Solved Question Paper
2017
Class – XII
Subject – Chemistry
All India

Time allowed: 3 hours **Maximum 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 number 6 to 10 are short answer questions and carry 2 marks each.

(iv) Questions number 11 to 22 are also short answer questions and carry 3 marks each.

(v) Question number 23 is a value based question and carries 4 marks.

(vi) Questions 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.

Question 1:

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

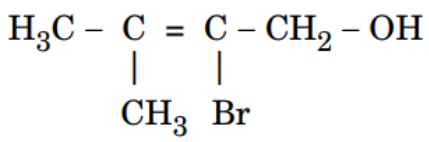
Solution 1:

$P_4 + 20HNO_3 \rightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$

H_3PO_4 will be obtained.

Question 2:

Write the IUPAC name of the following compound



Solution 2:

2-Bromo-3-methylbut-2-en-1-ol

Question 3:

What is the effect of adding a catalyst on

(a) Activation energy (E_a), and

(b) Gibbs energy (ΔG) of a reaction?

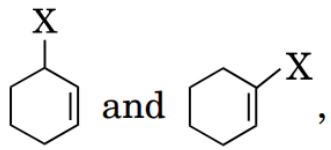
Solution 3:

(*a*) Activation energy decreases as catalyst provide a new reaction path in which a lower activation is offered.

(*b*) There will be no effect of Gibbs free energy, as for catalyzed & uncatalyzed reaction, the equilibrium constant is not affected and equilibrium constant is a function of Gibbs free energy.

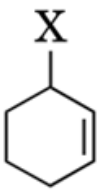
Question 4:

Out of



which is an example of allylic halide ?

Solution 4:



Question 5:

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

Solution 5:

Gel.

Example: Cheese.

Question 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:

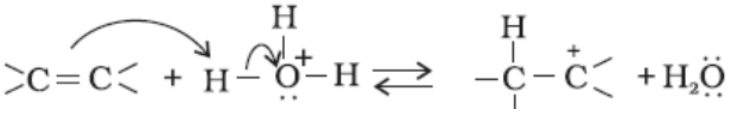
(a) CrO_3

(b) $SOCl_2$

Solution 6:

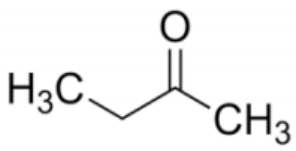
(*a*) p-cresol < Phenol < p-nitrophenol

(*b*)

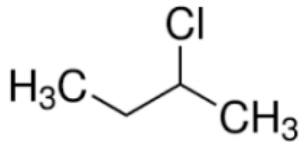


OR

(*a*)



(*b*)



Question 7:

Calculate the number of unit cells in 8·1 g of aluminium if it crystallizes 1–in a face-centred cubic (f.c.c.) structure. (Atomic mass of Al = 27 g mol^{-1})

Solution 7:

Number of moles of Aluminium = n = (given mass)/(molar mass) = 8.1/27 mole

$$\text{Number of atoms of Aluminium} = \frac{8.1}{27}\times 6.022\times 10^{23}$$

Number of atoms in present in one unit cell (fcc) = 4

1 Atom is present in ¼ unit cell

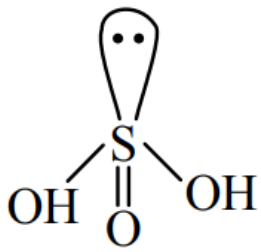
$$\text{Number of unit cells} = \frac{\frac{8.1}{27}\times 6.022\times 10^{23}}{4} = 4.5\times 10^{22}$$

Question 8:

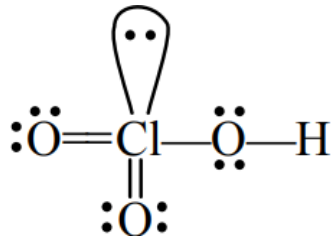
Draw the structures of the following : (a) H_2SO_3 (b) $HClO_3$

Solution 8:

(*a*) H_2SO_3



(*b*) $HClO_3$



Question 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 9:

Mercury cell are used.

