Solved Paper 2018

CHEMISTRY

Time : 3 Hours **Class-XII** **Max. Marks : 70**

General Instructions:

(i) All questions are compulsory.

*(ii) Question number **1** to **5** are very short answer questions and carry **1** mark each.*

*(iii) Question number **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) Questio number **23** is a value based question and carries **4** marks.*

*(vi) Question number **24** to **26** are long answer questions and carry **5** marks.*

*(vii) Use log tables, if necessary. Use of calculators is **not** allowed.*

* **1. Analysis shows that FeO has a non-stoichiometric composition with formula $Fe_{0.95}O$. Give reason. 1**

* **2. CO (g) and H_2 (g) react to give different products in the presence of different catalysts. Which ability of the catalyst is shown by these reactions ? 1**

3. Write the co-ordination number and oxidation state of Platinum in the complex $[Pt(en)_2Cl_2]$. 1

Ans. Co-ordination Number = 6 ,
Oxidation State = + 2 ½ + ½
[CBSE Marking Scheme, 2018]

Detailed Answer :

Co-ordination number = Denticity × Number of ligand
$= 2 \times 2 + 2 \times 1 = 6$

Charge on complex = 0

Therefore, $[x + (0 \times 2) + (-1 \times 2)] = 0$

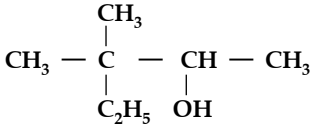
$x = +2$

Oxidation state of Pt = +2 ½ + ½

4. Out of chlorobenzene and benzyl chloride, which one gets easily hydrolysed by aqueous NaOH and why ? 1

Ans. Benzyl chloride ;
Due to resonance, stable benzyl carbocation is formed.

5. Write the IUPAC name of the following :



1

Ans. 3,3 - Dimethylpentan-2-ol

6. Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180 g mol^{-1}) in 250 g of water. (K_f of water = 1.86 K kg mol^{-1}) 2

Ans.

$$\Delta T_f = K_f m$$

$$= K_f \times \frac{w_2 \times 1000}{M_2 \times w_1}$$

$$= \frac{1.86 \times 60 \times 1000}{180 \times 250}$$

$$= 2.48 \text{ K}$$

$$\Delta T_f = T_f^o - T_f$$

$$2.48 = 273.15 - T_f$$

$$T_f = 273.15 - 2.48 = 270.67 \text{ K}$$

7. For the reaction

$2N_2O_5$ (g) ⟶ $4NO_2$ (g) + O_2 (g),

the rate of formation of NO_2 (g) is 2.8×10^{-3} M s^{-1}. Calculate the rate of disappearance of N_2O_5 (g). 2

Ans.

$$\text{Rate} = \frac{1}{4}\frac{\Delta NO_2}{\Delta(t)} = \frac{1}{2}\frac{\Delta(N_2O_5)}{\Delta(t)}$$

$$\frac{1}{4}\left(2.8 \times 10^{-3}\right) = -\frac{1}{2}\frac{\Delta(N_2O_5)}{\Delta(t)}$$

Rate of disappearance of N_2O_5

$$\left(-\frac{\Delta N_2O_5}{\Delta(t)}\right) \ 1.4 \times 10^{-3} \text{ M/s}$$

(Deduct half mark if unit is wrong or not written)

* **8. Among the hydrides of Group-15 elements, which have the**

(a) lowest boiling point ?

(b) maximum basic character ?

(c) highest bond angle ?

(d) maximum reducing character ? 2

* Out of Syllabus

9. How do you convert the following ?

(a) Ethanal to Propanone

(b) Toluene to Benzoic acid **2**

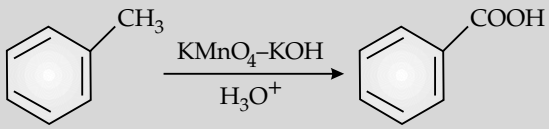
OR

Account for the following:

(a) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction.

