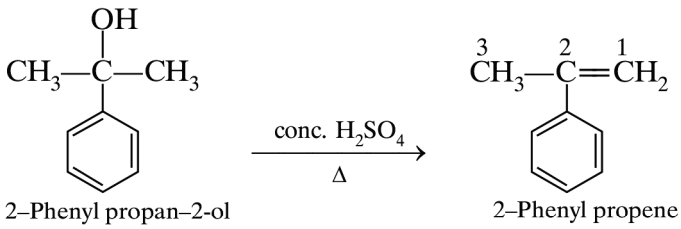
Answers to RSPL/1

1. (*c*) 

2–Phenyl propan–2-ol — 2–Phenyl propene

2. (*a*) ∵ both will form stable carbocation.

3. (*b*) CrO_4^{2-} are yellow in colour.

4. (*b*) Collision frequency will increase.

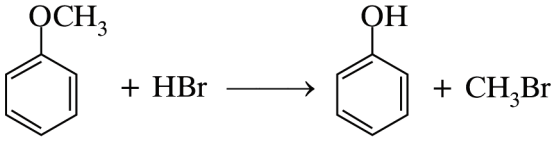
5. (*a*) $2H_2O + O_2 + 4e^- \longrightarrow 4OH^-$

6. (*d*) $k = \dfrac{[R_0]-[R]}{t} \Rightarrow 10^{-2} = \dfrac{10-[R]}{10\times 60}$

$\Rightarrow 6 = 10 - [R] \Rightarrow [R] = 4 \text{ mol } L^{-1}$

7. (*b*) ∵ 'N' is attached to two alkyl and one aryl group.

8. (*b*) Cis–$[CoCl_2(en)_2]^+$ will show optical isomerism.

9. (*d*) 

10. (*b*) ∵ $—C_6H_5$ group is electron withdrawing directly attached to $—NH_2$.

11. (*c*) It is due to steric hindrance of two bulky $(CH_3)_3C$ (tert. butyl groups)

12. (*b*) 'A' only. Slow step is rate determining step.

13. (*b*) $C_6H_5—CHO + HCHO \xrightarrow{\text{Conc. NaOH}} \underset{\text{'A'}}{C_6H_5—CH_2OH} + \underset{\text{'B'}}{HCOONa}$

∵ HCHO is better reducing agent, reduces C_6H_5CHO to $C_6H_5CH_2OH$ and gets oxidised to HCOOH.

14. (*d*) All of these

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

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

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

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

19.
$$t_{1/2} = \frac{0.693}{k} \Rightarrow k = \frac{0.693}{138.6} = 5 \times 10^{-3}\ \text{min}^{-1}$$

$$t_{25\%} = \frac{2.303}{k} \log \frac{[R_0]}{\frac{75}{100}[R_0]}$$

$$t_{25\%} = \frac{2.303}{5\times10^{-3}} (\log 4 - \log 3) = \frac{2.303}{5\times10^{-3}} (0.6021 - 0.4771)$$

$$t_{25\%} = \frac{2.303\times0.125}{5\times10^{-3}} = 57.575\ \text{min.}$$

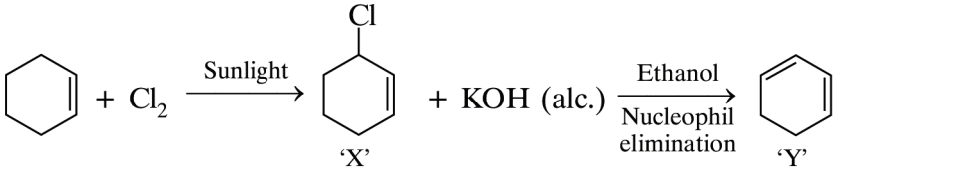
20. (*a*) Albumin is soluble in water and has α-helix structure, therefore, it is globular protein.

(*b*) Keratin is insoluble in water and has thread like β-pleated structure.

