CBSE-XII-2017 EXAMINATION

CHEMISTRY

SET-1

Series GBM

Paper & Solution

Code: 56/1

Time: 3 Hrs.

Max. Marks: 70

General Instructions:

(i) All questions are compulsory.
(ii) Questions number **1 to 5** are very short answer questions and carry **1** mark each.
(iii) Questions **6** to **10** are short answer questions and carry **2** marks each.
(iv) Question number **11 to 22** are also short-answer questions and carry **3** marks each.
(v) Question number **23** is a value based questions and carry **4** marks.
(vi) Question number **24 to 26** are long-answer questions and carry **5** marks each.
(vii) Use Log Tables, if necessary. Use of calculators is **not** allowed.

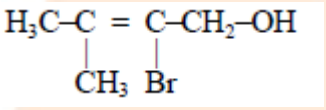
1. Write the formula of the compound of phosphorus which is obtained when conc. HNO_3 oxidizes P_4.

Solution:

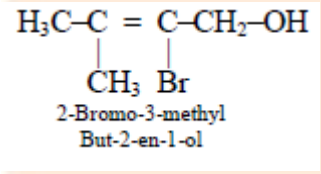
H_3PO_4 (phosphoric acid)

$P4 + 20HNO3 \longrightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$

2. Write the IUPAC name of the following compound:



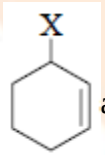
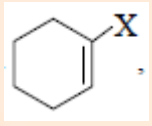
Solution:



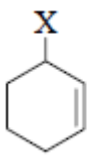
2-Bromo-3-methyl
But-2-en-1-ol

3. What is the effect of adding a catalyst on
(a) Activation energy (Ea), and
(b) Gibbs energy (ΔG) of a reaction?

Solution: (a) Catalyst provides a new reaction pathway in which a lower activation is offered. Hence catalyst increased rate of reaction by lowering the activation energy.
(b) Gibbs free energy will remain same as for catalyzed & unanalyzed reaction, the equilibrium constant is not affected which is a function of Gibbs free energy.

4. Out of the  and  which is an example of allylic halide?

Solution:



allylic halides.

5. What type of colloid is formed when a liquid is dispersed in a solid? Give an example.

Solution:

"The colloid formed when a liquid is dispersed in a solid is gel for example: - Cheese, butter etc"

6. (a) Arrange the following compounds in the increasing order of their acid strength :

P-cresol, p-nitrophenol, phenol

(b) Write the mechanism (using curved arrow notation) of the following reaction:

$$CH_2 = CH_2 \xrightarrow{H_3O^+} CH_3 - CH_2^+ + H_2O$$

OR

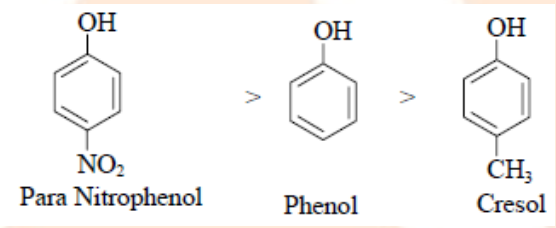
Write the structures of the products when Butan-2-ol reacts with the following:

(a) CrO_3

(b) $SOCl_2$

Solution:

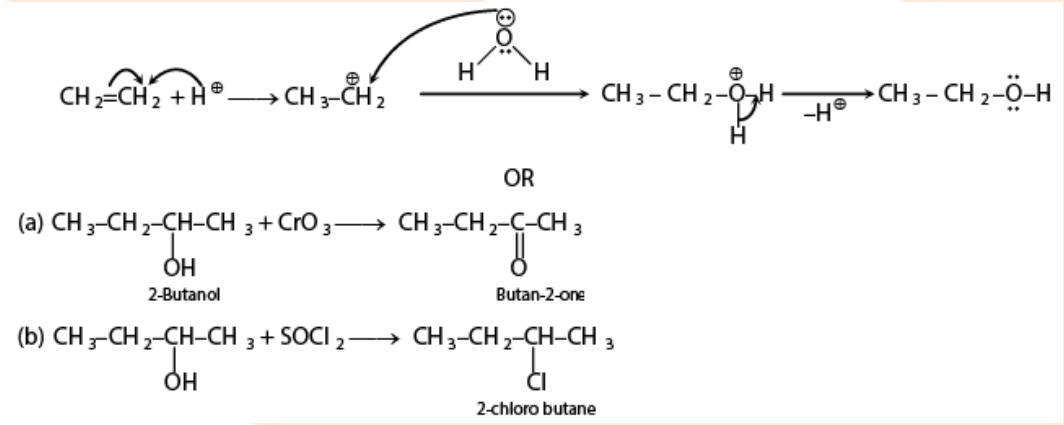
(a) The order of increasing acid strength is



