Answers to RSPL/3

1. (*a*) ∵ Phenols do undergo nucleophilic substitution reaction.

2. (*d*) ∵ 3° carbocation is most stable.

3. (*b*) Dil. H_2SO_4 is used.

4. (*c*) $\Delta H = (E_a)_f - (E_a)_b$

$\Rightarrow \quad -38 \text{ kJ} = 20 \text{ kJ} - (E_a)_b$

$\Rightarrow \quad (E_a)_b = 58 \text{ kJ mol}^{-1}$

5. (*d*) $m = Z \times Q$

$\Rightarrow \quad 100 = \frac{40}{2} \times Q \Rightarrow Q = 5F \text{ (Faraday)}$

6. (*b*) 1st order reaction $\boxed{t_{1/2} = \frac{0.693}{k}}$

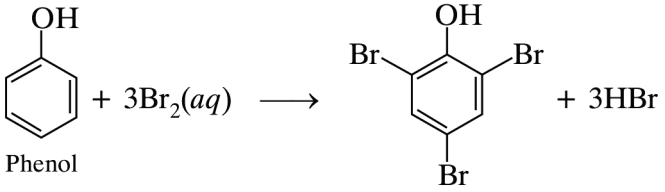
7. (*b*) Primary amines have highest boiling point, due to maximum intermolecular H-bonding.

8. (*c*) Primary valency is 2, secondary valency is 4.

$$[Pd(NH_3)_4]Cl_2 + 2AgNO_3(aq) \longrightarrow [Pd(NH_3)_4](NO_3)_2 + 2AgCl\downarrow$$

(Excess) (White ppt.)

9. (*d*)

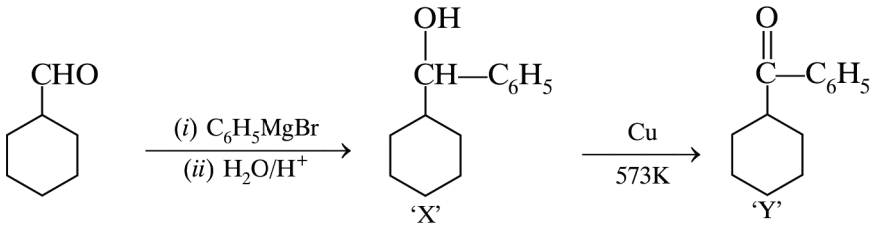


Phenol

2, 4, 6-Tribromo phenol

10. (*d*) It is Gattermann reaction, others are Sandmeyer's reaction.

11. (*d*)



'X' 'Y'

12. (*d*) $\text{rate} = k[x]^n \Rightarrow \text{mol L}^{-1}\text{ s}^{-1} = k\,[\text{mol L}^{-1}]^n$

$k = \text{mol}^{1-n}\,\text{L}^{n-1}\,\text{s}^{-1}$

13. (*c*) $\underset{[A]}{C_6H_5CHO} + \underset{[B]}{CH_3CHO} \xrightarrow{NaOH} C_6H_5-\underset{\displaystyle CH}{\underset{|}{}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-H$

$$\xrightarrow{Heat} C_6H_5-CH=CH-\overset{\displaystyle O}{\overset{\|}{C}}-H$$

14. (*b*) Since, Ti^{4+} does not have unpaired electrons.

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

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

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

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

19. $$\text{Rate} = k[A]^x\,[B]^y$$

$$4 \times 10^{-3} = k[6 \times 10^{-2}]^x\,[1 \times 10^{-2}]^y \quad \ldots(i)$$

$$8 \times 10^{-3} = k[6 \times 10^{-2}]^x\,[2 \times 10^{-2}]^y \quad \ldots(ii)$$

Dividing (*i*) by (*ii*), we get

$$\frac{1}{2} = \frac{1}{2^y} \Rightarrow 2^y = 2^1 \Rightarrow y = 1$$

$$4 \times 10^{-3} = k[6 \times 10^{-2}]^x\,[1 \times 10^{-2}]^y \quad \ldots(iii)$$

$$8 \times 10^{-3} = k[12 \times 10^{-2}]^x\,[1 \times 10^{-2}]^y \quad \ldots(iv)$$

