Board Paper of Class 12-Science 2022 Chemistry Term-II Delhi(Set 1) - Solutions

Total Time: 120

Total Marks: 35.0

Section A

Solution 1

(a) Units of k are given as $(\text{conc})^{1-n}\ (\text{time})^{-1}$.
When n = 2, units of k are $(\text{mol L}^{-1})^{1-2}\text{s}^{-1}$ or $\text{L mol}^{-1}\text{s}^{-1}$.
Hence, the order of the reaction will be 2.
(b) A $\rightarrow$ B
Since the given reaction follows second order kinetics, its rate can be written as follows:
$R = k[A]^2$
If the concentration of A is increased 3 times, the rate becomes,
$R' = k[3A]^2$
$R' = 9k[A]^2$
Hence, the rate of the reaction becomes 9 times.
(c) The expression for integrated rate of zero order reaction is given as follows:
$$k = \frac{[R]_o - [R]}{t}$$
where, k is rate constant, t is time, $[R]_0$ is initial concentration of reactant and $[R]$ is concentration of reactant at time t.

Solution 2

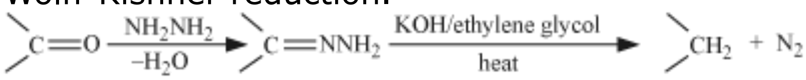
(a) Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons. Larger the alkyl group, lesser is the electrophilicity of the carbonyl carbon and lesser is the reactivity of the compound.
Butanone < Propanone < Propanal < Ethanal

(b) The presence of electron withdrawing group on the phenyl of aromatic carboxylic acid increases the acidity of carboxylic acids while electron donating groups decrease their acidity.
4-Methoxy benzoic acid < Benzoic acid < 4-Nitrobenzoic acid < 3, 4 -Dinitrobenzoic acid

Solution 3

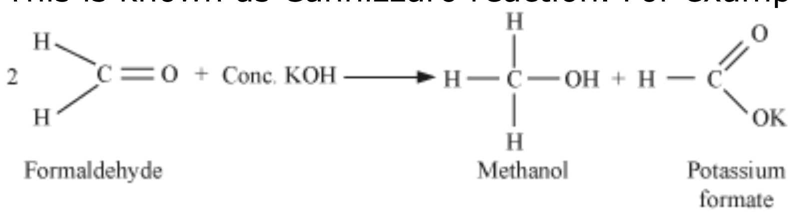
(a) **Wolf-Kishner reduction**

The reduction of aldehydes with hydrazine followed by heating with sodium or potassium hydroxide in high boiling solvent such as ethylene glycol is known as Wolff-Kishner reduction.



(b)**Cannizzaro reaction**

Aldehydes which do not have an α-hydrogen atom, undergo self oxidation and reduction (disproportionation) reaction on treatment with a concentrated alkali. This is known as Cannizzaro reaction. For example,



Section B

Solution 4

(a) For a first order reaction,

$$k = \frac{2.303}{t} \log \frac{[R]_o}{[R]}$$

$$\log \frac{[R]_o}{[R]} = \frac{kt}{2.303}$$

Therefore, the curve between $\log \frac{[R]_o}{[R]}$ and t is a straight line graph and represents a first order reaction.

(b) According to the given curve,

$$k = \frac{2.303}{t} \log \frac{[R]_o}{[R]}$$

$$\log \frac{[R]_o}{[R]} = \frac{kt}{2.303}$$

Comparing the above equation with the straight line equation, i.e., $y =$

We get,

$$\text{Slope} = \text{m} = \frac{k}{2.303}$$

(c) For a first order reaction, the half life and rate constant are related as follows:

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

Solution 5

(i) The IUPAC name of the complex $K_2[PdCl_4]$ is potassium tetrachloridopalladate(II).
(ii) Since magnitude of the crystal field splitting, $\Delta_0 > P$, the energy required for electron pairing in a single orbital, it becomes more energetically favourable for the fourth and fifth electron to occupy a t_2g orbital. Thus, the configuration of d^5 ion is $t_2g^5\ e_g^0$.
(iii) Complexes in which a metal is bound to only one kind of donor groups are known as homoleptic complexes. For , e.g., $[Co(NH_3)_6]^{3+}$.