Anode:

$Zn\ (Hg) + 2\ OH^- \rightarrow ZnO\ (s) + H_2O + 2e^-$

Cathode:

$HgO + H_2O + 2e^- \rightarrow Hg\ (l) + 2\ OH^-$

Question 10:

Using IUPAC norms write the formulae for the following :

(a) Sodium dicyanidoaurate (I)

(b) Tetraamminechloridonitrito-N-platinum (IV) sulphate

Solution 10:

(*a*) Sodium dicyanidoaurate (I): $Na[Au(CN)_2]$

(*b*) TetraamminechloridonitritoN-platinum (IV) sulphate: $[Pt(NH_3)_4Cl(NO_2)](SO_4)$

Question 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 11:

(*a*)

Silicon carbide: Covalent solid / network solid,

Argon: Molecular solid.

(*b*)

$$ZnO \xrightarrow{\Delta} Zn^{2+} + \frac{1}{2}O_2 + 2e^-$$

On heating ZnO looses Oxygen and it turns yellow as Zn^{2+} ions move to interstitial sites and the electrons move to neighbouring voids.

(*c*) Compounds prepared by combination of groups 12 and 16 behave like semiconductors. Example: ZnS or CdS.

Question 12:

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

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

has $E°_{cell} = 0{\cdot}236$ V at 298 K. Calculate the standard Gibbs energy of the cell reaction. (Given: 1 F = 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 12:

(*a*)

The two half cell reactions for the cell are:

$$2Fe^{+3}(aq) + 2e^- \rightarrow 2Fe^{2+} \text{ (reduction)}$$

$$2I^- \rightarrow I_2 + 2e^- \text{ (oxidation)}$$

So, the no of e^- transfer during reaction = 2.

$$\Delta G^o = -nFE^o_{cell} = -2 \times 96500 \times 0.263 = -45548 \text{ J/mol}$$
$$\Rightarrow \Delta G^o = -45.548 \text{ kJ/mol}$$

(*b*)

As, $Q = I\,t$ = 0.5 x 2 x 60 x 60 = 3600 C.

Now,

Electrons flowing through the wire on passing charge of one faraday (96500C) = 6.023×10^{23}

Electrons flowing through the wire on passing a charge of 3600C =

$$\frac{6.022\times10^{23}\times3600}{96500} = 2.246\times10^{22} \text{ electrons}$$

Question 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) Why are low spin tetrahedral complexes rarely observed?

Solution 13:

(*a*) Linkage isomerism

(*b*) $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic because in $[NiCl4]^{2-}$, due to the presence of Cl^-, a weak field ligand no pairing occurs whereas in $[Ni(CN)4]^{2-}$, CN^- is a strong field ligand and pairing takes place.

(*c*) Low spin tetrahedral complexes are rarely observed because the orbital splitting energies are not sufficiently large for forcing pairing. Due to which electron always goes to higher states avoiding pairing.

Question 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 14:

(*a*)

Multimolecular Colloid	Associated Colloid
It is Aggregation of large number of small atoms or molecules.	It is aggregation of large number of ions in concentrated solutions.

(*b*)

Coagulation	Peptization
Settling down of colloidal particles.	Conversion of precipitate into colloidal sol by adding small amount of electrolyte.

(*c*)

Homogenous catalysis	Heterogeneous catalysis
Reactants and catalyst are in same phase	Reactants and catalyst are in different phases.

OR

(*a*) Dispersed phase is liquid and dispersion medium is also liquid.

(*b*) Both physisorption and chemisorptions are surface phenomenon occur at the surface of adsorbent.

(*c*) Ferric hydroxide forms lyophobic sols on treatment with water. Ferric hydroxide sol is prepared by the hydrolysis of ferric chloride with boiling distilled water. The reaction takes place is as follows

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

Question 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 15:

Given,

A_o = 100%,

A = (100 – 25) % = 75%

t = 20 minute

k = ?

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

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

$$\Rightarrow k = 0.0143 \text{ min}^{-1}$$

For 75% completion of reaction

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

$$t = \frac{1}{0.0142} \times 2.303 \times \log \frac{100}{25}$$

$$t = 96.96 \text{ minute.}$$

Question 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. β-elimination

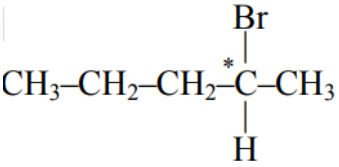
(c) Write the compound which is most reactive towards reaction.

