



Chapter Contents

02

JEE (MAIN) TOPICWISE SOLUTION OF TEST PAPERS JANUARY & SEPTEMBER 2020

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JANUARY & SEPTEMBER 2020 ATTEMPT (PC)

MOLE CONCEPT

1. NTA Ans. (3)

Sol. Option(3) is according to Gaylussac's law of volume combination.

2. NTA Ans. (3)

Sol. $\text{NH}_2\text{CONH}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{CO}_3 + 2\text{NH}_3$
 10 mmoles 20mmoles
 Hence, NH_3 will require 20 meq.

3. NTA Ans. (4.95 to 4.97)

Sol. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ (M = 277.85)

$$\text{ppm} = \frac{\text{wt. of Fe}}{\text{wt. of wheat}} \times 10^6$$

let the wt. of salt be = w gm

$$\text{moles} = \frac{w}{277.85}$$

$$\text{wt. of Fe} = \left(\frac{W}{277.85} \times 55.85 \right) \text{gm}$$

$$10 = \frac{\frac{W}{277.85} \times 55.85}{10^5} \times 10^6$$

$$W = \frac{277.85}{55.85} = 4.97$$

4. NTA Ans. (2120 to 2140)

Sol. Mole of O_2 consumed = $\frac{1 \times 492}{0.082 \times 300} = 20$

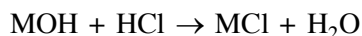
Mole of NaClO_3 required = 20

Mass of $\text{NaClO}_3 = 20 \times 106.5 = 2130 \text{ gm}$

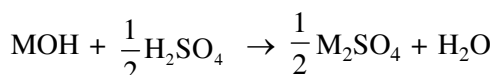
5. NTA Ans. (1)

Sol. IE values indicate, that the metal belongs to 1st group since second IE is very high (\because only one valence electron)

Metal hydroxide will be of type, MOH.



(1mol) (1mol)



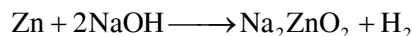
(1mol) ($\frac{1}{2}$ mol)

So one mole of HCl required to react with one mole MOH.

So $\frac{1}{2}$ mole of H_2SO_4 required to react with one mole MOH.

6. NTA Ans. (4)

Sol. $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$

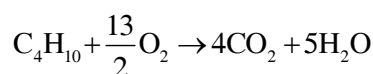


The ratio of the volume of H_2 is 1 : 1

7. Official Ans. by NTA (18)

Sol. $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
1mole 5mole

For 1 mole propane combustion 5 mole O_2 required



1 mole 6.5 mole

2 mole 13 mole

For 2 moles of butane 13 mole of O_2 is required
 total moles = 13 + 5 = 18

8. Official Ans. by NTA (5.00)

Sol. C : H = 4 : 1

C : O = 3 : 4

Mass ratio

C : H : O = 12 : 3 : 16

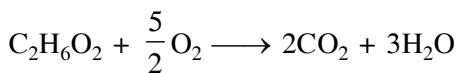
Mole ratio

C : H : O = 1 : 3 : 1

Empirical formula = CH_3O

Molecular formula = $\text{C}_2\text{H}_6\text{O}_2$

(saturated acyclic organic compound)



2 mole 5 mol

Moles of O_2 required = 5 moles

9. Official Ans. by NTA (50.00)

CONCENTRATION TERMS

1. NTA Ans. (14.00)

Sol. 100 gm soln \rightarrow 63 gm HNO_3

$$\frac{100}{1.4} \text{ mL} \rightarrow 1 \text{ mole } \text{HNO}_3$$

$$\text{Molarity} = \frac{1}{\frac{100}{1.4} \times \frac{1}{1000}} = 14\text{M}$$

2. NTA Ans. (10)

$$\text{Sol. ppm} = \frac{10.3 \times 10^{-3}}{1030} \times 10^6 = 10$$

3. Official Ans. by NTA (100)

Sol. Volume strength of H_2O_2 at 1 atm
 $273 \text{ kelvin} = M \times 11.2 = 8.9 \times 11.2 = 99.68$
 Ans : 100

4. Official Ans. by NTA (47)

Sol. $X_{\text{C}_6\text{H}_{12}\text{O}_6} = 0.1$
 Let total mole is 1 mol then mole of glucose will be 0.1 and mole of water will be 0.9

$$\text{so mass \% of water} = \frac{0.9 \times 18}{0.1 \times 180 + 0.9 \times 18} \times 100$$

$$= 47.36$$

Ans : 47

5. Official Ans. by NTA (25)

$$\text{Sol. moles} = \frac{\text{number of molecules}}{6 \times 10^{23}} = \frac{\text{given mass}}{\text{molar mass}}$$

$$\Rightarrow \text{molar mass} = \frac{10 \times 6.023 \times 10^{23}}{6.023 \times 10^{22}} = 100 \text{ g/mol}$$

$$\Rightarrow \text{molarity} = \frac{\text{moles of solute}}{\text{volume of sol}^n (\ell)} = \frac{(5/100)}{2} = 0.025$$

6. Official Ans. by NTA (2)

Sol. Volume strength = $11.2 \times \text{molarity}$

$$\Rightarrow \text{molarity} = \frac{5.6}{11.2} = 0.5$$

Assuming 1 litre solution;

mass of solution = $1000 \text{ ml} \times 1 \text{ g/ml} = 1000 \text{ g}$

mass of solute = moles \times molar mass
 $= 0.5 \text{ mol} \times 34 \text{ g/mol}$
 $= 17 \text{ gm.}$

$$\Rightarrow \text{mass\%} = \frac{17}{1000} \times 100 = 1.7\%$$

7. Official Ans. by NTA (4)

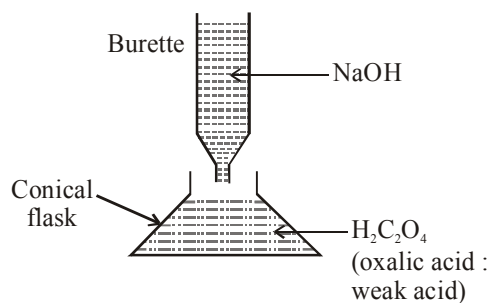
REDOX REACTIONS

1. NTA Ans. (3)

Sol. Potassium has an oxidation of +1 (only) in combined state.

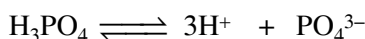
2. NTA Ans. (4)

Sol.



3. NTA Ans. (4)

Sol. (i) H_2O_2 act as oxidising agent as well as reducing agent depending on condition.
 (ii) H_2SO_3 act as oxidising agent as well as reducing agent depending on condition.
 (iii) HNO_2 act as oxidising agent as well as reducing agent depending on condition.
 (iv) H_3PO_4 can not act both as oxidising and reducing agent.
 H_3PO_4 can act as only oxidising agent.

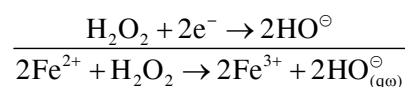


4. NTA Ans. (100)

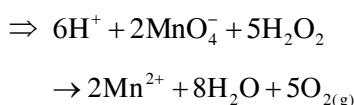
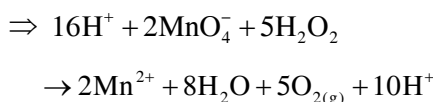
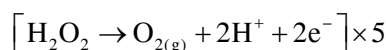
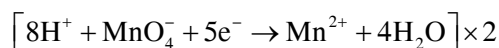
Sol. 1 Litre has 10^{-3} moles MgSO_4
 So, 1000 litre has 1 mole MgSO_4
 $= 1 \text{ mole CaCO}_3$
 $= 100 \text{ ppm}$

5. Official Ans. by NTA (19)

Sol. $[\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + e^-] \times 2$



$$x = 2 \quad y = 2$$



So $x' = 2 \quad y' = 8 \quad z' = 5$

so $x + y + x' + y' + z'$

$$\Rightarrow 2 + 2 + 2 + 8 + 5$$

$$\Rightarrow 19$$

6. Official Ans. by NTA (10)**Sol.** Molar mass of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$

$$\Rightarrow 23 \times 2 + 12 + 48 + 18x$$

$$\Rightarrow 46 + 12 + 48 + 18x$$

$$\Rightarrow (106 + 18x)$$

$$\text{Eqwt} = \frac{M}{2} = (53 + 9x)$$

As n_{factor} in dissolution will be determined from net cationic or anionic charge; which is 2 so

$$\text{Eqwt} = \frac{M}{2} = 53 + 9x$$

$$\text{Gmeq} = \frac{\text{wt}}{\text{Eqwt}} = \frac{1.43}{53 + 9x}$$

$$\text{Normality} = \frac{\text{Gmeq}}{V_{\text{litre}}}$$

$$\text{Normality} = 0.1 = \frac{1.43}{\frac{53 + 9x}{0.1}}$$

$$\begin{aligned} \text{As volume} &= 100 \text{ ml} \\ &= 0.1 \text{ Litre} \end{aligned}$$

$$\text{So } 10^{-2} = \frac{1.43}{53 + 9x}$$

$$53 + 9x = 143$$

$$9x = 90$$

$$x = 10.00$$

7. Official Ans. by NTA (85)**Sol.** Eq of $\text{H}_2\text{O}_2 = \text{Eq}$ of KMnO_4

$$x \times 2 = \frac{0.316}{158} \times 5$$

$$x = 5 \times 10^{-3} \text{ mol}$$

$$m_{\text{H}_2\text{O}_2} = 5 \times 10^{-3} \times 34 = 0.17 \text{ gm}$$

$$\% \text{H}_2\text{O}_2 = \frac{0.17}{0.2} \times 100 = 85$$

8. Official Ans. by NTA (10)**Sol.** $\text{H}_3\text{PO}_2 + \text{NaOH} \rightarrow \text{NaH}_2\text{PO}_2 + \text{H}_2\text{O}$

$$\frac{n_{\text{H}_3\text{PO}_2 \text{ reacted}}}{1} = \frac{n_{\text{NaOH} \text{ reacted}}}{1}$$

$$\Rightarrow \frac{0.1 \times 10}{1} = 0.1 \times V_{\text{NaOH}}$$

$$\Rightarrow V_{\text{NaOH}} = 10 \text{ ml.}$$

9. Official Ans. by NTA (50.00)**Sol.** $\text{K}_2\text{Cr}_2\text{O}_7 + \text{FeC}_2\text{O}_4 \longrightarrow \text{Cr}^{+3} + \text{Fe}^{+3} + \text{CO}_2$

$$n = 6 \quad n = 3$$

$$\frac{0.02 \times 6 \times V(\text{mL})}{1000} = \frac{0.288}{144} \times 3$$

$$\Rightarrow \boxed{V = 50 \text{ mL}}$$

10. Official Ans. by NTA (19.00)**Sol.** $\text{K}_2\text{Cr}_2\text{O}_7$

$$2(+1) + 2x + 7(-2) = 0$$

$$x = +6$$

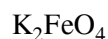
In $\text{K}_2\text{Cr}_2\text{O}_7$, Transition metal (Cr) present in +6 oxidation state.



$$(+1) + y + 4(-2) = 0$$

$$x = +7$$

In KMnO_4 , transition metal (Mn) present in +7 oxidation state



$$2(+1) + z + 4(-2) = 0$$

$$x = +6$$

In K_2FeO_4 , transition metal (Fe) present in +6 oxidation state

$$\text{So, } x = +6$$

$$y = +7$$

$$z = +6$$

$$\underline{\quad\quad\quad}$$

$$x + y + z = 19$$

IDEAL GAS

1. NTA Ans. (4)

Sol. $v_{mp} \left(= \sqrt{\frac{2RT}{M}} \right) < v_{av} \left(= \sqrt{\frac{8RT}{\pi M}} \right) < v_{rms} \left(= \sqrt{\frac{3RT}{M}} \right)$

2. Official Ans. by NTA (3)

Sol. According to Dalton's law of partial pressure

$$p_i = x_i \times P_T$$

p_i = partial pressure of the i^{th} component

x_i = mole fraction of the i^{th} component

P_T = total pressure of mixture

$$\Rightarrow 2 \text{ atm} = \left(\frac{n_{\text{H}_2}}{n_{\text{H}_2} + n_{\text{H}_e} + n_{\text{O}_2}} \right) \times P_T$$

$$\Rightarrow P_T = 2 \text{ atm} \times \frac{3}{1} = 6 \text{ atm}$$

3. Official Ans. by NTA (1)

Sol. $PM = dRT \Rightarrow d \propto \frac{1}{T}$

4. Official Ans. by NTA (750.00)

ATOMIC STRUCTURE

1. NTA Ans. (2)

Sol. No. of orbitals = $n^2 = 5^2 = 25$

For $n = 5$, no. of orbitals = $n^2 = 25$

Total number of orbitals is equal to no. of

electrons having $m_s = \frac{1}{2}$

2. NTA Ans. (2)

Sol. For balmer : $n_1 = 2, n_2 = 3, 4, 5, \dots \infty$

$$\frac{1}{\lambda} = R_H \left[\frac{1}{2^2} - \frac{1}{n_2^2} \right]$$

$$\frac{1}{\lambda_{\text{longest}}} = R_H \left[\frac{1}{2^2} - \frac{1}{3^2} \right]$$

Ans.(2)

3. NTA Ans. (4)

Sol. $r_n = \frac{n^2 \times a_0}{Z}$

For 2nd Bohr orbit of Li^{+2}

$$n = 2$$

$$Z = 3$$

$$\Rightarrow r_n = \frac{2^2 \times a_0}{3} = \frac{4a_0}{3}$$

4. NTA Ans. (1)

Sol. $2\pi r = n\lambda$

for $n = 1, r = a_0$

$$n = 4, r = 16a_0$$

So, $2\pi \times 16a_0 = 4 \times \lambda$

$$\lambda = 8\pi a_0$$

5. Official Ans. by NTA (3)

Sol. As we know $\Delta E = \frac{hc}{\lambda}$

So $\lambda = \frac{hc}{\Delta E}$ for λ minimum i.e.

shortest; $\Delta E = \text{maximum}$

for Lyman series $n = 1$ & for ΔE_{max}

Transition must be from $n = \infty$ to $n = 1$

So $\frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$

$$\frac{1}{\lambda} = R_H Z^2 (1 - 0)$$

$$\frac{1}{\lambda} = R \times (1)^2 \Rightarrow \lambda_1 = \frac{1}{R}$$

For longest wavelength $\Delta E = \text{minimum}$ for Balmer series $n = 3$ to $n = 2$ will have ΔE minimum

for $\text{He}^+ Z = 2$

So $\frac{1}{\lambda_2} = R_H \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$

$$\frac{1}{\lambda_2} = R_H \times 4 \left(\frac{1}{4} - \frac{1}{9} \right)$$

$$\frac{1}{\lambda_2} = R_H \times \frac{5}{9}$$

$$\lambda_2 = \lambda_1 \times \frac{9}{5}$$

6. Official Ans. by NTA (4)

$$\text{Sol. } \frac{\Delta R_1}{\Delta R_2} = \frac{(r_4 - r_3)_{4^{2+}}}{(r_4 - r_3)_{\text{He}^+}} = \frac{\frac{4^2}{2} - \frac{3^2}{2}}{\frac{4^2}{2} - \frac{3^2}{2}} = \frac{7/3}{7/2} = \frac{2}{3}$$

7. Official Ans. by NTA (1)

8. Official Ans. by NTA (222.00)

$$\text{Sol. } E = W + K \cdot E_{\text{max}}$$

$$K \cdot E_{\text{max}} = E - W$$

$$= \frac{hc}{\lambda} - 4.41 \times 10^{-19}$$

$$= \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{300 \times 10^{-9}} - 4.41 \times 10^{-19}$$

$$= 2.22 \times 10^{-19} \text{ J}$$

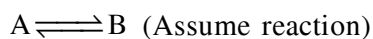
$$= 222 \times 10^{-21} \text{ J}$$

CHEMICAL EQUILIBRIUM

1. NTA Ans. (1)

ALLEN Ans. (1 or Bonus)

Sol. Bonus (no reaction is given)



$$K = \frac{[B]}{[A]} = \frac{11}{6} \approx 2$$

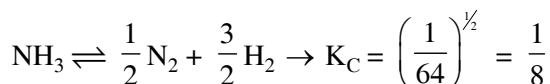
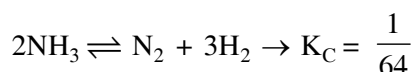
2. Official Ans. by NTA (1)

Sol. $\Delta H^\circ > 0$ $T \downarrow$ equation shifts back ward.

N_2 is treated as inert gas in this case hence no effect on equilibrium.

3. Official Ans. by NTA (2)

Sol. $N_2 + 3H_2 \rightleftharpoons 2NH_3 \rightarrow K_C = 64$



IONIC EQUILIBRIUM

1. NTA Ans. (10.60)

Sol. 4 gm of NaOH in 100 L sol. $\Rightarrow 10^{-3}$ M sol.

9.8 gm of H_2SO_4 in 100 L sol. $\Rightarrow 10^{-3}$ M sol.

Mixture : 40L of 10^{-3} M NaOH and 10 L of 10^{-3} M H_2SO_4 sol.

Final Conc. of OH^-

$$= \frac{10^{-3}(40 \times 1 - 10 \times 1 \times 2)}{40 + 10} = 6 \times 10^{-4} \text{ M}$$

$$pOH = -\log(6 \times 10^{-4})$$

$$= 4 - \log 6 = 4 - 0.60 = 3.40$$

$$pH = 14 - 3.40 = 10.60$$

2. NTA Ans. (5.22 to 5.24)

Sol. 3gm Acetic Acid + 250 ml 0.1 M HCl + Water

\longrightarrow made to 500 ml solution.

\Rightarrow 500 ml solution has 25 meq of HCl

50 meq of CH_3COOH

\therefore 20ml solution has 1 meq of HCl

2 meq of CH_3COOH

We have added 2.5 meq. of NaOH $\left(5M, \frac{1}{2} \text{ ml}\right)$

Finally, NaOH & HCl are completely consumed and we are left with 0.5 meq of CH_3COOH

and 1.5 meq of CH_3COONa

$$pH = pK_a + \log \frac{1.5}{0.5}$$

$$= 4.75 + \log 3 = 4.75 + 0.4771$$

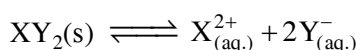
$$= 5.2271$$

3. NTA Ans. (3)

Sol. From the graph & dimensions salt is : XY_2

$$[X] = 1 \times 10^{-3} \text{ M}$$

$$[Y] = 2 \times 10^{-3} \text{ M}$$

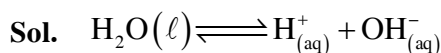


$$K_{sp} = [X^{2+}] [Y^-]^2$$

$$= (10^{-3}) (2 \times 10^{-3})^2$$

$$= 4 \times 10^{-9} \text{ M}^3$$

4. NTA Ans. (2)



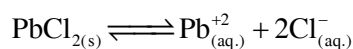
For ionization of H_2O : $\Delta H > 0$
 \Rightarrow ENDOTHERMIC

On temperature increase reaction shifts forward
 \Rightarrow both $[\text{H}^+]$ and $[\text{OH}^-]$ increase
 \Rightarrow pH & pOH decreases.

5. NTA Ans. (2)

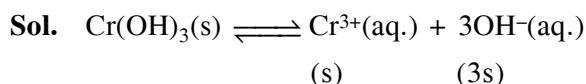
$$\text{Sol. } [\text{Pb}^{2+}] = \frac{300 \times 0.134}{400} = 1.005 \times 10^{-1} \text{ M}$$

$$[\text{Cl}^-] = \frac{100 \times 0.4}{400} = 10^{-1} \text{ M}$$



$$Q = [\text{Pb}^{2+}] \times [\text{Cl}^-]^2 = 1.005 \times 10^{-3} > K_{\text{sp}}$$

6. NTA Ans. (1)

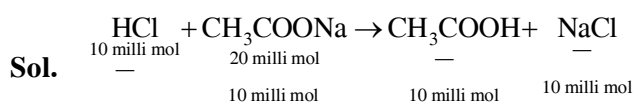


$$K_{\text{sp}} = 27(\text{s})^4 = 6 \times 10^{-31}$$

$$\Rightarrow [3(\text{s})]^4 = 18 \times 10^{-31}$$

$$[\text{OH}^-] = 3(\text{s}) = [18 \times 10^{-31}]^{1/4}$$

7. Official Ans. by NTA (3)



So finally we get mixture of
 $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$ that will work like
 acidic buffer solution.

8. Official Ans. by NTA (3)

Sol. Steep rise in pH around the equivalence point
 for titration of strong acid with strong base.