OR

(i) Chelate complexes contain di- or polydentate ligand which uses its two or more donor atoms simultaneously to bind a single metal ion. This leads to a strong interaction between metal and the ligand. Therefore, these complexes tend to be more stable than similar complexes containing unidentate ligands.
(ii) Spectrochemical series is an experimentally determined series based on the absorption of light by complexes with different ligands. The ligands are arranged in this series in the order of increasing field strength.
Ligands for which $\Delta_o < P$ are known as weak field ligands and form high spin complexes while ligands for which $\Delta_o > P$ are known as strong field ligands and form low spin complexes.

Solution 6

(i) The process of settling of colloidal particles is called coagulation or precipitation of the sol.
(ii) According to the Hardy-Schulze rule, the greater is the valence of the flocculating ion added, the greater is its power to cause precipitation. For example, in the coagulation of a negative sol, the flocculating power is in the order: $Al^{3+} > Ba^{2+} > Na^+$.
(iii) When an electric potential is applied across two platinum electrodes dipping in a colloidal solution, the colloidal particles move towards one or the other electrode. The movement of colloidal particles under an applied electric potential is called electrophoresis. Positively charged particles move towards the cathode while negatively charged particles move towards the anode.

OR

Physisorption	Chemisorption
(i) It arises because of van der Waals forces.	(i) It arises because of chemical bond formation.
(ii) It is not specific in nature.	(ii) It is highly specific in nature.
(iii) Enthalpy of adsorption is low.	(iii) Enthalpy of adsorption is high.

Solution 7

(a) The two consequences of lanthanoid contraction are as follows:

- The second and the third *d* series exhibit similar radii.
- The second and the third *d* series have very similar physical and chemical

properties much more than that expected on the basis of usual family relationship and difficulty is faced in their separation.

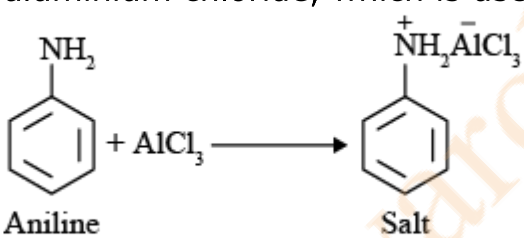
(b) Manganese is the element of 3*d* series which exhibits the largest number of oxidation states because its atom has the maximum number of unpaired electrons.

Solution 8

(a) Copper has a positive $E^{\ominus}$ which accounts for its inability to liberate H_2 from acids.
(b) Paramagnetism arises from the presence of unpaired electrons. Since transition metals and their compounds have unpaired electrons in *d* orbitals, they exhibit paramagnetic behaviour.
(c) Zn, Cd and Hg do not have the involvement of greater number of electrons from (*n*-1)*d* in addition to the *ns* electrons in the interatomic metallic bonding. Therefore, they are soft in nature.

Solution 9

(i) In aniline, the lone pair of electrons on the N atom is delocalised over the benzene ring. As a result, the electron density on the nitrogen atom decreases. In contrast, in CH_3NH_2, the +I effect of CH_3 increases the electron density on the N atom. Therefore, aniline is a weaker base than methylamine. Hence, its pK_b value is higher than that of methylamine.
(ii) Aniline does not undergo Friedel-Crafts reaction due to salt formation with aluminium chloride, which is used as a catalyst.



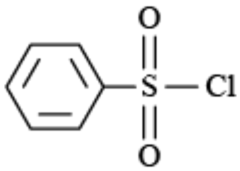
Due to this, nitrogen of aniline acquires a positive charge and hence, acts as a strong deactivating group for further reaction.
(iii) The intermolecular hydrogen bonding is present in primary amines due to the presence of two hydrogen atoms. On the other hand, tertiary amines lack the availability of hydrogen. Hence, primary amines show higher boiling point than the corresponding tertiary amines.