(b) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid. **2**

Ans. (a) $CH_3CHO \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CH_3MgBr,\ Dry\ ether} CH_3CH(OH)CH_3 \xrightarrow{CrO_3} CH_3COCH_3$ **1**

(b)  **1**

(or any other correct method) [CBSE Marking Scheme, 2018]

OR

(a) because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group **1**

(b) Nitro group is an electron withdrawing group (-I effect) so it stabilises the carboxylate anion and strengthens the acid / due to the presence of an electron withdrawing nitro group (-I effect). **1**

[CBSE Marking Scheme, 2018]

10. Complete and balance the following chemical equations:

(a) $Fe^{2+} + MnO_4^- + H^+ \longrightarrow$

(b) $MnO_4^- + H_2O + I^- \longrightarrow$ **2**

Ans. (a) $5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$ **1**

(b) $2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$ **1**

(Half mark to be deducted in each equation for not balancing)

[CBSE Marking Scheme, 2018]

Detailed Answer:

(a)
$$8H^+ + MnO_4^- + 5e^- \rightarrow Mn^{2+} + 4H_2O$$
$$5(Fe^{2+} \rightarrow Fe^{3+} + e^-)$$
$$8H^+ + MnO_4^- + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

(b)
$$(3e^- + 4H^+ + MnO_4^- \rightarrow MnO_2 + 2H_2O) \times 2$$
$$3H_2O + I^- \rightarrow IO_3^- + 6H^+ + 6e^-$$
$$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

11. Give reasons for the following:

(a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.

(b) Aquatic animals are more comfortable in cold water than in warm water.

(c) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution. **3**

Ans. (a) As compared to other colligative properties, its magnitude is large even for very dilute solutions / macromolecules are generally not stable at higher temperatures and polymers have poor solubility / pressure measurement is around the room temperature and the molarity of the solution is used instead of molality. **1**

(b) Because oxygen is more soluble in cold water or at low temperature. **1**

(c) Due to dissociation of KCl / KCl (aq) $\rightarrow K^+ + Cl^-$, i is nearly equal to 2. **1**

[CBSE Marking Scheme, 2018]

Detailed Answer:

(a) In osmotic pressure method, pressure is measured at room temperature and instead of molality, molarity of the solution is used. It is preferred for the macromolecules like proteins as they are unstable at high temperature and polymers have poor solubility. Also, due to their high molecular mass, the only colligative property which has a measurable magnitude is osmotic pressure. Therefore, osmotic pressure method is preferred.

*** 12. An element 'X' (At. mass = 40 g mol^{-1}) having f.c.c. structure, has unit cell edge length of 400 pm. Calculate the density of 'X' and the number of unit cells in 4 g of 'X'. ($N_A = 6.022 \times 10^{23}\ mol^{-1}$)** **3**

13. A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the activation energy of the reaction.

* Out of Syllabus

(Given : log 2 = 0.3010, log 4 = 0.6021, R = 8.314 $JK^{-1}mol^{-1}$) **3**

Ans. $k_2 = 0.693/20,$

$k_1 = 0.693/40$

$$\log\frac{k_2}{k_1}=\frac{E_a}{2.303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$$

$k_2/k_1 = 2$

$$\log 2=\frac{E_a}{2.303\times 8.314}\left[\frac{320-300}{320\times 300}\right]$$

E_a = 27663.8 J/mol or 27.66 kJ/ mol

*** 14. What happens when**

(a) a freshly prepared precipitate of $Fe(OH)_3$ is shaken with a small amount of $FeCl_3$ solution ?

(b) persistent dialysis of a colloidal solution is carried out ?

(c) an emulsion is centrifuged ? **3**

*** 15. Write the chemical reactions involved in the process of extraction of Gold. Explain the role of dilute NaCN and Zn in this process.** **3**

16. Give reasons :

(a) E° value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Fe^{3+}/Fe^{2+}.

(b) Iron has higher enthalpy of atomization than that of copper.