9. Official Ans. by NTA (37)

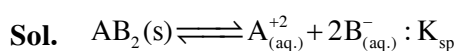
$$\text{Sol. } P_{\text{CO}_2} = K_{\text{H}} \times \text{CO}_2$$

$$\frac{3}{30} = \frac{K_{\text{H}} \cdot n_{\text{CO}_2}}{K_{\text{H}} \cdot 1} \Rightarrow n_{\text{CO}_2} = 0.1 \text{ mol}$$

$$\text{pH} = \frac{1}{2}(\text{p}K_{\text{a}1} - \log c) = \frac{1}{2}(6.4 \times 1) = 3.7$$

$$\text{pH} = 37 \times 10^{-1}$$

10. Official Ans. by NTA (2.00)



$$K_{\text{SP}} = S^1 \times (2S)^2 = 4S^3$$

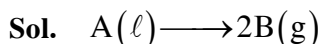
$$3.2 \times 10^{-11} = 4 \times S^3$$

$$S = 2 \times 10^{-4} \text{ M/L}$$

11. Official Ans. by NTA (4)

THERMODYNAMICS

1. NTA Ans. (-2.70 to -2.71)



$$\Delta U = 2.1 \text{ Kcal}, \Delta S = 20 \text{ cal K}^{-1} \text{ at } 300 \text{ K}$$

$$\Delta H = \Delta U + \Delta n_{\text{g}}RT$$

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G = \Delta U + \Delta n_{\text{g}}RT - T\Delta S$$

$$= 2.1 + \frac{2 \times 2 \times 300}{1000} - \frac{300 \times 20}{1000}$$

$$(R = 2 \text{ cal K}^{-1} \text{ mol}^{-1})$$

$$= 2.1 + 1.2 - 6 = -2.70 \text{ Kcal/mol}$$

2. NTA Ans. (48.00)

Sol. Area enclosed under

$$P \text{ V curve} = 48 = 48 \text{ Joule}$$

3. NTA Ans. (6.25)

Sol. For ideal gas :

$$\Delta U = nC_{\text{V}}[T_2 - T_1]$$

$$\Rightarrow 5000 = 4 \times C_{\text{V}}[500 - 300]$$

$$\Rightarrow C_{\text{V}} = \frac{5000}{800} = 6.25 \text{ J mole}^{-1} \text{ K}^{-1}$$

4. NTA Ans. (1)

$$\text{Sol. } ds = \int \frac{q_{\text{rev.}}}{T}$$

5. NTA Ans. (2.17 to 2.23)

$$\text{Sol. } 0 - T_f' = 2 \times 0.5 = 1$$

$$T_f' = -1^\circ\text{C} = 272 \text{ K}$$

$$\text{for gas } P = \frac{0.1 \times 0.08 \times 272}{1}$$

$$P = 2.176 \text{ atm}$$

$$P_1V_1 = P_2V_2$$

$$2.176 \times 1 = 1 \times V_2$$

$$V_2 = 2.176 \text{ litre}$$

6. Official Ans. by NTA (4)

Sol. As the expansion is done in vacuum that is in
 absence of p_{ext} so

$$W = \text{zero}$$

7. Official Ans. by NTA (1)

Sol. For ideal Gas

$$\# U = f(T), H = f(T)$$

$$\# Z = 1$$

$$\# C_{\text{P}} - C_{\text{V}} = R$$

$$\# dU = C_{\text{V}} dT$$

8. Official Ans. by NTA (–13538.00)

Official Ans. by ALLEN (–13537.57)

$$\begin{aligned}\text{Sol. } \Delta G^\circ &= \Delta H^\circ - T\Delta S^\circ \\ &= (\Delta U^\circ + \Delta n_g RT) - T\Delta S^\circ \\ &= \left[\left\{ -20 + (-1) \frac{8.314}{1000} \times 298 \right\} - \frac{298}{1000} \times (-30) \right] \text{ kJ} \\ &= -13.537572 \text{ kJ} \\ &= -13537.57 \text{ Joule}\end{aligned}$$

9. Official Ans. by NTA (189494.00)

Official Ans. by ALLEN (189494.39)

$$\begin{aligned}\text{Sol. } \text{H}_2\text{O}(\ell) &\rightleftharpoons \text{H}_2\text{O}(\text{g}) \quad 90 \text{ gm of H}_2\text{O} \\ \Delta H &= \Delta U + \Delta n_g RT \quad \Rightarrow 5 \text{ moles of H}_2\text{O} \\ 5 \times 41000 \text{ J} &= \Delta U + 1 \times 8.314 \times 373 \times 5 \\ \Delta U &= 189494.39 \text{ Joule}\end{aligned}$$

10. Official Ans. by NTA (96500.00)

$$\begin{aligned}\text{Sol. } \Delta G &= \Delta G^\circ + RT \ln \left[\frac{\text{Sn}^{+2}}{\text{Cu}^{+2}} \right] \\ &= -2 \times 96500 [(-0.16) - 0.34] + RT \ln \left(\frac{1}{1} \right) \\ &= 96500 \text{ J}\end{aligned}$$

11. Official Ans. by NTA (3)

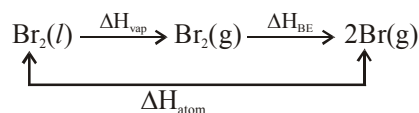
THERMOCHEMISTRY

1. NTA Ans. (–192.50 or –85.00)

$$\begin{aligned}\text{Sol. } 2\text{C}(\text{graphite}) + 3\text{H}_2(\text{g}) &\longrightarrow \text{C}_2\text{H}_6(\text{g}) \\ \Delta_f H(\text{C}_2\text{H}_6) &= 2\Delta H_{\text{comb}}(\text{C}_{\text{graphite}}) + 3\Delta H_{\text{comb}}(\text{H}_2) \\ &\quad - \Delta H_{\text{comb}}(\text{C}_2\text{H}_6) \\ &= -(286 \times 2) - (393.5 \times 3) - (-1560) \\ &= -572 - 1180.5 + 1560 = -192.5 \text{ kJ/mole}\end{aligned}$$

2. NTA Ans. (4)

Sol. Enthalpy of atomisation of Br₂(l)

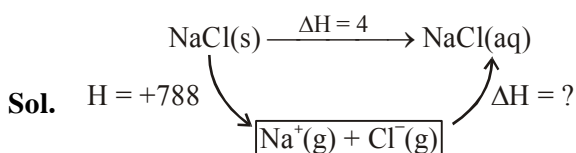


$$\Delta H_{\text{atom}} = \Delta H_{\text{vap}} + \Delta H_{\text{BE}}$$

$$x = \Delta H_{\text{vap}} + y$$

So, $x > y$

3. Official Ans. by NTA (2)



$$4 = 788 + \Delta H$$

$$\Delta H = -784 \text{ kJ}$$

4. Official Ans. by NTA (–326400.00)

Official Ans. by ALLEN (326400.00)

$$\begin{aligned}\text{Sol. } \text{C}_2\text{H}_5\text{OH}(\ell) + 3\text{O}_2(\text{g}) &\longrightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\ell) \\ \Delta n_g &= 2 - 3 = -1 \\ \Delta_c H &= \Delta_c U + (\Delta n_g) RT \\ \Delta_c H &= \Delta_c U - RT \\ \Delta_c U &= \Delta_c H + RT \\ &= -327 \times 10^3 + 2 \times 300 \\ &= -326400 \text{ cal.} \\ \therefore \text{Heat evolved} &= 326400 \text{ cal.}\end{aligned}$$

SOLID STATE

1. NTA Ans. (1)

Sol. Since AgBr has intermediate radius ratio

∴ it shows both schottky & Frenkel defects

ZnS → Frenkel defects

KBr, CsCl → Schottky defects

2. Official Ans. by NTA (143)

$$\text{Sol. } d = \frac{z \left(\frac{M}{N_A} \right)}{a^3}$$

$$2.7 \times 10^3 = z \frac{\left(\frac{2.7 \times 10^{-2}}{6 \times 10^{23}} \right)}{\left(405 \times 10^{-12} \right)^3}$$

$$2.7 \times 10^3 = z \frac{(2.7 \times 10^{-2})}{6 \times 10^{23} (4.05 \times 10^{-10})^3}$$

$$2.7 \times 10^3 = z \frac{(2.7 \times 10^{-2})}{6 \times 10^{23} \times 66.43 \times 10^{-30}}$$

$$3.98 = z$$

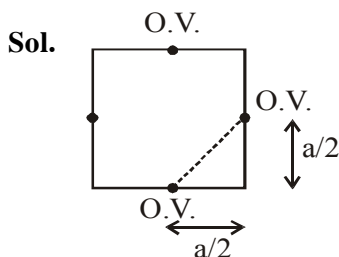
$z \approx 4$ structure is fcc

$$\frac{a}{\sqrt{2}} = 2r$$

$$r = \frac{a}{2\sqrt{2}} = \frac{\sqrt{2}a}{4} = \frac{1.414 \times 405 \times 10^{-12}}{4}$$

$$r = 143.16 \times 10^{-12}$$

3. Official Ans. by NTA (3)



distance between nearest octahedral voids(O.V.)

$$= \sqrt{\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2} \Rightarrow = \frac{a}{\sqrt{2}}$$

4. Official Ans. by NTA (1)

Sol. O^{2-} ions form ccp. O_4
(-8 charge)

$$M_1 = 50\% \text{ of O.V.} \Rightarrow \frac{50}{100} \times 4 = 2 : (M_1)_2$$

$$M_2 = 12.5\% \text{ of T.V.} \Rightarrow \frac{12.5}{100} \times 8 = 1 : (M_2)_1$$

So formula is : $(M_1)_2 (M_2)_1 O_4$

This must be neutral. Both metals must have +8 charge in total.

From given options : $\left\{ \begin{array}{l} \text{O.N. of } M_1 = +2 \\ M_2 = +4 \end{array} \right\}$

CHEMICAL KINETICS

1. NTA Ans. (4)

Sol. $K_{eq} = \frac{k_f}{k_b} = \frac{[N_2][H_2O]^2}{[H_2]^2[NO]^2}$

At equilibrium $r_f = r_b$

$$k_f [H_2] [NO]^2 = k_b \frac{[N_2][H_2O]^2}{[H_2]}$$

[Given]

Hence, rate expression for reverse reaction.

$$= k_b \frac{[N_2][H_2O]^2}{[H_2]}$$

2. NTA Ans. (4)

Sol. $K = Ae^{\frac{-E_a}{RT}}$

$$K' = Ae^{\frac{-E'_a}{RT}} = 10^6 K$$

$$Ae^{\frac{-E'_a}{RT}} = 10^6 \times Ae^{\frac{-E_a}{RT}}$$

$$\frac{-E'_a}{RT} = \frac{-E_a}{RT} + \ln 10^6$$

$$E'_a = E_a - RT \ln 10^6$$

$$E'_a - E_a = -RT \ln 10^6 = -6RT \times 2.303$$

3. NTA Ans. (3)

Sol. $\log K = \frac{-E_a}{2.303RT} + \log A$

According to Arrhenius equation plot of 'log K'

vs. $\frac{1}{T}$ is linear with.

$$\text{Slope} = \frac{-E_a}{2.303R}$$

From plot we conclude :

$$|\text{slope}| : c > a > d > b$$

(magnitude)

$$\therefore E_c > E_a > E_d > E_b$$

4. NTA Ans. (4)

Sol. $K_1 = Ae^{\frac{-E_a}{R \times 700}}$

$$K_2 = A \times e^{\frac{(E_a - 30)}{R \times 500}}$$

For same rate

$$K_1 = K_2$$

$$e^{\frac{-E_a}{700R}} = e^{\frac{(E_a - 30)}{R \times 500}}$$

$$\frac{E_a}{700R} = \frac{E_a - 30}{R \times 500}$$

$$5E_a = 7E_a - 210$$

$$210 = 2E_a$$

$$E_a = 105 \text{ kJ/mole}$$

$$E_a - 30 = 75$$

5. NTA Ans. (3.98 to 4.00 or -3.98 to -4.00)

Sol. $\ln\left(\frac{t_1}{t_2}\right) = \frac{-E_a}{R} \left[\frac{1}{T_2} - \frac{1}{T_1}\right]$

$$\ln\left(\frac{60}{40}\right) = \frac{-E_a}{8.3} \left[\frac{1}{400} - \frac{1}{300}\right]$$

$$E = 0.4 \times 1200 \times 8.3$$

$$= 3.984 \text{ kJ/mole}$$

6. Official Ans. by NTA (84297)

**Official Ans. by ALLEN
(84297.47 or 84297.48)**

Sol. $T_1 = 300\text{K}$ $T_2 = 315\text{K}$

As per question $K_{T_2} = 5K_{T_1}$ as molecules activated are increased five times so k will increase 5 times

Now

$$\ln\left(\frac{K_{T_2}}{K_{T_1}}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln 5 = \frac{E_a}{R}\left(\frac{15}{300 \times 315}\right)$$

$$\text{So } E_a = \frac{1.6094 \times 8.314 \times 300 \times 315}{15}$$

$$E_a = 84297.47 \text{ Joules/mole}$$

7. Official Ans. by NTA (60)

Sol. $t_{0.75} = 2 \times \frac{\ln 2}{k} = 90$

$$k = \frac{\ln 2}{45} \text{ min}^{-1}$$

$$kt = \ln \frac{1}{1-0.6} = \ln 2.5$$

$$\frac{\ln 2}{45} \times t = \ln 2.5$$

$$t = 45 \times \frac{\log 2.5}{\log 2} = 45 \times \frac{0.4}{0.3} = 60 \text{ min}$$

8. Official Ans. by NTA (4)

Sol. Zero order reaction is multiple step reaction.

9. Official Ans. by NTA (4)

Sol. For $aA + bB \rightarrow cC$;

$$\frac{-1}{a} \frac{d[A]}{dt} = \frac{-1}{b} \frac{d[B]}{dt} = \frac{1}{c} \frac{d[C]}{dt}$$

$$\therefore \frac{-1}{2} \frac{d[A]}{dt} = \frac{-1}{3} \frac{d[B]}{dt} = \frac{-2}{3} \frac{d[C]}{dt} = \frac{1}{3} \frac{d[P]}{dt}$$

10. Official Ans. by NTA (4)

Sol. $[A]_t = 4[B]_t$

$$[A]_0 e^{-(\ln^2/300)t} = 4[B]_0 e^{(-\ln 2/180)t}$$

$$e^{\left(\frac{\ln^2}{180} - \frac{\ln^2}{300}\right)t} = 4$$

$$\left(\frac{\ln^2}{180} - \frac{\ln^2}{300}\right)t = \ln 4$$

$$\left(\frac{1}{180} - \frac{1}{300}\right)t = 2 \Rightarrow t = \frac{2 \times 180 \times 300}{120} = 900 \text{ sec.}$$

11. Official Ans. by NTA (1)

Sol. Slope = $-\frac{E_a}{R}$

$$-\frac{10}{5} = -\frac{E_a}{R}$$

$$E_a = 2R$$

12. Official Ans. by NTA (1)

Sol. From rate law

$$r = -\frac{1}{2} \frac{d[A]}{dt} = \frac{-d[B]}{dt}$$

$$= K[A]^x [B]^y$$

$$6 \times 10^{-3} = K(0.1)^x (0.1)^y \quad \dots\dots(1)$$

$$2.4 \times 10^{-2} = K(0.1)^x (0.2)^y \quad \dots\dots(2)$$

$$1.2 \times 10^{-2} = K(0.2)^x (0.1)^y \quad \dots\dots(3)$$

$$(3) \div (1) \Rightarrow x = 1$$

$$(2) \div (3) \Rightarrow x = 2$$

So, order with respect to A = 1

Order with respect to B = 2

$$(4) \div (3)$$

$$\left(\frac{x}{0.2}\right) \times \left(\frac{0.2}{0.1}\right)^2 = \frac{7.2 \times 10^{-2}}{1.2 \times 10^{-2}}$$

$$x = \frac{6 \times 0.2}{4}$$

$$x = 0.3 \text{ M}$$

$$(5) \div (4)$$

$$\left(\frac{y}{0.2}\right)^2 = \frac{2.88 \times 10^{-1}}{7.2 \times 10^{-2}}$$

$$y^2 = 4 \times 0.2^2$$

$$y = 0.4 \text{ M}$$

13. Official Ans. by NTA (3)

14. Official Ans. by NTA (100.00)

Official Ans. by ALLEN (99.98)

$$\text{Sol. } \ln\left(\frac{K_{T_2}}{K_{T_1}}\right) = \frac{E_a}{R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$T_1 = 303 \text{ K} ; T_2 = 313 \text{ K}$$

$$\frac{K_{T_2}}{K_{T_1}} = 3.555$$

$$\ln(3.555) = \frac{E_a}{8.314} \left[\frac{1}{303} - \frac{1}{313} \right]$$

$$E_a = 99980.715$$

$$E_a = 99.98 \frac{\text{kJ}}{\text{mole}}$$

RADIOACTIVITY

1. NTA Ans. (23 to 23.03)

Sol. All nuclear decays follow first order kinetics

$$t = \frac{1}{k} \ln \frac{[A_0]}{[A]}$$

$$= \frac{(t_{1/2})}{0.693} \times 2.303 \log_{10} 10 = 10 \times 2.303 \times 1$$

$$= 23.03 \text{ years}$$

SURFACE CHEMISTRY

1. NTA Ans. (0.36 to 0.38)

Sol. 1 L solution requires 30 m.mol HCl

250 ml sol. will require 7.5 m.mol HCl

or 3.75 m.mol H_2SO_4

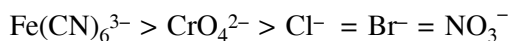
$$\Rightarrow \frac{3.75 \times 98}{1000} \text{ gm } \text{H}_2\text{SO}_4$$

$$= 0.3675 \text{ gm } \text{H}_2\text{SO}_4$$

2. NTA Ans. (4)

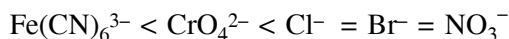
Sol. Since, $\text{Fe}(\text{OH})_3$ is positively charged sol, hence, anionic charge will flocculate

As per Hardy Schulze rules coagulation power of anion follows the order :



Higher the coagulation power lower will be its flocculation value

therefore order will be :



3. NTA Ans. (4)

4. NTA Ans. (4)

Sol. Adsorption of Gases will decrease

5. Official Ans. by NTA (3)

Sol. Foam - Froth

Gel \rightarrow Jellies

Aerosol \rightarrow Smoke


Sol \rightarrow Cell fluids

Solid sol \rightarrow rubber

6. Official Ans. by NTA (3)

Sol. The diameter of dispersed particles is similar to wavelength of light used.

7. Official Ans. by NTA (3)

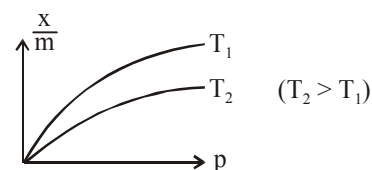
Sol.  Polar head more compatible with polar aq. solution



Micelles formed at CMC.

8. Official Ans. by NTA (3)

Sol. $\frac{x}{m} = K.P.^{1/n}$



9. Official Ans. by NTA (6.00)

Official Ans. by ALLEN (48.00)

Sol. $\frac{x}{m} = k p^x \dots (1)$

$$\Rightarrow \frac{\log \frac{x}{m}}{y} = \frac{\log k}{c} + \frac{x \log p}{m}$$

Given $c = \log k = 0.4771$ or $k = 3$
slope $x = 2$

$$\text{put in eq. (1)} \quad \frac{x}{m} = 3 \times (4)^2 \Rightarrow 48$$

10. Official Ans. by NTA (2)

Sol.(a) Since adsorption is exothermic process, as adsorption proceeds number of active sites present over adsorbent decreases, so less heat is evolved.

(b) Since NH₃ has higher force of attraction on adsorbent due to its polar nature (high value of 'a').

(c) As the adsorption increases, residual forces over surface decreases.

(d) Since process is exothermic, on increasing temperature it shift to backward direction, so concentration of adsorbate particle decreases.

11. Official Ans. by NTA (48.00)

Sol. $\frac{x}{m} = KP^{\frac{1}{n}}$

$$\log\left(\frac{x}{m}\right) = \frac{1}{n} \log P + \log K$$

$$\text{slope} = \frac{1}{n} = 2$$

$$\text{intercept} = \log K = 0.4771$$

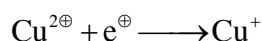
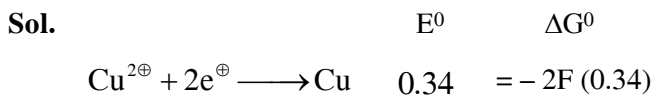
$$K = 3$$

$$\text{mass of gas adsorbed per gm of adsorbent} = \frac{x}{m}$$

$$\frac{x}{m} = 3 \times (0.04)^2 = 48 \times 10^{-4}$$

ELECTROCHEMISTRY

1. NTA Ans. (1)



$$\Delta G^0 = -2F (0.34) - (-F (0.522)) = -F (0.68 - 0.522) = -F (0.158)$$

$$E^0 = \frac{-F(0.158)}{-F} = 0.158V$$

2. NTA Ans. (1)

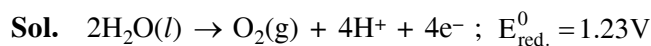
Sol. Option (1) is incorrect.

According to Kohlrausch's law correct expression is

$$\left(\Lambda_m^0\right)_{\text{NaBr}} - \left(\Lambda_m^0\right)_{\text{NaI}} = \left(\Lambda_m^0\right)_{\text{KBr}} - \left(\Lambda_m^0\right)_{\text{KI}}$$

The other statements are correct.

3. NTA Ans. (-0.93 to -0.94)



From nernst equation

$$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{RT}{nF} \ln Q$$

at 1 bar & 298 K

$$\frac{2.303RT}{F} = 0.059$$

$$\text{pH} = 5 \Rightarrow [\text{H}^+] = 10^{-5} \text{ M}$$

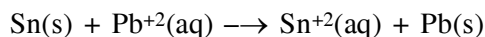
$$E_{\text{oxidation}}^0 = -1.23 \text{ volt}$$

$$E_{\text{cell}} = -1.23 - \frac{0.059}{4} \log[\text{H}^+]^4$$

$$E_{\text{cell}} = -1.23 - \frac{0.059}{4} \log(10^{-5})^4 = -1.23 + 0.059 \times 5 = -0.935 \text{ V}$$

4. NTA Ans. (2.13 to 2.17)

Sol. Cell reaction is :



Apply Nernst equation :

$$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{0.06}{2} \log \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]} \dots(1)$$

$$E_{\text{cell}}^0 = -0.13 + 0.14 = 0.01 \text{ V}$$

At equilibrium : $E_{\text{cell}} = 0$

Substituting in (1)

$$0 = 0.01 - \frac{0.06}{2} \log \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]}$$

$$\Rightarrow \frac{1}{3} = \log \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]}$$

$$\Rightarrow \frac{[\text{Sn}^{+2}]}{[\text{Pb}^{+2}]} = 2.15$$

5. NTA Ans. (5.66 to 5.68)

$$\text{Sol. gm eq. of Ag} = \frac{108}{108} = 1$$

$$\text{gm eq. of O}_2(\text{g}) = 1$$

$$\text{Volume of O}_2(\text{g}) = 22.7 \times \frac{1}{4} = 5.675 \text{ litre}$$

6. NTA Ans. (1)

Sol. Distilled water have lowest ionic conductance.

