CBSE 2019 Chemistry Solved Paper

SECTION: A

1. Out of NaCl and AgCl, which one shows Frenkel defect and why?

Solution

AgCl shows Frenkel defect due to large difference in size between the positive (Ag^+) and negative (Cl^-) ion.

2. Arrange the following in increasing order of boiling points:

$(CH_3)_3N, C_2H_5OH, C_2H_2NH_2$

Solution

The increasing order of boiling point is $C_2H_5OH > C_2H_5NH_2 > (CH_3)_3N$. N–H···N hydrogen bond is weaker than an O–H···O hydrogen bond, because the difference in electronegativity between nitrogen and hydrogen (3.0–2.1 = 0.9) is less than that between oxygen and hydrogen (3.5–2.1 = 1.4).

3. Why are medicines more effective in colloidal state?

Solution

Medicines are more effective in colloidal solutions because the drug particles being larger in size is more effective and easily assimilated in the body.

Or

3. What is difference between an emulsion and a gel?

Solution

Emulsion	Gel

Emulsions are the colloidal sols in which both the dispersed phase and dispersion medium is a liquid.	Gels is that kind of colloid in which the dispersed phase is a liquid and the dispersion medium is a solid.

4. Define ambient nucleophile with an example.

Solution

Ambidentate nucleophile have more than one binding site but bind to the central atom through any one site at a time. For example, NO_2^- (nitro-N), where bonding occurs through N and ONO^- (nitro-O) where bonding occurs through O.

5. What is the basic structural difference between glucose and fructose?

Solution

Glucose contains aldehydic functional group while fructose contains ketonic functional group.

Or

5. Write the products obtained after hydrolysis of lactose.

Solution

$$\text{Lactose} + \text{Water} \xrightarrow{H^+ \text{ or Lactase}} \text{Galactose} + \text{Glucose}$$

SECTION: B

6. Write balanced chemical equations for the following processes:

(a) XeF_2 undergoes hydrolysis.

(b) MnO_2 is heated with conc. HCl.

Solution

(a) XeF_2 is soluble in water but undergoes slow hydrolysis.

$$2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$$

(b) $MnO_2(s) + conc.4HCl \rightarrow Cl_2(g) + MnCl_2(aq) + 2H_2O(l)$

Or

6. Arrange the following in order of property indicated for each set:

(a) H_2O, H_2S, H_2Se, H_2Te – increasing acidic character

(b) HF, HCl, HBr, HI – decreasing bond enthalpy

Solution

(a) The order of increasing acidic strength is $H_2O < H_2S < H_2Se < H_2Te$.

(b) The decreasing order of bond enthalpy is HF > HCl > HBr > HI.

7. State Raoult's law for a solution containing volatile components. Write two characteristics of the solution which obeys Raoult's law at all concentrations.

Solution

Raoult's law states that for a solution containing a non-volatile solute, the vapor pressure of the solution is directly proportional to mole fraction of the solvent.

$$p_{solution} = K_H x_{solution}$$

Consider a binary solution of two components A and B (both liquids). Let p total be the total vapor pressure of the solution due to both the components and let p_A and p_B be the partial pressures of component A and B, respectively. Then,

$$p_A = x_A p_A^o$$

$$p_B = x_B p_B^o$$

The total vapor pressure of the solution of liquids A and B is then, by Dalton's law of partial pressures, the sum of p_A and p_B.

$$p_{Total} = p_A + p_B$$

Substituting for p_A and p_B, we get

$$p_{Total} = x_A p_A^o + x_B p_B^o$$

The characteristics of the solution which obeys Raoult's law at all concentrations are as follows:

(i) In a binary solution of components, A and B, the enthalpy of mixing ΔH_{mix} is zero, that is, in preparation of an ideal solution no thermal change is observed.

(ii) In an ideal solution, the volume of mixing (ΔV_{mix}) is also zero, that is, the final volume of the solution is equal to the sum of volumes of components being mixed.

8. For a reaction

$$2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$$

the proposed mechanism is as given below:

(I) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)

(II) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

(a) Write rate law for the reaction.

(b) Write the overall order of reaction.

(c) Out of steps (I) and (II), which one is rate determining step?

Solution

The reactions given are as follows:

$$2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$$

$$H_2O_2 + I^- \rightarrow H_2O + IO^- \text{ (slow)} \qquad \text{(I)}$$

$$H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2 \qquad \text{(fast)} \qquad \text{(II)}$$

(a) To find the rate expression, we consider rate determining step, which is step (I) for this reaction. Then according to the rate law,

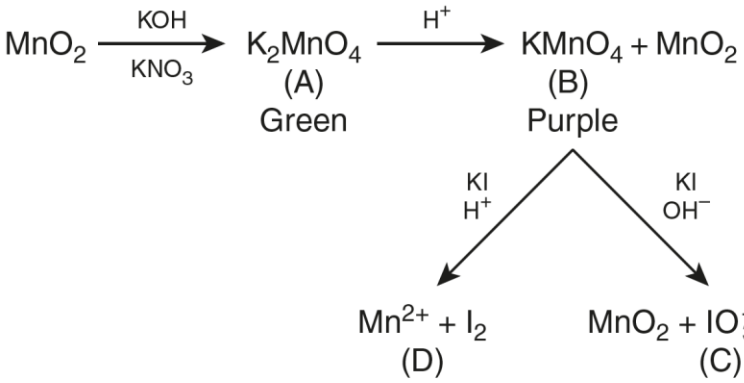
$$\text{Rate} = k[H_2O_2][I^-]$$

(b) Since, two reagents are involved in the rate-limiting step, thus overall rate of reaction is proportional to the concentration of those reagents, that is, 2.