OR

(i) There is a subtle interplay of the inductive effect, solvation effect and steric hinderance of the alkyl group which decides the basic strength of alkyl amines in the aqueous state. The correct order of basic strength of methyl substituted amines in aqueous solution is as follows:

$$(CH_3)_3N < CH_3NH_2 < (CH_3)_2NH$$

(ii) Benzenesulphonyl chloride ($C_6H_5SO_2Cl$), is known as Hinsberg's reagent. This reagent is used to distinguish between primary, secondary and tertiary amines. The structure is as follows:

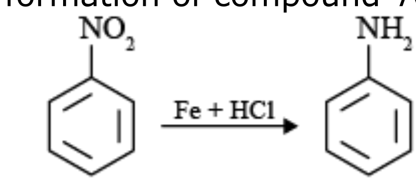


It reacts with primary and secondary amines to form sulphonamides and show no reaction with tertiary amines.

(iii) The presence of pyridine in the acylation of amine helps in removing the acidic by-product (i.e., HCl) formed during the acylation reaction and shifts the equilibrium to the right-hand side.

Solution 10

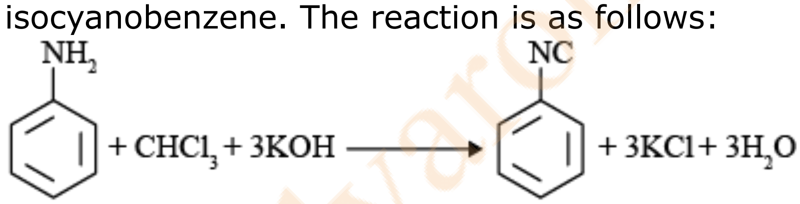
Reduction of nitro compounds with iron scrap and hydrochloric acid yields the corresponding amines. Since the compound 'B' which is formed on the reduction of the compound 'A' has the chemical formula C_6H_7N, therefore the formula of compound 'A' will $C_6H_5NO_2$. The chemical reaction involved in the formation of compound 'A' to 'B' is as follows:



Nitrobenzene Aniline

(A) (B)

Further, on reacting compound 'B' (aniline) with $CHCl_3$ and alcoholic KOH, it will produce, the corresponding isocyanide. Therefore, compound 'C' is isocyanobenzene. The reaction is as follows:



Aniline Isocyanobenzene

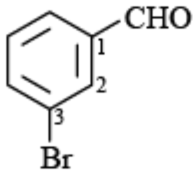
(B) (C)

Solution 11

(i)

$$CH_3CN \xrightarrow[2.\ H_2O]{1.\ AlH(i\text{-}Bu)_2} CH_3CHO \xrightarrow[H^+]{H_2N\text{-}OH} \underset{\text{Oxime}}{CH_3CH=N\text{-}OH}$$

(ii)

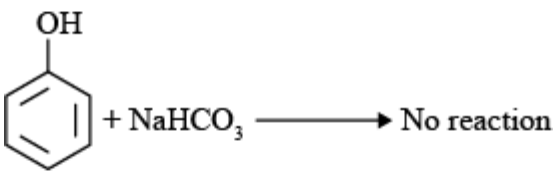


The IUPAC name of the given compound is 3-Bromobenzaldehyde.

(iii) Benzoic acid and phenol can be distinguished by sodium bicarbonate test. Benzoic acid reacts with sodium bicarbonate to form sodium benzoate and liberate carbon dioxide gas, whereas, phenol does not show any reaction with $NaHCO_3$.

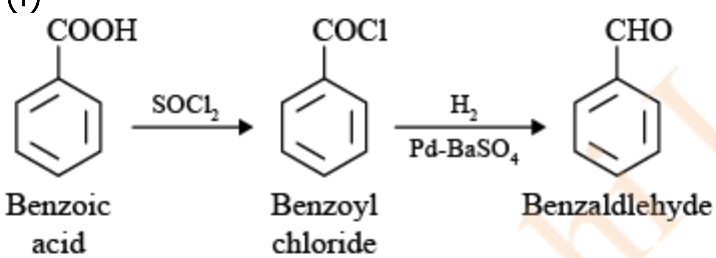
$C_6H_5COOH + NaHCO_3 \rightarrow C_6H_5COONa + CO_2 + H_2O$

