Answers to RCH–DS1/Set-1

1. (*c*) Zinc dissolves forming Zn^{2+} at anode and copper deposits at cathode in 'P'.

2. (*d*) It is Clemmensen reduction, converts ketones to hydrocarbons.

3. (*a*) Sucrose $\xrightarrow{\text{Invertase}}$ Glucose + Fructose

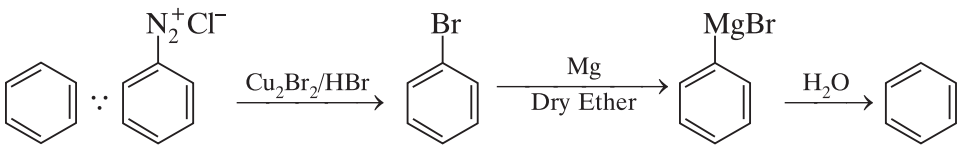
4. (*b*) Phenyl ethanone, $2C_6H_5{-}\overset{\overset{O}{\|}}{C}{-}CH_3 \xrightarrow{OH^-} C_6H_5{-}\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}{-}CH_2COC_6H_5 \xrightarrow[-H_2O]{\Delta}$

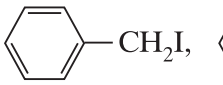
$C_6H_5{-}\underset{\underset{CH_3}{|}}{C}{=}CHCOC_6H_5$

5. (*b*) allylic halide, ∵ X is attached to sp^3-hybridised carbon atom attached to C═C i.e., to allylic carbon.

6. (*c*) *p* – II, *q* – III, *r* – I, *s* – IV ∵ Ti(22) $4s^2 3d^2$, V(23) $4s^2 3d^3$, Mn(25)$4s^2 3d^5$ Cu(29) $4s^1 3d^{10}$

7. (*a*) $k[P]^2[Q]$

8. (*a*) 

9. (*b*)  ∵ Benzylic carbocation is stabilized by resonance.

10. (*a*) 2.5×10^{-4} ∵ $+\dfrac{d[N_2]}{dt} = k = 2.5 \times 10^{-4}$. $[2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)]$

11. (*c*) Cu ∵ $E^\circ_{Cu^{2+}/Cu} = +0.34$ V due to high ΔaH and low enthalpy of hydration of Cu^{2+}.

12. (*a*) Phenols do not react with HCl.

13. (*a*) Both A and R are true and R is the correct explanation of A.

14. (*b*) Both A and R are true but R is not correct explanation of 'A'.

15. (*c*) A is true but R is false.

16. (*a*) Both A and R are true and R is the correct explanation of A.

17. $k = \frac{0.693}{t_{1/2}} = \frac{0.693}{30\ \text{min}} \Rightarrow k = 2.31 \times 10^{-2}\ \text{min}^{-1}$

$$t = \frac{2.303}{k} \log \frac{[R]_0}{\frac{1}{8}[R]_0} = \frac{2.303}{2.31 \times 10^{-2}} \log 8$$

$$t = \frac{2.303}{2.31 \times 10^{-2}} \times 0.9031 \Rightarrow t = 90\ \text{min}$$

18. $CH_3—\underset{\underset{O}{\|}}{C}—CH_2—CH_3 + 3I_2 + 4NaOH \longrightarrow CHI_3 + CH_3CH_2COONa + 3NaI + 3H_2O$

'A' Butan-2-one

It gives iodoform test but does not give Tollen's reagent test

$$CH_3—CH_2—CH_2—\overset{\overset{O}{\|}}{C}—H + [Ag(NH_3)_2]^+ + 3OH^- \longrightarrow CH_3CH_2CH_2COOH + Ag\downarrow$$

'B' (Butanal)

$$CH_3CH_2CH_2CHO \xrightarrow[\text{conc. HCl}]{\text{Zn(Hg)}} CH_3—CH_2—CH_2—CH_3$$