(c) The slowest step in this reaction is called the rate-determining step, that is step (I).

9. When MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A). Compound (A) disproportionates in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidizes KI to compound (C) whereas an acidified solution of compound (B) oxidizes KI to (D). Identify (A), (B), (C) and (D).

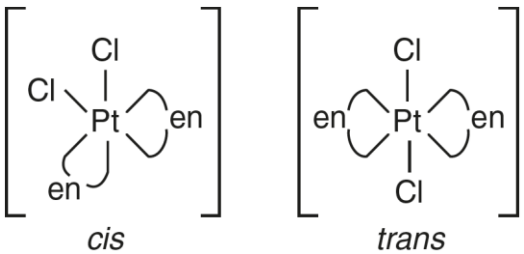
Solution



10. Write IUPAC name of the complex $[Pt(en)_2Cl_2]$. Draw structures of geometrical isomers for this complex.

Solution

The IUPAC name of $[Pt(en)_2Cl_2]$ is dichlorobis(ethylenediamine)platinum(II).



Or

10. Using IUPAC norms write the formulae for the following:

(a) Hexaamminecobalt (III) sulphate

(b) Potassium trioxalatochromate (III)

Solution

(a) $[Co(NH_3)_6]_2(SO_4)_3$

(b) $K_3[Cr(ox)_3]$

11. Out of $[CoF_6]^{3-}$ and $[Co(en)_3]^{3+}$, which one complex is

(a) paramagnetic

(b) more stable

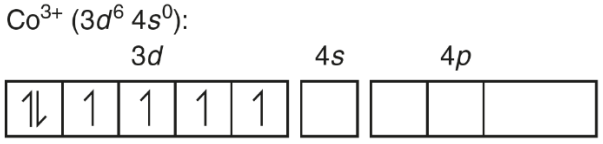
(c) inner orbital complex and

(d) high spin complex

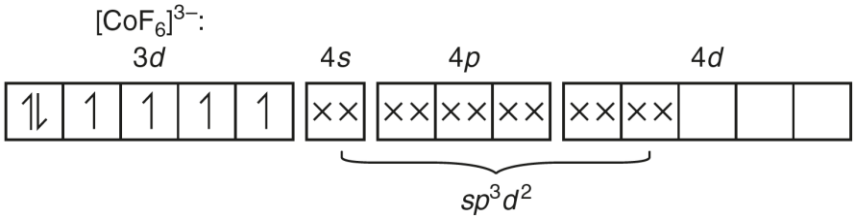
(Atomic no. of Co = 27)

Solution

The electronic configuration of Co^{3+} is $3d^6\,4s^0$. The unpaired electrons can be calculated as



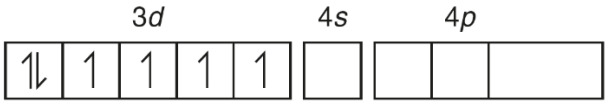
F^- is a weak field ligand, therefore, pairing of electrons will not take place.



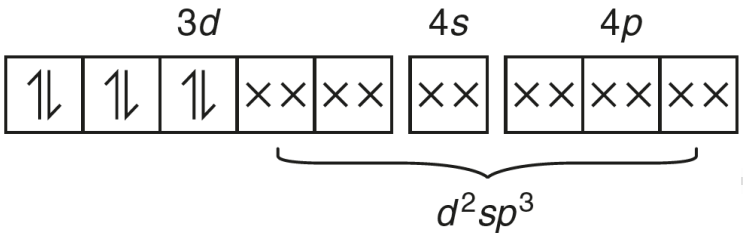
Therefore, the complex has four unpaired electrons.

The electronic configuration of Co^{3+} is $3d^6\,4s^0$. The unpaired electrons can be calculated as

Co^{3+} ($3d^6\,4s^0$):



en is a strong field ligand, therefore, pairing of electrons will take place.



Therefore, the complex does not have any unpaired electrons.

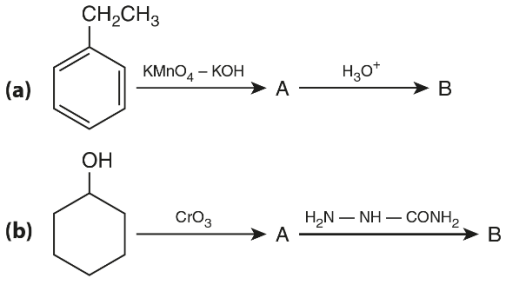
(a) $[CoF_6]^{3-}$ is paramagnetic as it contains four unpaired electrons.

(b) $[Co(en)_3]^{3+}$ is more stable than $[CoF_6]^{3-}$.