Reason: -

Since the –NO2 group is (–M) group so it withdraw the e– density from benzene. A stabilized the conjugate Base of para nitrophenol so "higher the stability of conjugate base more will be the reactivity of corresponding acids" while in case of cresol +H effect of Methyl group destabilised conjugate base.

(b) Mechanism: -



7. Calculate the number of unit cells in 8.1 g of aluminum if it crystallizes in a face-centered cubic (f.c.c.) structure. (Atomic mass of Al = 27 g mol^{-1})

Solution: Moles of aluminum = $\frac{\text{Mass}}{\text{Molecular mass}}$

$$n_{Al} \Rightarrow \frac{8.1}{2.7} = 0.3 \text{ moles}$$

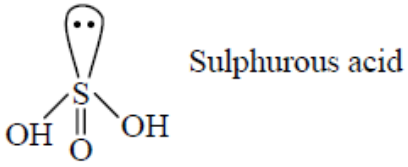
We know that one unit of f.c.c., No. of atoms = 4

4 - atoms are found in unit cell = 1
1 - atoms are found in unit cell = 1/4
(1 mole) N_A atoms are found in unit cell = $N_A/4$

0.3 moles atoms are found in unit cell $= \frac{N_A}{4} \times 0.3$

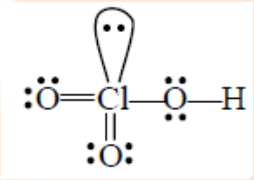
$\Rightarrow .075 \times N_A$

8. Draw the structures of the following:
(a) H_2SO_3
(b) $HClO_3$
Solution:
Structure of the following compound: -
(a) H_2SO_3:



Sulphurous acid

(b) $HClO_3$



9. Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell.
Solution:
The Mercury cell are used in the hearing aids which consist of zinc-mercury amalgam as anode and a paste of Hgo and carbon at the cathode.
Reaction occur at the 2-electrode: -
anode: $Zn(Hg) + 2OH^{\ominus} \longrightarrow ZnO(g) + H_2O + 2e^{\ominus}$
cathode: $HgO + H_2O + 2e^{\ominus} \longrightarrow Hg(l) + 2OH^{\ominus}$

10. Using IUPAC norms write the formulae for the following:
(a) Sodium dicyanidoaurate (I)
(b) Tetra ammine chloridonitrito-N-platinum (IV) sulphate
Solution:
(a) Sodium dicyanidoaurate (I)
Na $[Au(CN)_2]$
(b) Tetraammine chloridonitrito-N-platinum (IV) sulphate
$[Pt\ (NH_3)_4Cl(NO_2)](SO_4)_2$

11. (a) Based on the nature of intermolecular forces, classify the following solids: Silicon carbide, Argon

(b) ZnO turns yellow on heating. Why?
(c) What is meant by groups 12-16 compounds? Give an example.
Solution:
(a) On the basis of intermolecular forces: -
(i) Silicon carbide: - Covalent or network solid (Covalent Bonding)
(ii) Argon: - Non-polar molecular solid which possess dispersion or London forces.
(b) Zinc oxide is white in color at room temperature. On heating it loses oxygen & turns yellow

$$ZnO \xrightarrow{\Delta} Zn^{+2} + 1/2O_2 + 2e^{\Theta}$$

the excess Zn^{+2} ions move to interstitial sites and the electron to neighboring interstitial sites.
(c) Some of the compound like Zns, CdSe and HgTe are example of group 12 – 16 compound.
In these compound bonds are having same ionic character along with covalent.