Solution 17:

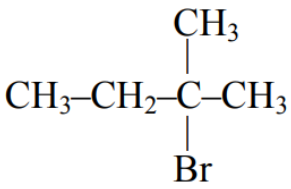
(*a*) 1-Bromopentane

$$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - Br$$

(*b*) 2-Bromopentane



(*c*) 2-Bromo-2-methylbutane



Question 17:

Write the principle of the following:

(a) Zone refining

(b) Froth floatation process

(c) Chromatography

Solution 17:

(*a*) Zone Refining – It is based on the principal that the impurities are more soluble in molten state than in the solid state. It is used to obtain metal of high purity.

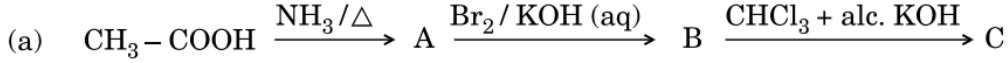
(*b*) Froth floatation process –

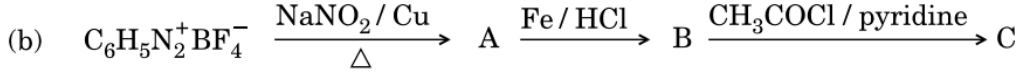
In this process, mineral particles are wetted by oils forming froth while gangue particles are wetted by water and settle down. A rotating paddle agitates the mixture and draws air in it. As a result froth is formed which carries the mineral particles. It is used to concentrate sulphide ore.

(*c*) Chromatography – It is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. After which the adsorbed component are removed by using suitable solvents.

Question 18:

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





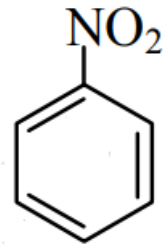
Solution 18:

(*a*)

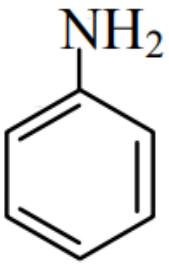
Compound A is CH_3CONH_2, B is CH_3NH_2 and C is CH_3NC

(*b*)

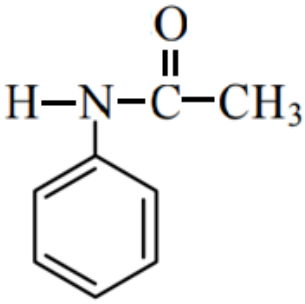
Compound A is



Compound B is



Compound C is



Question 19:

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

(a) Nylon-6,6

(b) Melamine-formaldehyde polymer

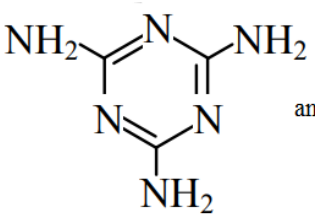
(c) Buna-S

Solution 19:

(*a*) Monomers used for getting Nylon-6, 6 are

$NH_2-(CH_2)_6-NH_2$, $HOOC-(CH_2)_4-COOH$

(*b*)



Melamin

and

$HCHO$

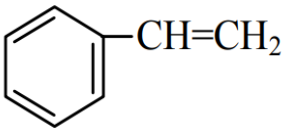
Formaldehyde

(*c*)

$CH_2=CH-CH=CH_2$

1, 3 - Butadiene

and



Styrene

Question 20:

Define the following:

(a) Anionic detergents

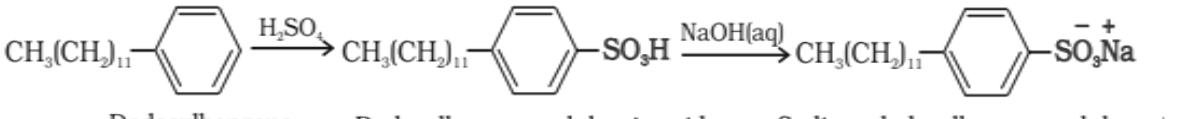
(b) Limited spectrum antibiotics

(c) Antiseptics

Solution 20:

(*a*) Anionic detergents are sodium salts of sulphonated long chain alcohols or hydrocarbons.

Alkyl hydrogensulphates formed by treating long chain alcohols with concentrated sulphuric acid are neutralised with alkali to form anionic detergents. Similarly alkyl benzene sulphonates are obtained by neutralising alkyl benzene sulphonic acids with alkali.