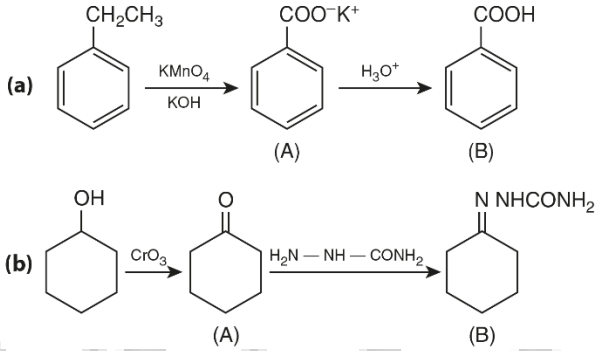
(c) $[Co(en)_3]^{3+}$ forms an inner orbital complex.

(d) $[CoF_6]^{3-}$ forms high spin complex.

12. Write structures compounds A and B in each of the following reactions:



Solution



SECTION: C

13. The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is $4\times10^{-3}\,Ms^{-1}$, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M.

Solution

Given that the decomposition of NH_3 is a zero-order reaction. Integrated form of the zero-order rate law is

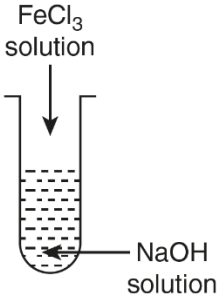
$$t = \frac{[A]_0 - [A]}{k} \qquad (1)$$

Substituting $[A]_0 = 0.1$ M, $[A] = 0.064$ M and $k = 4 \times 10^{-3}\ Ms^{-1}$ in Eq. (1), we get

$$t = \frac{0.1 - 0.064}{4\times10^{-3}}$$
$$= 9\,s$$

14. (a) What is the role of activated charcoal in gas mask?

(b) A colloidal sol is prepared by the given method in figure. What is the charge on hydrated ferric oxide colloidal particles formed in the test tube? How is the sol represented?



(c) How does chemisorption vary with temperature?

Solution

(a) Activated carbon or activated charcoal is an extremely porous carbon that has a very large surface area available for adsorption or chemical reactions. It is the most widely used adsorbent for preparing gas masks to selectively adsorb toxic gases.

(b) The coagulation will take place when $FeCl_3$ is added to NaOH solution. The $Fe(OH)_3$ gets coagulated by the oppositely charged particle Cl^-.

(c) Adsorption is always accompanied by evolution of heat, so according to Le Chatelier's principle, the magnitude of adsorption should increase with a decrease in temperature. In chemisorption since it requires some activation energy, the magnitude of adsorption increases initially and then decreases with an increase in temperature.

15. An element crystallizes in fcc lattice with a cell of 300 pm. The density of the element is 10.8 g cm^{-3}. Calculate the number of atoms in 108 g of the element.

Solution

We know $$\rho = \frac{Z \times M}{N_A \times a^3}$$

$$10.8 = \frac{4 \times 108}{N \times (300 \times 10^{-8})^3}$$

$$N = \frac{4 \times 108}{10.8 \times (300 \times 10^{-8})^3} = 1.48 \times 10^{18}$$

16. A 4% solution (*w*/*w*) of sucrose (M = 342 g mol^{-1}) in water has a freezing of 271.15 K. Calculate the freezing point of 5% glucose (M = 108 g mol^{-1}) in water.
(Given: Freezing point of pure water = 273.15 K)

Solution

We know $\Delta T_f = K_f m$ or $\Delta T_f = \frac{K_f \times w_B \times 1000}{M_B \times w_A}$ (1)

where w_B gram is the amount of solute of molar mass M_B dissolved in mass w_A grams of the solvent of molar mass M_A.

$$\Delta T_f = 273.15 - 271.15 = 2\,\text{K}$$

$$2 = \frac{K_f \times 1000 \times 4}{342 \times 100} \Rightarrow K_f = 17.1\,\text{K}$$

$$\Delta T_f = \frac{17.1 \times 5 \times 1000}{180 \times 100} = 4.75\,\text{K}$$

$$T_f = 273.15 - 4.75\,\text{K}$$
$$= 268.4\,\text{K}$$

17. (a) Name the method of refining which is
(i) used to obtain semiconductor of high purity,
(ii) used to obtain low boiling metal.

(b) Write chemical reactions taking place in the extraction of copper from Cu_2S.

Solution

(a) (i) Zone refining is the method which is used to obtain the semiconductors like Si, Ge and Ga in high purity.

(ii) This method is applicable for metals, such as Sn, Pb and Bi, which have low melting points as compared to their impurities.

(b)

$$Cu_2S + \tfrac{3}{2}O_2 \rightarrow Cu_2O + SO_2 \uparrow$$
$$Cu_2S + 2Cu_2O \rightarrow 6Cu(l) + SO_2 \uparrow$$

18. Give reasons for the following:

(a) Transition elements and their compounds act as catalysts.

(b) E° value for $(Mn^{2+}|Mn)$ is negative whereas for $(Cu^{2+}|Cu)$ is positive.

(c) Actinoids show irregularities in their electronic configuration.