(Benzoic acid) (Sodium benzoate)

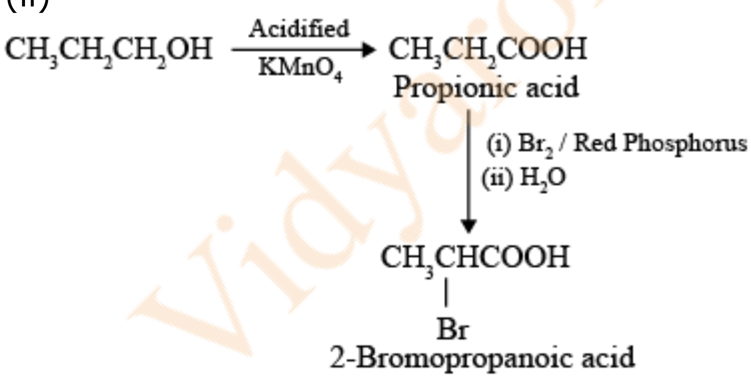


OR

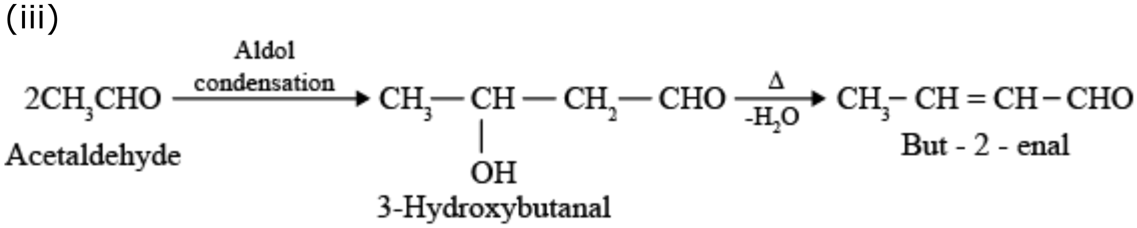
(i)



(ii)



(iii)



Section C

Solution 12

(a) Due to a higher standard reduction potential, silver will act as a cathode and in the external circuit, electrons will flow from zinc anode to the silver cathode.

(b) The removal of salt bridge will lead to a sudden drop in the potential to zero.

(c) An electrochemical cell can behave like an electrolytic cell when there is an application of an external opposite potential on the galvanic cell which is greater than the cell potential. The reaction will function in the opposite direction.

(d) (i) A state of equilibrium is attained when E_{cell} = 0. At equilibrium (discharged state, potential drop to zero), the concentration of $Zn^{2+}$and Ag^{+} will not change.
(ii) The conductivity of a solution is the conductance of ions present in a unit volume of the solution. On dilution, the number of ions per unit volume decreases. Hence, the conductivity decreases.

OR

(d) Molar conductivity is related to the conductivity of the solution by the equation:

$\Lambda_m = \frac{\kappa}{c}$

$$\Lambda_m\left(\mathrm{Scm^2\,mol^{-1}}\right) = \frac{\kappa\left(\mathrm{Scm^{-1}}\right)\times 1000\left(\mathrm{cm^3\,L^{-1}}\right)}{\mathrm{molarity}\left(\mathrm{molL^{-1}}\right)}$$

$$\kappa\left(\mathrm{Scm^{-1}}\right) = \frac{\Lambda_m\left(\mathrm{Scm^2\,mol^{-1}}\right)\times \mathrm{molarity}\left(\mathrm{molL^{-1}}\right)}{1000(\mathrm{cm^3\,L^{-1}})}$$

$$= \frac{138.9\left(\mathrm{Scm^2\,mol^{-1}}\right)\times 1.5\left(\mathrm{mol}\,L^{-1}\right)}{1000\,\mathrm{cm^3\,L^{-1}}}$$

$$= 0.208\ \mathrm{Scm^{-1}}$$

Hence, the conductivity of the given solution is 0.208 Scm^{-1}.