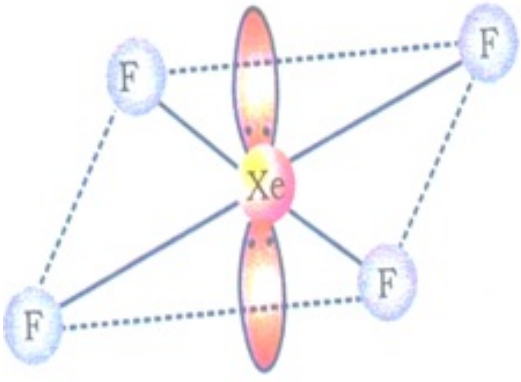
(i) SF_4

(ii) XeF_4

Ans. (i) SF_4



(ii) XeF_4



18. What are biodegradable and non-biodegradable detergents? Give one example of each class. [2]

Ans. Biodegradable detergents are those detergents which are easily degraded by the microorganisms and hence are pollution free.
ex. Soap / Sodium laurylsulphate / any other unbranched chain detergent. (any one)
Non-Biodegradable Detergents are those detergents which cannot be degraded by the bacteria easily and hence create pollution. [example not essential]

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19. What is a semiconductor? Describe the two main types of semiconductors and explain mechanisms for their conduction. [3]

Ans. The solids with intermediate conductivities between insulators and conductors are termed semiconductors.
(i) n- type semiconductor: It is obtained by doping Si or Ge with a group 15 element like P. Out of 5 valence electrons, only 4 are involved in bond formation and the fifth electron is delocalized and can be easily provided to the conduction band. The conduction is thus mainly caused by the movement of electron.
(ii) p – type semi-conductor: It is obtained by doping Si or Ge with a group 13 element like Gallium which contains only 3 valence electrons. Due to missing of 4^{th} valence electron, electron hole or electron vacancy is created. The movement of these positively charged hole is responsible for the conduction.

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20. Calculate the temperature at which a solution containing $54\ g$ of glucose, $(C_6H_{12}O_6)$, in $250\ g$ of water will freeze. $(K_f\ for\ water = 1.86\ K\ mol^{-1}\ kg)$ [3]

Ans. $\Delta T_f = K_f m$

No. of moles of glucose $= \dfrac{54\ g}{180\ g\ mol^{-1}}$

Molality of Glucose solution $= \dfrac{54\ mol}{180} \times \dfrac{1000}{250\ kg} = 1.20\ mol\ kg^{-1}$

$\Delta T_f = K_f m$

$= 1.86\ K\ kg\ mol^{-1} \times 1.20\ mol\ kg^{-1}$

$= 2.23\ K$

Temperature at which solution freezes

$= (273.15 - 2.23)\,K = 270.77\,K\,or - 2.23°\,C$

$Or\,(273.000 - 2.23)K = 2270.7\,K$

21. What are Iyophilic and Iyophobic sols? Give one example of each type. Which one of these two types of sols is easily coagulated and why? [3]

Ans. Lyophilic sols are solvent attracting sols

ex. Gum, gelatine, starch, rubber (any one)

Lyophobic sols are solvent repelling sols

ex. Metal sols, metal sulphides (any one)

Lyophobic sols are readily coagulated because they are not stable.

22. State briefly the principles which serve as basis for the following operations in metallurgy: [3]

(i) Froth floatation process

(ii) Zone refining

(iii) Refining by liquation

Ans. (i) Froth floatation process: This method is based on the difference in the wettability of the mineral particles (sulphide ores) and the gangue particles. The mineral particles become wet by oils while the gangue particles by water and hence gets separated.

(ii) Zone refining: This method is based on the principle that the impurities are more soluble in the melt than in the solid state of metal.

(iii) Refining by Liquation: The method is based on the lower melting point of the metal than the impurities and tendency of the molten metal to flow on the sloping surface.

23. Write chemical equations for the following processes: [3]

(i) Chlorine reacts with a hot concentrated solution of sodium hydroxide

(ii) Orthophosphorous acid is heated

(iii) PtF_6 **and xenon are mixed together**

OR

Complete the following chemical equations:

(i) $Ca_3P_2(s)+H_2O(l)\rightarrow ...$

(ii) $Cu^{2+}(aq)+\underset{(excess)}{NH_3(aq)}\rightarrow ...$

(iii) $F_2(g)+H_2O(l)\rightarrow ...$

Ans.