Solution

(a) The catalytic properties of transition metals are attributed to their ability to exist in multiple oxidation states and form complexes. Variable oxidation states make them more efficient catalysts.

(b) The electronic configuration of Mn^{2+} is d^5 which is more stable because of half-filled *d*-subshell. While Cu^{2+} with electronic configuration d^9 becomes stable after accepting two electrons with configuration $d^{10}s^1$ due to fully-filled *d*-orbital.

(c) The elements Th (At. no. 90) to Lr (At. no. 103) are together known as actinoids. For the first four actinoids Th, Pa, U and Np, the difference between the energy levels of 5*f* and 6*d* orbitals is small. Thus, in these elements (or ions) electrons may occupy either 5*d* or 6*f* orbitals.

19. Write the structures or monomers used for getting the following polymers:

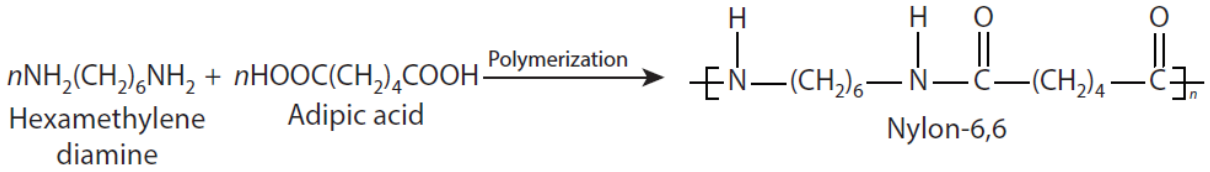
(a) Nylon – 6,6

(b) Glyptal

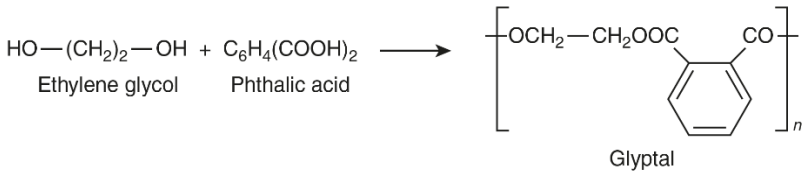
(c) Buna-S

Solution

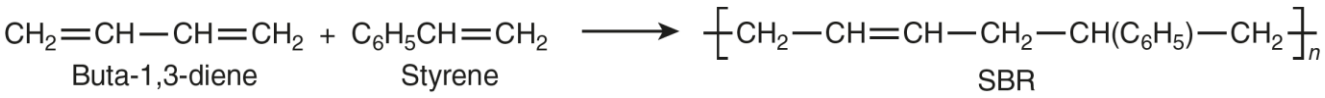
(a) Hexamethylene diamine and adipic acid are the monomers of Nylon-6,6.



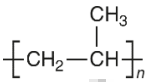
(b) Ethylene glycol and phthalic acid are the monomers of glyptal.



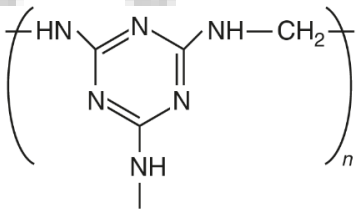
(c) Buta-1,3-diene and styrene are the monomers of Buna-S.



Or

19. (a) Is  a homopolymer or copolymer? Give reason.

(b) Write the monomers of the following polymer:

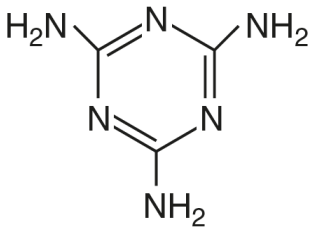


(c) What is the role of sulphur in vulcanization of rubber?

Solution

(a) It is homopolymer. Polymers formed from the same type of monomers are called homopolymers.

(b) The monomers of the given polymer are



and (CH2O) Formaldehyde

(c) The process of heating and mixing crude rubber with sulphur to a definite temperature for a specific time is known as vulcanization.

20. (a) What type of drug is used in sleeping pills?

(b) What type of detergents are used in toothpastes?

(c) Why the use of alitame as artificial sweetener is not recommended?

Solution

(a) Tranquilizers are used to treat mild mental diseases and form an essential component of sleeping pills. Their use creates a sense of tranquility and well-being.

(b) Anionic detergents are used in toothpastes.

(c) Alitame is not recommended as artificial sweetener because of its high potency sweetener.

Or

20. Define the following terms with a suitable example in each:

(a) Broad-spectrum antibiotics

(b) Disinfectants

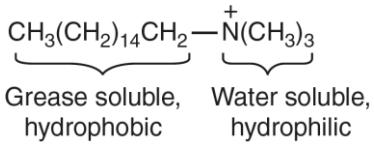
(c) Cationic detergents

Solution

(a) A broad-spectrum antibiotic is one which can be used to treat a wide range of infections caused by both Gram positive and Gram-negative bacteria. For example, ampicillin and amoxycillin.

(b) Disinfectants are used on non-living substances, such as instruments, floors, etc. These are harmful to human tissues and cannot be applied directly to the wounds. For example, chlorine (0.2–0.4 ppm in aqueous solution), sodium hypochlorite and very low concentration of sulphur dioxide is disinfectants.