Dodecylbenzene — Dodecylbenzenesulphonic acid — Sodium dodecylbenzenesulphonate

In anionic detergents, the anionic part of the molecule is involved in the cleansing action.

(*b*) Limited spectrum antibiotics are effective against a single organism or disease.

(*c*) Antiseptics are the chemicals which either kill or prevent growth of microbes on living tissues.

Question 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 21:

(*a*)

Red phosphorous being polymeric is less reactive than white phosphorous which has discrete tetrahedral structure. White phosphorus posses angle strain in the P_4 molecule where the angle are only 60^o.

(*b*)

Electron gain enthalpies of halogens are largely negative because they readily accept an electron to attain noble gas configuration.

(*c*)

N_2O_5 is more acidic then N_2O_3 because in N_2O_5 the N is in +5 oxidation state whereas in N_2O_3 it is in +3 oxidation state. Higher the oxidation state of central atom in a given oxide, higher will be acidic character.

Question 22:

Give reasons for the following:

(a) Acetylation of aniline reduces its activation effect.

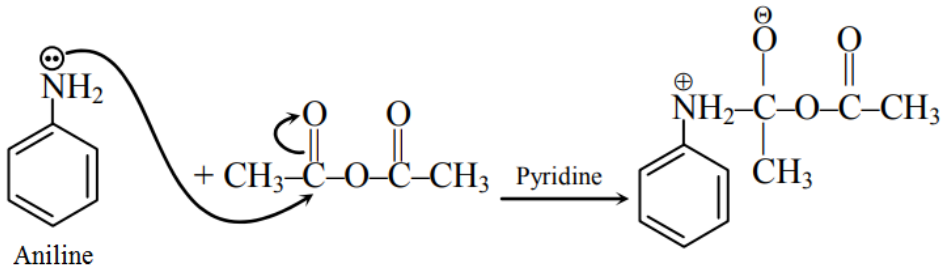
(b) CH_3NH_2 is more basic than $C_6H_5NH_2$.

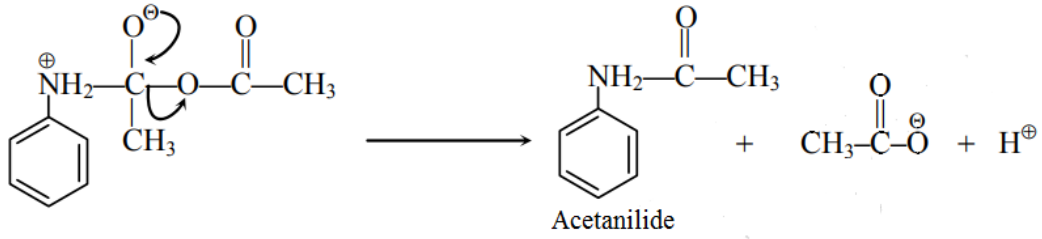
(c) $-NH_2$ although is o/p directing group, yet aniline on nitration gives a significant amount of m-nitroaniline.

Solution 22:

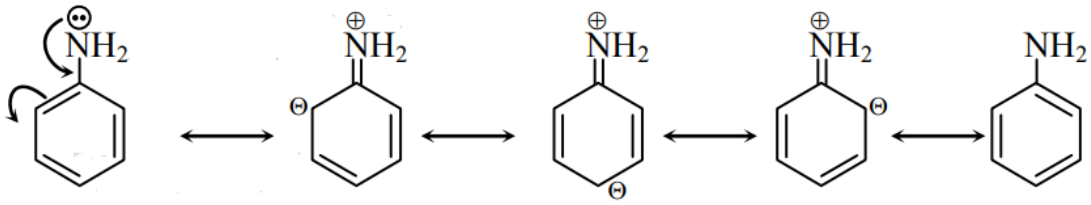
(*a*)

When accetylation aniline occur with acid anhydride it get convert into acetanilide in which lone pair on Nitrogen are in conjugate with oxygen atom, due to the resonance, the electron pair of nitrogen atom gets delocalised towards carbonyl group.
The resonance structure are shown below:

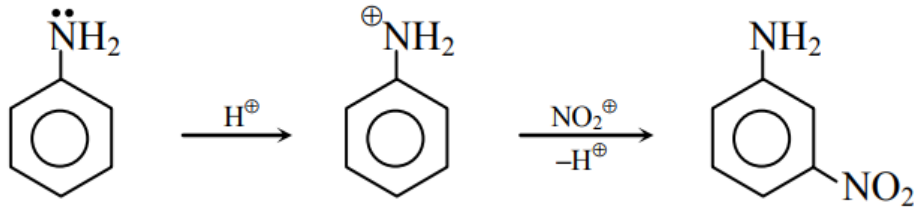




(*b*) Because of +I effect in methylamine electron density at nitrogen increases whereas in aniline resonance takes place and electron density on nitrogen decreases. This can be easily understood with the help of resonating structures.