(c) Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured. **3**

Ans. (a) The comparatively high value for Mn shows that $Mn^{2+}(d^5)$ is particularly stable / Much larger third ionisation energy of Mn (where the required change is from d^5 to d^4) **1**

(b) Due to higher number of unpaired electrons. **1**

(c) Absence of unpaired *d*-electron in Sc^{3+} whereas in Ti^{3+} there is one unpaired electron or Ti^{3+}shows *d-d* transition.

[CBSE Marking Scheme, 2018] 1

Detailed Answer:

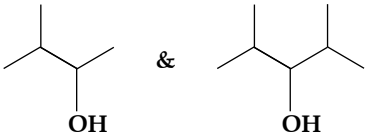
(a) Because Mn^{2+} is more stable than Mn^{3+} due to half-filled d^5 configuration whereas Fe^{2+} becomes unstable after loosing an electron from half filled orbital.

(b) Iron has higher enthalpy of atomization then that of copper because of higher number of unpaired electrons present in iron. Fe ($3d^6 4s^2$) possesses and unpaired electron while Cu ($3d^{10}\ 4s^1$) possesses only 1 unpaired electron.

Number of unpaired electrons α Inter atomic interaction α metallic bonding a entnalpy of atomization.

(c) Sc^{3+} ($3d^0$) is colourless in aqueous solution due to absence of unpaired electron and no *d-d* transition takes place. While Ti^{3+} ($3d^1$) is coloured due to the presence of one unpaired electron and *d-d* transition takes place which absorbs light in visible region.

17. (a) Identify the chiral molecule in the following pair:

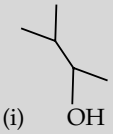


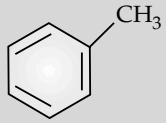
(i) **(ii)**

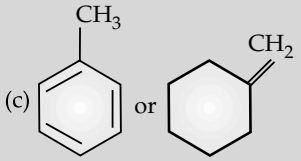
(b) Write the structure of the product when chlorobenzene is treated with methyl chloride in the presence of sodium metal and dry ether.

(c) Write the structure of the alkene formed by dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH. **3**

Ans.

(a) (i)  **1**

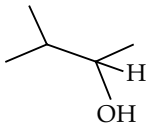
(b)  **1**

(c)  **1**

[CBSE Marking Scheme, 2018]

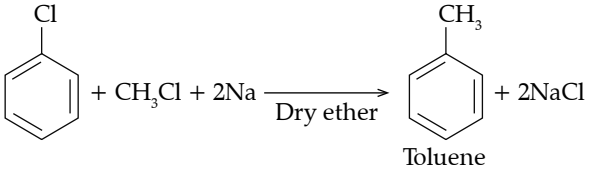
Detailed Answer :

(a)



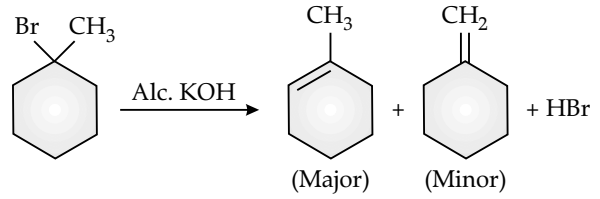
It is chiral carbon as it is attached to four different atoms or groups so, it is a chiral molecule.

(b) Wurtz-Fittig reaction



* Out of Syllabus

(c)



1-Methyl Cyclohexane

18. (A), (B) and (C) are three non-cyclic functional isomers of a carbonyl compound with molecular formula C_4H_8O. Isomers (A) and (C) give positive Tollens' test whereas isomer (B) does not give Tollens' test but gives positive Iodoform test. Isomers (A) and (B) on reduction with Zn(Hg)/conc. HCl give the same product (D).

(a) Write the structures of (A), (B), (C) and (D).