Or

(*a*) $CH_3—\underset{\underset{COO^-}{|}}{CH}—\overset{\oplus}{N}H_3$ (Zwitter ion of alanine)

(*b*) Lysine is an example of basic amino acid. It is basic because it has two $—NH_2$ group and one —COOH.

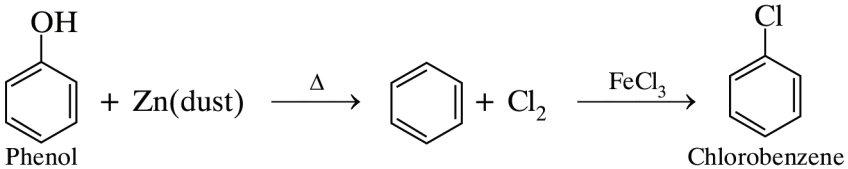
21. (*a*) 

Cyclohexa 1, 3-diene

(*b*) $C_2H_5Cl + AgCN \longrightarrow \underset{\text{'X'}}{C_2H_5N\rightleftharpoons C} \xrightarrow{LiAlH_4} \underset{\text{'Y'}}{C_2H_5NHCH_3}$

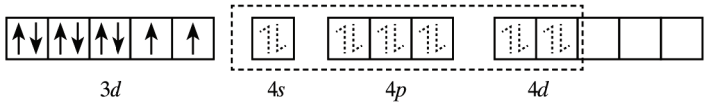
Or

(*a*) $\underset{\text{Chloro ethane}}{C_2H_5Cl} + KCN \longrightarrow \underset{\text{Propane nitrile}}{C_2H_5C{\equiv}N} + H_2O \xrightarrow{H^+} \underset{\text{Propanoic acid}}{C_2H_5COOH}$

(*b*) 

22. Ni(28): [Ar] $4s^2\ 3d^8$; Ni^{2+}(28) : [Ar] $4s^0\ 3d^8$

$[Ni(NH_6)]^{2+}$:



sp^3d^2

It has sp^3d^2 hybridisation (outer orbital complex), octahedral, paramagnetic in nature.

23. $$K_a = c\alpha^2 \Rightarrow \alpha^2 = \frac{K_a}{c}$$

$$\Rightarrow \quad \alpha = \sqrt{\frac{K_a}{c}} = \sqrt{\frac{1.8\times10^{-5}}{0.01}} = \sqrt{18\times10^{-4}} = 4.24 \times 10^{-2}$$

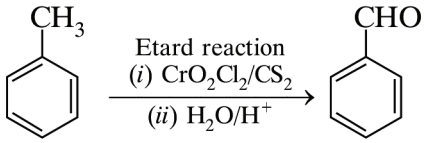
$$\alpha = \frac{\Lambda_m}{\Lambda_m^o} \Rightarrow 4.24 \times 10^{-2} = \frac{\Lambda_m}{390.7}$$

$$\Lambda_m = 4.24 \times 10^{-2} \times 390.7 = 16.57\ Scm^2mol^{-1}$$

24. (*a*) Rate constant '*k*' does not change when concentration of reactants is increased because its value depends on temperature.

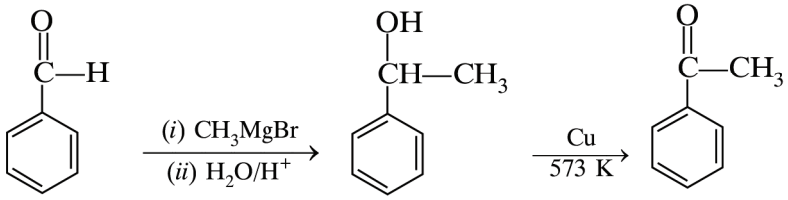
(*b*) Rate constant, '*k*' increases with increase in temperature because rate of reaction increases, therefore, rate constant also increases.

25. (*a*)



Toluene Benzaldehyde

(*b*)



Benzaldehyde 1-Phenyl ethanol Acetophenone

26. (*a*) It is because surface area increases with increase in carbon chain and with branching, surface area decreases. Greater the surface area, more will be van der Waals' forces, hence, higher boiling point. Less surface area, less van der Waals' forces hence, lower boiling point.