7. Official Ans. by NTA (4)

Sol. As voltage is '2V' so both Ag^+ & Au^+ will reduce and their equal gm equivalent will reduce so

$$\text{gmeq Ag} = \text{gmeq of Au}$$

$$\frac{\text{Wt}_{\text{Ag}}}{E_{\text{qwt}_{\text{Ag}}}} = \frac{\text{Wt}_{\text{Au}}}{E_{\text{qwt}_{\text{Au}}}}$$

$$\text{So } \frac{\text{wt}_{\text{Ag}}}{\text{wt}_{\text{Au}}} = \frac{E_{\text{qwt}_{\text{Ag}}}}{E_{\text{qwt}_{\text{Au}}}} = \frac{\text{At wt}_{\text{Ag}}}{\text{At wt}_{\text{Au}}}$$

8. Official Ans. by NTA (1)

$$\text{Sol. } E_{\text{cell}}^{\circ} = 0.34 - (-0.76) \\ = 1.10 \text{ volt}$$

If $E_{\text{ext}} > 1.10 \text{ volt}$

$\text{Cu} \rightarrow \text{Anode}$

$\text{Zn} \rightarrow \text{Cathode}$

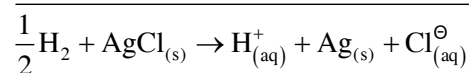
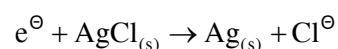
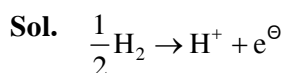
If $E_{\text{ext}} = 1.10 \text{ volt}$

$\text{Zn} \rightarrow \text{Anode}$

$\text{Cu} \rightarrow \text{Cathode}$

9. Official Ans. by NTA (58)

Official Ans. by ALLEN (142)



$$E = \varepsilon^{\circ} - \frac{.06}{1} \log \frac{[\text{H}^+][\text{Cl}^{\ominus}]}{P_{\text{H}_2}^{\frac{1}{2}}}$$

$$E = 0.22 - .06 \log \frac{(10^{-1})(10^{-1})}{1^{\frac{1}{2}}}$$

$$E = 0.22 + .12 = .34 \text{ volt}$$

$$\Rightarrow \text{total energy of photon will be (for Na)} \\ = 2.3 + 0.34 = 2.64 \text{ eV}$$

10. Official Ans. by NTA (60)

$$\text{Sol. Moles of } \text{e}^{\ominus} = \left(\frac{8 \times 60 \times 2}{96000} \right)$$

Using stoichiometry; theoretically

$$\frac{n_{\text{e}^{\ominus} \text{ used}}}{6} = \frac{n_{\text{Cr}^{+3} \text{ produced}}}{2}$$

$$\Rightarrow n_{\text{Cr}^{+3} \text{ produced}} = \frac{2}{6} \times \frac{8 \times 60 \times 2}{96000}$$

$$= \frac{0.02}{6}$$

$$\Rightarrow \text{wt}_{\text{Cr}^{+3}} \text{ theoretically produced}$$

$$= \left(\frac{0.02}{6} \times 52 \right) \text{g}$$

$$\Rightarrow \% \text{ efficiency} = \frac{0.104 \text{g}}{\left(\frac{0.02 \times 52}{6} \right) \text{g}} \times 100$$

$$= 60\%$$

11. Official Ans. by NTA (6)

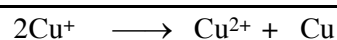
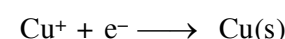
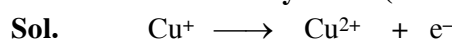
$$\text{Sol. } \Delta G^{\circ} = -nFE^{\circ} = -3 \times 96500 \times E^{\circ}$$

$$\Rightarrow E^{\circ} = -6 \times 10^{-2} \text{ V}$$

12. Official Ans. by NTA (1)

Sol. Its a weak electrolyte hence : CH_3COOH

13. Official Ans. by NTA (144.00)



$$E_{\text{cell}}^{\circ} = E_{\text{Cu}^+/\text{Cu}}^{\circ} - E_{\text{Cu}^{2+}/\text{Cu}^+}^{\circ} \\ = 0.52 - 0.16 \\ = 0.36 \text{ V}$$

$$\text{At equilibrium } \rightarrow E_{\text{cell}} = 0$$

$$E_{\text{cell}}^{\circ} = \frac{RT}{nF} \ln K$$

$$\ln K = \frac{E_{\text{cell}}^{\circ} \times nF}{RT}$$

$$\ln K = \frac{0.36 \times 1}{0.025}$$

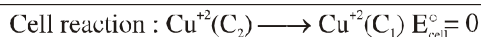
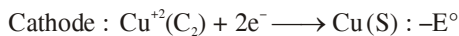
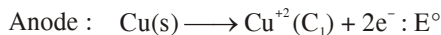
$$= 14.4 = 144 \times 10^{-1}$$

14. Official Ans. by NTA (11.00)

15. Official Ans. by NTA (4)

Sol. $\Delta G = -n F E_{\text{cell}}$

ΔG is negative, if E_{cell} is positive



$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{2.303RT}{nF} \log Q$$

$$E_{\text{cell}} = 0 - \frac{2.303RT}{nF} \log \left(\frac{C_1}{C_2} \right)$$

$$E_{\text{cell}} > 0 : \text{if } \frac{C_1}{C_2} < 1 \Rightarrow C_1 < C_2$$

LIQUID SOLUTION

1. NTA Ans. (3)

Sol. The vapour pressure of mixture (= 600 mm Hg) is greater than the individual vapour pressure of its constituents (Vapour pressure of CS_2 = 512 mm Hg, acetone = 344 mm Hg). Hence, the solution formed shows positive deviation from Raoult's law.

\Rightarrow (1) $\Delta_{\text{sol}} H > 0$, (2) Raoult's law is not obeyed

(3) Δ_{sol} Volume > 0

(4) CS_2 and Acetone are less attracted to each other than to themselves.

2. NTA Ans. (3)

Sol. The pure solvent solution will try to maintain higher vapour pressure in the sealed container and in return the solvent vapour molecules will condense in the solution of non-volatile solute as it maintains an equilibrium with lower vapour pressure. (Lowering of vapour pressure is observed when a non volatile solute is mixed in a volatile solvent)

This will eventually lead to increase in the volume of solution and decrease in the volume of solvent.

3. NTA Ans. (3)

Sol. Order of B.P. is : $Z > Y > X$

Order of vapour pressure : $Z < Y < X$

order of intermolecular interaction : $Z > Y > X$.

4. NTA Ans. (1.74 to 1.76 or 0.03)

Sol. $\Delta T_f = i \times m \times K_f$

$$0.2 = 2 \times 2 \times \frac{w/58.5}{600/1000}$$

$$w = 1.755 \text{ gm}$$

5. Official Ans. by NTA (167)

Sol. Osmotic pressure $= \pi = i \times C \times RT$

For NaCl $i = 2$ so

$$\pi_{\text{NaCl}} = i \times C_{\text{NaCl}} \times RT \quad C_{\text{NaCl}} = \text{conc. of NaCl}$$

$$0.1 = 2 \times C_{\text{NaCl}} \times RT$$

$$C_{\text{NaCl}} = \frac{0.05}{RT} \quad C_{\text{glucose}} = \text{conc. of glucose}$$

For glucose $i = 1$ so

$$\pi_{\text{Glucose}} = i \times C_{\text{glucose}} \times RT$$

$$0.2 = 1 \times C_{\text{glucose}} \times RT$$

$$C_{\text{Glucose}} = \frac{0.2}{RT} \quad \eta_{\text{NaCl}} = \text{No. of moles NaCl}$$

$$\eta_{\text{NaCl}} \text{ in 1 L} = C_{\text{NaCl}} \times V_{\text{Litre}}$$

$$= \frac{0.05}{RT} \quad \eta_{\text{glucose}} = \text{No. of moles glucose}$$

$$\eta_{\text{glucose}} \text{ in 2 L} = C_{\text{glucose}} \times V_{\text{Litre}}$$

$$= \frac{0.4}{RT}$$

$$V_{\text{Total}} = 1 + 2 = 3\text{L}$$

$$\text{so Final conc. NaCl} = \frac{0.05}{3RT}$$

$$\text{Final conc. glucose} = \frac{0.4}{3RT}$$

$$\pi_{\text{Total}} = \pi_{\text{NaCl}} + \pi_{\text{glucose}}$$

$$= [i \times C_{\text{NaCl}} + C_{\text{glucose}}] \times RT$$

$$= \left(\frac{2 \times 0.05}{3RT} + \frac{0.4}{3RT} \right) \times RT$$

$$= \frac{0.5}{3} \text{ atm}$$

$$= 0.1666 \text{ atm}$$

$$= 166.6 \times 10^{-3} \text{ atm}$$

$$\Rightarrow 167.00 \times 10^{-3} \text{ atm}$$

$$\text{so } x = 167.00$$

6. Official Ans. by NTA (600)

$$\text{Sol. } 550 = P_A^0 \times \frac{1}{4} + P_B^0 \times \frac{3}{4}$$

$$2200 = P_A^0 + 3P_B^0 \quad \dots(i)$$

$$2800 = P_A^0 + 4P_B^0 \quad \dots(ii)$$

$$560 = P_A^0 \times \frac{1}{5} + P_B^0 \times \frac{4}{5}$$

$$P_B^0 = 600, P_A^0 = 400$$

7. Official Ans. by NTA (2)

$$\text{Sol. } (1) P_\gamma = K_H X_\gamma$$

$$P_\gamma = 2 \times 10^{-15} \times \frac{55.5}{55.5 + \frac{1000}{18}} = 2 \times 10^{-5} \text{ K bar}$$

$$= 2 \times 10^{-2} \text{ bar}$$

$$(2) P_\delta = K_H X_\delta$$

$$P_\delta = 0.5 \times \frac{55.5}{55.5 + \frac{1000}{18}} = .249 \text{ K bar} = 249 \text{ bar}$$

(3) On increasing temperature solubility of gases decreases

(4) $K_H \downarrow$ solubility \uparrow and lowest K_H is for γ .

8. Official Ans. by NTA (177)

9. Official Ans. by NTA (1)

$$\text{Sol. } \text{Relative lowering of V.P.} = \frac{\Delta P}{P^0} = x_{\text{solute}}$$

$$\left(\frac{\Delta P}{P^0}\right)_A = \frac{\frac{10}{100}}{\frac{10}{100} + \frac{180}{18}} : \left(\frac{\Delta P}{P^0}\right)_B = \frac{\frac{10}{200}}{\frac{10}{200} + \frac{180}{18}}$$

$$\left(\frac{\Delta P}{P^0}\right)_C = \frac{\frac{10}{10,000}}{\frac{10}{10,000} + \frac{180}{18}} : \left(\frac{\Delta P}{P^0}\right)_A > \left(\frac{\Delta P}{P^0}\right)_B > \left(\frac{\Delta P}{P^0}\right)_C$$

CHEMICAL EQUILIBRIUM

1. Official Ans. by NTA (2)

$$\text{Sol. } A \rightleftharpoons B + C \quad K_{\text{eq}}^{(1)} = \frac{[B][C]}{[A]} \quad \dots(1)$$

$$B + C \rightleftharpoons P \quad K_{\text{eq}}^{(2)} = \frac{[P]}{[B][C]} \quad \dots(2)$$

For

$$A \rightleftharpoons P \quad K_{\text{eq}} = \frac{[P]}{[A]}$$

Multiplying equation (1) & (2)

$$K_{\text{eq}}^{(1)} \times K_{\text{eq}}^{(2)} = \frac{[P]}{[A]} = K_{\text{eq}}$$

2. Official Ans. by NTA (3)

Sol. at equilibrium

$$r_a = r_b$$

3. Official Ans. by NTA (16)

$$\begin{array}{cccc} & X & + & Y & = & 2Z \\ \text{Sol. } t=0 & 1 & & 1.5 & & 0.5 \\ \text{At eq.} & 0.75 & & 1.25 & & 1 \end{array};$$

$$K_{\text{eq.}} = \frac{1^2}{\frac{3}{4} \times \frac{5}{4}} = \frac{16}{15}$$

4. Official Ans. by NTA (2)

$$\text{Sol. } N_2 + 3H_2 \rightleftharpoons 2NH_3 \rightarrow K_C = 64$$

$$2NH_3 \rightleftharpoons N_2 + 3H_2 \rightarrow K_C = \frac{1}{64}$$

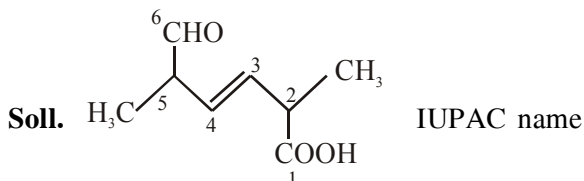
$$NH_3 \rightleftharpoons \frac{1}{2}N_2 + \frac{3}{2}H_2 \rightarrow K_C = \left(\frac{1}{64}\right)^{\frac{1}{2}} = \frac{1}{8}$$

5. Official Ans. by NTA (4)

JANUARY & SEPTEMBER 2020 ATTEMPT (OC)

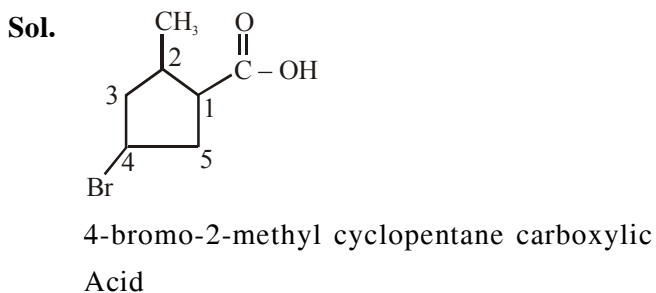
NOMENCLATURE

1. Official Ans. by NTA (4)

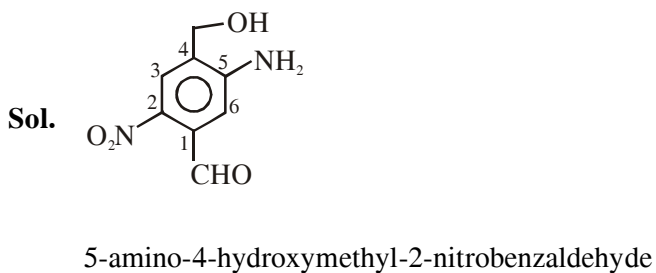


2, 5-dimethyl-6-oxo-hex-3-enoic acid

2. Official Ans. by NTA (1)



3. Official Ans. by NTA (4)



ACIDITY & BASICITY

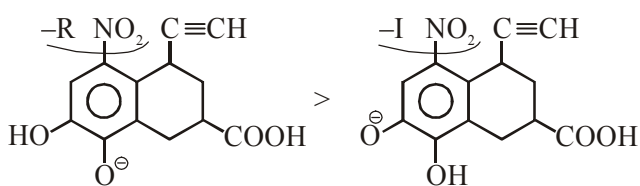
1. Official Ans. by NTA (1)

Soll. Acidic strength order :



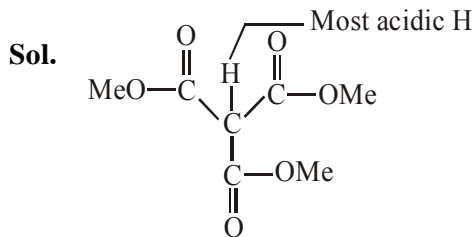
Reason : $R-\overset{\overset{O}{\parallel}}{C}-O^{\ominus}$ stable by equivalent resonance.

Stable :



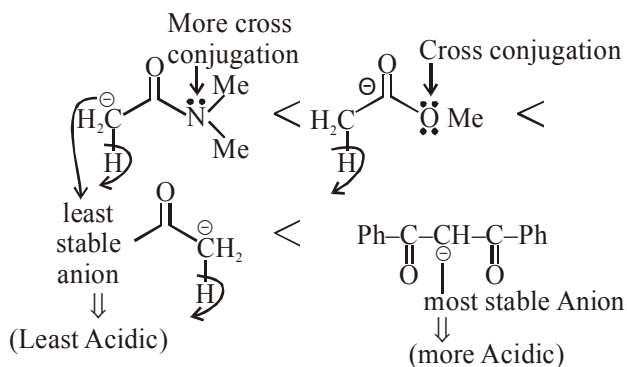
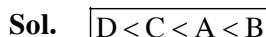
So answer is $b > c > d > a$.

2. Official Ans. by NTA (4)

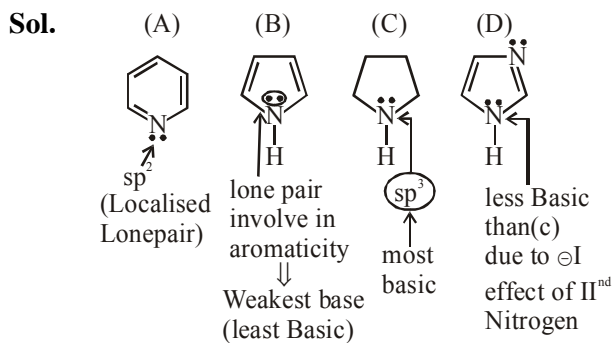


Due to presence of 3 (-R) groups

3. Official Ans. by NTA (4)



4. Official Ans. by NTA (4)

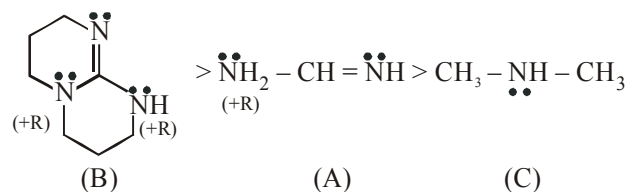


5. Official Ans. by NTA (1)

ELECTRONIC DISPLACEMENT EFFECT

1. NTA Ans. (3)

Soll. Base strength order

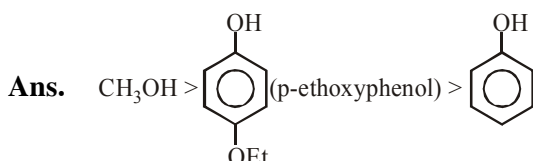
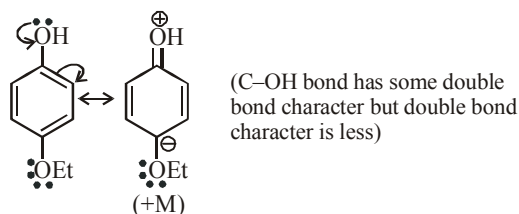
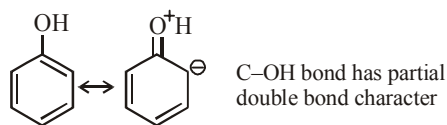


pK_b order (C > A > B)

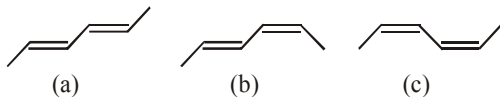
2. NTA Ans. (1)

Soll. (C) > (B) > (A)

3. NTA Ans. (2)

Sol. $\text{H}_3\text{C} - \text{OH}$ (100% single bond)

4. NTA Ans. (1)



Sol.

(Trans, Trans)

(Trans, Cis)

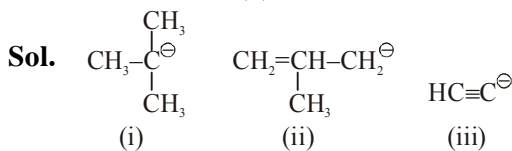
(Cis, Cis)

 \therefore Generally trans is more stable than cis form.

$$\text{Heat of combustion (HOC)} \propto \frac{1}{\text{Stability}}$$

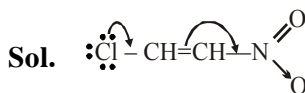
Stability : $a > b > c$ HOC : $c > b > a$

5. NTA Ans. (3)



Basic strength order : (i) > (iv) > (ii) > (iii) > (v)

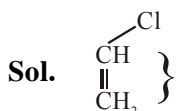
6. NTA Ans. (4)



Due to -M effect of $-\text{NO}_2$ and +M effect of Cl more D.B. character between C - Cl bond. So shortest bond length.

7. NTA Ans. (3)

8. Official Ans. by NTA (3)



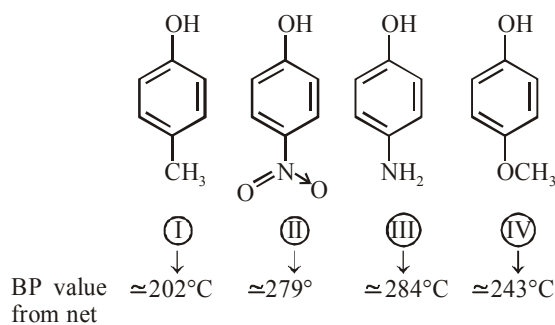
In option (3) C—Cl bond is shortest due to resonance of lone pair of -Cl.

Due to resonance C—Cl bond acquires partial double bond character.

Hence C—Cl bond length is least.

9. Official Ans. by NTA (1)

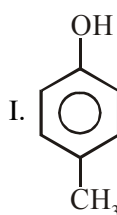
Sol.



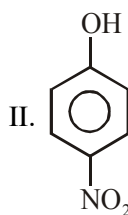
$$\text{BP} \propto \text{dipole moment } (\mu)$$

Alter

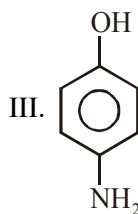
Increasing order of boiling point is :



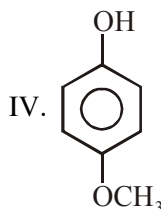
\Rightarrow Shows hydrogen bonding from -O-H group only



\Rightarrow Shows strongest hydrogen bonding from both sides of -OH group as well as $-\text{NO}_2$ group.