(b) Out of (A), (B) and (C) isomers, which one is least reactive towards addition of HCN ? 3

Ans. (a) A= $CH_3CH_2CH_2CHO$ ½

B = $CH_3COCH_2CH_3$ ½

C= $(CH_3)_2CHCHO$ ½

D= $CH_3CH_2CH_2CH_3$ ½

(b) B **[CBSE Marking Scheme, 2018] 1**

Detailed Answer:

(b) (B) as ketones are less reactive towards addition of HCN than aldehydes and alkane due to higher hinderance caused by steric effect and inductive effect.

(c) The possible non-cyclic functional isomers of a carbonyl compound having molecular formula. C_4H_8O are —

$CH_3 - CH_2 - CH_2 - CHO$

(I)

$CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_3$

(II)

$CH(CH_3)-CHO$

(III)

Since isomer (B) does not give Tollen's test, it must be a ketone but it gives positive iodofo on test, so it must be methyl ketone. Hence, structure of (B) is (II).

The isomers (A) and (C) give positive Tollen's test so both the isomers are aldehyder. Since isomers (A) and (B) on reduction with Zn/Hg/ conc. HCl give the some product (D).

$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_3 \xrightarrow[\text{conc.HCl}]{\text{Zn(Hg)}}$

(B)

$CH_3-CH_2-CH_2-CH_3$

(D)

∴ Structure of (A) is (I) and

Structure of (C) is (III).

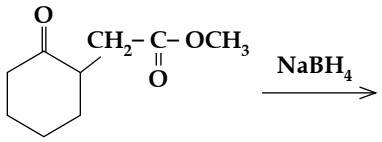
Hence, A ⇒ $CH_3-CH_2-CH_2-CHO$

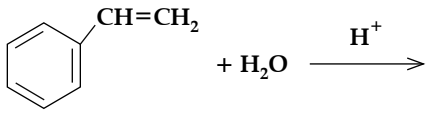
B ⇒ $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$

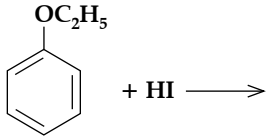
C ⇒ $CH_3-CH(CH_3)-CHO$

D ⇒ $CH_3-CH_2-CH_2-CH_3$

*** 19. Write the structures of the main products in the following reactions : 3**

(i) 

(ii) 

(iii) 

3

*** 20. (a) Why is bithional added to soap ?**

(b) What is tincture of iodine ? Write its one use.

(c) Among the following, which one acts as a food preservative ?

Aspartame, Aspirin, Sodium benzoate, Paracetamol 3

21. Define the following with an example of each :

(a) Polysaccharides

(b) Denatured protein

(c) Essential amino acids 3

OR

(a) Write the product when D-glucose reacts with conc. HNO_3.

(b) Amino acids show amphoteric behaviour. Why ?

(c) Write one difference between α-helix and β-pleated structures of proteins.

Ans. (a) Carbohydrates that give large number of monosaccharide units on hydrolysis / large number of monosaccharide units joined together by glycosidic linkage starch/ glycogen/ cellulose (or any other) ½+½

* Out of Syllabus

(b) Proteins that lose their biological activity / proteins in which secondary and tertiary structures are destroyed Curdling of milk (or any other) ½+½

(c) Amino acids which cannot be synthesised in the body. ½
Valine / Leucine (or any other) ½

[CBSE Marking Scheme, 2018]

OR

(a) Saccharic acid/COOH-$(CHOH)_4$-COOH **1**

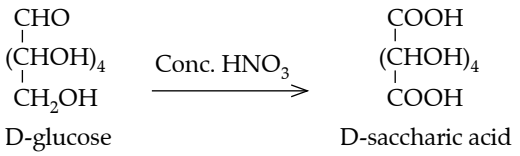
(b) Due to the presence of carboxyl and amino group in the same molecule / due to formation of zwitter ion or dipolar ion. **1**

(c) α-helix has intramolecular hydrogen bonding while β pleated has intermolecular hydrogen bonding / α-helix results due to regular coiling of polypeptide chains while in β pleated all polypeptide chains are stretched and arranged side by side. **1**

[CBSE Marking Scheme, 2018]

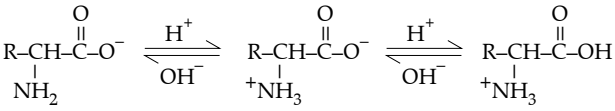
Detailed Answer:

(a) When D-glucose reacts with conc. HNO_3, it forms saccharic acid.