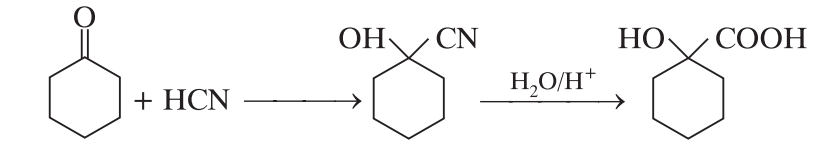
n-Butane

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

'A'

Or

(*i*)

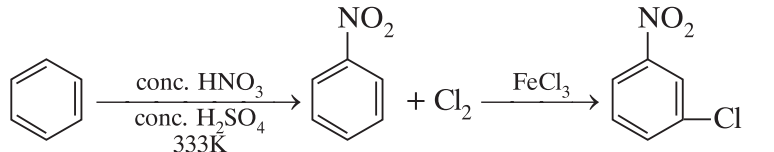


Cyclohexanone — 'A' 1-Hydroxycyclohexane carbonitrile — 'B' 1-Hydroxycyclohexane carboxylic acid

(*ii*) $CH_3C{\equiv}N \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CH_3MgBr} CH_3—\underset{\text{'A'}}{\overset{\overset{O}{\|}}{C}}—CH_3 \xrightarrow{OH^-} CH_3—\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}—CH_2COCH_3$

Ethane nitrile — Propanone — 'B' 4-hydroxy-4-methyl pentan-2-one

19. (*i*)



Benzene — Nitrobenzene — *m*-Nitro chlorobenzene

(*ii*) $CH_3—\underset{\underset{OH}{|}}{CH}—CH_3 \xrightarrow[\Delta]{\text{conc. } H_2SO_4} \underset{\text{Propene}}{CH_3—CH=CH_2} + HBr \xrightarrow{\text{Peroxide}} CH_3CH_2CH_2Br$

Propan-2-ol

$CH_3—CH_2—CH_2Br + NaI \xrightarrow{\text{Acetone}} CH_3CH_2CH_2I$

1-Bromopropane 1-Iodopropane

20. $\frac{p_A^\circ - p_A}{p_A^\circ} = x_B \Rightarrow 1 - \frac{p_A}{p_A^\circ} = \frac{\frac{30}{180}}{\frac{70}{18}} \Rightarrow 1 - \frac{p_A}{760} = \frac{3}{70} \Rightarrow \frac{p_A}{760} = \frac{67}{70}$

$\Rightarrow p_A = \frac{760 \times 67}{70}$ $p_A = 727.428$ mm

21. **Basic Amino acids** – Lysine, Arginine, Histidine

Amphoteric amino acids – Isoleucine, Glycine

Acidic amino acids – Glutamic acid, Aspartic acid

22. (*a*) NH_4^+ ∵ it does not have lone pair of electrons

(*b*) Pentaammine nitrito-O-cobalt (III) chloride

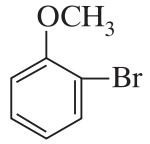
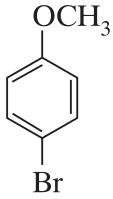
(*c*) d^2sp^3, octahedral, diamagnetic due to absence of unpaired electrons.

23. $\Lambda^\circ_{mCH_3COOH} = 40.9 + 349.6 = 390.5$ S cm^2 mol^{-1}

$\Lambda_m = \frac{1000\,\kappa}{M} = \frac{1000 \times 3.905 \times 10^{-5}}{0.001} = 39.05$ S cm^2 mol^{-1}

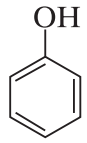
$\alpha = \frac{\Lambda_m}{\Lambda^\circ_{m^2}} = \frac{39.05}{390.5} = 0.1$, $\alpha = 0.1 \times 100 = 10\%$

24. (*a*) Reduction,  (Benzene)