\Rightarrow Shows stronger hydrogen from both side of -OH group as well as $-\text{NH}_2$ group.



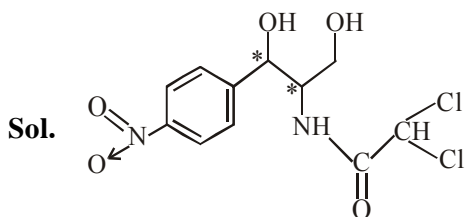
\Rightarrow Shows stronger hydrogen bonding from one side -OH-group and another side of $-\text{OCH}_3$ group shows only dipole-dipole interaction.

\Rightarrow Hence correct order of boiling point is:

(I) < (IV) < (III) < (II)

ISOMERISM

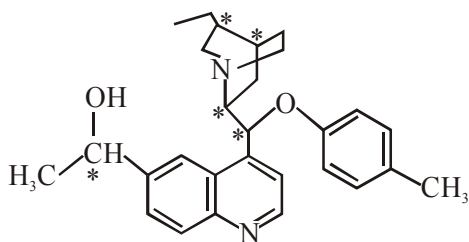
1. NTA Ans. (2)



Chloramphenicol

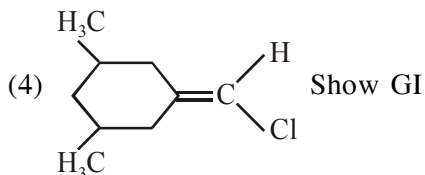
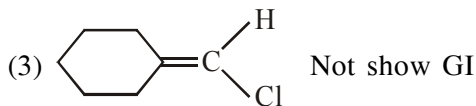
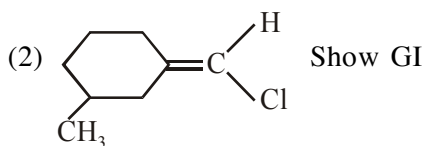
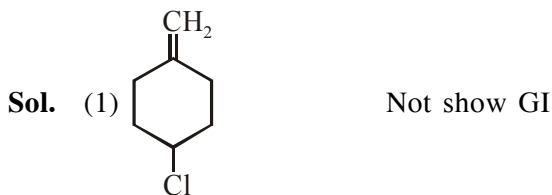
2. Official Ans. by NTA (5.00)

Sol. No. of chiral centres



3. Official Ans. by NTA (2)

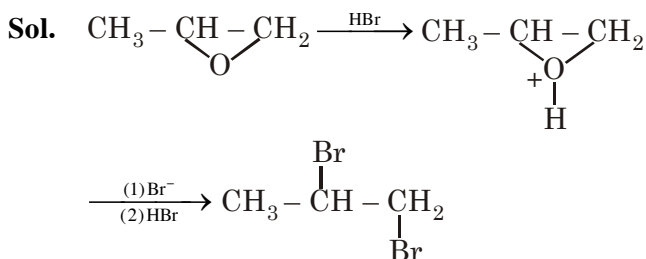
Official Ans. by ALLEN (2 & 4)



4. Official Ans. by NTA (3)

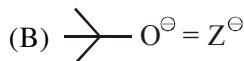
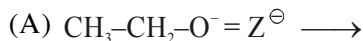
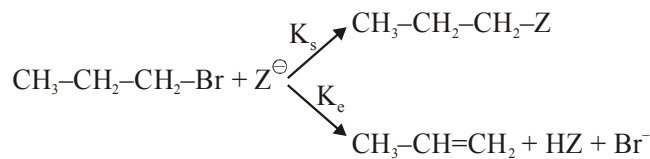
HALOGEN DERIVATIVE

1. NTA Ans. (4)



2. NTA Ans. (3)

Sol.



(B) with more steric crowding forms elimination product compared to substitution.

$K_e(\text{B}) > K_e(\text{A})$

$\mu_B = \frac{K_s(\text{B})}{K_e(\text{A})} < \mu_A = \frac{K_s(\text{A})}{K_e(\text{A})}$

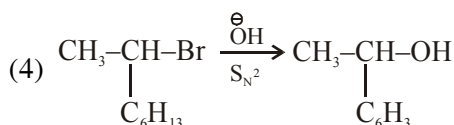
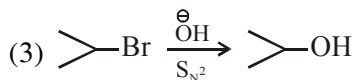
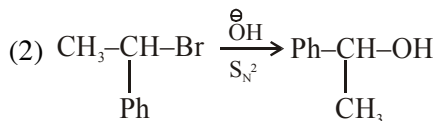
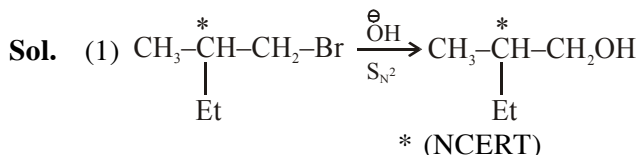
3. NTA Ans. (3)

Sol. Reactivity $\text{D} > \text{B} > \text{C} > \text{A}$

Carbocation formed from D is most stable

Carbocation formed from A is least stable

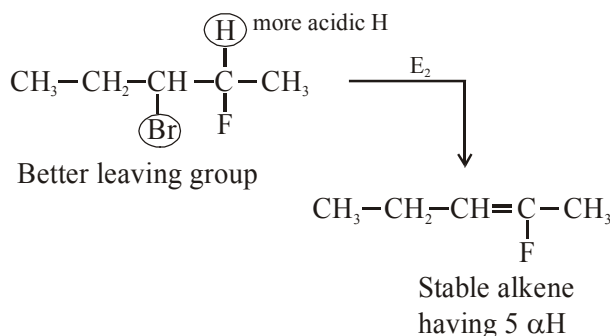
4. Official Ans. by NTA (1)



As language given, we have to go with option (1) as stereochemistry of chiral centre is not distorted.

5. Official Ans. by NTA (4)

Sol.



6. Official Ans. by NTA (1)

Sol. Reaction 1 : S_N1 Reaction 2 : E_2

S_N1 is independent of concentration of nucleophile/base

7. Official Ans. by NTA (2)

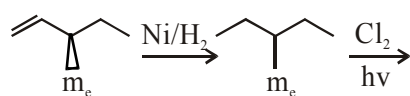
Sol. S_N1 favours

(a) The reaction is favoured by weak nucleophiles

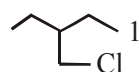
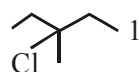
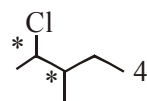
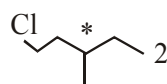
(b) R^\oplus would be easily formed if the substituents are bulky

(c) The reaction is accompanied by racemization

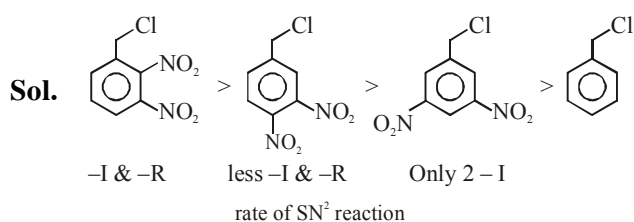
8. Official Ans. by NTA (8)



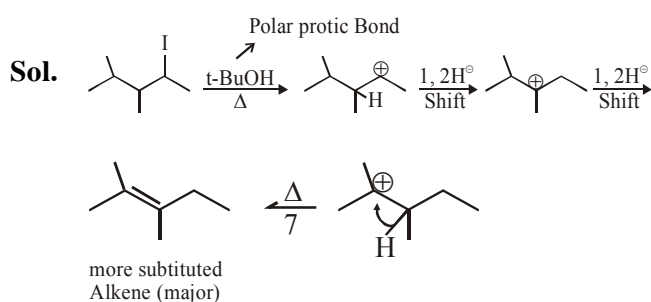
Sol. Simplest O.A. Alkene



9. Official Ans. by NTA (2)

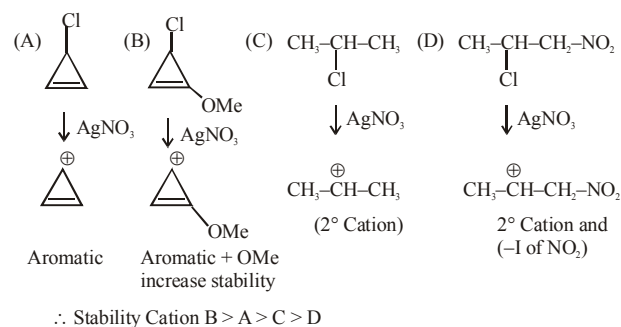


10. Official Ans. by NTA (4)

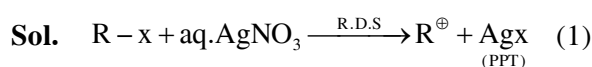


11. Official Ans. by NTA (4)

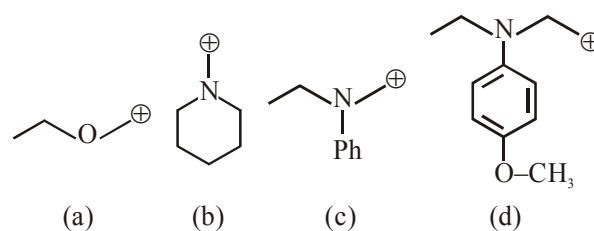
Sol.



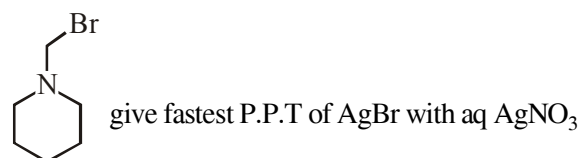
12. Official Ans. by NTA (2)

So rate of P.P.T formation of Agx depend's on stability of carbocation (R^\oplus)

In given question formed carbocation will be

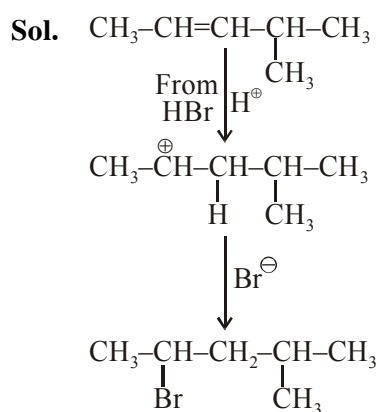


Most stable carbocation is (b) so

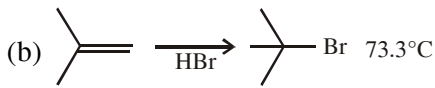
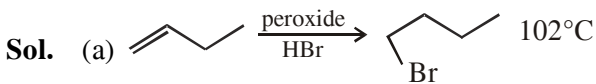


13. Official Ans. by NTA (1)

Official Ans. by ALLEN (4)

Addition of HBr according to M.R.

14. Official Ans. by NTA (2)



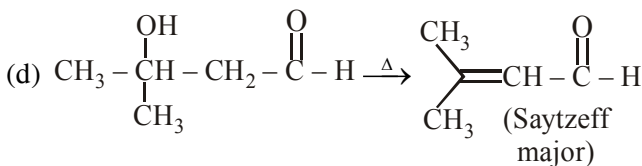
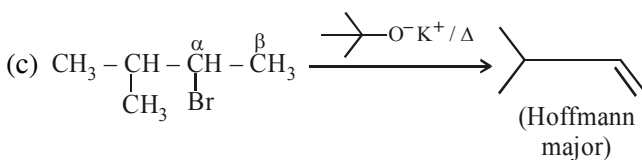
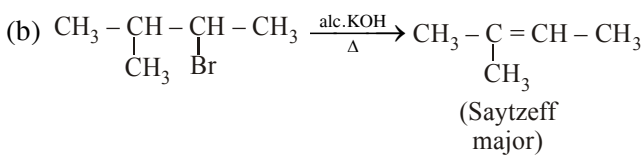
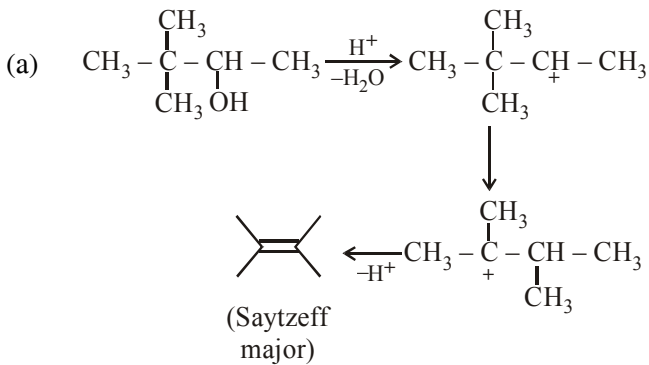
B.P. $\propto \frac{1}{\text{Branching}}$ $\therefore a > c > b$ (order of B.P.)

15. Official Ans. by NTA (2)

ALCOHOL & ETHER

1. NTA Ans. (1)

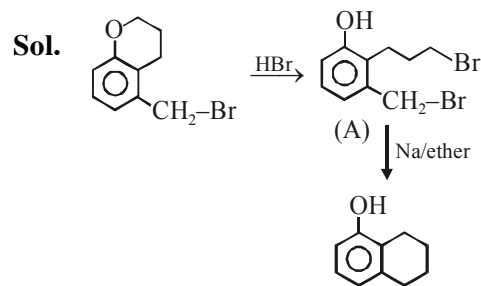
Sol.



$(\text{CH}_3)_3\text{O}^-\text{K}^+$ is incorrect representation of potassium tert-butoxide $[(\text{CH}_3)_3\text{CO}^-\text{K}^+]$.

So it is possible that it can be given as **Bonus**

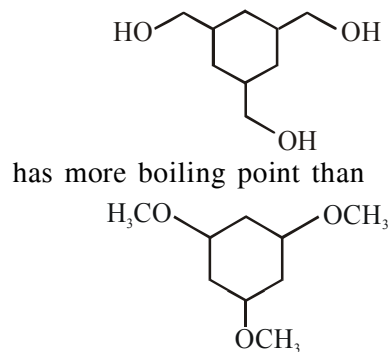
2. NTA Ans. (4)



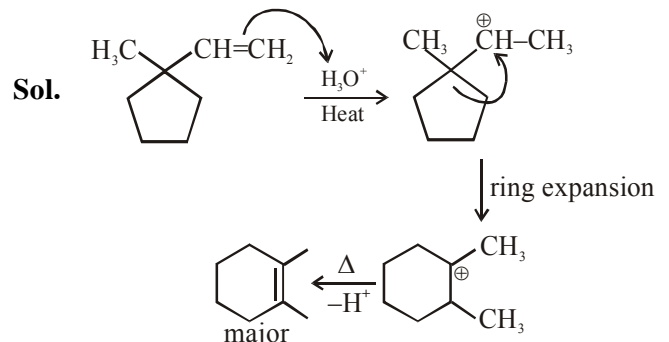
3. NTA Ans. (1)

Sol. Alcohol has more boiling point than ether (due to hydrogen bonding).

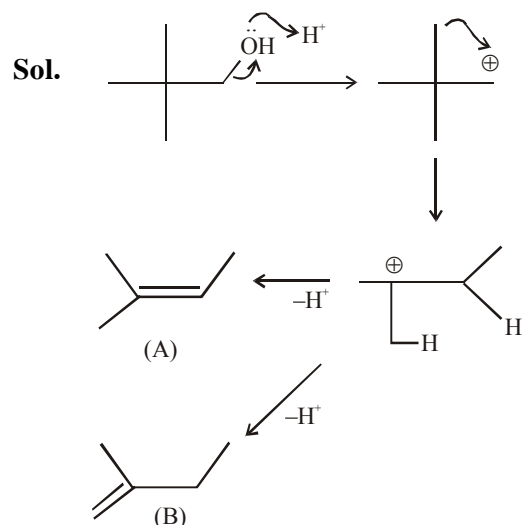
So,



4. Official Ans. by NTA (3)

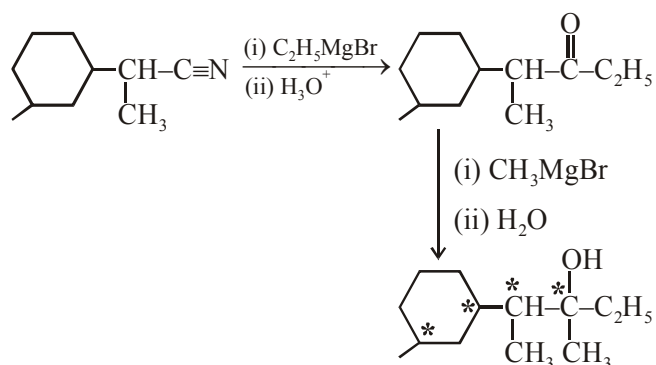


5. Official Ans. by NTA (4)



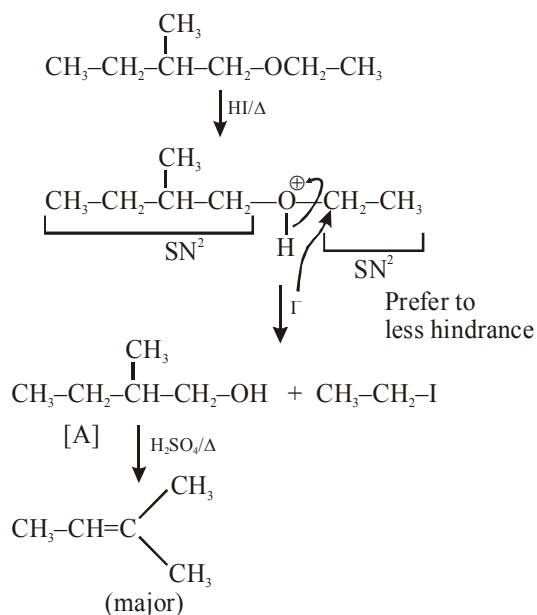
6. Official Ans. by NTA (4)

Sol.



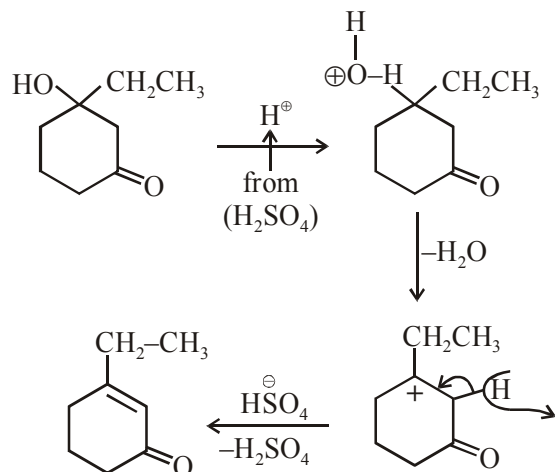
7. Official Ans. by NTA (4)

Sol.



8. Official Ans. by NTA (2)

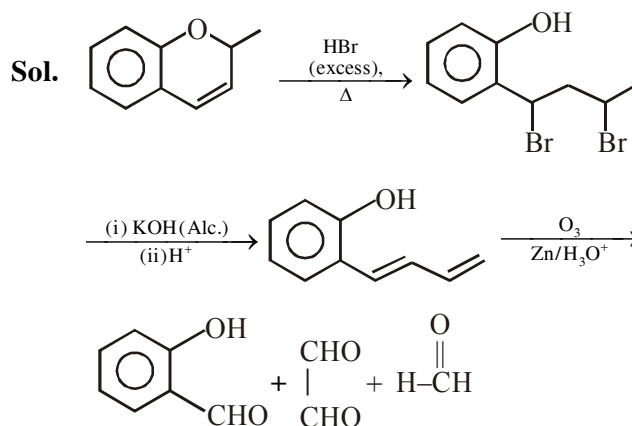
Sol.



9. Official Ans. by NTA (3)

OXIDATION

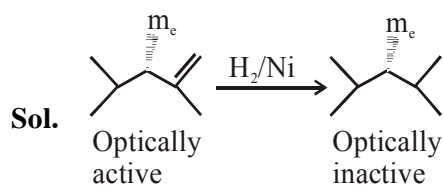
1. Official Ans. by NTA (2)



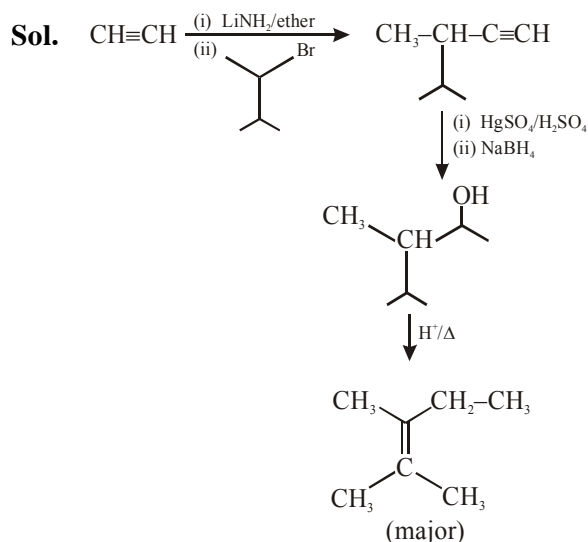
2. Official Ans. by NTA (1)

REDUCTION

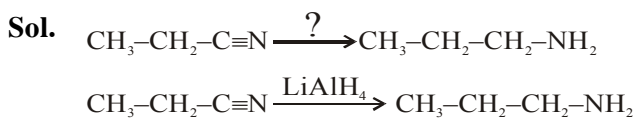
1. Official Ans. by NTA (2)



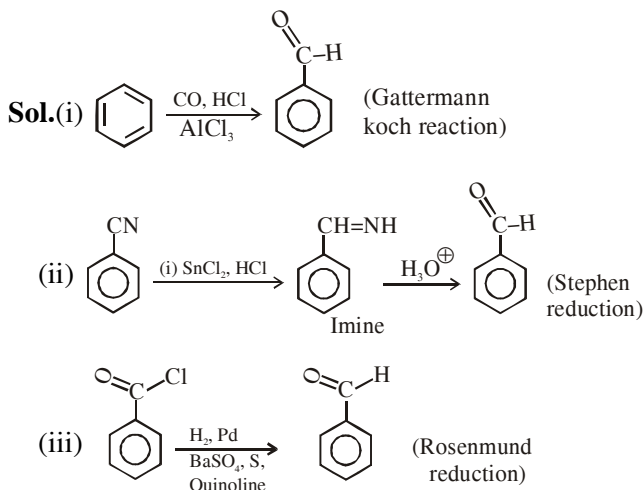
2. Official Ans. by NTA (2)

Now :- (i) $\text{HgSO}_4/\text{dil. H}_2\text{SO}_4$ (ii) NaBH_4 is convert triple bond into ketone and formed ketone is reduced by NaBH_4 and convert into Alcohol.