D-glucose D-saccharic acid

(b) In aqueous solution, the carboxyl group present in amino acid can lose a proton and the amino group can accept a proton to form zwitter ion. This zwitter ion can act both as an acid and a base showing amphoteric behaviour.



22. (a) Write the formula of the following co-ordination compound :
Iron(III) hexacyanoferrate(II)

(b) What type of isomerism is exhibited by the complex $[Co(NH_3)_5Cl]SO_4$?

(c) Write the hybridisation and number of unpaired electrons in the complex $[CoF_6]^{3-}$. (Atomic No. of Co = 27) **3**

Ans. (a) $Fe_4[Fe(CN)_6]_3$ **1**

(b) Ionisation isomerism **1**

(c) sp^3d^2, 4 ½+½

[CBSE Marking Scheme, 2018]

Detailed Answer:

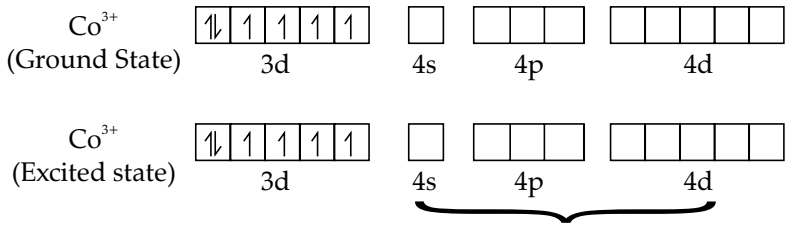
(b) Ionization isomerism.

$[Co(NH_3)_5 SO_4]Cl$ and $[Co(NH_3)_5 Cl] SO_4$

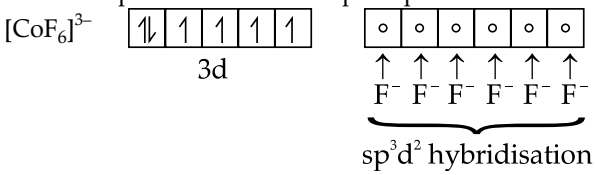
(c) $[COF_6]^{3-}$

In this complex, Co possesses + 3 oxidation state.

$Co^{3+} = 3d^6$



Since F^- is weak ligand so it cannot push the electrons to pair up and it forms outer orbital high spin complex.



sp^3d^2 hybridisation

Number of unpaired electrons = 4

*** 23. Shyam went to a grocery shop to purchase some food items. The shopkeeper packed all the items in polythene bags and gave them to Shyam. But Shyam refused to accept the polythene bags and asked the shopkeeper to pack the items in paper bags. He informed the shopkeeper about the heavy penalty imposed by the government for using polythene bags. The shopkeeper promised that he would use paper bags in future in place of polythene bags.**

Answer the following:

(a) Write the values (at least two) shown by Shyam.

* Out of Syllabus

(b) Write one structural difference between low-density polythene and high-density polythene.

(c) Why did Shyam refuse to accept the items in polythene bags ?

(d) What is a biodegradable polymer ? Give an example. 4

*** 24. (a) Give reasons:**

(i) H_3PO_3 undergoes disproportionation reaction but H_3PO_4 does not.

(ii) When Cl_2 reacts with excess of F_2, ClF_3 is formed and not FCl_3.

(iii) Dioxygen is a gas while sulphur is a solid at room temperature.