(*b*) Phenoxide ion is more stable than $C_6H_5CH_2O^{\ominus}$ ion.

(*c*) It is because ethers are not associated with intermolecular hydrogen bonding, therefore, have lower boiling points.

27. (*a*) $[CrCl_6]^{3-} < [Cr(NH_3)_6]^{3+} < [Cr(CN)_6]^{3-}$, stronger the ligand, more will be Δ_0.

(*b*) Tetrachlorido nickelate (II)

(*c*) The complex which has only one type of ligand is called homoleptic complex, e.g., $[Co(NH_3)_6]^{3+}$.

28. (*a*) 1M NaCl has twice number of particles than 1M glucose, hence, osmotic pressure of 1M NaCl is higher than 1 M glucose solution.

(*b*) $\Delta T_f = 273 - 272.44 = 0.56$

$\Delta T_f = K_f \times m$

$$m = \frac{\Delta T_f}{K_f} = \frac{0.56}{1.86} = 0.30$$

$\pi = CRT$

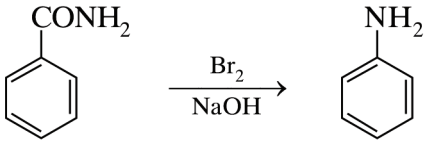
$\pi = 0.30 \times 0.082 \times 310K = 7.626$ atm.

29. (*a*) $CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH \xrightarrow{PCl_5} CH_3CH_2Cl \xrightarrow{KCN} C_2H_5C{\equiv}N$

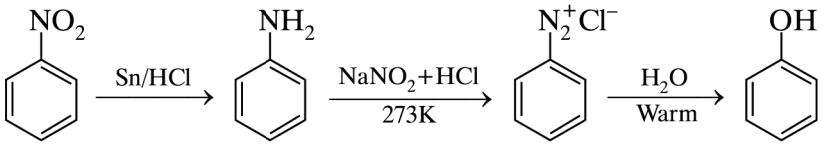
Ethanamine — Ethanol — Chloro ethane

$C_2H_5C{\equiv}N \xrightarrow{LiAlH_4} CH_3CH_2CH_2NH_2$

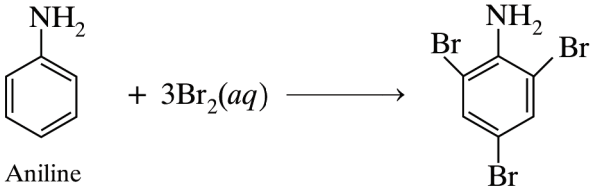
Propane nitrile — 1-Propanamine

(*a*) 

Benzamide — Aniline

(*c*) 

Nitrobenzene — Phenol

(*d*) 

Aniline — 2,4,6-Tribromo aniline

30. (*a*) 1-Bromo-4-chloro but-2-ene

(*b*) It is due to double bond character between C···Cl bond in $CH_2=CHCl$

$CH_2=CH-\ddot{Cl}: \longleftrightarrow \overset{\ominus}{C}H_2-CH=\overset{\oplus}{Cl}$, but not in CH_3CH_2Cl.

(*c*) It is due to presence $\left(CH_3-\overset{*}{\underset{\displaystyle Cl}{\underset{|}{C}}}H-CH_2-CH_3\right)$ of chiral 'C' atom.

Or

(*a*) $C_2H_5Cl + \overset{\oplus}{K}-\overset{\ominus}{O}-N=O \longrightarrow C_2H_5-O-N=O + KCl$

(*b*) $CH_3CH_2Br + NaI \xrightarrow{\text{Acetone}} CH_3CH_2I + NaBr$

(*c*) $CH_3-\underset{\displaystyle Cl}{\underset{|}{C}}H-CH_2-CH_3 + KOH\,(alc) \xrightarrow{\text{Ethanol}} \underset{\text{But-2-ene}}{CH_3-CH=CH-CH_3}$

31. (*a*) Cancer is caused by changes in DNA due to genetic changes, leads to abnormal cells.