Dividing (*iii*) by (*iv*), we get

$$\frac{1}{2} = \frac{1}{2^x} \Rightarrow 2^x = 2^1 \Rightarrow x = 1$$

Order of the reaction is $x + y = 1 + 1 = 2$

$$\text{Rate} = k[A]^1\,[B]^1$$

$$4 \times 10^{-3} = k[6 \times 10^{-2}]\,[1 \times 10^{-2}]$$

$$k = \frac{4}{6} \times 10 = \frac{40}{6} = 6.66 \text{ L mol}^{-1} \text{ min}^{-1}$$

20. RNA, on complete hydrolysis gives β-D-ribose, phosphoric acid and heterocyclic bases, Adenine(A), Uracil(U), Cytosine(C) and Guanine(G).

Or

(*a*) It shows glucose has —CHO group which gets oxidised to —COOH by mild oxidising agent [$Br_2(aq)$].

(*b*) It shows glucose has 5 —OH groups.

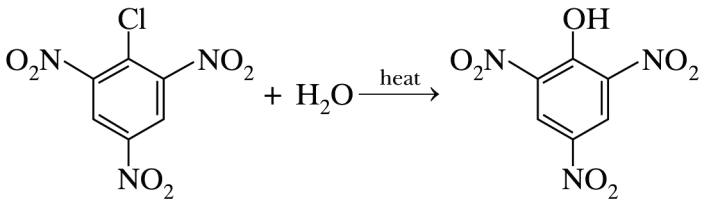
21. (*a*) In S_N1, racemisation takes place i.e. *dl*(±) mixture is formed.

In S_N2, inversion of configuration takes place i.e. *d*(+) changes to *l*(–) and vice-versa.

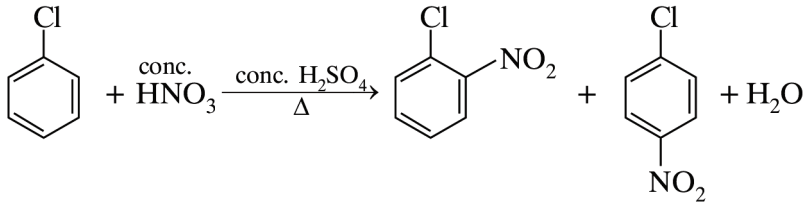
(*b*) It is because allyl carbocation ($CH_2{=}CH{-}\overset{\oplus}{C}H_2$) is more stable.

Or

(*a*) 2, 4, 6-Trinitro phenol (Picric acid) will be formed.



(*b*) *o* & *p*-nitro chloro benzene will be formed.



22. $[Ni(CO)_4]$ has sp^3 hybridisation, therefore, it is tetrahedral.

$[Ni(CN)_4]^{2-}$ has dsp^2 hybridisation, therefore, it is square planar.

23. $Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$

$Cd^{2+}(aq) + 2e^- \longrightarrow Cd(s)$

$E_{Cell} = E^\circ_{Cd^{2+}/Cd} - E^\circ_{Zn^{2+}/Zn} = -0.40\ V - (-0.76\ V) = +0.36\ V$

$$E_{Cell} = E^\circ_{Cell} - \frac{0.0591}{n} \log \frac{[Zn^{2+}]}{[Cd^{2+}]}$$

$$= 0.36\ V - \frac{0.0591}{2} \log \frac{4 \times 10^{-2}}{2 \times 10^{-1}}$$

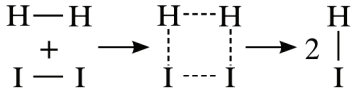
$$= 0.36\ V - \frac{0.0591}{2} (\log 2 + \log 10^{-1})$$