(b) Draw the structures of the following:

(i) XeF_4

(ii) $HClO_3$ 5

OR

(a) When concentrated sulphuric acid was added to an unknown salt present in a test tube, a brown gas (A) was evolved. This gas intensified when copper turnings were added to this test tube. On cooling, the gas (A) changed into a colourless solid (B).

(i) Identify (A) and (B).

(ii) Write the structures of (A) and (B).

(iii) Why does gas (A) change to solid on cooling ?

(b) Arrange the following in the decreasing order of their reducing character :

HF, H, HBr, HI

(c) Complete the following reaction:

$XeF_4 + SbF_5 \longrightarrow$

25. (a) Write the cell reaction and calculate the e.m.f. of the following cell at 298 K :

Sn (s) | Sn^{2+} (0.004 M) || H^+ (0.020 M) | H_2 (g) (1 bar) | Pt (s)

(Given : $E^\circ_{Sn^{2+}/Sn} = -0.14V$)

(b) Give reasons:

(i) On the basis of E° values, O_2 gas should be liberated at anode but it is Cl_2 gas which is liberated in the electrolysis of aqueous NaCl.

(ii) Conductivity of CH_3COOH decreases on dilution. 5

OR

(a) For the reaction

$2AgCl(s) + H_2(g)\ (1\ atm) \longrightarrow 2Ag(s) + 2H^+\ (0.1\ M) + 2Cl^-(0.1\ M)$,

$\Delta G^\circ = -43600$ J at 25°C.

Calculate the e.m.f. of the cell.

[$\log 10^{-n} = -n$]

(b) Define fuel cell and write its two advantages.

Ans. (a) $Sn + 2H^+ \rightarrow Sn^{2+} + H_2$ (Equation must be balanced) **1**

$$E = E^o - \frac{0.059}{2}\log\frac{\left[Sn^{2+}\right]}{\left[H^+\right]^2}$$ ½

$$0 = [0 - (-0.14)] - 0.0295 \log \frac{(0.004)}{(0.02)^2}$$ ½

$= 0.14 - 0.0295 \log 10 = 0.11$ V / 0.1105 V **1**

(b) (i) Due to overpotential/ overvoltage of O_2 **1**

(ii) The number of ions per unit volume decreases. **1**

OR

(a) $\Delta G^o = -nFE^o$ ½

$-43600 = -2 \times 96500 \times E^o$

$E^o = 0.226$ V

$E = E^o - 0.059/2 \log ([H^+]^2 [Cl^-]^2 / [H_2])$ ½

$= 0.226 - 0.059/2 \log[(0.1)^2 \times (0.1)^2] / 1$ ½

* Out of Syllabus

$= 0.226 - 0.059/2 \log 10^{-4}$ ½

$= 0.226 + 0.118 = 0.344$ V (Deduct half mark if unit is wrong or not written) **1**

(b) Cells that convert the energy of combustion of fuels (like hydrogen, methane, methanol etc.) directly into electrical energy are called fuel cells. **1**

Advantages : High efficiency, non polluting (or any other suitable advantage) ½+½

[CBSE Marking Scheme, 2018]

Detailed Answer:

(a) $Sn(s)|\, Sn^{2+}(0.004\,M)||\, H^+(0.020\,M)|\, H_2(g)(1\,bar)|\, Pt(s)$

$$E^\circ_{cell} = E^\circ_{(H^+/H_2)} - E^\circ_{(Sn^{2+}/Sn)}$$
$$= 0.00 - (-0.14)$$
$$= +0.14\,V$$

$$Sn(s) \rightarrow Sn^{2+}(aq) + 2e^-$$
$$2H^+(aq) + 2e^- \rightarrow H_2(g)$$
$$Sn(s) + 2H^+(aq) \rightarrow Sn^{2+}(aq) + H_2(g)$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n} \log \frac{[Sn^{2+}]}{[H^+]^2}$$
$$= 0.14 - \frac{0.0591}{2} \log \frac{(4\times10^{-3})}{(2\times10^{-2})^2}$$
$$= 0.14 - 0.0295 \log 10$$
$$= 0.14 - 0.0295$$
$$= 0.1105\ V$$

(b) (i) $NaCl \rightarrow Na^+ + Cl^-$

$H_2O \rightleftharpoons H^+ + OH^-$

The value of E° of O_2 is higher than Cl_2 but O_2 is evolved from H_2O only when the higher voltage is applied. So, because of this Cl_2 is evolved instead of O_2.