12. (a) The cell in which the following reaction occurs :

$$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$$

has $E°_{cell}$ = 0.236 V at 298 K. Calculate the standard Gibbs energy of the cell reaction.
(Given: 1F = 96,500 C mol^{-1})
(b) How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 hours?
(Given 1 F = 96,500 C mol^{-1})
Solution:
(a) The two half-cell reaction for the cell are: -

$$2Fe^{+3}(aq) + 2e^{\Theta} \longrightarrow 2Fe^{+2} \quad \text{(reduction)}$$

$$2I^{\Theta} \longrightarrow I_2 + 2e^{\Theta} \quad \text{(Oxidation)}$$

So the no of e^{Θ} transfer during reaction = 2
So,

$$\Delta_r G° = -nF \;\; E°_{cell}$$
$$= -(2\ \text{mol}) \times (96500\ \text{mol}^{-1}) \times (.236\,V)$$
$$= -45548\,CV$$

or

$$\Delta_r G° = -45548\text{J} \;\text{ or }\; -45.55\text{KJ}$$

(b) Charge (Q) passed $\Rightarrow$ Current (I) × Time (t) $\Rightarrow$ (0.5A) × (2 × 60 × 60 s)
$\Rightarrow$ (3600) Ampere Sec. $\Rightarrow$ 3600 C
No of electrons flowing through the wire on passing charge of one faraday (96500C) = 6.023×10^{23} So the no. of electrons flowing through the wire on passing a charge of 3600C

$$\Rightarrow \frac{6.022 \times 10^{23} \times (3600\text{C})}{(96500\text{C})} \Rightarrow 2.246 \times 10^{22} \text{ “no. of electron”}$$

13. (a) What type of isomerism is shown by the complex $[Co(NH_3)_5(SCN)]^{2+}$?
(b) Why is $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic?
(Atomic number of Ni = 28)
(c) Whey are low spin tetrahedral complexes rarely observed?
Solution:

(a) The complex $[Co(NH_3)_5 (SCN)]^{2+}$ exhibit the linkage isomerism.
(b) In both $[NiCl_4]^{2-}$ & $[Ni(CN)_4]^{2-}$ the nickel is in +2 o.s. and having configuration 3d8 and it contain 2 unpaired e^{Θ} but CN is a strong ligand compare to Cl so it repel the e^{Θ} density of metal ion because of which e^{Θ} get paired in case of $[Ni(CN)_4]^{-2}$ hence it is diamagnetic in nature.
(c) "The low spin complex rarely observed in tetrahedral as energy gap between the two energy level eg: - eg & t_2g in tetrahedral complex are very low. Because of which electron always go to higher states avoiding pairing".

14. Write one difference in each of the following:
(a) Multimolecular colloid and associated colloid
(b) Coagulation and Peptization
(c) Homogeneous catalysis and Heterogeneous catalysis.

OR

(a) Write the dispersed phase and dispersion medium of milk.
(b) Write one similarity between physisorption and chemisorption.
(c) Write the chemical method by which Fe $(OH)_3$ sol is prepared from $FeCl_3$.

Solution:

(a) "Multimolecular collidal solution consist of aggregates of atoms or small molecules with diameter of less than 1 nm eg: - gold sol etc"
Macromolecular collides are those in which dispersed particles are themselves large molecules of colloidal dimensions eg: - cellulose etc.
(b) "Coagulation is the change in the state from colloidal to suspended of colloidal particles"
"Conversion of precipitate into colloidal sol by shaking it with dispersion medium in presence of an electrolyte.
(c) "Homogenous catalysis are reaction in which reactant and catalyst are in same phase"
"Netrogenous catalysis are reaction in which reactant and catalyst are in different phase".

OR

(a) Both the dispersed phase & dispersion medium of milk are liquid. "It is an example of emulsion".
(b) Both the physisoption & chemisorption are the surface phenomena occur at the surface of adsorbent.
(c) Chemical method for preparation of Fe $(OH)_3$ **Solution:** -
Reaction involved: -

$$FeCl_3 + 3H_2O \xrightarrow{\text{Hydrolysis}} \underset{\text{(Sol)}}{Fe(OH)_3} + 3HCl$$

"In this method the hydrolysis of Ferric chloride occur by which molecule then aggregate and lead to the formation ferric hydroxide colloidal sol"

15. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the reaction will be completed.
(Given: log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021)

Solution:

It is given: - (for 1st order reaction)
t = 20 min
A_O = 100%

A = 100 – 25 $\Rightarrow$ 75%

k =?

$$K = \frac{1}{t} \times 2.303 \log A_O/A$$

$$\Rightarrow K = \frac{1}{20} \times 2.303 \log \frac{100}{75}$$

$$K = \frac{1}{20} \times 2.303 \times \log (1.33)$$

$$\Rightarrow \frac{1}{20} \times 2.303 \times 0.1248 \Rightarrow k = .0143 \ \ \text{min}^{-1}$$

So for 75% completion of reaction: -

$$t = \frac{1}{k} 2.303 \times \log \frac{A_O}{A}$$

$$\Rightarrow \frac{1}{0.0143} \times 2.303 \times \log \frac{100}{25} \Rightarrow \frac{1}{0.0143} \times 2.303 \times 0.6021 \Rightarrow 96.96 \text{min}.$$

16. The following compounds are given to you:

2-Bromopentane, 2-Bromo-2-methylbutane, 1-Bromopentane

(a) Write the compound which is most reactive towards S_N2 reaction.