$$= 0.36\ V - \frac{0.0591}{2}\ (0.3010 - 1.000)$$

$$= 0.36\ V + 0.0295 \times 0.6990$$

$$= 0.36\ V + 0.0206 = 0.3806\ V$$

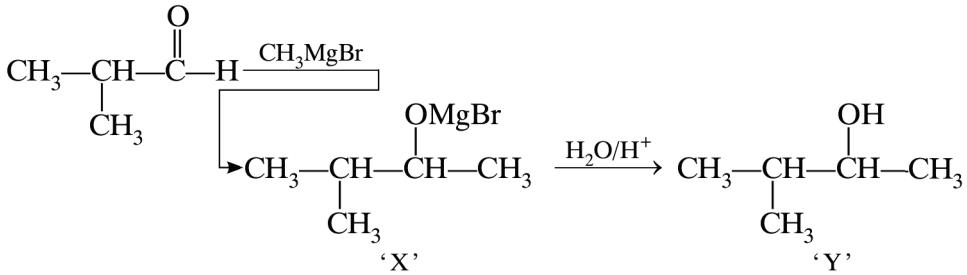
24. (*a*) **Activated complex:** It is intermediate between reactants and products which is highly unstable and readily changes into product e.g.



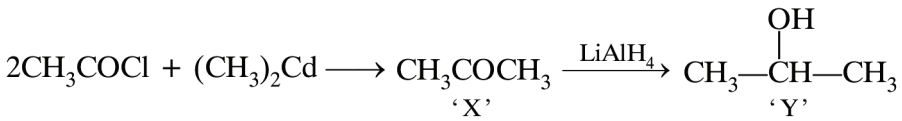
Activated complex

(*b*) **Activation energy:** It is extra energy which must be supplied to reactants so as to form activated complex which readily changes into product.

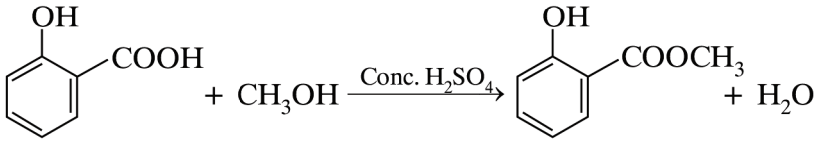
25. (*a*)



(*b*)

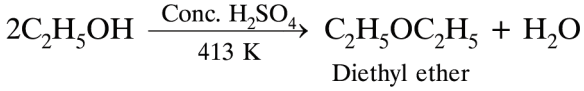


26. (*a*)



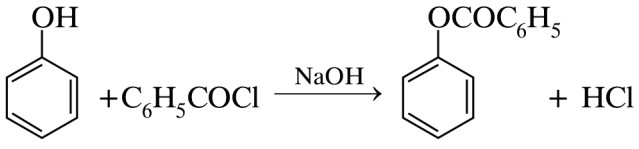
Methyl salicylate

(*b*)



Diethyl ether

(*c*)



Phenyl benzoate

27. (*a*) 0, 6

(*b*) $[Co(NH_3)_5SO_4]Br$, Pentaammine sulphato cobalt (III) bromide.

(*c*) $[Co(en)_3]^{3+} < [Ni(NH_3)_6]^{2+} < [Fe(H_2O)_6]^{2+}$ due to increase in number of unpaired electrons.

28. (*a*) Those solutions which follow Raoult's law are known as ideal salution.

$\Delta H_{mixing} = 0$; $\Delta V_{mixing} = 0$.

(*b*) $W_B = ?$ $\Delta T_b = 373.52 - 373 = 0.52$ K, $W_A = 2$ kg, $K_b = 0.52$ K kg mol^{-1}

M = 342 g/mol

$$\Delta T_b = K_b \times \frac{W_B}{M_B} \times \frac{1000}{W_A}$$

$$0.52 = 0.52 \times \frac{W_B}{342} \times \frac{1000}{2000}$$

$$W_B = 342 \times 2 = 684 \text{ g}$$

29. (*a*) $CH_3CH_2I \xrightarrow{NaCN} CH_3CH_2C{\equiv}N \xrightarrow[\text{partial hydrolysis}]{OH^-} CH_3CH_2{-}\overset{\overset{O}{\|}}{C}{-}NH_2$

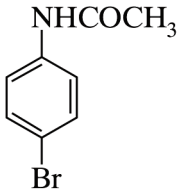
Iodoethane; 'A' Propane nitrile; 'B' Propanamide

(*b*) $C_6H_5N_2^+Cl^- \xrightarrow{CuCN} C_6H_5C{\equiv}N \xrightarrow{H_2O/H^+} C_6H_5COOH$