(i) $3Cl_2+6NaOH \rightarrow 5NaCl+NaClO_3+3H_2O$

(ii) $4H_3PO_3 \rightarrow 3H_3PO_4+PH_3$

(iii) $Xe^+[PtF_6]^-$

OR

(i) $Ca_3P_2(s)+ 6H_2O(l)\rightarrow 3Ca(OH)_2(aq) + 2PH_3(g)$

(ii) $Cu^{2+}(aq)+ 4NH_3(aq)\rightarrow [Cu(NH_3)_4]^{2+}(aq)$

(iii) $2F_2(g)+ 2H_2O(l) \rightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$

24. (a) What is a ligand? Give an example of a bidentate ligand.

(b) Explain as to how the two complexes of nickel, $\left[Ni(CN)_4\right]^{2-}$ **and** $Ni(CO)_4$**, have different structures but do not differ in their magnetic behaviour.** $(Ni=28)$ **[3]**

Ans. (a) Ligand: The ions or molecules bound to the central atom/ion in the coordination

entity are called ligands.

ex. of bidentate ligand- ethane-1,2-diamine or oxalate ion (or any other)

(b) * In $\left[Ni(CN)_4\right]^{2-}$, nickel is $Ni^{2+}, \left(3d^8\right)$, with strong Ligand like CN^-, all the electrons are paired up in four d-orbitals resulting into dsp^2 hybridization giving square planar structure and diamagnetic character.

In $Ni(CO)_4$:, nickel is in zero valence state, $\left(3d^8 4s^2\right)$, with strong Ligand like $CO, 4s^2$, electrons are pushed to the d-orbitals resulting into sp^3 hybridization giving tetrahedral shape and diamagnetic in nature.

(or this can be explained by drawing orbital configurations too.)

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25. Name the reagents which are used in the following conversions: [3]

(i) A primary alcohol to an aldehyde

(ii) Butan-2-one to butan-2-ol

(iii) Phenol to 2, 4, 6-tribromophenol

Ans. $(i) PCC, KMnO_4, CrO_3\ (any\ one)$

$(ii) LiAlH_4, NaBH_4\ (any\ one)$

$(iii)\ aqueous\ Br_2$

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26. Account for the following observations: [3]

(i) pK_b for aniline is more than that for methylamine.

(ii) Methylamine solution in water reacts with ferric chloride solution to give a precipitate of ferric hydroxide.

(iii) Aniline does not undergo Friedel-Crafts reaction.

Ans. (i) It is because in aniline the $-NH_2$ group is attached directly to the benzene ring. It results in the unshared electron pair on nitrogen atom to be in conjugation with the benzene ring and thus making it less available for protonation. (or any other suitable reason)

(ii) Methyl amine in water gives OH^- ions which react with $FeCl_3$ to give precipitate of ferric hydroxide/ or

$$CH_3NH_2 + H_2O \rightarrow CH_3\overset{+}{N}H_3OH^- \rightarrow CH_3NH_3^+ + OH^-$$

$$Fe^{3+} + 3OH^- \rightarrow Fe(OH)_3$$

(iii) Aniline does not undergo Friedel-Crafts reaction due to salt formation with aluminium chloride, the Lewis acid.

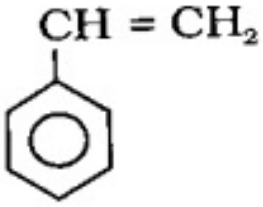
27. Write the names and structures of the monomers of the following polymers: [3]

(i) Buna-S

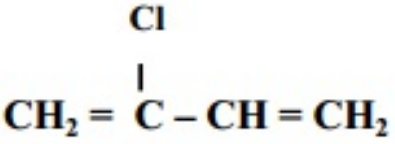
(ii) Neoprene

(iii) Nylon-6

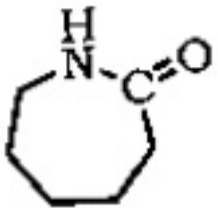
Ans. (i) Buna-S: 1,3- Butadiene and Styrene