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



Question 23:

After watching a programme 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 23:

(*a*) Rupali is concerned, caring and socially alert.

(*b*) The polysaccharide component of carbohydrates commonly present in bread is Starch.

(*c*) α -Helix and β-pleated sheets

(*d*) Vitamin B and Vitamin C.

Question 24:

(a) Account for the following:

(i) Transition metals show variable oxidation states.

(ii) Zn, Cd and Hg are soft metals.

(iii) E° 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) $2\ MnO_4^- + 16\ H^+ + 5\ S^{2-} \longrightarrow$

(ii) $KMnO_4 \xrightarrow{heat}$

Solution 24:

(*a*)

(*i*)

Transition metals show variable oxidation states due to the availability of partially filled *d*-orbitals / comparable energies of *ns* and (*n*-1) *d* orbitals.

(*ii*)

Group 12 elements (Zn, Cd, Hg) have Completely filled *d*-orbitals and there is absence of unpaired *d* electrons cause weak metallic bonding due to which they are soft.

(*iii*)

E^o value for the Mn^{+3}/Mn^{+2} is high because Mn^{2+} has d^5 as a stable configuration whereas Cr^{3+} is more stable due to stable t^3_{2g}.

Similarity:

• Both series elements are stable in +3 oxidation state.

• Both series elements show contraction.

Difference:

• Actinoids are radioactive whereas Lanthanoids are not radioactive.

• Actinoids show wide range of oxidation states but lanthanoids don't show wide range of oxidation states.

OR

(*a*)

(*i*) Cr^{3+} is the most stable ion because it has half filled t^3_{2g}.

(*ii*) Mn^{3+} is a strong oxidising agent due to stable d^5 configuration in Mn^{2+}.

(*iii*) Ti^{4+} is colourless because it has no unpaired electrons.

(*b*)

(*i*) $2\ MnO^{4-} + 16H^{+} + 5S^{2-} \rightarrow 2Mn^{+2} + 8H_2O + 5S$

(*ii*) $2KM_nO_4 \xrightarrow{\text{heat}} K_2MnO_4 + MnO_2 + O_2 \uparrow$

Question 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 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 25:

(*a*)

As, $\Delta T_f = k_f m$

$\Delta T_f = \Delta T_{solvent} - \Delta T_{solution}$

$\Delta T_f = = 273.15 - 269.15 = 4$

Using, $m = \dfrac{w_2 \times 1000}{M_2 \times M_1}$

$\therefore m = \dfrac{10}{90} \times \dfrac{1000}{342} = 0.325$

$\Delta T_f = k_f m$

$\Rightarrow 4 = k_f (0.325) \Rightarrow k_f = 12.30$

For glucose,

$$\Delta T_f = k_f \times m$$

$$\Rightarrow \Delta T_f = 12.30 \times \frac{10 \times 100}{180 \times 90} = 7.7$$

$$\Delta T_f = \Delta T_{solvent} - \Delta T_{solution}$$

$$\Rightarrow \Delta T_{solution} = 273.15 - 7.7 = 265.45\ \text{K}$$

(*b*)

(*i*) Molality (m): Number of moles of solute dissolved in per kilo gram of the solvent.

(*ii*) Abnormal molar mass: If the molar mass calculated by using any of the colligative properties to be different than theoretically expected molar mass.

OR

(*a*) W_{Urea} = 30g

MW_{Urea} = 60 g/mol

$$W_{H_2O} = 846\ \text{g}$$

$$MW_{H_2O} = 18\ \text{g/mol}$$

$$\frac{P^o_{\text{Pure water}} - P_{solution}}{P^o_{\text{Pure water}}} = \frac{W_{urea} \times MW_{H_2O}}{MW_{urea} \times W_{H_2O}}$$

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

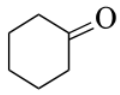
$$P_{solution} = 23.55\ \text{mm Hg}$$

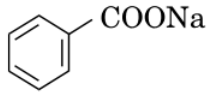
(*b*)

Ideal Solution	Non – ideal Solution
(i) It obeys Raoult's law over the entire range of concentration.	It does not obey Raoult's law over the entire range of concentration.
(ii) Heat is neither absorbed nor evolved on dissolution.	Heat is evolved or absorbed during dissolution.