(*b*) Electrophilic substitution (Bromination)  and 

(2-Bromo-1-methoxy benzene

(4-Bromo-1-methoxy benzene

(*c*) Cleavage of Ethers (S_N2),  and CH_3I

Phenol Iodomethane

25. (*i*) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{LiAlH_4} CH_3-\overset{\overset{OH}{|}}{CH}-CH_3 \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} CH_3-CH=CH_2$

Acetone → Propan-2-ol → Propene

$CH_3-CH=CH_2 \xrightarrow[(ii)\ H_2O_2/OH^-]{(i)\ B_2H_6} CH_3-CH_2-CH_2OH$

Propene → Propan-1-ol

(*ii*) $C_6H_5-\overset{\overset{O}{\|}}{C}-H \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CH_3MgBr} C_6H_5-\overset{\overset{OH}{|}}{CH}-CH_3 \xrightarrow[573\ K]{Cu} C_6H_5-\overset{\overset{O}{\|}}{C}-CH_3$

Benzaldehyde → 1-Phenyl ethanol → Acetophenone

(*iii*) $2C_6H_5COCl + (CH_3CH_2)_2Cd \longrightarrow 2C_6H_5COCH_2CH_3 + CdCl_2$

Benzoyl chloride; Diethyl cadmium; 1-Phenyl propanone

26. $$\log \frac{\frac{0.693}{(t_{1/2})_2}}{\frac{0.693}{(t_{1/2})_1}} = \frac{E_a}{2.303\,R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

$\because\ (t_{1/2})_1 = \dfrac{0.693}{k_1}$ and $(t_{1/2})_2 = \dfrac{0.693}{k_2}$

$$\log 2 = \frac{E_a}{2.303\times 8.314}\left(\frac{1}{300}-\frac{1}{320}\right) \qquad [\because (t_{1/2})_1 = 40\text{ min},\ (t_{1/2})_2 = 20\text{ min}]$$

$$E_a = \frac{0.3010\times 19.147\times 9600}{2\times 1000} = 27.66\text{ kJ mol}^{-1}$$

27. (*a*) 4-chloro pent-1-ene $\because$ Double bond is preferred over halogen.

(*b*) When there is no symmetry in compound, this property is called chirality of a molecule e.g. 2-chloro butane is chiral.

(*c*) It is due to less stearic hindrance, nucleophile can attack from opposite side of halogen atom.

28. (*a*) It is zero order reaction. $\because$ rate $= k[A]^\circ \Rightarrow$ rate $= k =$ mol L^{-1} s^{-1}

(*b*) $$t_{99\%} = \frac{2.303}{k}\log\frac{[R]_0}{\frac{1}{100}[R]_0} = \frac{2.303}{k}\log 100 = \frac{2.303\times 2}{k} = \frac{4.606}{k} \qquad \ldots(i)$$

$$t_{90\%} = \frac{2.303}{k} \log \frac{[R]_0}{\frac{10}{100}[R]_0} = \frac{2.303}{k} \log 10 = \frac{2.303}{k} \quad \ldots(ii)$$

From (*i*) and (*ii*) $t_{99\%} = 2\, t_{90\%}$

29. (*a*) $[Ni(H_2O)_6]Cl_2$, secondary valency = 6

(*b*) Pentaammine chlorido cobalt (III) sulphate is IUPAC name of its ionisation isomer.

(*c*) (*i*) sp^3, tetrahedral, diamagnetic

(*ii*) d^2sp^3, octahedral, paramagnetic

Or

(*c*) (*i*) It is because Δ_t is less, therefore, low spin complexes are rarely formed.

(*ii*) $[Co(NH_3)_6]^{3+}$ is d^2sp^3 hybridised, therefore, inner orbital complex.

$[Ni(NH_3)_6]^{2+}$ is outer orbital complex since, it has sp^3d^2 hybridisation.