3. Official Ans. by NTA (2)

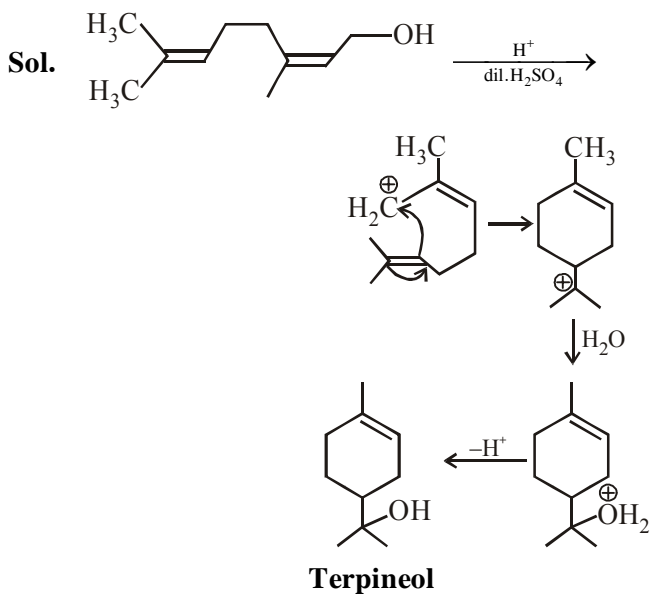


4. Official Ans. by NTA (3)

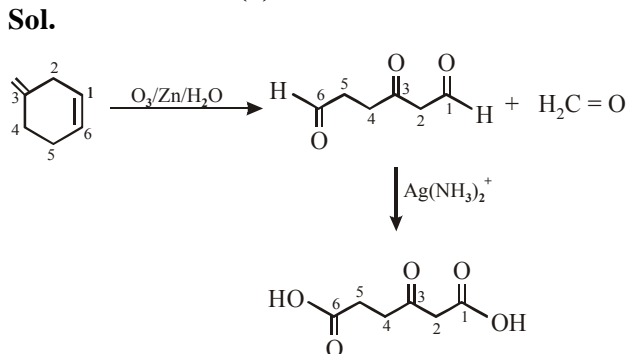


HYDROCARBON

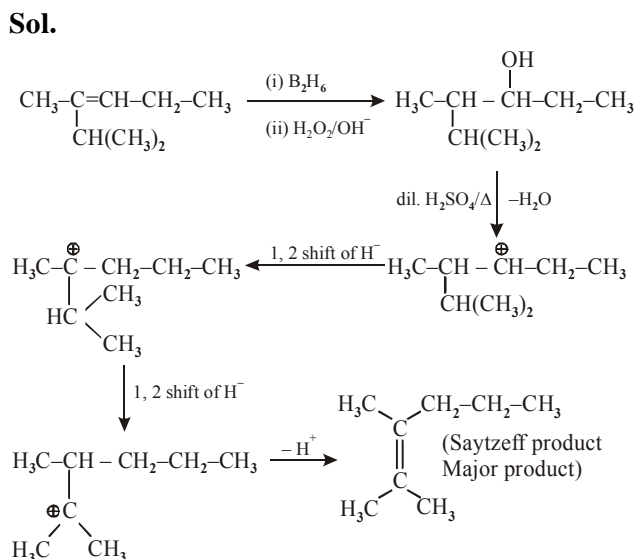
1. NTA Ans. (2)



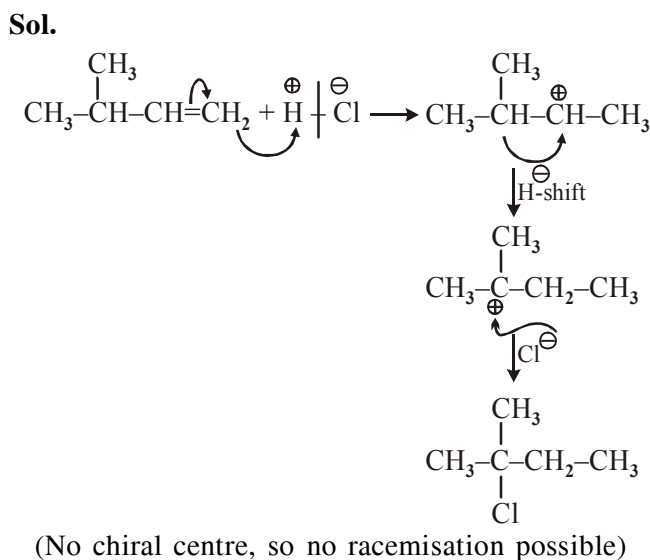
2. NTA Ans. (1)



3. NTA Ans. (1)

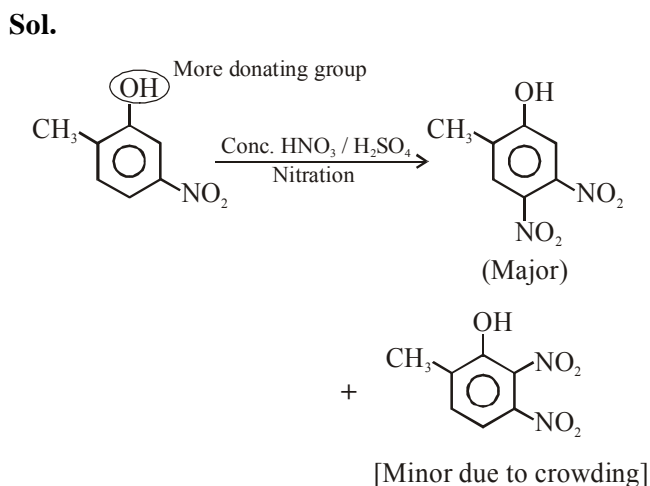


4. NTA Ans. (1)

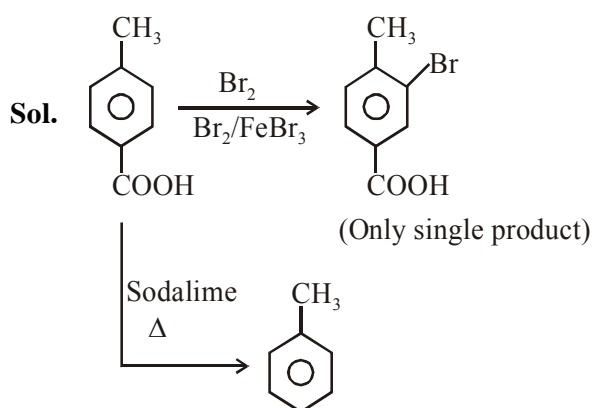


AROMATIC COMPOUND

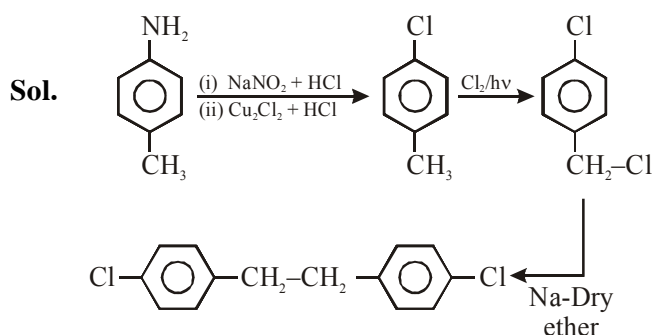
1. Official Ans. by NTA (3)



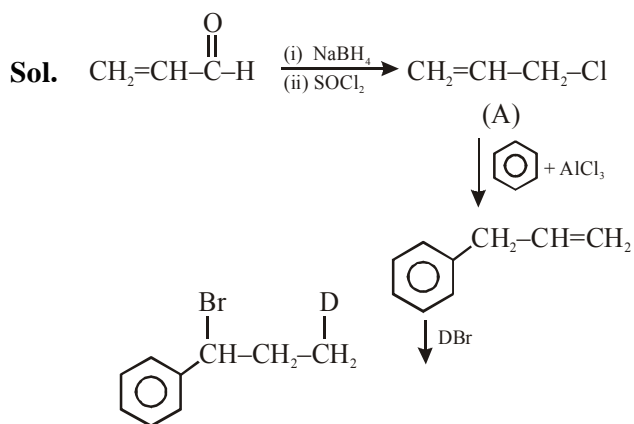
2. Official Ans. by NTA (4)



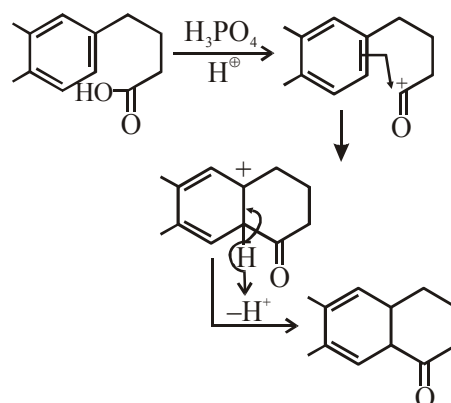
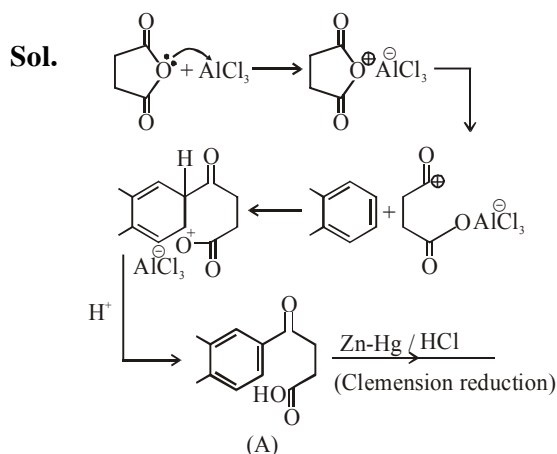
3. Official Ans. by NTA (3)



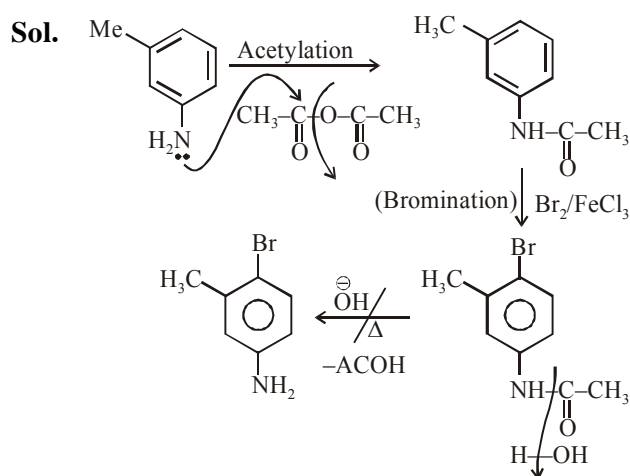
4. Official Ans. by NTA (3)



5. Official Ans. by NTA (1)

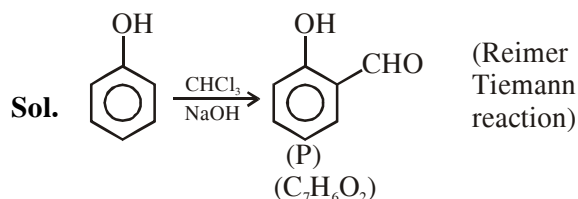


6. Official Ans. by NTA (1)



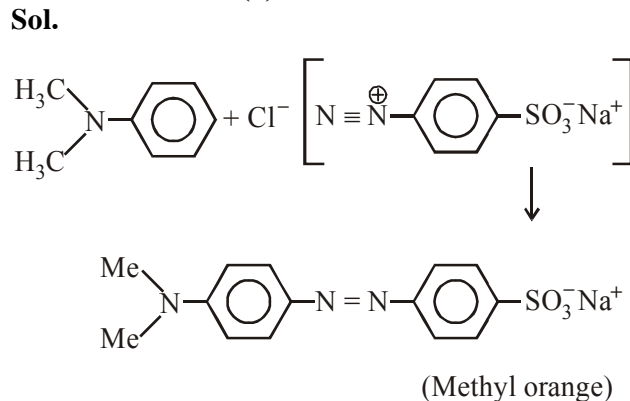
7. Official Ans. by NTA (69.00)

Official Ans. by ALLEN (68.85)

Molecular weight of $\text{C}_7\text{H}_6\text{O}_2 = 122$

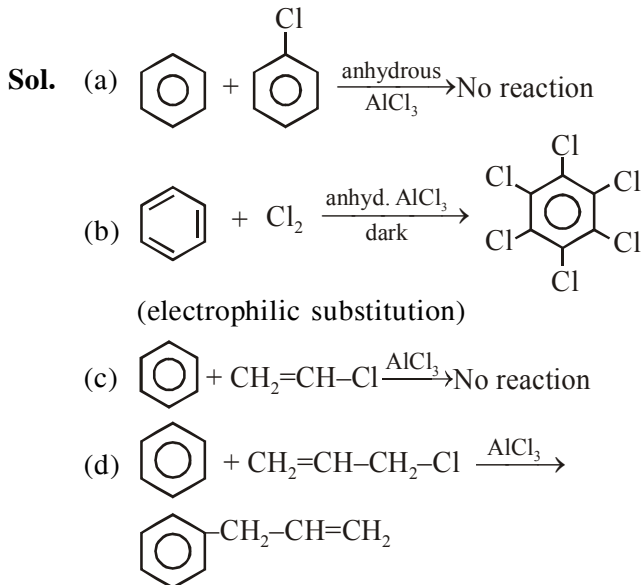
$$\% \text{C} = \frac{12 \times 7 \times 100}{122} = 68.85 \approx 69$$

8. NTA Ans. (1)

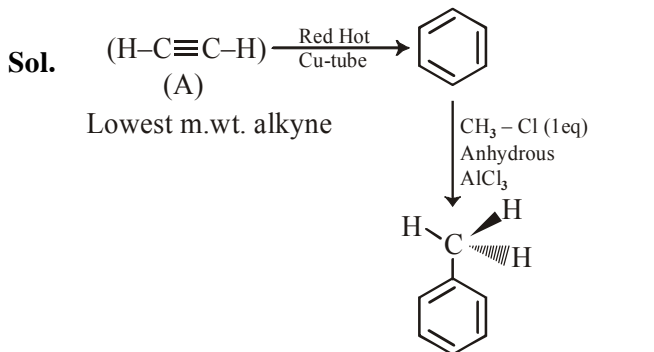


It is an acid base indicator

9. NTA Ans. (2)

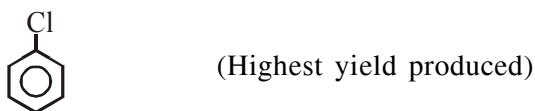
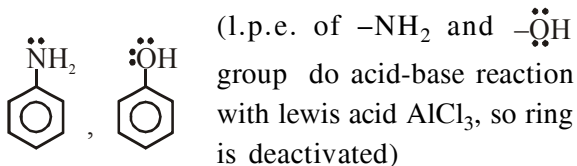
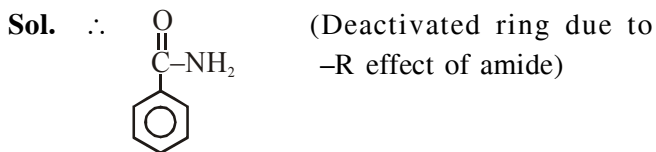


10. NTA Ans. (13)

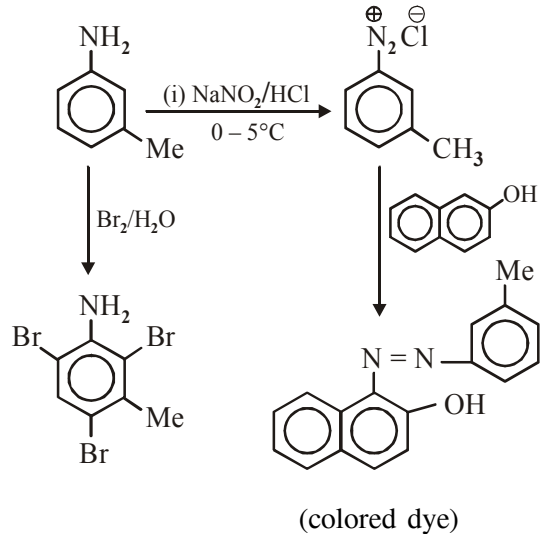
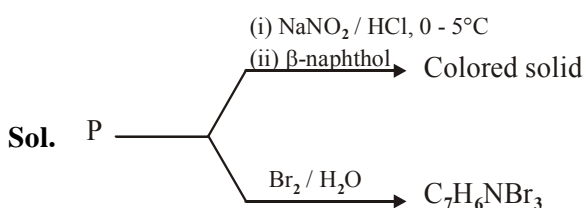


Total 13 atom are present in same plane (7 carbon & 6 hydrogen atoms.)

11. NTA Ans. (3)

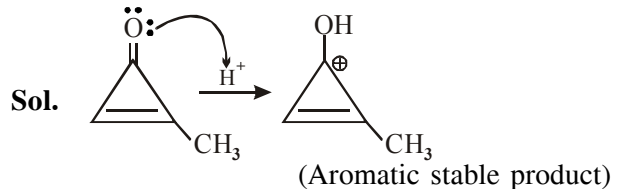


12. NTA Ans. (2)

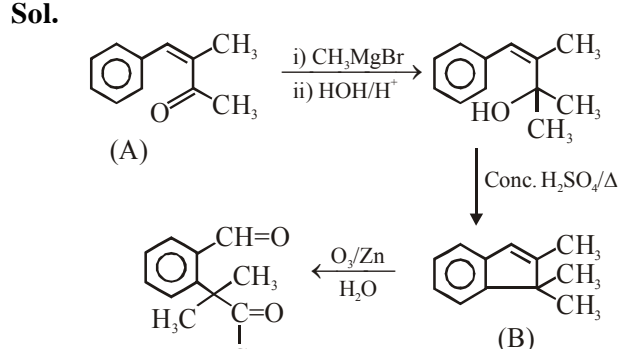


CARBONYL COMPOUNDS

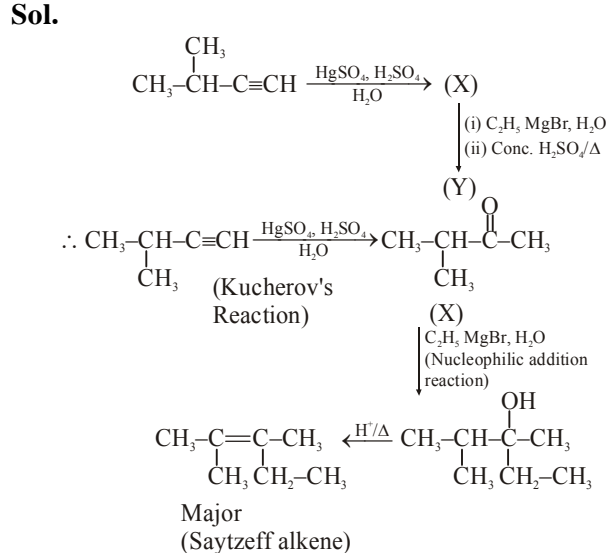
1. NTA Ans. (2)



2. NTA Ans. (4)

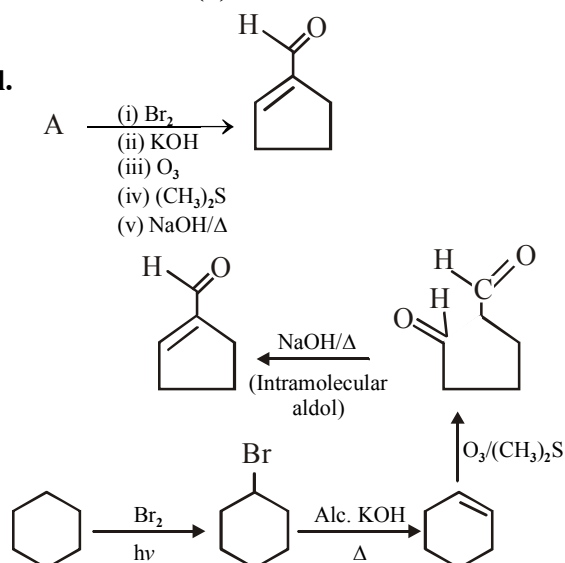


3. NTA Ans. (3)



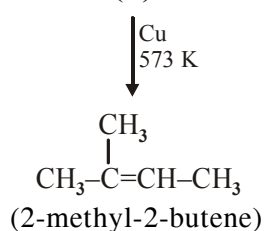
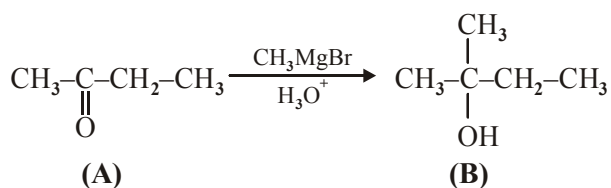
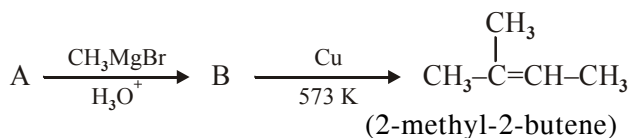
4. NTA Ans. (3)

Sol.