(b) Write the compound which is optically active.

(c) Write the compound which is most reactive towards β-elimination reaction.

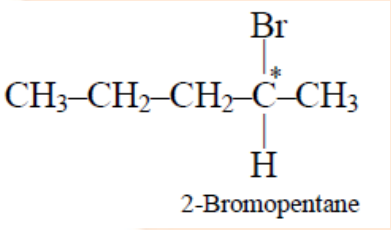
Solution:

(a) The compound most reactive towards S_N2 reaction: -

$CH_3–CH_2–CH_2–CH_2–CH_2–Br$

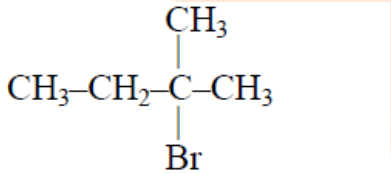
1-Bromopentane

(b) The compound which is optically active: -



2-Bromopentane

(c) The compound which is most reactive towards β-elimination reaction is



2-Bromo-2-methyl butane

17. Write the principle of the following:

(a) Zone refining

(b) Froth floatation process

(c) Chromatography

Solution:

(a) Zone refining: -

It is used to obtain metal of high purity. It is based on the principal that the impurities are more soluble in molten state than in the solid state.

(b) Froth floatation process: -

It is used to concentrate sulphide ore. It is based on the fact that the mineral. Particles become wet by oil while a gangue particles by water. A rotating paddle agitates the mixture and draws air in it. As a result froth is formed which carries the mineral particles.

(c) Chromatography: -

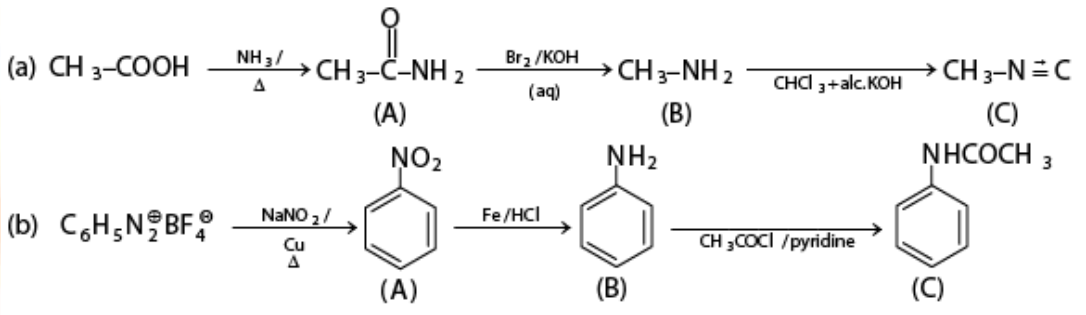
It is based on the principle that different component of a mixture are differently adsorbed on an adsorbent. The adsorbed component are removed by using suitable solvents.

18. Write the structures of compounds A, B and C in the following reactions:

(a) $CH_3-COOH \xrightarrow{NH_3/\Delta} A \xrightarrow{Br_2/KOH\,(aq)} B \xrightarrow{CHCl_3+alc.KOH} C$

(b) $C_6H_5N_2^+BF_4^- \xrightarrow[\Delta]{NaNO_2/Cu} A \xrightarrow{Fe/HCl} B \xrightarrow{CH_3COCl+pyridine} C$

Solution:



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

(a) Nylon-6, 6

(b) Melamine-formaldehyde polymer

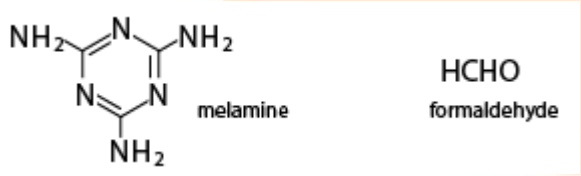
(c) Buna-S

Solution:

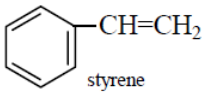
(a) Nylon-6, 6

$\underset{\text{hexamethylene dia mine}}{NH_2-(CH_2)_6-NH_2}$ $\underset{\text{adapic acid}}{COOH-(CH_2)_4-COOH}$

(b) Melamine-formaldehyde polymer



(c) Buna-S

$\underset{\text{1,3–butadiene}}{CH_2=CH-CH=CH_2}$ 

20. Define the following:

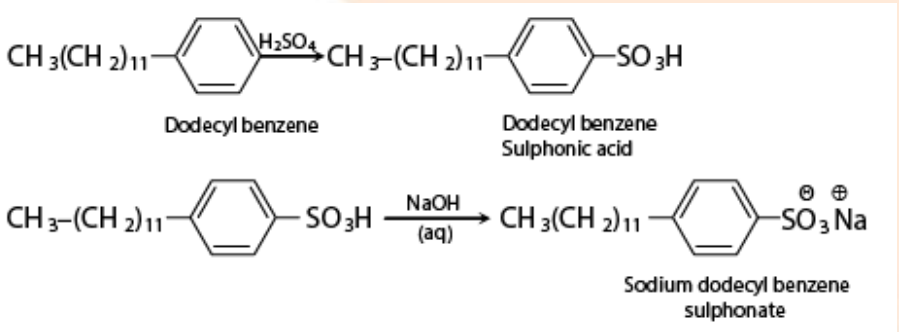
(a) Anionic detergents
(b) Limited spectrum antibiotics
(c) Antiseptics

Solution:

(a) Anionic detergents

These are sodium salt of sulphonated long chain alcohols or hydrocarbon eg: - Sodium dodecyl benzene Sulphonate.

Eg:



(b) Limited spectrum antibiotics

The antibiotics which kill or inhibit a short range of gram-positive or gram negative bacteria are known as narrow spectrum antibiotics" but if they are effective against a single organism or disease, they are referred as" limited spectrum antibiotics".

(c) Antiseptics

"The chemical that kill microorganism and are not harmful to living Tissues. eg: - Dettol, Tincture of iodine etc."

21. Give reasons for the following:

(a) Red phosphorus is less reactive than white phosphorus.

(b) Electron gain enthalpies of halogens are largely negative.

(c) N_2O_5 is more acidic than N_2O_3.

Solution:

(a) Red phosphorus are less reactive than white phosphorus as the white phosphorous posses angle strain in the P_4 molecule where the angle are only 60 & also they have low M.P."

(b) Electron gain enthalpy of halogen are largely negativity it is due to the fact that they have high effective nuclear charge & smallest size among period. Although they contain 7 $e^{\ominus}$ in valence shell & required one electron to attain their nearest noble gas configuration.

(c) N_2O_5 is more acidic then N_2O_3 as in N_2O_5 the N is in +5 O.S. while in N_2O_3 it is in +3 O.S.

So higher the oxidation state of central atom in a given oxide, higher will be acidic character"

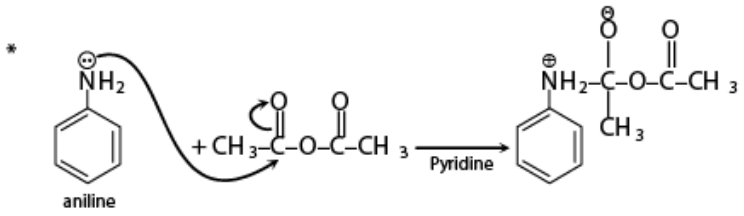
22. Give reasons for the following:

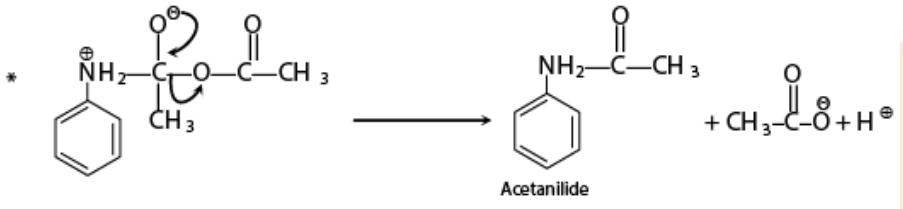
(a) Acetylation of aniline reduces its activation effect.

(b) CH_3NH_2 is more basic than $C_6H_5NH_2$.