(ii) Conductivity varies with the change in the concentration of the electrolyte. The number of ions per unit volume decreases on dilution. So, conductivity decreases with decrease in concentration. Therefore, conductivity of CH_3COOH decreases on dilution.

26. (a) Write the reactions involved in the following:

(i) Hoffmann bromamide degradation reaction

(ii) Diazotisation

(iii) Gabriel phthalimide synthesis

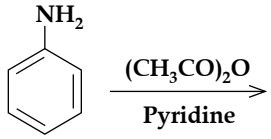
(b) Give reasons:

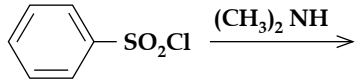
(i) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

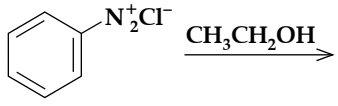
(ii) Aromatic diazonium salts are more stable than aliphatic diazonium salts. **3+2=5**

OR

(a) Write the structures of the main products of the following reactions:

(i) 

(ii) 

(iii) 

(b) Give a simple chemical test to distinguish between aniline and N,N-dimethylaniline.

(c) Arrange the following in the increasing order of their pK_b values:

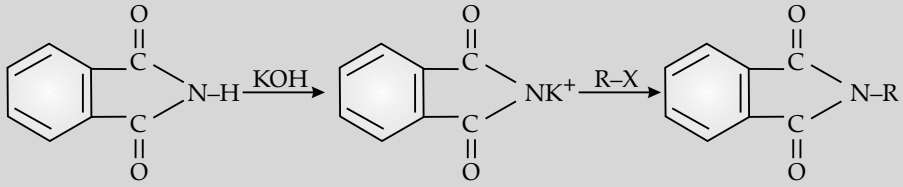
$C_6H_5NH_2$, $C_2H_5NH_2$, $C_6H_5NHCH_3$ **5**

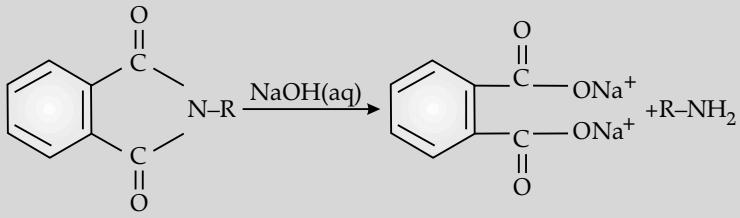
Ans. **(a)** **(i)** $Ar/\ R\text{-}CONH_2 + Br_2 + 4\,NaOH \rightarrow Ar/\ R\text{-}NH_2 + 2NaBr + Na_2CO_3 + 2\,H_2O$ **1**

(ii) $C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273-278K} C_6H_5N_2^+\,Cl^- + NaCl + 2H_2O$ **1**

(or any other correct equation)

(iii)





1

(b) **(i)** Because of the combined factors of inductive effect and solvation or hydration effect **1**

(ii) Due to resonance stabilisation or structural representation / resonating structures. **1**