5. NTA Ans. (66.65 to 66.70)

Sol.



$$C \Rightarrow 12 \times 4 = 48$$

$$H \Rightarrow 8 \times 1 = 8$$

$$O \Rightarrow 16 \times 1 = 16$$

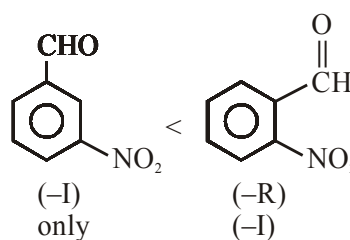
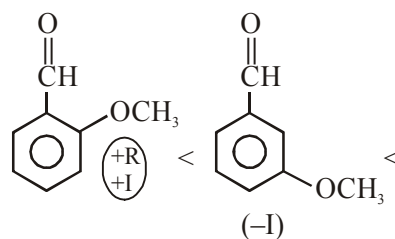
$$\text{Total} \quad 72$$

$$\% \text{ of C} = \frac{48}{72} \times 100 = 66.66\%$$

6. Official Ans. by NTA (3)

Sol. Increasing order of reactivity towards HCN addition

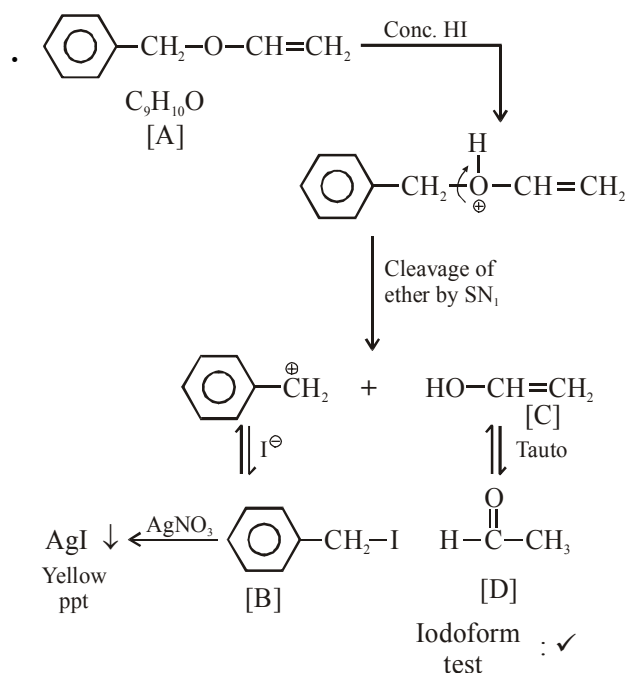
Greater the electrophilicity on $-\overset{\text{O}}{\parallel}{\text{C}}-$ group greater the reactivity in nucleophilic addition.



$$(iii) < (i) < (iv) < (ii)$$

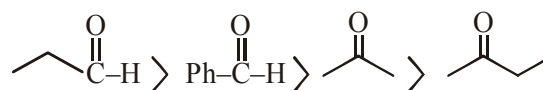
7. Official Ans. by NTA (2)

Sol

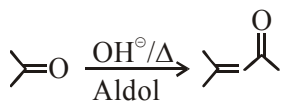
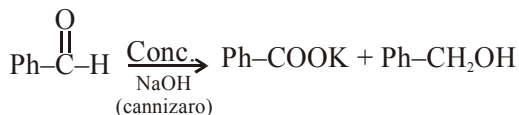
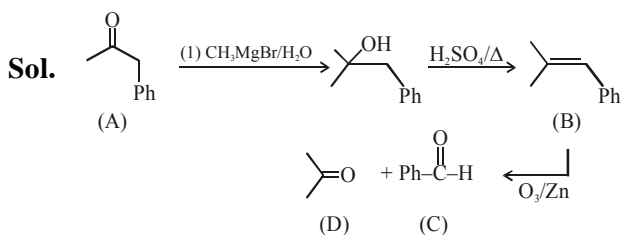


8. Official Ans. by NTA (1)

Sol. Reactivity order of various carbonyl compounds \rightarrow Aldehydes $>$ Ketones



9. Official Ans. by NTA (3)

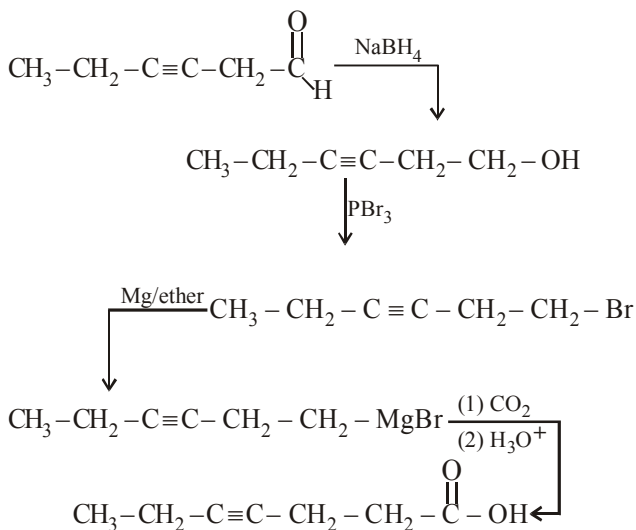


10. Official Ans. by NTA (2)

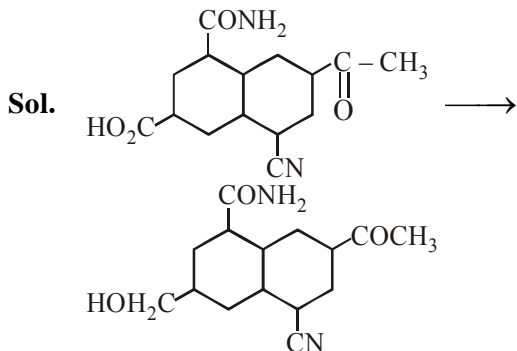
CARBOXYLIC ACID AND THEIR DERIVATIVES

1. NTA Ans. (3)

Sol.



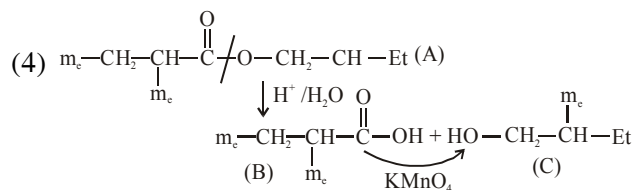
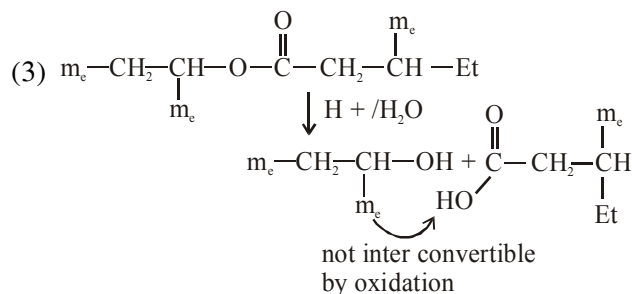
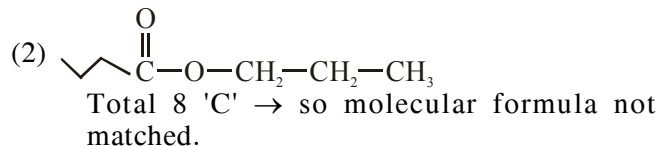
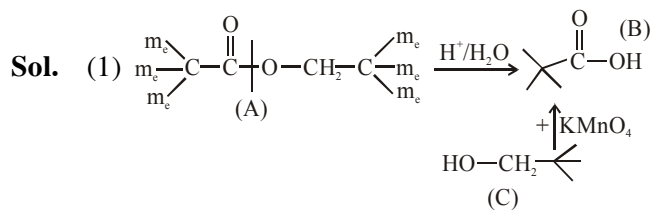
2. NTA Ans. (4)



Most suitable reagent for given conversion is B_2H_6 (electrophilic reducing agent)

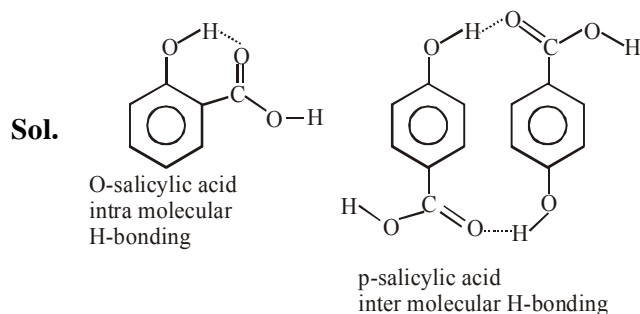
3. Official Ans. by NTA (3)

Official Ans. by ALLEN (2 & 3)



4. Official Ans. by NTA (3)

Official Ans. by ALLEN (2, 3 & 4)



(a) B will be more crystalline due to more inter molecular interactions hence more efficient packing.

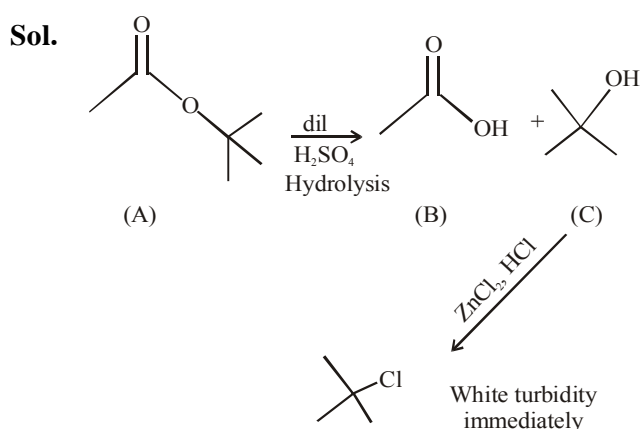
(b) B will have higher boiling point due to higher intermolecular interactions.

(c) B will be more soluble in water than A as B will have more extent of H-bonding in water

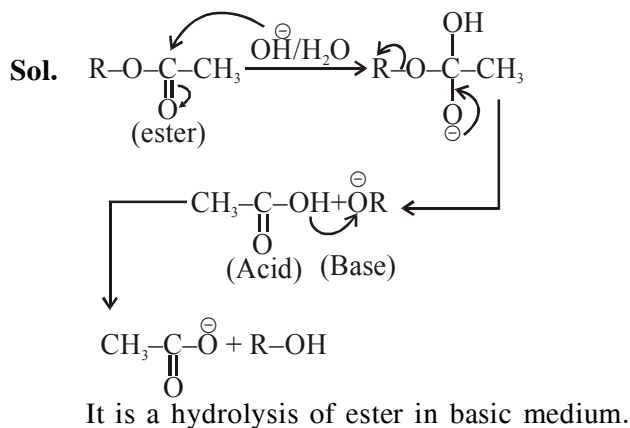
So all three statements are correct

{Solubility data \Rightarrow O-salicylic acid = 2g/L
P-salicylic acid = 5g/L}

5. Official Ans. by NTA (1)



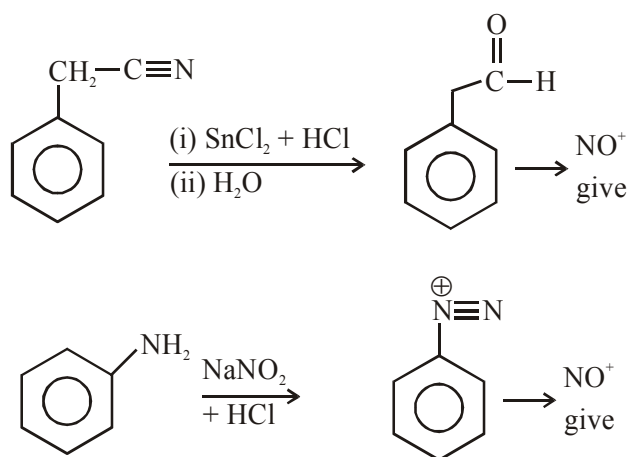
6. Official Ans. by NTA (2)



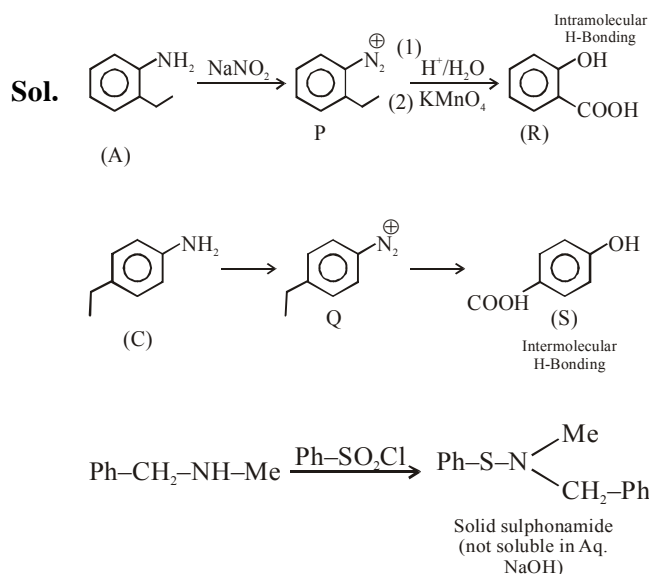
AMINES

1. Official Ans. by NTA (2)

Sol. Kjeldahl method is used for N estimation But not given by 'Diazo' compounds

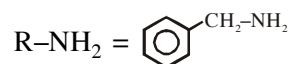
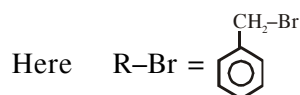
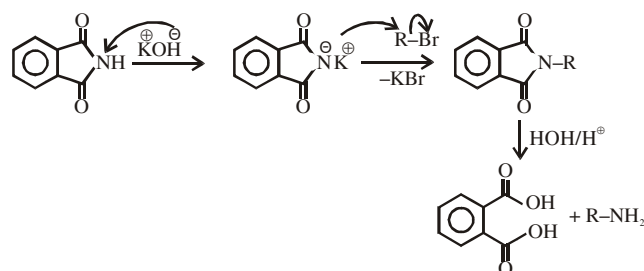


2. Official Ans. by NTA (2)

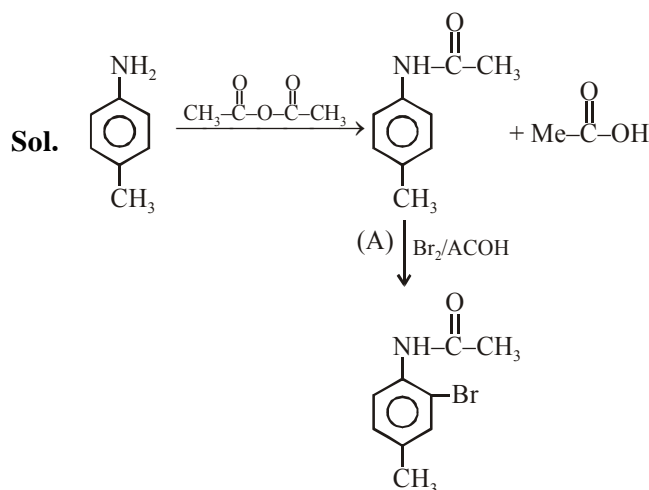


3. Official Ans. by NTA (1)

Sol. Gabriel phthalimide synthesis is used for preparation of 1° Aliphatic amine

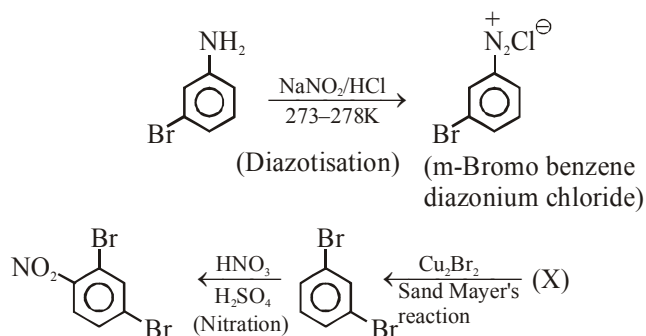


4. NTA Ans. (1)



5. NTA Ans. (2)

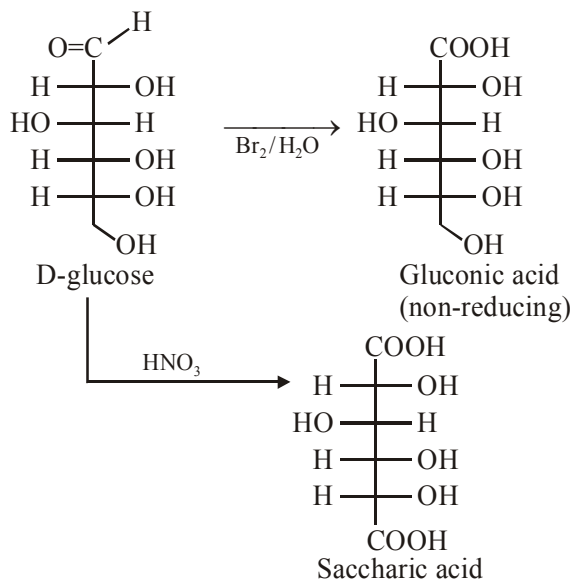
Sol.



BIOMOLECULES

1. NTA Ans. (2)

Sol.



2. NTA Ans. (2)

Sol. Glucose gives negative test with Schiff reagent

3. NTA Ans. (3)

Sol. Two monomers in maltose are α -D-glucose & α -D-glucose.

4. NTA Ans. (4)

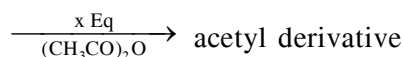
Sol. Alanine does not show **Biuret test** because **Biuret test** is used for deduction of peptide linkage & alanine is amino acid.

Albumine is protein so have paptide linkage so it gives positive **Biuret test**.

Positive **Barfoed test** is shown by monosaccharide but not disaccharide. Positive **Molisch's test** is shown by glucose.

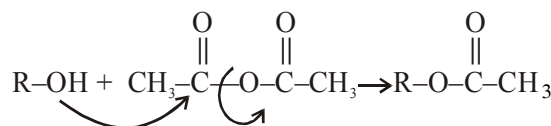
5. Official Ans. by NTA (4)

Sol. (i) Glucose + dry HCl \xrightarrow{ROH} Acetal



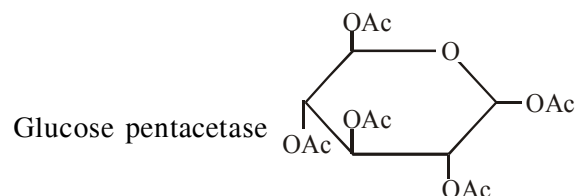
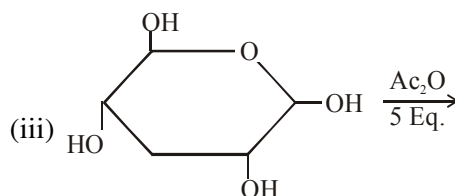
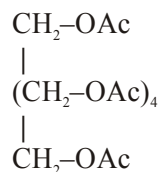
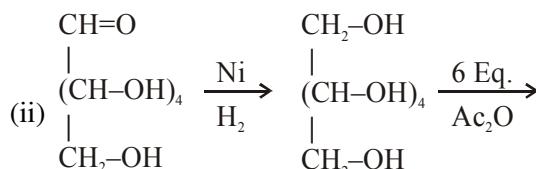
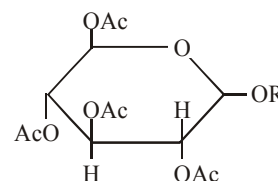
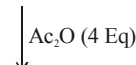
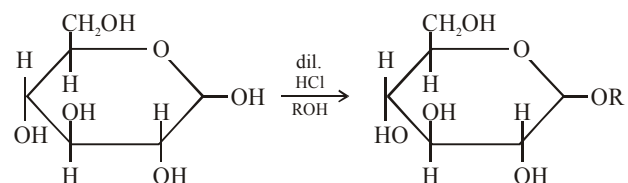
(ii) Glucose $\xrightarrow{Ni/H_2}$ A $\xrightarrow[(CH_3CO)_2O]{y Eq}$ Acetyl derivative

(iii) Glucose $\xrightarrow[(CH_3CO)_2O]{z Eq}$ Acetyl derivative due to presence of $-OH$ group in Glucose the reaction is



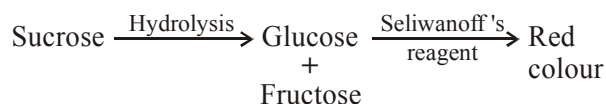
Acetyl derivative

so for (i)

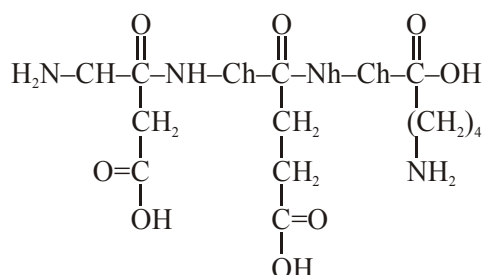


6. Official Ans. by NTA (3)

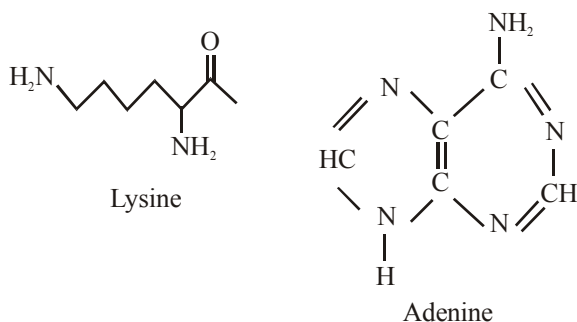
Sol. Seliwanoff's test is used to distinguish between aldose and ketose sugars; when added to a solution containing ketose, red colour is formed rapidly.