$CH_2 = CH - CH = CH_2$ and 

(ii) Neoprene: Chloroprene



(iii) Nylon-6: Caprolactum



28. Conductivity of $0.00241\,M$ acetic acid solution is $7.896\times10^{-5}\ S\ cm^{-1}$. Calculate its molar conductivity in this solution. If Λ_m^0 for acetic acid be $390.5\ S\ cm^2\ mol^{-1}$, what would be its dissociation constant? [5]

OR

Three electrolytic cells A, B and C containing solutions of zinc sulphate, silver nitrate and copper sulphate, respectively are connected in series. A steady current of 1.5 ampere was passed through them until 1.45 g of silver were deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc were deposited in the concerned cells? $(Atomic\ masses\ of\ Ag = 108, Zn = 65.4, Cu = 63.5)$

Ans. $\Lambda_m = \dfrac{\kappa}{c}$

$$= \frac{7.896\times10^{-5}\ S\,cm^{-1}\times1000\,cm^3L^{-1}}{0.00241\,molL^{-1}}$$

$$= 32.76\,S\,cm^2\ mol^{-1}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_m^0}$$

$$= \frac{32.76\,S\,cm^2\ mol^{-1}}{390.5\,S\,cm^2\ mol^{-1}}$$

$$= 0.084\,S\,cm^2\ mol^{-1}$$

$$\kappa = \frac{C\alpha^2}{C(1-\alpha)} = C\alpha^2$$

$$= 0.00241 \times (0.084)^2$$

$$= 1.7 \times 10^{-5} \; or \; 1.865 \times 10^{-5} \; (If \; \alpha \; is \; not \; neglected.)$$

Or

$$Ag^+ + e^- \rightarrow Ag$$

108 g is deposited by 96500 C electric charge

1.45 g of silver is deposited by $\frac{96500C \times 1.45\,g}{108\,g} = 1295.6C$

Quantity of electricity passed $= Current \times t$

$$t = \frac{1295.6C}{1.5amp} = 863.7s$$

$$Cu^{2+} + 2e^- \rightarrow Cu$$

$2 \times 96500C$ deposits $63.5\,g \; of \; Cu$

$1295.6C$ deposits $\frac{63.5\,g \times 1295.6C}{2 \times 96500C} of \; Cu$

$$= 0.426\,g \; of \; Cu$$

$$Zn^{2+} + 2e^- \rightarrow Zn$$

$2 \times 96500C$ deposits $65.4\,g \; of \; Zn$

$1295.6C$ deposits $\frac{65.4\,g \times 1295.6C}{2 \times 96500C} of \; Zn$

$$= 0.44\,g \; of \; Zn.$$

29. Assign reasons for the following: [5]

(i) The enthalpies of atomisation of transition elements are high.
(ii) The transition metals and many of their compounds act as good catalyst.
(iii) From element to element the actinoid contraction is greater than the Ianthanoid contraction.
(iv) The $E^{\ominus}$ value for the Mn^{3+} / Mn^{2+} couple is much more positive than that for Cr^{3+} / Cr^{2+}.
(v) Scandium $(Z = 21)$ does not exhibit variable oxidation states and yet it is regarded as a transition element.

OR

(a) What may be the possible oxidation states of the transition metals with the following d electronic configurations in the ground state of their atoms: $3d^3 4s^2$, $3d^5 4s^2$ and $3d^6 4s^2$. Indicate relative stability of oxidation states in each case.
Write steps involved in the preparation of
(i) Na_2CrO_4 from chromite ore and
(ii) K_2MnO_4 from pyrolusite ore. [3, 2]

Ans. (i) Because of larger number of unpaired electrons in their atoms they have stronger interatomic interaction and hence stronger bonding between atoms resulting in higher enthalpies of atomisation.
(ii) Because of their ability to adopt multiple oxidation states and to form complexes.
(iii) Because of poorer shielding by $5f$ electrons than that by $4f$, actinoid contraction is greater than the lanthanoid contraction.
(iv) Much larger third inonisation energy of Mn (where the required change is d^5 *to* d^4) is mainly responsible for this.
(v) Because of the presence of incomplete $d-orbital\left(3d^1 4s^2\right)$ in its ground state.