(*b*) Chemotherapy is followed by radiotherapy. Surgery may be needed in some cases before radiotherapy.

(*c*) Nucleic acids are delivered into tumor or normal cells which change the pattern of expression of genes whose products achieve the desired effect.

Or

(*c*) (*i*) Genes or portion of genes, oligonucleotides of RNA are present in nucleic acids.

(*ii*) Oligonucleotides are short, single or double stranded DNA or RNA molecules, made up of large number of nucleotides.

32. (*a*) It is because both are non-electrolytes and contain equal number of particles.

(*b*) It is because number of particles in $NaCl\,(aq) \longrightarrow Na^+ + Cl^-$ are twice and in $K_2SO_4(aq) \longrightarrow 2K^+(aq) + SO_4^{2-}(aq)$, particles are three times as compared to glucose and cane sugar.

(*c*) $\Delta T_b = iK_b \times \frac{W_B}{M_B} \times \frac{1000}{W_A}$ $\alpha = 95\%$

$\Delta T_b = 1.95 \times 0.52 \times \frac{5.85}{58.5} \times \frac{1000}{250}$ $\alpha = \frac{i-1}{n-1} \Rightarrow 0.95 = \frac{i-1}{2-1}$

$\Delta T_b = \frac{1.95 \times 4 \times 0.52}{10} = 0.4056K$ $\Rightarrow \boxed{i = 1.95}$

Or

$K_2SO_4 \longrightarrow 2K^+(aq) + SO_4^{2-}(aq)$

$i = 3, \quad \Delta T_b = iK_b \times \frac{W_B}{M_B} \times \frac{1000}{W_A}$

$\Rightarrow \quad 3 \times 0.52 \times \frac{W_B}{174} \times \frac{1000}{500} = 1$

$W_B = \frac{174}{3 \times 0.52 \times 2} = \frac{174}{3.12} = 55.769$ g

33. (*a*) $\underset{\text{'A'}}{CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3} + H_2O \xrightarrow[\text{dil. } H_2SO_4]{H^+} \underset{\text{'B'}}{CH_3CH_2CH_2COOH} + \underset{\text{'C'}}{CH_3CH_2CH_2CH_2OH}$

Butyl butanoate — Butanoic acid — Butan-l-ol

$\underset{\text{'C'}}{CH_3CH_2CH_2CH_2OH} \xrightarrow[\text{(Chromic acid)}]{\text{conc. } K_2Cr_2O_2 + H_2SO_4} \underset{\text{'B'}}{CH_3CH_2CH_2COOH}$

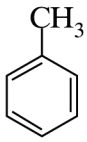
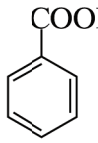
$\underset{\text{'C'}}{CH_3CH_2CH_2CH_2OH} \xrightarrow[\Delta]{\text{conc. } H_2SO_4} \underset{\text{'D'}}{CH_3—CH_2—CH=CH_2} + H_2O$

But-l-ene

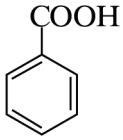
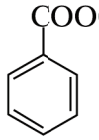
(*b*) Pentane-2,4-dione

(*c*) $C_6H_5—\overset{O}{\overset{\|}{C}}—H + CH_3CH_2CHO \xrightarrow[\Delta]{NaOH} C_6H_5—\underset{CH_3}{\overset{OH}{\underset{|}{\overset{|}{CH}}}}—CH \; —\overset{O}{\overset{\|}{C}}—H \xrightarrow{\Delta} C_6H_5—CH=\underset{CH_3}{\overset{O}{\underset{|}{\overset{\|}{C}}}}—C—H$

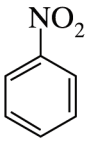
Or

(*a*) (*i*)  + CH_3Cl $\xrightarrow{AlCl_3(anhy.)}$  $\xrightarrow[K_2Cr_2O_2 / H_2SO_4]{conc.}$ 

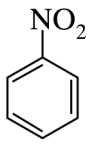
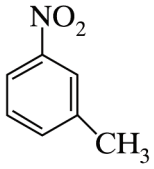
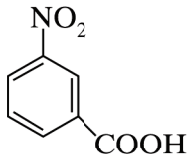
Benzene — Toluene — Benzoic acid