**7. Official Ans. by NTA (5)**

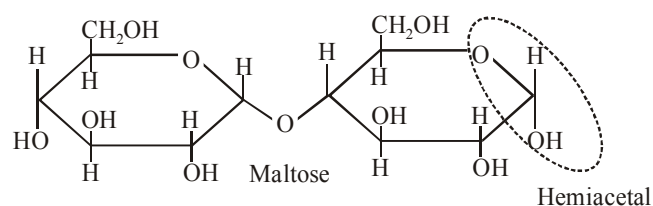
Sol. Structure of Tri peptide Asp – Glu – Lys

**8. Official Ans. by NTA (1)**

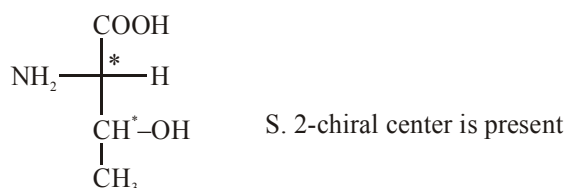
Sol. Adenine and lysine Both have primary amine react with $\text{CHCl}_3 + \text{alc. KOH}$

**9. Official Ans. by NTA (2)**

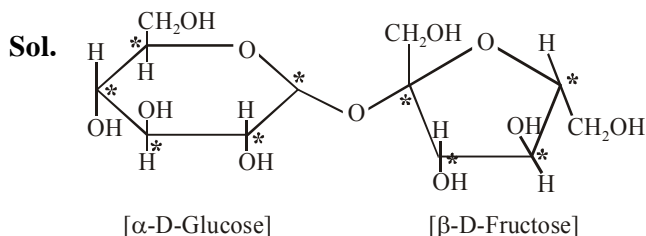
Sol.

**10. Official Ans. by NTA (2)**

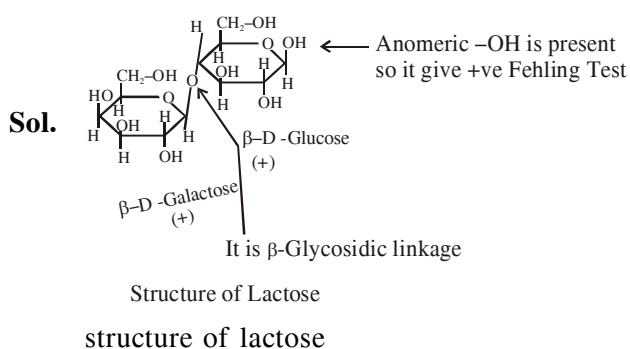
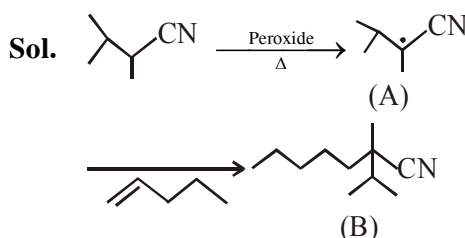
Sol. Structure of Threonine is :

**11. Official Ans. by NTA (4)**

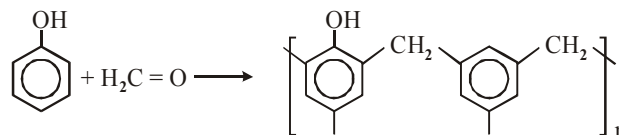
Sol. Tyrosine is not an essential amino acid.

12. Official Ans. by NTA (4)**13. Official Ans. by NTA (9)**

Total no. of chiral carbon in sucrose = 9

14. Official Ans. by NTA (1)**POLYMER****1. NTA Ans. (1)****2. NTA Ans. (3)**

Sol. Bakelite formation is example of electrophilic substitution and dehydration.

**3. NTA Ans. (4)**

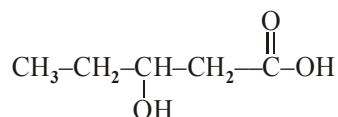
Sol. PHBV :

Poly β-hydroxy butyrate-co-β-hydroxy valerate



(3-hydroxy butanoic acid)

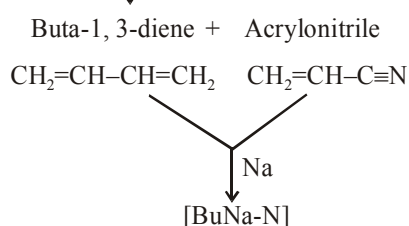
+



(3-hydroxy pentanoic acid)

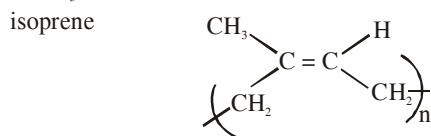
4. Official Ans. by NTA (1)

Sol. $\boxed{\text{BuNa-N}}$ is an addition polymer



5. Official Ans. by NTA (2)

Sol.(a) $n\text{CH}_2=\text{C}(\text{CH}_3)-\text{CH}=\text{CH}_2 \longrightarrow$ Poly cis-isoprene
 (Natural rubber)



(b) $n\text{CH}_2=\text{C}(\text{Cl})-\text{CH}=\text{CH}_2 \longrightarrow$ $(\text{CH}_2-\text{C}(\text{Cl})=\text{CH}-\text{CH}_2)_n$
 Chloroprene Neoprene

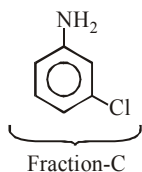
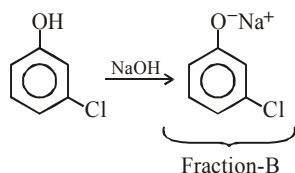
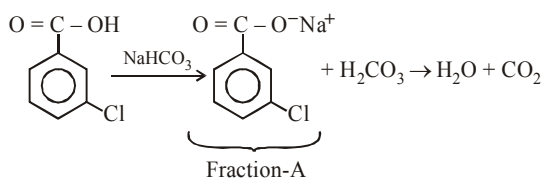
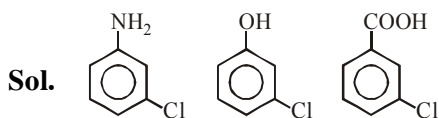
(c) $n\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2 + n\text{CH}_2=\text{CH}-\text{CN} \longrightarrow$ $[-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}(\text{CN})-]_n$
 1,3-butadiene Acrylonitrile Buna-N

(d) $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2 + \text{CH}_2=\text{CH}-\text{C}_6\text{H}_5 \longrightarrow$ $[\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}(\text{C}_6\text{H}_5)]_n$
 1,3-butadiene styrene Buna-S

6. Official Ans. by NTA (3)

PRACTICAL ORGANIC CHEMISTRY (POC)

1. NTA Ans. (3)



2. NTA Ans. (2)

Sol. (A) Benzanilide \rightarrow $\text{Ph}-\text{NH}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Ph}$ ($\mu = 2.71 \text{ D}$)
 (B) Aniline \rightarrow $\text{Ph}-\text{NH}_2$ ($\mu = 1.59 \text{ D}$)

(C) Acetophenone \rightarrow $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ ($\mu = 3.05 \text{ D}$)

Dipole moment : $\text{C} > \text{A} > \text{B}$

Hence the sequence of obtained compounds is (C), (A) and (B)

3. NTA Ans. (3)

Sol. Liquid which have less difference in boiling point can be isolated by fractional distillation and liquid with less boiling point will be isolated first.

4. NTA Ans. (1)

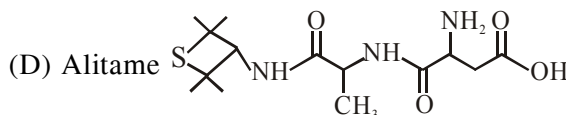
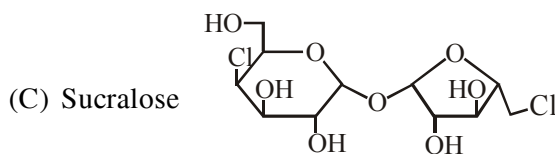
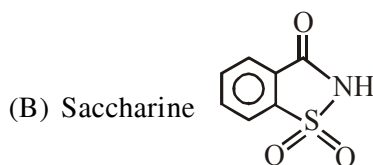
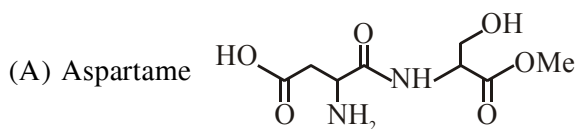
Sol. Kjeldahl's method for estimation of nitrogen is not applicable for nitrobenzene $\text{C}_6\text{H}_5\text{NO}_2$. because reaction with H_2SO_4 , nitrobenzene can not give ammonia.

5. NTA Ans. (1)

Sol. (i) Blue violet color with Ninhydrine \rightarrow amino acid derivative. So it cannot be saccharide or sucralose.

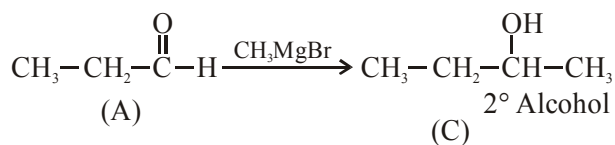
(ii) Lassaigne extract give +ve test with AgNO_3 . So Cl is present, -ve test with $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ means N is absent. So it can't be Aspartame or Saccharine or Alitame, so C is sucralose.

(iii) Lassaigne solution of B and D given +ve sodium nitroprusside test, so it is having S, so it is Saccharine and Alitame.



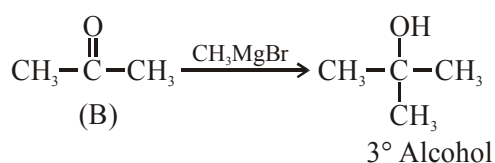
6. Official Ans. by NTA (3)

Sol.



CAN test for alcohol : ✓

Iodoform test : ✓

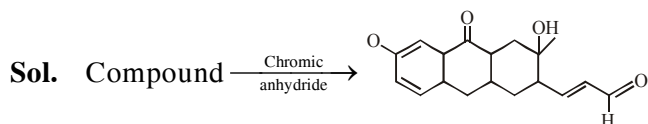


CAN test for alcohol : ✓

Lucas test : Immediately

Iodoform test : ✗

7. Official Ans. by NTA (2)



due to pressure of b

8. Official Ans. by NTA (1)

Sol. Test Correct reagent

(i) Lucas test \longrightarrow conc. HCl + ZnCl₂(ii) Dumas method \longrightarrow CuO / CO₂(iii) Kjeldahl's method \longrightarrow H₂SO₄(iv) Hinsberg Test \longrightarrow C₆H₅SO₂Cl + aq. KOHPURIFICATION AND
SEPRATION TECHNIQUE

1. Official Ans. by NTA (1)

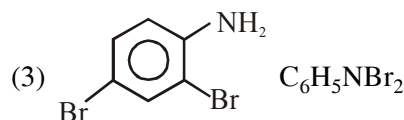
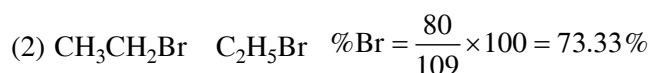
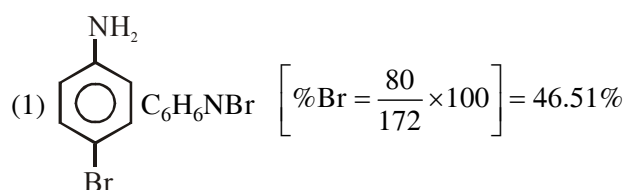
Sol. In Carius method

mass of organic compound = 0.172 gm

mass of Bromine = 0.08 gm

$$\text{Hence \% of Bromine} = \frac{0.08}{0.172} \times 100$$

$$= 46.51\%$$

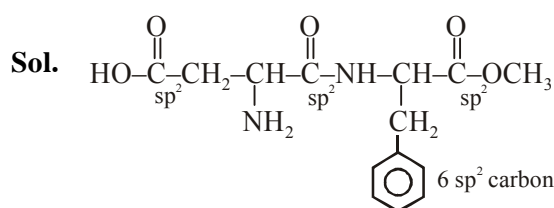


CHEMISTRY IN EVERYDAY LIFE

1. NTA Ans. (1)

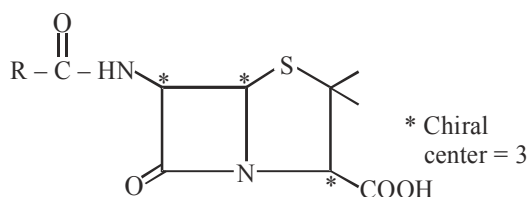
Sol. (i) Riboflavin \longrightarrow (c) Cheilosis(ii) Thiamine \longrightarrow (a) Beriberi(iii) Pyridoxin \longrightarrow (d) Convulsions(iv) Ascorbic acid \longrightarrow (b) Scurvy

2. NTA Ans. (9.00)

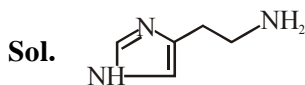
no. of sp²-carbon \rightarrow 9

3. NTA Ans. (3.00)

Sol. The structure of penicillin is



4. NTA Ans. (37.80 to 38.20)



M.F. of Histamine is $C_5H_9N_3$

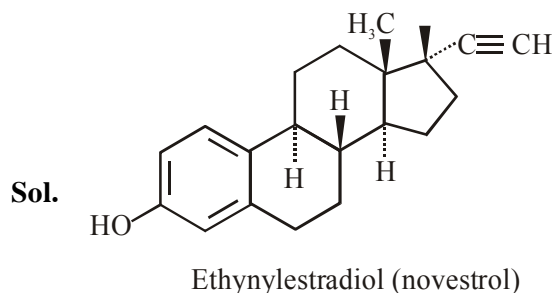
Molecular mass of Histamine is 111

$$\begin{aligned} \text{Now, mass \% of nitrogen} &= \left(\frac{42}{111} \right) \times 100 \\ &= 37.84\% \end{aligned}$$

5. Official Ans. by NTA (3)

Sol. Glycerol is separated by reduced pressure distillation in soap industries.

6. Official Ans. by NTA (1)



gives (1) $Br_2 + H_2O$ test

(2) Lucas test with $ZnCl_2 + HCl$

(3) $FeCl_3$ test of phenolic group.

7. Official Ans. by NTA (3)

Sol. Ranitidine \rightarrow Antacid

Nardil \rightarrow Antidepressant

Chloramphenicol \rightarrow Antibiotic

Dimetane \rightarrow Antihistamine

8. Official Ans. by NTA (4)

Sol. Anti depressant \rightarrow drug which enhance the mood. Non adrenaline is neurotransmitter and its level is low in body due to some reason then person suffers from depression and in that situation anti depressant drug is required.

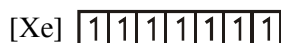
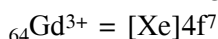
9. Official Ans. by NTA (3)

JANUARY & SEPTEMBER 2020 ATTEMPT (IOC)

QUANTUM NUMBER

1. Official Ans. by NTA (2)

Sol. Electronic configuration of Gd^{3+} is



Gd^{3+} having 7 unpaired electrons.

Magnetic moment (μ) = $\sqrt{n(n+2)}$ B.M.

$$\begin{aligned} \mu &= \sqrt{7(7+2)}\text{B.M.} \\ &= 7.9 \text{ B.M.} \end{aligned}$$

$n \Rightarrow$ Number of unpaired electrons.

2. Official Ans. by NTA (4)

Sol. As per $(n + \ell)$ rule in 6th period, order of orbitals filling is 6s, 4f, 5d, 6p.

3. Official Ans. by NTA (1)

Official Ans. by ALLEN (2,3)

Sol. $l = 0$ to $(n + 1)$

$n = 1$	$n = 2$
$l = 0, 1, 2$	$l = 0, 1, 2, 3$

$$(n + l) \Rightarrow \begin{array}{c|c|c} 1s & 1p & 1d \\ \hline 1 & 2 & 3 \end{array} \qquad \begin{array}{c|c|c|c} 2s & 2p & 2d & 2f \\ \hline 2 & 3 & 4 & 5 \end{array}$$

$$n = 3$$

$$l = 0, 1, 2, 3, 4$$

$$\begin{array}{c|c|c|c|c} 3s & 3p & 3d & 3f & 3g \\ \hline 3 & 4 & 5 & 6 & 7 \end{array}$$

Now, in order to write electronic configuration, we need to apply $(n + l)$ rule

Energy order : $1s < 1p < 2s < 1d < 2p < 3s < 2d \dots$

Option 1) 13 : $1s^2 1p^6 2s^2 1d^3$ is not half filled

Option 2) 9 : $1s^2 1p^6 2s^1$ is the first alkali metal because after losing one electron, it will achieve first noble gas configuration

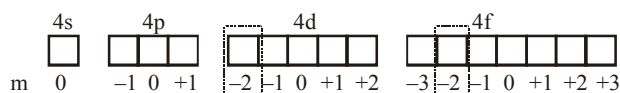
Option 3) 8 : $1s^2 1p^6$ is the first noble gas because after $1p^6 e^-$ will enter 2s hence new period

Option 4) 6 : $1s^2 1p^4$ has 1p valence subshell.

4. Official Ans. by NTA (4)

Sol. For $n = 4$

$$l = 0, 1, 2, 3$$



\therefore 4d & 4f subshell associated with $n = 4, m = -2$

PERIODIC TABLE

1. NTA Ans. (1)

Sol. Order of electron gain enthalpy (magnitude) is $Cl > F > Br > I$

2. NTA Ans. (3)

Sol. (i) Electron affinity of second period p-block element is less than third period p-block element due to small size of second period p-block element.

E.A. order : $F < Cl$

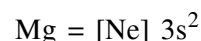
(ii) Down the group electron affinity decreases due to size increases.

E.A. order : $S > Se$

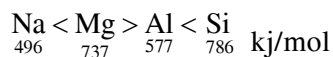
$Li > Na$

3. NTA Ans. (1)

Sol. Electronic configuration of $Na = [Ne] 3s^1$



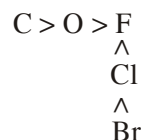
So order of first ionisation energy is



$Na < Al < Mg < Si$ (IE_1 order)

4. NTA Ans. (4)

Sol. If the given elements are arranged according to their position in periodic table Atomic radius



$Br > Cl > C > O > F$

$c < b < a < d < e$

5. NTA Ans. (1)

Sol. $\text{Be} \Rightarrow 1s^2 2s^2$

$\text{B} \Rightarrow 1s^2 2s^2 2p^1$

B has a smaller size than Be

it is easier to remove 2p electron than 2s electron due to less penetration effect of 2p than 2s.

2p electron of Boron is more shielded from the nucleus by the inner core of electron than the 2s electron of Be

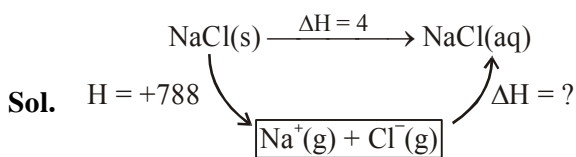
B has a smaller size than Be

6. Official Ans. by NTA (3)

Sol. Correct order of size for isoelectronic species.

$\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-} < \text{N}^{3-}$

7. Official Ans. by NTA (2)



$4 = 788 + \Delta H$

$\Delta H = -784 \text{ kJ}$

8. Official Ans. by NTA (2)

Sol. $\text{H}_{(\text{g})} + e^- \rightarrow \text{H}^-$ is exothermic rest of all endothermic process.

9. Official Ans. by NTA (4)

Sol.

	O^{-2}	F^-	Na^+	Mg^{2+}
z	8	9	11	12
e^-	10	10	10	10
$\frac{z}{e}$	0.8	0.9	1.1	1.2

as $\frac{z}{e}$ ratio increases size decreases.

Thus correct ionic radii order is

$\text{O}^{-2} > \text{F}^- > \text{Na}^+ > \text{Mg}^{2+}$

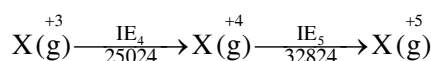
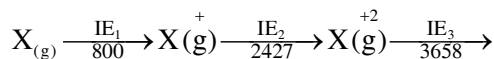
Therefore correct option is (4)

10. Official Ans. by NTA (2)

Sol. Element with atomic no. 101 is an Actinoid element.

11. Official Ans. by NTA (2)

Sol. Let suppose element X \Rightarrow



X^{+3} has stable inert gas configuration as there is high jump after IE_3

So valence electrons are 3

12. Official Ans. by NTA (3)

Sol. I, A_N : Be < Mg

II IE : Be > Al

III Charge/radius ratio of Be is less than that of Al

IV Be, Al mainly form covalent compounds

13. Official Ans. by NTA (4)

Sol. 1 0 9

un nil enn

Hence correct name \rightarrow unnilennium

14. Official Ans. by NTA (3)

Sol. When we are moving from left to right in a periodic table acidic character of oxides increases (as well as atomic number of atom increases)

$\therefore X < Y < Z$ (acidic character)

$X < Y < Z$ (atomic number)

15. Official Ans. by NTA (4)

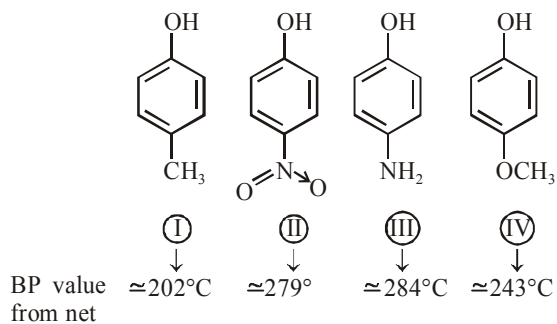
Sol. In general across a period atomic radius decreases while ionisation enthalpy, electron gain enthalpy and electronegativity increases because effective nuclear charge (Z_{eff}) increases.

16. Official Ans. by NTA (101.00)

Sol. Unnilunium \Rightarrow 101

12. Official Ans. by NTA (1)

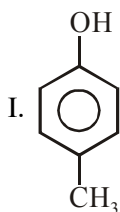
Sol.