30. (*a*) It is because A.C. current keeps on changing direction every $\frac{1}{100}$th of second which leads to shunting of metallic ions between the electrodes which keep changing polarity.

Or

$H_2SO_4\ (aq) \longrightarrow 2H^+(aq) + SO_4^{2-}$

At cathode : $2H^+\ (aq) + 2e^- \longrightarrow H_2(g)$

At anode : $2H_2O(l) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$

(*b*) Anode is positive and cathode is negative in electrolytic cell.

(*c*) $m = Z \times I \times t$

$$m = \frac{63.5}{2 \times 96500} \times 1.5 \times 10 \times 60 = 0.2961 \text{ g}$$

31. (*a*) Sc(21) has $4s^2 3d^1$ i.e. incomplete *d*-orbitals in ground state.

(*b*) It is due to strong metallic bonds due to presence of unpaired electrons, occurrence of metal-metal bonding is more frequent in 5*d* series.

(*c*) +8 in OsO_4

(*d*) It is due to poor shielding effect of 5 *f*-electrons, effective nuclear charge increases.

(*e*) It is because Th^{4+} has stable inert gas configuration of $[Rn]_{86}$.

(*f*) $I^- + 2MnO_4^- + H_2O \longrightarrow IO_3^- + 2MnO_2 + 2OH^-$

(*g*) $Cr_2O_7^{2-} + 3H_2S + 8H^+ \longrightarrow 2Cr^{3+} + 7H_2O + 3S$

32. (*a*) $i = \frac{1}{8}$ $\because$ sulphur exist as S_8

(*b*) It shows negative deviation due to formation of H-bonds between phenol and aniline. They form maximum boiling azeotropes. [ΔH = –ve, ΔV = – ve]

(*c*) $\Delta T_f = k_f \times \frac{W_2}{M_2} \times \frac{1000}{W_1}$

$$0.40 = 5.12 \times \frac{1}{M_2} \times \frac{1000}{50} \Rightarrow M_2 = \frac{5.12 \times 20}{0.40} = 256 \text{ g/mol.}$$

Or

(*a*) $i = 3$, $Na_2SO_4 \cdot 10H_2O \longrightarrow 2Na^+ + SO_4^{2-} + 10H_2O$

(*b*) Ideal solutions can be separated by fractional distillation.

(*c*) $\pi V = \frac{W_2}{M_2} \times R \times T$

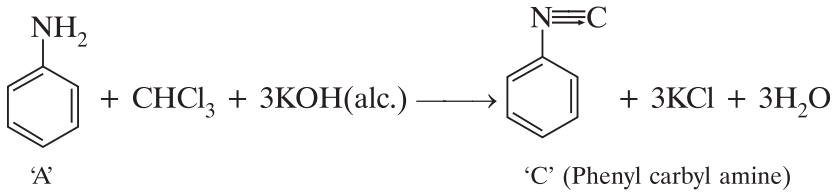
$$2.57 \times 10^{-3} \times 0.2 \text{ L} = \frac{1.26}{M_2} \times 0.083 \times 300 \text{ K}$$

$$M_2 = \frac{1.26 \times 0.083 \times 300}{2.57 \times 10^{-3} \times 0.2}$$

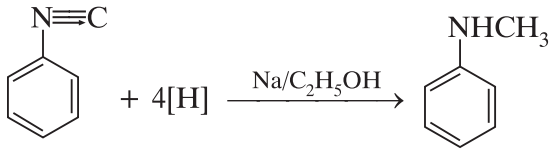
Molar mass of protein = M_2 = 61,038.91 g/mol

33. 'A' is $C_6H_5NH_2$ (Aniline). It becomes coloured in air due to oxidation.