Or

$3d^3 4s^2$ (Vanadium): Oxidation states $+2, +3, +4, +5$

Stable oxidation state: $+4$ *as* VO^{2+}, $+5$ *as* VO_4^{3-}

$3d^5 4s^2$ (Manganese): Oxidation states $+2, +3, +4, +5, +6, +7$

Stable oxidation states: $+2$ *as* Mn^{2+}, $+7$ *as* MnO_4^-

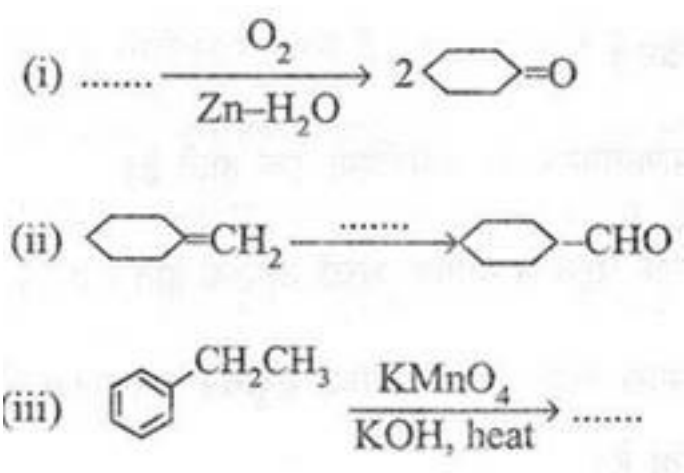
$3d^6 4s^2$ (Iron): Oxidation states $+2, +3$

Stable oxidation state: +2 in acidic medium, +3 in neutral or in alkaline medium.

(b) (i) $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

(ii) $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$

30. (a) Complete the following reaction statements by giving the missing starting material, reagent or product as required: [5]



(b) Describe the following reactions:

(i) Cannizaro reaction

(ii) Cross aldol condensation

OR

(a) How would you account for the following:

(i) Aldehydes are more reactive than ketones towards nucleophiles.

(ii) The boiling points of aldehydes and ketones are lower than of the corresponding acids.

(iii) The aldehydes and ketones undergo a number of addition reactions.

(b) Give chemical tests to distinguish between:

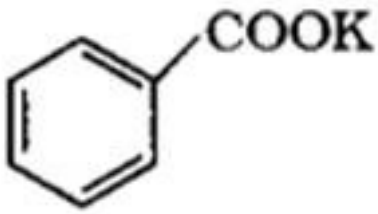
(i) Acetaldehyde and benzaldehyde

(ii) Propanone and propanol [3, 2]

Ans. (a) (i)

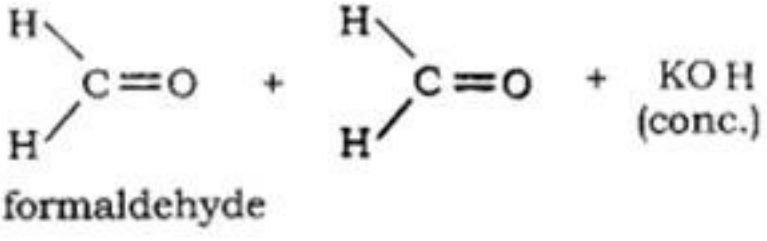
(ii) $BH_3, H_2O_2 / OH^+, PCC\ (any\ one)$

(iii)

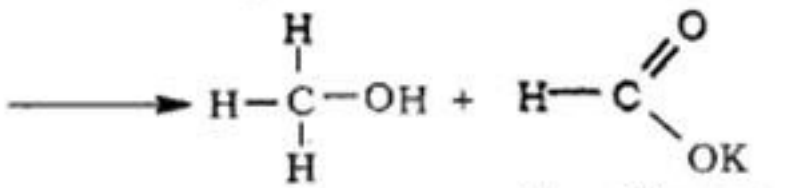


(NOTE: any two correct answers to be evaluated and 1½ marks for each to be awarded)

(b) (i) Cannizzaro reaction: Aldehydes which do not have an $\alpha - hydrogen\ atom,$ uhdergo self-oxidation and reduction reaction on treament with concentrated alkali.