Question 26:

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

(i)  + HCN ⟶ ?

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

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

(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

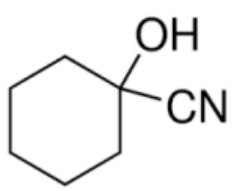
(ii) Acetophenone to Benzoic acid

(iii) Ethanoic acid to 2-Hydroxyethanoic acid

Solution 26:

(*a*)

(*i*)



(*ii*)

(*iii*)

CH_3-CH=CH-CHO

(*b*)

(*i*) Tollen's reagent test can be used to distinguish between Butanal and Butan-2-one

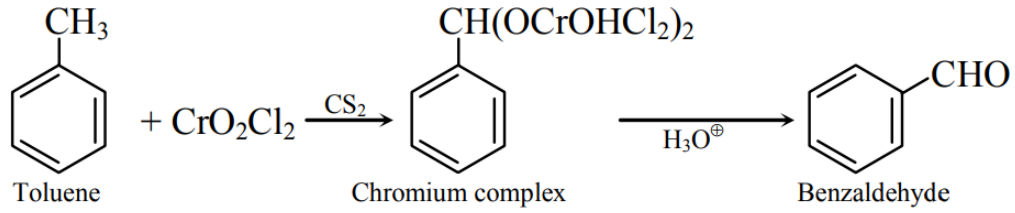
Add ammoniacal solution of silver nitrate (Tollen's Reagent) in both the solutions. Butanal gives silver mirror whereas Butan-2-one does not.

(*ii*) $FeCl_3$ can be used to distinguish between Benzoic acid and Phenol.

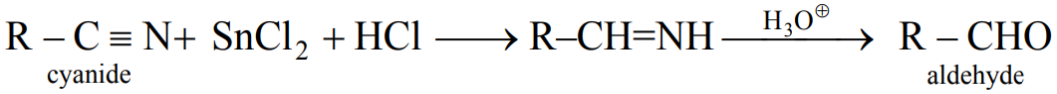
Add neutral $FeCl_3$ in both the solutions, phenol forms violet colour but benzoic acid does not.

OR

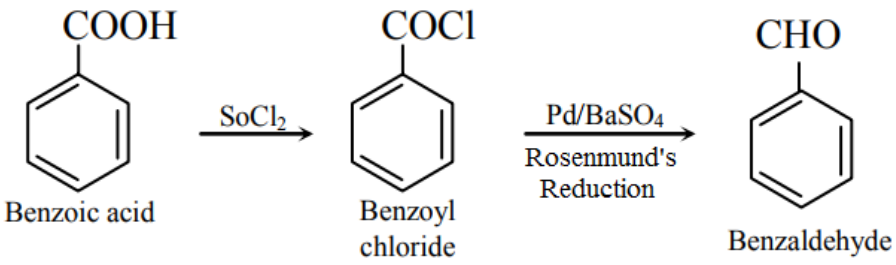
(*i*) Etard reaction:



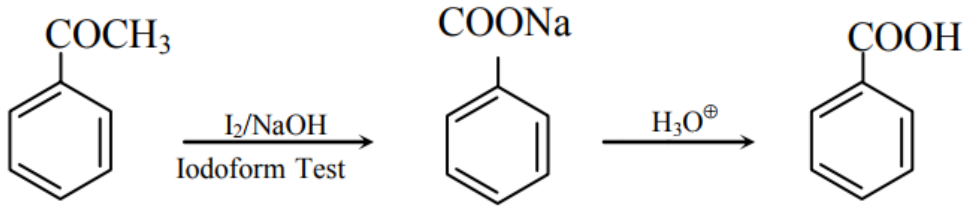
(*ii*) Stephen reaction:



(*i*) Benzoic acid to Benzaldehyde



(*ii*) Acetophenone to Benzoic acid



(*iii*) Ethanoic acid to 2-Hydroxyethanoic acid