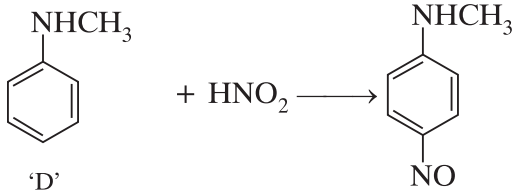
$$\underset{\text{'A'}}{C_6H_5NH_2} + HCl \longrightarrow \underset{\text{'B'}}{C_6H_5\overset{+}{N}H_3Cl^-} \text{ (soluble in water)}$$



'A' 'C' (Phenyl carbyl amine)



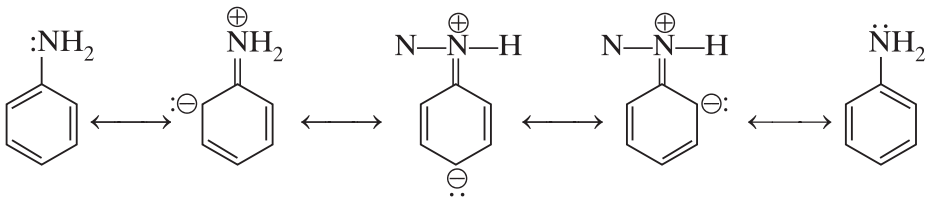
'D' (N-Methyl Aniline)



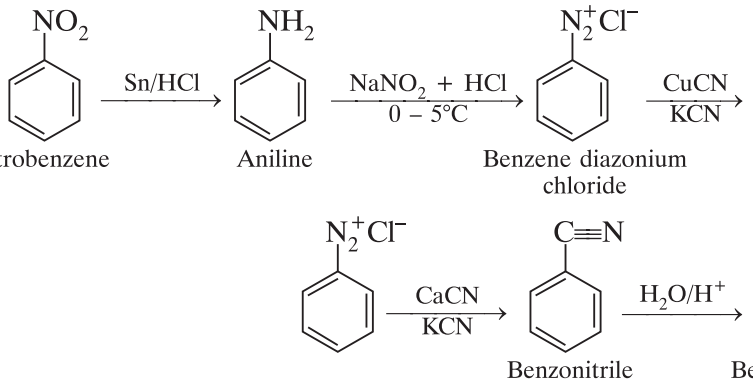
'D' 'E' (*p*-Nitroso N-Methyl Aniline)

Or

I. It is because electron density is maximum at *o* and *p*-position as shown in resonating structures.



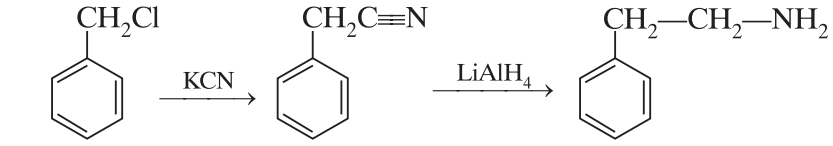
II. (*i*)



Nitrobenzene Aniline Benzene diazonium chloride

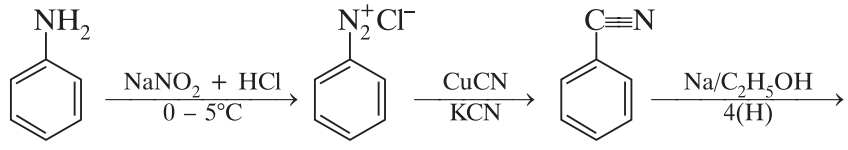
Benzonitrile Benzoic acid

(*ii*)

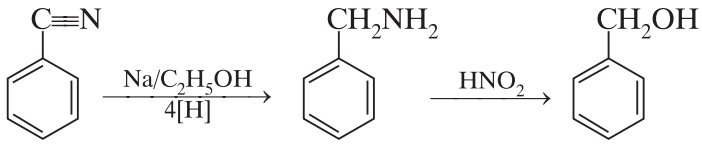


Benzyl chloride — 2-Phenyl ethane nitrite — 2-Phenyl ethanamine

(*iii*)



Aniline — Benzene diazonium chloride — Benzonitrile



Benzylamine — Benzyl alcohol