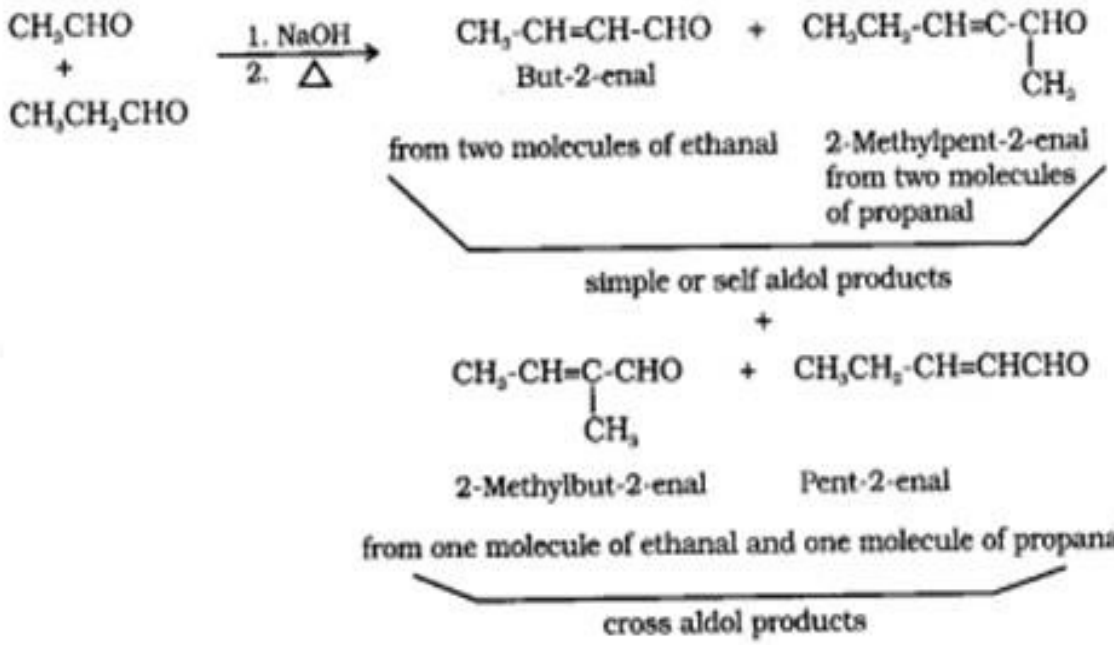
formaldehyde

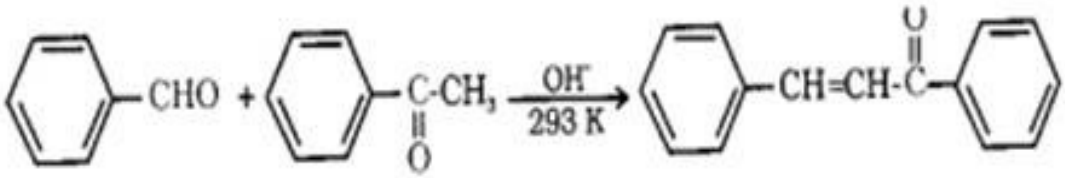


methanol sodium formate

(or any other suitable reaction)

(ii) Cross aldol condensation: When aldol condensation is carried out between two different aldehydes and /or ketones, it is called Cross aldol condensation.





(or any other suitable reaction)

OR

(i) Because two alkyl groups in ketones reduce the positive charge on carbon atom of the carbonyl group more effectivelythan in aldehydes. / or sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituents.

(ii) Beacuase of the absence of hydrogen bonding in aldehydes and ketones.

(iii) Because of the presence of the sp^2 hybridised orbitals(or π-bond) of carbonyl carbon.

(b) (i)Acetaldehyde and benzaldehyde: Acetaldehyde gives yellow ppt of Iodoform (CHI_3) on addition of $NaOH / I_2$ whereas benzaldehyde does not give this test.

(or any other suitable test)

(ii) Propanone and propanol: Propanone gives yellow ppt of Iodoform (CHI_3) on addition of $NaOH / I_2$ whereas propanol does not give this test. Or / Propanol gives brisk effervesence on adding a piece of Sodium metal whereas Propanone does not give this test.

(or any other suitable test)