(c) Although –NH2 is o/p directing group, yet aniline on nitration gives a significant amount of m-nitro aniline.

Solution: (a)

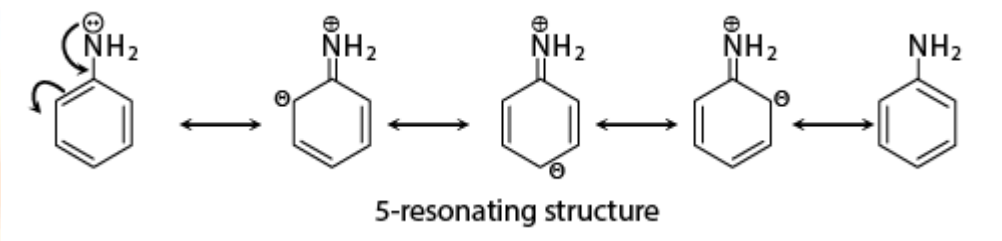




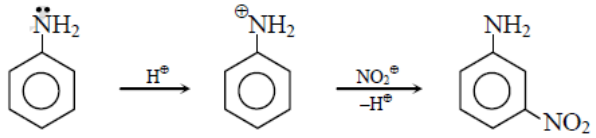
Reason: -

"Reactivity of aromatic amine is very high so when acetylation aniline occur with acid anhydride it get convert into acetanilide in which L.P on Nitrogen are in conjugate with oxygen atom due to resonance hence the reactivity reduce"

(b) $CH_3–NH_2$ is more basic then $C_6H_5–NH_2$ Because In case of aniline the L.P of –NH2 (amino group) are in conjugation with benzene ring due to which e– density less available on N-atom hence higher the "electron density on N-atom more will be the basicity."



(c) "$–NH_2$ group of aniline is ortho-para directing group but on nitration it also give meta product as the aromatic amine (aniline) is highly reactive and it react with acidic hydrogen of nitrating agent and form anilinium ion which gives meta product".



23. After watching a programmer on TV about the presence of carcinogens (cancer causing agents) Potassium bromate and Potassium iodate in bread and other bakery products, Rupali a Class XII student decided to make others aware about the adverse effects of these carcinogens in foods. She consulted the school principal and requested him to instruct the canteen contractor to stop selling sandwiches, pizzas, burgers and other bakery products to the students. The principal took an immediate action and instructed the canteen contractor to replace the bakery products with some protein and vitamin rich food like fruits, salads, sprouts, etc. The decision was welcomed by the parents and the students.

After reading the above passage, answer the following questions:

(a) What are the values (at least two) displayed by Rupali?

(b) Which polysaccharide component of carbohydrates is commonly present in bread?

(c) Write the two types of secondary structures of proteins.

(d) Give two examples of water soluble vitamins.

Solution:

(a) The value displaced by rupali are-
(i) Awareness regarding about the adverse effect of these carcinogens in foods.
(ii) She is concern for the health and has feeling of humanity.
(b) The polysaccharide component of carbohydrates is commonly by present in bread is starch.
(c) "The two types of secondary structure of proteins are α-helix β-Sheet"
(d) "Vitamins B & C are water soluble vitamin"

24. (a) Account for the following :
(i) Transition metals show variable oxidation states.
(ii) Zn, Cd and Hg are soft metals.
(iii) E^o value for the Mn^{3+}/Mn^{2+} couple is highly positive (+1.57 V) as compared to Cr^{3+}/Cr^{2+}.
(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.

OR

(a) Following are the transition metal ions of 3d series:
Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+}
(Atomic numbers: Ti = 22, V = 23, Mn = 25, Cr = 24)
Answer the following:
(i) Which ion is most stable in an aqueous solution and why?
(ii) Which ion is a strong oxidising agent and why?
(iii) Which ion is colourless and why?
(b) Complete the following equations:
(i) $2MnO_4^- + 16H^+ + 5S^{2-} \longrightarrow$
(ii) $KMnO_4 \xrightarrow{heat}$