(c) Cationic detergents have a long hydrocarbon chain and a positive charge. They are quaternary ammonium salts with a positive charge on the N atom and acetates, chlorides or bromides as anions. A representative structure is as follows:



21. (a) Out of $(CH_3)_3C$ – Br and $(CH_3)_3C$ – I, which one is more reactive towards S_N1 and why?

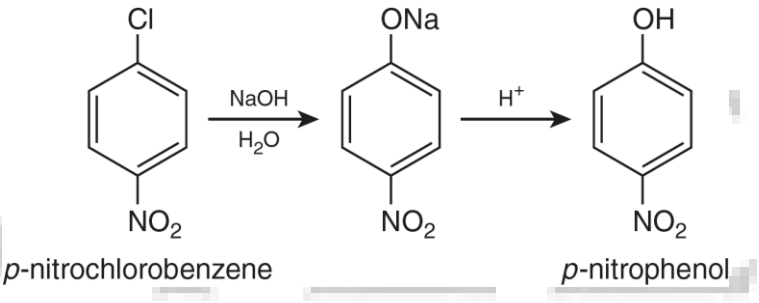
(b) Write the product formed when *p*-nitrochlorobenzene is heated with aqueous NaOH at 443 K followed by acidification.

(c) Why *dextro* and *laevo* – rotatory isomers of butan-2-ol are difficult to separate by fractional distillation?

Solution

(a) $(CH_3)_3C$–I is more reactive towards S_N1 than $(CH_3)_3C$–Br as I^- is a better leaving group than Br^-.

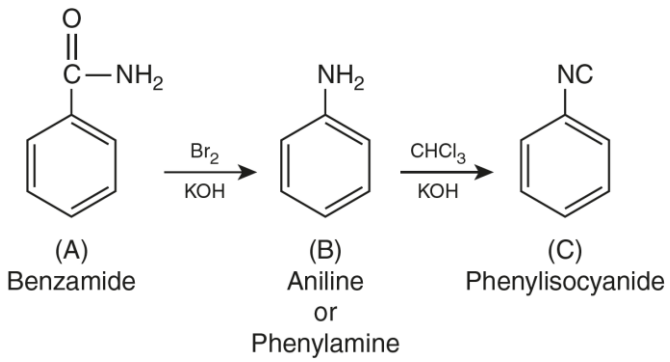
(b)



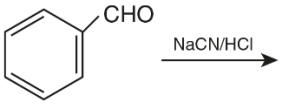
(c) *Dextro* and *laevo*-rotatory isomers of butan-2-ol are difficult to separate by fractional crystallization due to their identical boiling points.

22. An aromatic compound 'A' on heating with Br_2 and KOH forms a compound 'B' of molecular formula C_6H_7N which on reacting with $CHCl_3$ and alcoholic KOH products a foul-smelling compound 'C'. Write the structures and IUPAC names of compounds A, B and C.

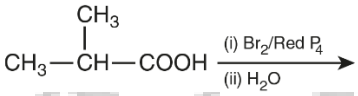
Solution



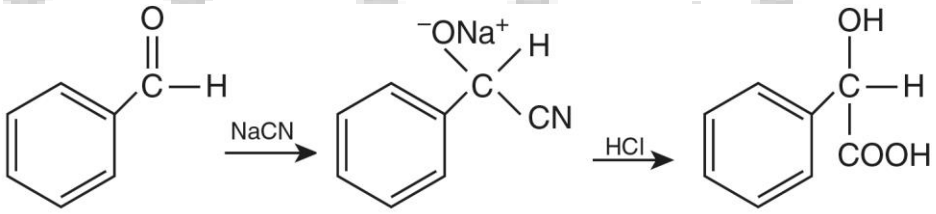
23. Complete the following reactions:

(a) 

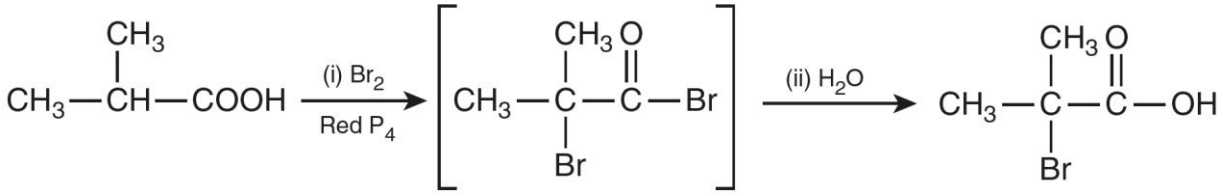
(b) $(C_6H_5CH_2)_2Cd + 2CH_3COCl \longrightarrow$

(c) 

Solution

(a) 

(b) $(C_6H_5CH_2)_2Cd + 2CH_3COCl \longrightarrow 2C_6H_5CH_2COCH_3 + CdCl_2$

(c) 

Or

23. Write chemical equations for the following reactions:

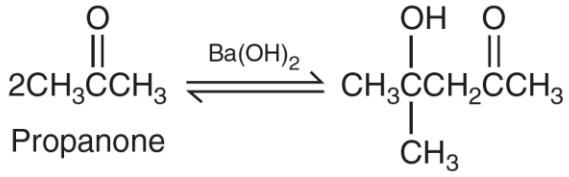
(a) Propanone is treated with dilute $Ba(OH)_2$.