 + CH_3OH $\xrightarrow{conc.\ H_2SO_4}$ 

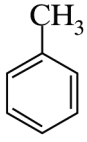
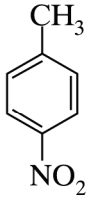
Benzoic acid — Methyl benzoate

(*ii*)  + HNO_3 $\xrightarrow[conc.\ H_2SO_4]{conc.}$ 

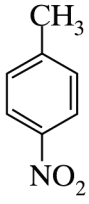
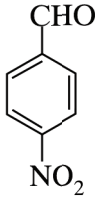
Benzene — Nitrobenzene

 $\xrightarrow[CH_3Cl]{AlCl_3(anhy.)}$  $\xrightarrow[(ii)\ H^+]{(i)\ \Delta,\ KMnO_4/KOH}$ 

Nitrobenzene — *m*-nitro toluene — *m*-Nitro benzoic acid

(*iii*)  + CH_3Cl $\xrightarrow{AlCl_3}$  + HNO_3 $\xrightarrow{H_2SO_4}$ 

Benzene — *p*-nitro toluene

 $\xrightarrow[(ii)\ H_2O/H^+]{(i)\ CrO_2Cl_2/CS_2}$ 

p-nitro toluene — *p*-nitro benzaldehyde

(*b*) Add I_2 and NaOH. Pentan-2-one will give yellow ppt. of Iodoform but pentan-3-one will not.

(*c*) It is because HCOOH does not have α-hydrogen.

34. (*a*) $\frac{2}{3}\ Al^{3+} + 4e^- \longrightarrow \frac{4}{3}\ Al$

$\boxed{n = 4}$, $\Delta G^\circ = -nE^\circ F$

$960 \times 1000\ J = -4 \times E^\circ_{cell} \times 96500$

$E^\circ_{cell} = -\frac{960000}{4 \times 96500} = -\frac{9600}{3860} = -2.48\ V$

(*b*) (*i*) $AgNO_3(aq) \longrightarrow Ag^+(aq) + NO_3^-$

$H_2O(l) \longrightarrow H^+(aq) + OH^-$

At cathode: $Ag^+ + e^- \longrightarrow Ag$

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

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

$H_2O(l) \longrightarrow H^+ + OH^-(aq)$

At cathode: $2H^+ + 2e^- \longrightarrow H_2$

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

Or

(*a*) $m = Z \times I \times t$ $\quad \left[Z = \frac{\text{Eq. Wt}}{96500}\right] \quad \left[\text{Eq Wt} = \frac{\text{At. Wt}}{\text{Valency}}\right]$

$m = \frac{58.7}{2 \times 96500} \times 5 \times 20 \times 60s = \frac{58.7 \times 30}{965} = \frac{1761}{965} = 1.825\ g$

$m = 1.825\ g$

(*b*) It states that limiting molar conductivity (Λ°_m) of an eletrolyte is equal to sum of contribution due to cations as well as anions at infinite dilution.

$$\Lambda^\circ_m\ NaCl = \lambda^\circ Na^+ + \lambda^\circ Cl^-$$

(*c*) It is because no ions are involved in net cell reaction, therefore, its emf remains constant (1.35 V) over a long period of time.

35. (*a*) +3 is most common oxidation state in lanthanoids. Few elements show +2 and +4 oxidation states also.

(*b*) It is due to increase in effective nuclear charge.

(*c*) (*i*) Ti^{3+} (22) : [Ar] $4s^0 3d^1$ (There is one unpaired electron)

(*ii*) V^{3+} (23) : [Ar] $4s^0 3d^2$ (There is 2 unpaired electrons)

(*d*) Ce^{3+} has $4f^1$ $\mu_B = \sqrt{n(n+2)} = \sqrt{1 \times 3} = 1.732$ B.M.

(*e*) It is because Cu^{2+} ($3d^9$), has incompletely filled *d*-orbitals.