Solution: (a)
(i) In case of transition element ns and (n – 1)d electron both participate in bonding due to less energy difference when ns electron take part in bonding they exhibit lower oxidation state while in case of higher O.S. (n – 1)d and ns e^{Θ} both involve in bonding.
(ii) Transition element are hard & have high M.P & B.P. as they exhibit two types of bonding both covalent and metallic due to which constituent particles are tightly packed while group 12 element (Zn, Cd, Hg) do not exhibit covalency bonding as their (n – 1) d is fully filled so they are soft.
(iii) E^o value for the Mn^{+3}/Mn^{+2} is high due to the fact that Mn^{+2} (d^5) more stable due to half-filled configuration while low for chromium due to stability of Cr^{+3}, therefore Cr^{+3} cannot reduce to Cr^{+2}.
(b) Similarity: -
* "Both series element exhibit mainly +3 oxidation state"
* Both show magnetic and spectral properties.
Difference: -

Lanthanoids	**Actinoids**
* Less tendency of complex formation	High tendency of complex formation
* Do not form oxo cations	Form oxo cations eg: - UO_2^{+2} etc.

OR

(a)

(i) Stability of ions in aq state depends on the electrode potential because the stability of ion in aq solution depend on electrode potential due to small size Cr^{+3} is more stable.
(ii) Mn^{+3} is the strong oxidising agent as the Mn^{+2} is more stable then Mn^{+3} due to its half-filled configuration
(iii) Ti+4 is colourless ion it due to d0 configuration of the ion as if do not contain electron for the excitation.
(b) Complete the following reactions :

(i) $2MnO_4^- + 16H^+ + 5S^{-2} \longrightarrow 2Mn^{+2} + 8H_2O + 5s$

(ii) $2KMnO_4 \xrightarrow{\text{heat}} K_2MnO_4 + MnO_2 + O_2 \uparrow$

25. (a) A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K.
Given:
(Molar mass of sucrose = 342 g mol^{-1})
(Molar mass of glucose = 180 g mol^{-1})
(b) Define the following terms:
(i) Molality (m)
(ii) Abnormal molar mass

OR

(a) 30 g of urea (M = 60 g mol^{-1}) is dissolved in 846 g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23.8 mm Hg.
(b) Write two differences between ideal solutions and non-ideal solutions.

Solution:

(a) It is given that
Mass of sucrose (w) = 10g
Mass of water = 90g
Molecular weight of sucrose = 342 g/mol
Molecular weight of water = 18 g/mol
So $\Delta t_f = k_f\, m$

$\Delta t_f = t_{(\text{solvent})} - t_{(\text{solution})}$

$\Delta tf = 273.15 - 269.15 = 4$

So m = $\frac{10}{90} \times \frac{1000}{342} \Rightarrow \frac{1000}{3070} \Rightarrow .325$

So $\Delta t_f = k_f m \Rightarrow k_f = \frac{4}{.325} \Rightarrow 12.30$

So for glucose: -

$\Delta t_f = k_f \times m \Rightarrow 12.3 \times \frac{10 \times 1000}{180 \times 90} \Rightarrow 7.7$

$\Delta t_f = t_{(\text{solvent})} - t_{(\text{solution})}$

So $t_{(\text{solution})} \Rightarrow 273.15 - 7.7 \Rightarrow 265.45k$

(b) (i) Molality (m): -
It is defined as the number of moles of solute per kilogram of the solvent.

(ii) Abnormal molar mass: -
When the substance undergo association or dissociation in the solution, molecular mass determine from colligative property is different from expected value. This is abnormal molecular mass.

OR

(a)

Urea (w) = 30 g H_2O(w) = 846 g

Urea (M.w) = 60 g/mol. H_2O(M.w.) = 18 g/mol.

So $\frac{P^\circ - P_s}{P^\circ} = x_2$

$$\frac{23.8 - P_s}{23.8} = \frac{W_{(\text{urea})} \times M.w._{(H_2O)}}{M.w._{(\text{urea})} \times W_{(H_2O)}}$$

$$\frac{23.8 - P_s}{23.8} = \frac{30}{60} \times \frac{18}{846}$$

$23.8 - P_s \Rightarrow .0106 \times 23.8$

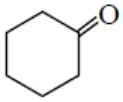
$23.8 - P_s \Rightarrow .2531$

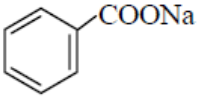
So $P_s \Rightarrow 23.8 - .2530$

$\Rightarrow 23.54$ mm of Hg

(b) **Ideal solution**	**Non-ideal solution**
(i) Obey rault's law at every range of concentration	They do not obey rault's law
(ii) Neither the heat is absorbed or evolve during dissolution	Heat is evolve or absorbed during dissolution.

26. (a) Write the product(s) in the following reactions :

(i)  + HCN ⟶ ?