(b) Acetophenone is treated with Zn(Hg)/conc. HCl.

(c) Benzoyl chloride is hydrogenated in presence of $Pd/BaSO_4$.

Solution

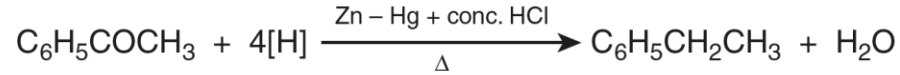
(a)



Propanone

(Aldol condensation)

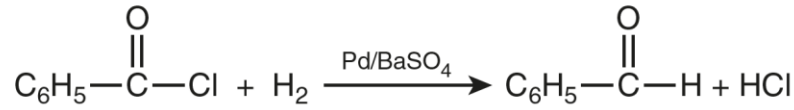
(b)



Acetophenone — Ethylbenzene

(Clemmenson reduction)

(c)



Benzoyl chloride — Benzaldehyde

(Rosenmund reduction)

24. Difference between the following:

(a) Amylose and Amylopectin

(b) Peptide linkage and Glycosidic linkage

(c) Fibrous proteins and Globular proteins

Solution

(a) Amylose typically consists of 200–1000 D-glucopyranoside units connected in α-linkages between C1 of one unit and C4 of the next. Water-insoluble amylopectin has a structure similar to that of amylose [i.e., $\alpha(1\rightarrow4)$ links] with the exception that in amylopectin the chains are branched.

(b) The bond connecting the amino acids in a protein is commonly called a peptide linkage or peptide bond. The peptide linkage is an amide bond formed between –COOH group and $–NH_2$ group.

Polysaccharides, also known as glycans, consist of monosaccharides joined together by glycosidic linkages.

(c) Fibrous proteins exist as long fibers or strings stabilized by hydrogen and disulphide bonds. They run parallel to each other. These proteins, including myosin (in muscles), collagen (in skin) and keratin (in hair), are usually tough and water insoluble.

Globular proteins are spherical in shape, highly folded and tend to be water soluble. The common examples are albumins and insulin.

Or

24. Write chemical reactions to show that open structure of D-glucose contains the following:

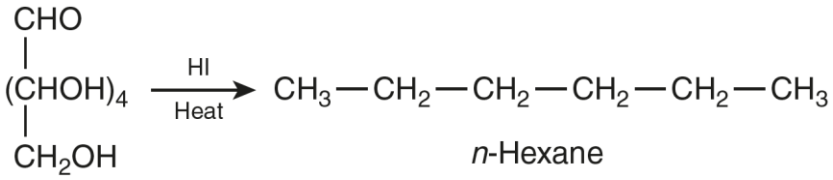
(a) Straight chain

(b) Five alcohol groups

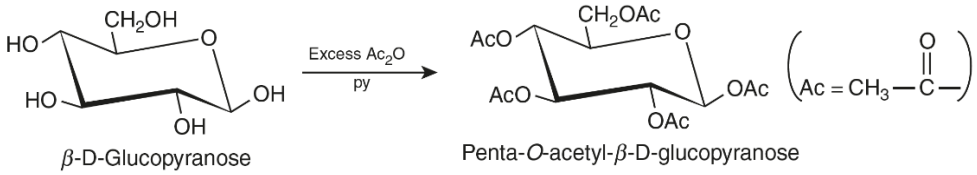
(c) Aldehyde as carbonyl group

Solution

(a) Glucose reacts with HI to form *n*-hexane indicating that the six carbons are linked in a straight chain.

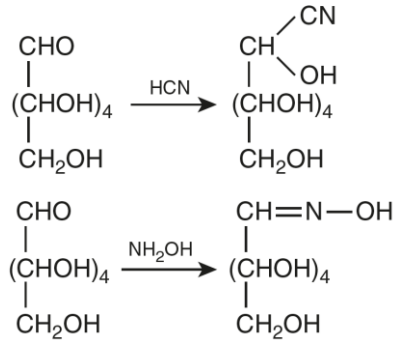


(b) Glucose reacts with acetic anhydride to form glucose pentaacetate on acetylation. This reaction confirms that five –OH groups are present in glucose and that too on different carbon atoms, otherwise the resulting pentaacetate would be highly unstable.



(c) It reacts with hydrogen cyanide to form cyanohydrin and with hydroxylamine to form an oxime.

The reactions clearly indicate the presence of a carbonyl group $\diagup C{=}O \diagdown$ in glucose.