Benzene diazonium chloride; 'A' Benzonitrile; 'B' Benzoic acid

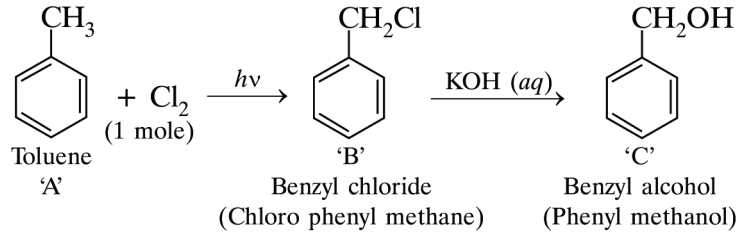
(*c*) $C_2H_5NO_2 \xrightarrow{Sn/HCl} C_2H_5NH_2 \xrightarrow[0\text{-}5°C]{HNO_2} C_2H_5OH$

Nitroethane; 'A' Ethanamine; 'B' Ethanol

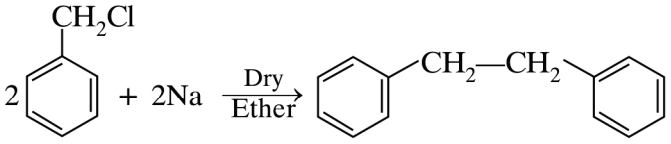
(*d*) $C_6H_5NH_2 \xrightarrow[Pyridine]{CH_3COCl} C_6H_5NHCOCH_3 \xrightarrow[CH_3COOH]{Br_2}$ 

Aniline; 'A' N-Phenyl ethanamide; 'B' (*p*-Bromo acetanilide) 4-Bromo phenyl ethanamide)

30.



Toluene 'A' | 'B' Benzyl chloride (Chloro phenyl methane) | 'C' Benzyl alcohol (Phenyl methanol)



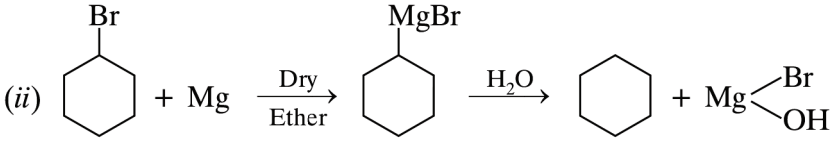
'B' | 'D' 1, 2-diphenyl ethane

Or

(*i*) $2CHCl_3 + O_2 \xrightarrow{\text{sunlight}} 2COCl_2 + 2HCl$

Carbonyl chloride (Phosgene)

(*ii*)



Cyclohexane

(*iii*) $C_2H_5ONa + CH_3I \longrightarrow C_2H_5OCH_3 + NaI$

Methoxy ethane

31. (*a*) It is because rate of metabolism is slow in elderly people than younger people.

(*b*) Polysaccharides are healthier because these produce energy slowly.

(*c*) (*i*) Insulin controls blood sugar in our body.

(*ii*) It is because rate of metabolism will increase and blood sugar will decrease.

Or

(*c*) (*i*) Proteins are essential for growth and development of body. They strengthen muscles of our body. That is why, protein should be increased in diet especially for growing children. White of egg contains protein (albumin)

(*ii*) Fruits and vegetables are rich in vitamins, minerals and fibres which help in digestion and keep body healthy.

32. (*a*) It is because both are non-electrolytes, have equal number of particles i.e. isotonic.

(*b*) It is because NaCl is electrolyte, ionises in aqueous solution, particles are double than 0.1 M urea solution.

(*c*) $\pi = iCRT$

$$7.143 = i \times 0.1 \times 0.082 \times 300$$

$$i = \frac{7.143}{2.46} = 2.90$$

$$\alpha = \frac{i-1}{n-1} = \frac{2.90-1}{3-1} = \frac{1.90}{2} = 0.95$$

$$\alpha = 0.95 \times 100 = 95\%$$

Or

(*a*) In hypertonic solution, cell will shrink because cell fluids will come out.

(*b*) In hypotonic solution, cell will swell and may burst because solution will enter the cell.