OR

(a) **(i)** $C_6H_5NHCOCH_3$ **1**

(ii) $C_6H_5SO_2N(CH_3)_2$ **1**

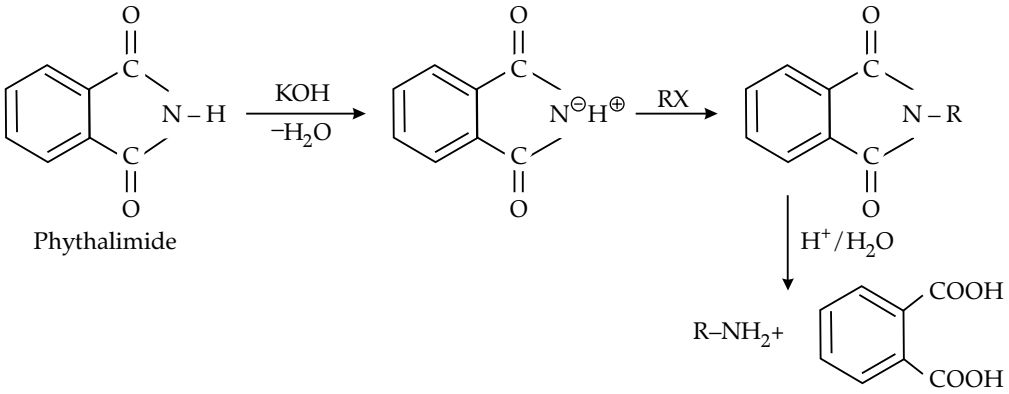
(iii) C_6H_6 **1**

(b) Add chloroform in the presence of KOH and heat, Aniline gives a offensive smell while N, N dimethylaniline does not. (or any other correct test) **1**

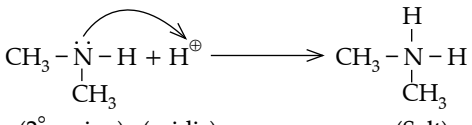
(c) $C_2H_5NH_2 < C_6H_5NHCH_3 < C_6H_5NH_2$ **[CBSE Marking Scheme, 2018]** **1**

Detailed Answer:

(iii) Gabriel Pthalimide reaction:



(b) **(i)**

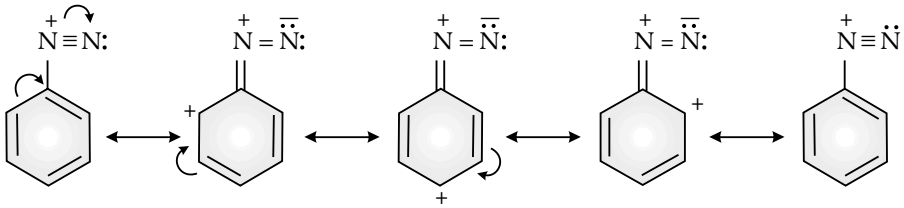


(2° amine) (acidic) (Salt)
More stable

(3° amine) (acidic) (Salt)
Less stable

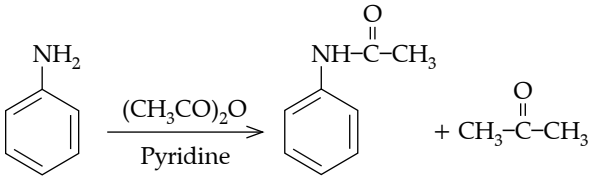
2° amine salt form are more stable than 3° amine due to inductive effect and higher degree of hydration. Therefore, higher the stability of salt, greater will be the reactivity of corresponding compound.

(ii) Aromatic diazonium salts are more stable than aliphatic diazonium salts due to dispersion of positive charge over the benzene ring caused by resonance. This is not found in aliphatic diazonium salts.



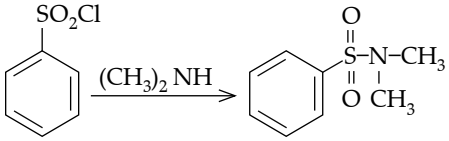
OR

(a) (i)



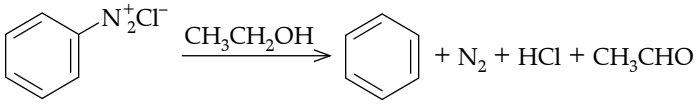
Acetanilide

(ii)



N, N-dimethyl benzene sulphonamide

(iii)



Benzene

❑❑