SECTION: D

25. E^{o}_{cell} for the given redox reaction is 2.71 V

$$Mg(s) + Cu^{2+}(0.01M) \rightarrow Mg^{2+}(0.001M) + Cu(s)$$

Calculate E_{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is

(a) less than 2.71 V and

(b) greater than 2.71 V

Solution

According to Nernst equation

$$E_{cell} = E^{o}_{cell} - \frac{2.303RT}{nF}\log\frac{C_2}{C_1} \qquad (1)$$

Substituting the values $E^{o}_{cell} = 2.71\text{V}$, $n = 2$, $F = 96500$ C, $C_2 = 0.001$ M, $C_1 = 0.01$ M in Eq. (1), we get

$$E_{cell} = 2.71 - \frac{2.303 \times 8.314 \times 298}{2 \times 96500}\log\frac{0.001}{0.01}$$
$$= 2.74\,\text{V}$$

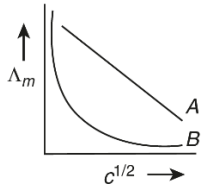
(a) When an external opposite potential is applied less than 2.71 V the direction of flow of current would remain same.

(b) When an external opposite potential is applied more than 2.71 V the direction of flow of current would be reversed.

Or

25. (a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow? Calculate the mass of Zn deposited at the cathode of cell Y.
(Molar mass: Fe = 56 g mol^{-1} Zn = 65.3 g mol^{-1}, 1 F = 96500 C mol^{-1})

(b) In the plot of molar conductivity (Λ_m) vs square root of concentration $(c^{1/2})$, following curves are obtained for two electrolytes A and B:



Answer the following:

(i) Predict the nature of electrolytes A and B.

(ii) What happens on extrapolation of (Λ_m) to concentration approaching zero for electrolytes A and B?

Solution

(a) According to Faraday's first law

$$2.8 = \frac{(56) \times 2 \times t}{2 \times 96500} = 4825\,\text{s} = 80\ \text{min},\ 41\,\text{s}$$

$$\text{Wt. of Zn deposited} = \frac{65.3}{2 \times 96500} \times 2 \times 4825 = 3.265\,\text{g}$$

(b) (i) A represents the strong electrolyte whereas B represents the weak electrolyte.

(ii) It can be found from the graph that for a strong electrolyte A, as the concentration approaches the zero value, the molar conductance approaches a limiting value called molar conductance at infinite dilution.

The curve for a weak electrolyte B is a rectangular hyperbola and does not intercept the *y*-axis. Even though the concept of molar conductance at infinite dilution exists for a weak electrolyte, graphically the value cannot be evaluated.

26. (a) How do you convert the following:

(i) Phenol to Anisole

(ii) Ethanol to Propan-2-ol

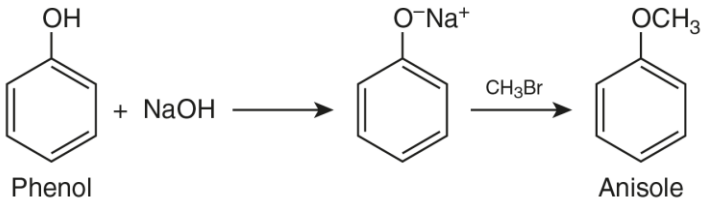
(b) Write mechanism of the following reaction:

$$C_2H_5OH \xrightarrow[443\ K]{H_2SO_4} CH_2 = CH_2 + H_2O$$

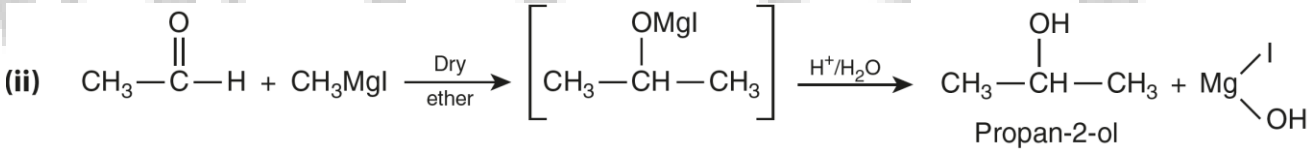
(c) Why phenol undergoes electrophilic substitution more easily than benzene?

Solution

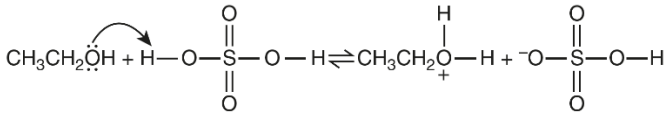
(a) (i)



(ii)



(b) The mechanism for the given reaction $C_2H_5OH \xrightarrow[443\ K]{H_2SO_4} CH_2 = CH_2 + H_2O$ is as follows:



(c) Phenol undergoes electrophilic substitution reaction easily because hydroxyl is a powerful activating group which activates the benzene ring towards electrophilic substitution reaction.

Or

26. (a) Account for the following:

(i) *o*-nitrophenol is more steam volatile than *p*-nitrophenol.

(ii) *t*-butyl chloride on heating with sodium methoxide gives 2-methypropene instead of *t*-butylmethylether.