33. (*a*) $CH_3—CH_2—\overset{O}{\overset{\|}{C}}—H$ ('A') $\xrightarrow{\text{Tollen's reagent}}$ $CH_3—CH_2—\overset{O}{\overset{\|}{C}}—OH + Ag\downarrow$ (silver mirror)

'A' $\xrightarrow{I_2/NaOH}$ No reaction

$CH_3—\overset{O}{\overset{\|}{C}}—CH_3$ ('B') $\xrightarrow{I_2/NaOH}$ $CHI_3 + CH_3COONa$

'B' $\xrightarrow{\text{Tollen's reagent}}$ No reaction

$CH_3—CH_2—\overset{O}{\overset{\|}{C}}—H$ ('A') $\xrightarrow[\text{conc. HCl}]{\text{Zn(Hg)}}$ $CH_3CH_2CH_3$ ('C') Propane

$CH_3—\overset{O}{\overset{\|}{C}}—CH_3$ ('B') $\xrightarrow[\text{conc. HCl}]{\text{Zn(Hg)}}$ $CH_3CH_2CH_3$ ('C') Propane

(*b*) $CH_3—CH=N—NH—\overset{O}{\overset{\|}{C}}—NH_2$ (semicarbazone of acetaldehyde)

(*c*) 4-oxo-pentanoic acid.

Or

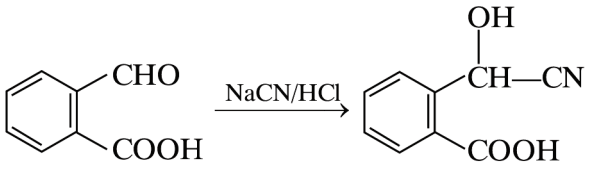
(*a*) (*i*) It is due to steric hindrance.

(*ii*) It is due to double bond character between C----N bond due to resonance.

$$H_2N—NH—\overset{\ddot{O}:}{\overset{\|}{C}}—\ddot{N}H_2 \leftrightarrow H_2N—NH—\overset{:\ddot{O}:^{\ominus}}{\overset{|}{C}}=\overset{\oplus}{N}H_2$$

(*iii*) If H_2O or ester is not removed, product will change into reactants back.

(*b*) (*i*) $CH_3COCH_2COOC_2H_5 \xrightarrow[(ii)\ H^+]{(i)\ NaBH_4} CH_3\overset{\overset{OH}{|}}{C}H—CH_2COOC_2H_5$

(*ii*) 

34. (*a*) (*i*) Its efficiency is higher than ordinary cell.

(*ii*) It does not create pollution.

(*b*) $A(s) \longrightarrow A^{2+}(aq) + 2e^-$

$B^{2+}(aq) + 2e^- \longrightarrow B(s)$

$n = 2,\ K_c = 10,\ E^\circ_{Cell} = ?$

$$\log K_c = \frac{nE^\circ}{0.0591} \Rightarrow \log 10 = \frac{2 \times E^\circ}{0.0591}$$

$$E^\circ_{Cell} = \frac{0.0591}{2} = 0.0296 \text{ V}$$

(*c*) Specific conductance of electrolyte increases with increase in concentration because number of ions per unit volume increase.

Or

(*a*) $$\Lambda_m = \frac{1000 \times \kappa}{M}$$

$$\Lambda_m = \frac{1000 \times 0.025 \text{ S cm}^{-1}}{0.2 \text{ M}}$$

$$\Lambda_m = \frac{1000 \times 25 \times 10}{1000 \times 2} = 125 \text{ Scm}^2 \text{ mol}^{-1}$$

(*b*) (*i*) Mercury cell

(*ii*) Fuel cell (H_2—O_2)

(*iii*) Lead storage battery

(*iv*) Dry cell

(*c*) It is because $E^\circ_{F_2/F^-}$ (reduction potential) is highest.

35. (*a*) The decrease in atomic and ionic size among lanthanoids with increase in atomic number is called **lanthanoid contraction**.

Cause: Its cause is poor shielding effect of 4*f* electrons, ∴ effective nuclear charge increases.

(*b*) It is because Fe^{2+} loses one electron to form $Fe^{3+}(3d^5)$ which is more stable.

(*c*) It is because $Fe^{2+}(26)$ has more effective nuclear charge than $Mn^{2+}(25)$.

(*d*) It is because $Yb^{2+}(4f^{14})$ is more stable due to completely filled *f*-orbitals.