(ii)  + NaOH $\xrightarrow[\Delta]{CaO}$?

(iii) $CH_3–CH=CH–CN \xrightarrow[(b)\,H_2O]{(a)\,DIBAL-H}$?

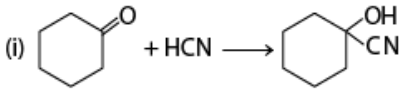
(b) Give simple chemical tests to distinguish between the following pairs of compounds:
(i) Butanal and Butan-2-one
(ii) Benzoic acid and Phenol

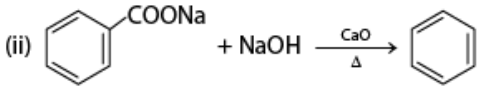
OR

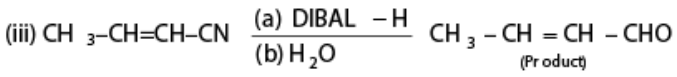
(a) Write the reactions involved in the following:
(i) Etard reaction
(ii) Stephen reduction
(b) How will you convert the following in not more than two steps:
(i) Benzoic acid to Benzaldehyde
(ii) Acetophenone to Benzoic acid

(iii) Ethanoic acid to 2-Hydroxyethanoic acid

Solution: (a) Product of following reactions:



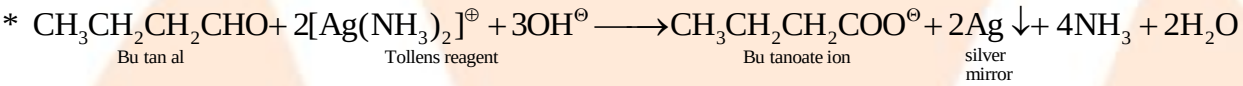




(b) Test to distinguish following compound are -

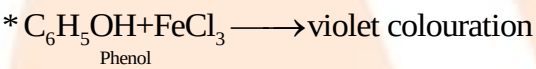
(i) Butanal and Butan-2-one

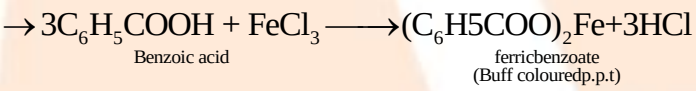
These compound can be distinguish by Tollen's reagent: -



(ii) Benzoic acid and phenol: -

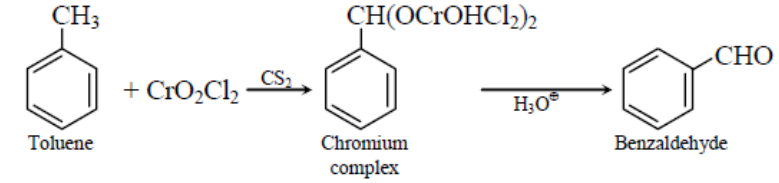
Both can distinguished by $FeCl_3$ test



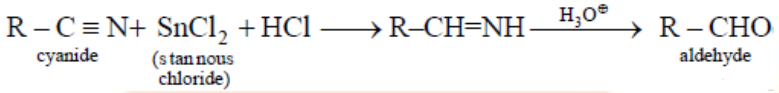


(a) Reactions involve: -

(i) Etard reaction

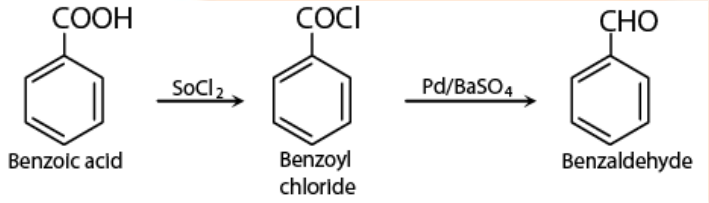


(ii) Stephen reduction: -

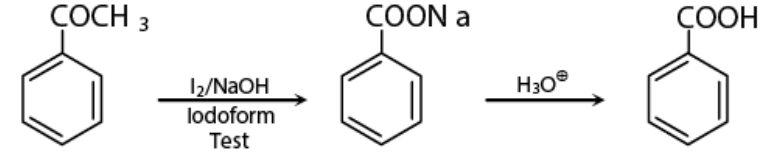


(b) Conversion: -

(i) Benzoic acid to Benz aldehyde



(ii) Acetophenone to Benzoic acid



(iii) Ethanoic acid to 2-Hydroxyethanoic acid