(b) Write the reaction involved in the following:

(i) Reimer – Tiemann reaction

(ii) Friedal-Crafts alkylation of phenol

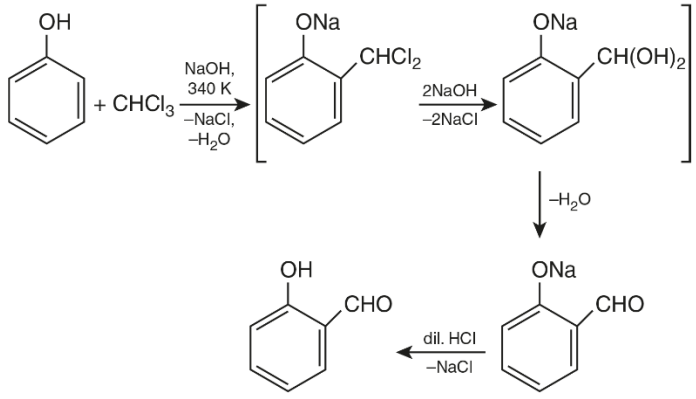
(c) Give simple chemical test to distinguish between ethanol and phenol.

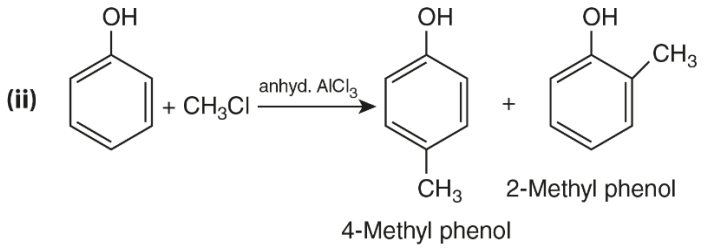
Solution

(a) (i) *o*-Nitrophenol is the more volatile isomer because its hydrogen bonding is intramolecular. *p*-Nitrophenol is less volatile because intermolecular hydrogen bonding causes association among its among its molecules. Thus, *o*-nitrophenol passes over with the steam, and *p*-nitrophenol remains in the distillation flask.

(ii) *t*-Butyl chloride on heating with sodium methoxide gives 2-methylpropene instead of *t*-butylmethylether because E1 favored over S_N1. E1 reactions are favored with substrates that can form stable carbocations (i.e., tertiary halides); they are also favored by the use of poor nucleophiles (weak bases) and they are generally favored by the use of polar solvents.

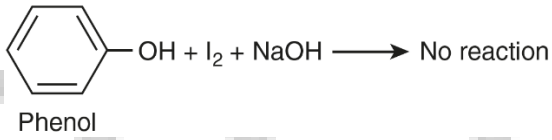
(b) (i)





(c) Ethanol and phenol can be distinguished by iodoform test.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + 4I_2 + 6NaOH \rightarrow \underset{\substack{\text{Iodoform}\\(\text{Yellow})}}{CHI_3}\downarrow + HCOONa + 5NaI + 5H_2O$$



27. (a) Give reasons for the following:

(i) Sulphur in vapor state shows paramagnetic behavior.

(ii) N–N bond is weaker than P-P bond.

(iii) Ozone is thermodynamically less stable than oxygen.

(b) Write the name of gas released when Cu is added to

(i) dilute HNO_3 and

(ii) conc. HNO_3

Solution

(a) (i) In vapor state sulphur partly exists as S_2 molecule, which like O_2 has two unpaired electrons in the antibonding π^* orbitals and hence exhibits paramagnetism.

(ii) The single N–N bond is weaker than P–P bond because of high interelectronic repulsion of the non-bonding electrons, owing to the small bond length.

(iii) O_3 is thermodynamically unstable and decomposes to O_2. The decomposition is exothermic.

(b) (i) $3Cu + 8HNO_3 \xrightarrow{\text{Cold dilute}} 2NO + Cu(NO_3)_2 + 4H_2O$

(ii) $Cu + 3HNO_3 \xrightarrow{\text{Strong acid}} NO_2 + Cu(NO_3)_2 + H_2O$

Or

27. (a) **(i)** Write the disproportionation reaction of H_3PO_3

(ii) Draw the structure of XeF_4.

(b) Account for the following:

(i) Although fluorine has the less negative electron gain enthalpy yet F_2 is strong oxidizing agent.

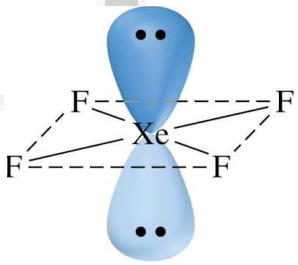
(ii) Acidic character decreases from N_2O_3 to Bi_2O_3 in Group 15.

(c) Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.

Solution

(a) (i) $4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$

(ii) The structure of XeF_4 is



(b) (i) Fluorine is the strongest oxidizing agent. There are two main reasons for this:

- F_2 has a low enthalpy of dissociation (arising from the weakness of the F—F bond).
- F_2 has a high free energy of hydration (arising from the smaller size of the F^- ion).

(ii) Group 15 elements show two important trends (a) the stability of the higher oxidation state decreases with increasing atomic number and (b) in a given oxidation state, the metallic character of the element and hence the basicity of its oxide increases with increasing atomic number. Thus, the oxides

E_2O_3 of nitrogen and phosphorus are acidic, those of arsenic and antimony are amphoteric and those of bismuth is strictly basic.

(c) SO_2 turns a filter paper moistened with acidified potassium dichromate solution

green, due to the formation of Cr^{3+} and acts as a reducing agent.

$$K_2Cr_2O_7 + 3SO_2 + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + K_2SO_4 + H_2O$$