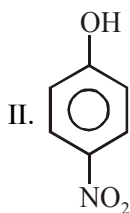
$$\text{BP} \propto \text{dipole moment } (\mu)$$

Alter

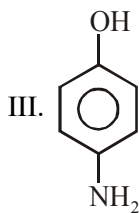
Increasing order of boiling point is :



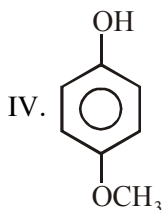
⇒ Shows hydrogen bonding from -O-H group only



⇒ Shows strongest hydrogen bonding from both sides of -OH group as well as -NO₂ group.



⇒ Shows stronger hydrogen from both side of -OH group as well as -NH₂ group.

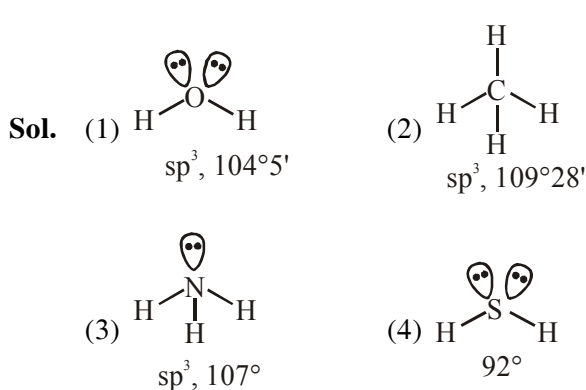


⇒ Shows stronger hydrogen bonding from one side -OH-group and another side of -OCH₃ group shows only dipole-dipole interaction.

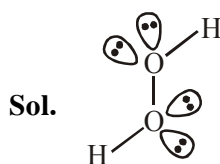
⇒ Hence correct order of boiling point is:

(I) < (IV) < (III) < (II)

13. Official Ans. by NTA (2)



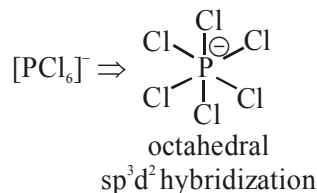
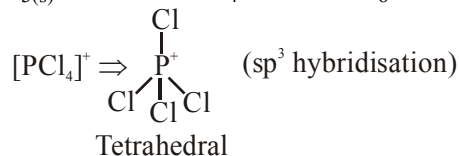
14. Official Ans. by NTA (1)



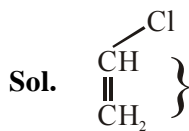
hydrogen peroxide, in the pure state, is non-planar and almost colourless (very pale blue) liquid.

15. Official Ans. by NTA (2)

Sol. PCl_{5(s)} exist as [PCl₄]⁺ and [PCl₆]⁻



16. Official Ans. by NTA (3)

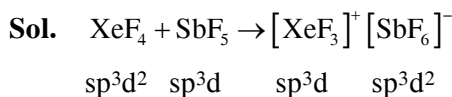


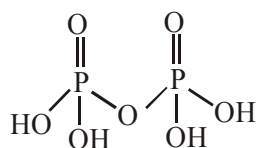
In option (3) C—Cl bond is shortest due to resonance of lone pair of -Cl.

Due to resonance C—Cl bond acquire partial double bond character.

Hence C—Cl bond length is least.

17. Official Ans. by NTA (2)

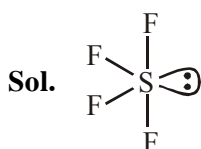
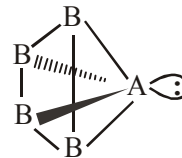


18. Official Ans. by NTA (4)**Sol.** Bond order of $\text{NO}^{2+} = 2.5$ Bond order of $\text{NO}^+ = 3$ Bond order of $\text{NO} = 2.5$ Bond order of $\text{NO}^- = 2$ Bond order \propto bond strength.**19. Official Ans. by NTA (4)****Sol.** Pyrophosphoric acid.

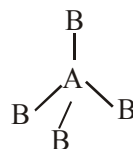
P - OH linkages = 4

P = O linkages = 2

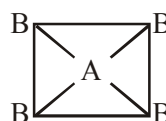
P-O-P linkages = 1

20. Official Ans. by NTA (3)**Official Ans. by ALLEN (2)****Sol.** Type of interaction Interaction Energy (E)ion - ion $E \propto \frac{1}{r}$ dipole - dipole $E \propto \frac{1}{r^3}$ London dispersion $E \propto \frac{1}{r^6}$ **21. Official Ans. by NTA (1)**4 σ bonds + 1 lone pair \therefore Shape (including lone pair of electrons) is Trigonal bipyramidal**22. Official Ans. by NTA (1)****Sol.** (1) If AB_4 molecule is a square pyramidal then it has one lone pair and their structure should be

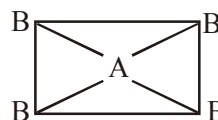
and it should be polar because dipole moment of lone pair of 'A' never be cancelled by others.

(2) If AB_4 molecule is a tetrahedral then it has no lone pair and their structure should be

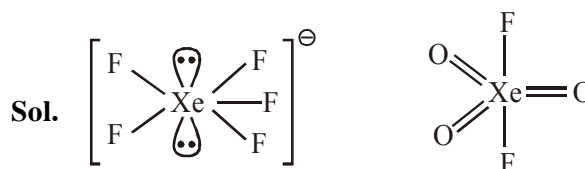
and it should be non polar due to perfect symmetry.

(3) If AB_4 molecule is a square planar then

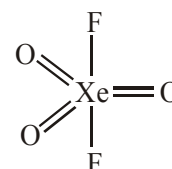
it should be non polar because vector sum of dipole moment is zero.

(4) If AB_4 molecule is a rectangular planar then

it should be non polar because vector sum of dipole moment is zero.

23. Official Ans. by NTA (1) XeF_5^- sp^3d^3

Pentagonal planar

 XeO_3F_2 sp^3d

Trigonal bipyramidal

COORDINATION CHEMISTRY

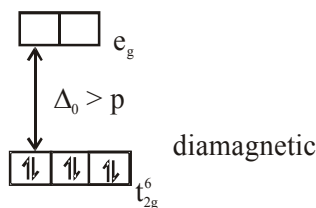
1. NTA Ans. (4)

Sol. In complex $[\text{Ni}(\text{CO})_4]$ decrease in Ni–C bond length and increase in C–O bond length as well as its magnetic property is explained by MOT.

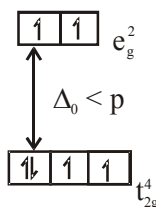
2. NTA Ans. (4)

3. NTA Ans. (4)

Sol. (a) Co^{+3} (with strong field ligands)



(b) If $\Delta_0 < p$;



(c) Splitting power of ethylenediamine (en) is greater than fluoride (F^-) ligand therefore more energy absorbed by $[\text{Co}(\text{en})_3]^{3+}$ as compared to $[\text{CoF}_6]^{3-}$.

So wave length of light absorbed by $[\text{Co}(\text{en})_3]^{3+}$ is lower than that of $[\text{CoF}_6]^{3-}$

$$(d) \Delta_t = \frac{4}{9} \Delta_0$$

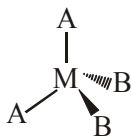
so if $\Delta_0 = 18,000 \text{ cm}^{-1}$

$$\Delta_t = \frac{4}{9} \times 18000 = 8000 \text{ cm}^{-1}$$

Statement (a) and (d) are incorrect.

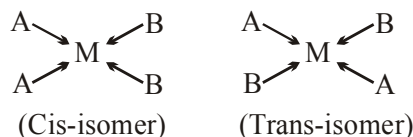
4. NTA Ans. (1)

Sol. (a) If the complex MA_2B_2 is sp^3 hybridised then the shape of this complex is tetrahedral this structure is optically inactive due to the presence of plane of symmetry.



Optical isomers = 0

(b) If the complex MA_2B_2 is dsp^2 hybridised then the shape of this complex is square planar.

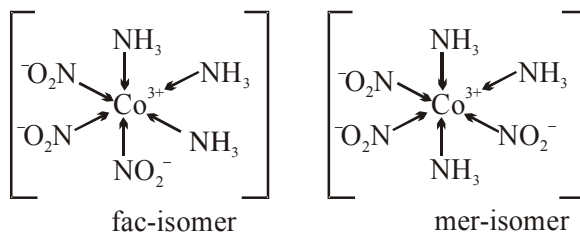
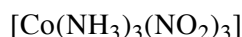


Both isomers are optically inactive due to the presence of plane of symmetry.

Optical isomers = 0

5. NTA Ans. (3)

Sol. $[\text{Ma}_3\text{b}_3]$ type complex shows fac and mer isomerism.



6. NTA Ans. (26.60 to 27.00)

Sol. Number of moles of Cl^- precipitated in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is equal to number of moles of AgNO_3 used.

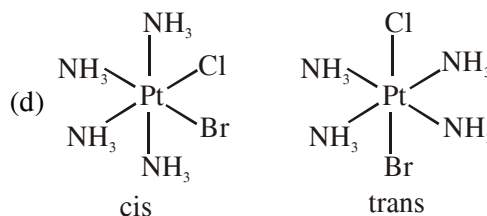
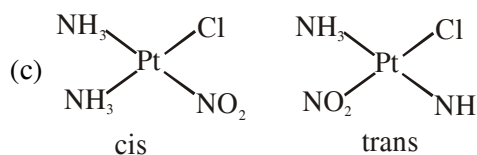
$$\frac{0.3}{267.46} \times 3 = \frac{0.125 \times V}{1000}$$

where V is volume of AgNO_3 (in mL)

$V = 26.92 \text{ mL}$

7. NTA Ans. (4)

Sol. $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^+$ & $[\text{Pt}(\text{NH}_3)\text{Cl}_5]^-$ does not show geometrical isomerism



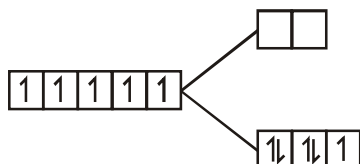
8. NTA Ans. (1)

Sol. $[\text{Ni}(\text{CO})_4]$ $\mu_m = 0 \text{ B.M.}$
 $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$ $\mu_m = 2.8 \text{ B.M.}$
 $\text{Na}_2[\text{Ni}(\text{CN})_4]$ $\mu_m = 0 \text{ B.M.}$
 $[\text{PdCl}_2(\text{PPh}_3)_2]$ $\mu_m = 0 \text{ B.M.}$
 $A \approx C \approx D < B$

9. NTA Ans. (20)

10. NTA Ans. (2)

Sol. $[\text{Pb}(\text{F})(\text{Cl})(\text{Br})(\text{I})]^{2-}$ have three geometrical isomer so formula for $[\text{Fe}(\text{CN})_6]^{n-6}$ is $[\text{Fe}(\text{CN})_6]^{3-}$ and CFSE for this complex is $\text{Fe}^{3+} \Rightarrow 3d^5 4s^0$



$$\text{Magnetic Moment} = \sqrt{3}$$

$$= 1.73 \text{ B.M}$$

$$\text{CFSE} = [(-0.4 \times 5) + (0.6 \times 0)] \Delta_0$$

$$= -2.0 \Delta_0$$

11. NTA Ans. (1)

Sol. $\text{Cr}(\text{H}_2\text{O})_6 \text{Cl}_n$

if magnetic moment is 3.83 BM then it contain three unpaired electrons. It means chromium in +3 oxidation state so molecular formula is $\text{Cr}(\text{H}_2\text{O})_6 \text{Cl}_3$

\therefore This formula have following isomers

(a) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$: react with AgNO_3 but does not show geometrical isomerism.

(b) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$ react with AgNO_3 but does not show geometrical isomerism.

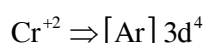
(c) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ react with AgNO_3 & show geometrical isomerism.

(d) $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$ does not react with AgNO_3 & show geometrical isomerism.

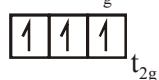
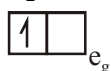
$[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ react with AgNO_3 & show geometrical isomerism and it's IUPAC nomenclature is Tetraaquadichlorido chromium (III) Chloride dihydrate.

12. NTA Ans. (2)

Sol. I $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$



$\text{H}_2\text{O} \rightarrow$ Weak field ligand

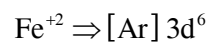


Unpaired $e^- = 4$

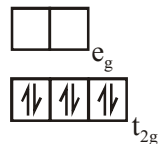
$$\text{Magnetic moment} = \sqrt{24} \text{ BM}$$

$$= 4.89 \text{ BM}$$

II $[\text{Fe}(\text{CN})_6]^{4-}$



$\text{CN}^- \rightarrow$ Strong field ligand

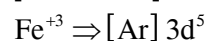


Unpaired $e^- = 0$

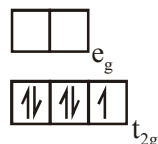
$$\text{Magnetic moment} = 0 \text{ BM}$$

$$= 0 \text{ BM}$$

III $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$



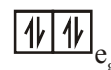
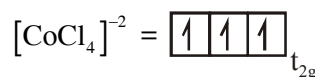
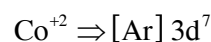
As $\Delta_0 > P$



Unpaired $e^- = 1$

$$\text{Magnetic moment} = \sqrt{3} \text{ BM} = 1.73 \text{ BM}$$

IV $(\text{Et}_4\text{N})^+ [\text{CoCl}_4]^{2-}$



Unpaired electrons = 3

$$\text{Magnetic moment} = \sqrt{15} \text{ BM}$$

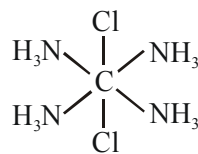
$$= 3.87 \text{ BM}$$

Hence order of magnetic moment is

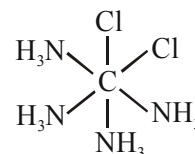
I > IV > III > II

13. NTA Ans. (4)

Sol. $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$ has 2 geometrical isomers



trans

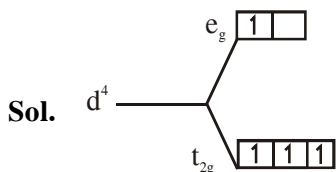


cis

cis isomer has $\text{Cl}-\text{Co}-\text{Cl}$ angle of 90°

14. Official Ans. by NTA (2)

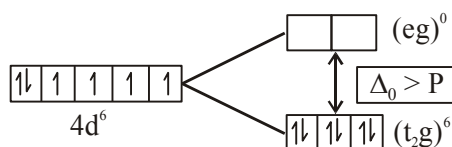
15. Official Ans. by NTA (3)



back pairing is not possible because pairing energy $> \Delta_0$.

16. Official Ans. by NTA (00)

Sol. Magnetic moment (in B.M.) of $[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$ would be; while considering that $\Delta_0 > P$, $\text{Ru}_{(44)}$; $[\text{Kr}]4d^75s^1$ (in ground state)
 \Rightarrow In $\text{Ru}^{2+} \Rightarrow 4d^6 \Rightarrow (t_{2g})^6(eg)^0$



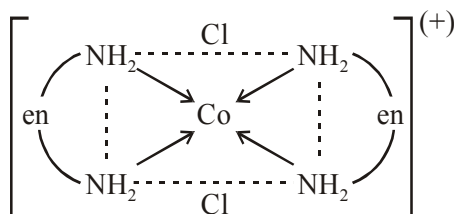
\Rightarrow Here number of unpaired electrons in

$\text{Ru}^{2+} = (t_{2g})^6(eg)^0 = 0$ and Hence

$$\mu_m = \sqrt{n(n+2)} \text{B.M.} = \boxed{0 \text{ B.M.}}$$

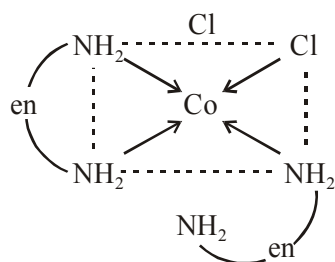
17. Official Ans. by NTA (4)

Sol. (A) *trans*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$



\Rightarrow (A) is *trans* form and shows plane of symmetry which is optically inactive (not optically active)

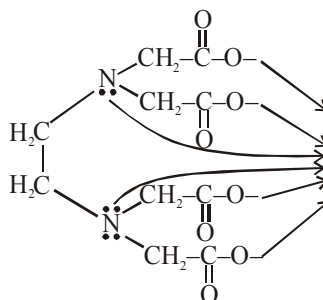
(B) *cis*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$



\Rightarrow (B) is *cis* form and does not shows plane of symmetry, hence it is optically active.

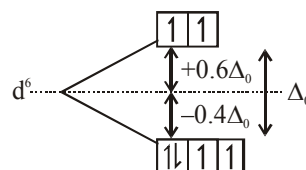
18. Official Ans. by NTA (6)

Sol. EDTA^{4-} is hexadentate ligand, so its donation sites are six.



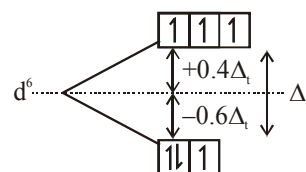
19. Official Ans. by NTA (3)

Sol. For high spin octahedral field



$$\text{CFSE} = (4)(-0.4\Delta_0) + 2(0.6\Delta_0) = -0.4\Delta_0$$

For high spin tetrahedral field



$$\text{CFSE} = 3(-0.6\Delta_t) + 3(0.4\Delta_t) = -0.6\Delta_t$$

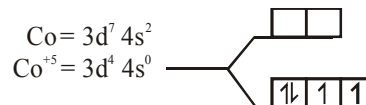
20. Official Ans. by NTA (1)

Sol. $[\text{Ni}(\text{CN})_4]^{2-}$

dsp^2 hybridisation.

21. Official Ans. by NTA (3)

Sol. $[\text{Co}(\text{OX})_2(\text{OH})_2]^-$ $\Delta_0 > P$ [S.F.L.]



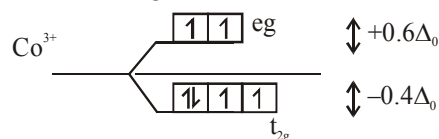
It has highest number of unpaired e-s. so it is most paramagnetic.

22. Official Ans. by NTA (4)

Official Ans. by ALLEN (2, 4)

Sol. $[\text{CoF}_3(\text{H}_2\text{O})_3]$ $\Delta_0 < P$

Means all ligands behaves as weak field ligands



$$= [-0.4 \times 4 + 0.6 \times 2] \Delta_0$$

$$= [-1.6 + 1.2] \Delta_0$$

$$= [-0.4 \Delta_0]$$

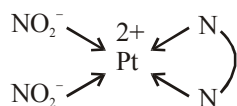
23. Official Ans. by NTA (3)

Sol.	Complex	e ⁻ configuration	no. of unpaired e ⁻
	[Mn(H ₂ O) ₆] ²⁺	$\begin{array}{ c c } \hline \uparrow\uparrow \\ \hline \end{array} eg$	5
	WFL	$\begin{array}{ c c c c } \hline \uparrow\uparrow\uparrow\uparrow \\ \hline \end{array} t_{2g}$	
	[Cr(H ₂ O) ₆] ²⁺	$\begin{array}{ c } \hline \uparrow \\ \hline \end{array} eg$	4
	WFL	$\begin{array}{ c c c } \hline \uparrow\uparrow\uparrow \\ \hline \end{array}$	
	[CoCl ₄] ²⁻	$\begin{array}{ c c c } \hline \uparrow\uparrow\uparrow \\ \hline \end{array} t_2$	3
	Tetrahedral	$\begin{array}{ c c } \hline \uparrow\downarrow \\ \hline \end{array} e$	
	[Fe(H ₂ O) ₆] ²⁺	$\begin{array}{ c c } \hline \uparrow\uparrow \\ \hline \end{array} eg$	4
	WFL	$\begin{array}{ c c c c } \hline \uparrow\downarrow\uparrow\uparrow \\ \hline \end{array} t_{2g}$	
	[Co(OH) ₄] ²⁻	$\begin{array}{ c c c } \hline \uparrow\uparrow\uparrow \\ \hline \end{array} t_2$	3
	WFL	$\begin{array}{ c c } \hline \uparrow\downarrow \\ \hline \end{array} e$	
	Tetrahedral	$\begin{array}{ c c } \hline \uparrow\uparrow \\ \hline \end{array}$	4
	[Fe(NH ₃) ₆] ²⁺	$\begin{array}{ c c c c } \hline \uparrow\downarrow\uparrow\uparrow \\ \hline \end{array}$	

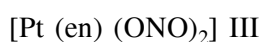
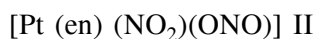
Thus complex [Cr(H₂O)₆]²⁺ and [Fe(H₂O)₆]²⁺ have same no. of unpaired e⁻ and hence same magnetic moment (spin only).

24. Official Ans. by NTA (1)

Sol. [Pt(en)(NO₂)₂] ⇒ does not show G.I. as well as optical isomerism.



This complex will have three linkage isomers as follows :-



25. Official Ans. by NTA (3)

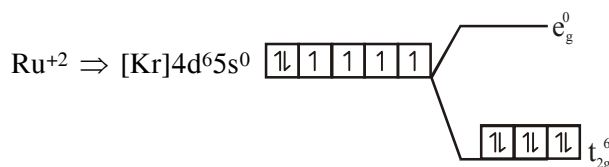
Sol. % mass of water

$$= \frac{x \times 18}{(12 + 6 \times 16 + 35 \times 3 + 52)} \times 100 = 13.5$$

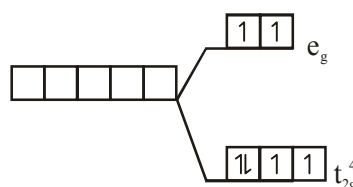
$$\Rightarrow x = \frac{265 \times 13.5}{18 \times 100} \approx 2$$

26. Official Ans. by NTA (3)

Sol. [Ru(en)₃]Cl₂ Ru ⇒ 4d series
en ⇒ chelating ligand
CN = 6, octahedral splitting hence large splitting of d-subshell



[Fe(H₂O)₆]Cl₂ ⇒ H₂O ⇒ Weak filled ligand
Fe²⁺ ⇒ [Ar] 3d⁶4s⁰
less splitting
CN = 6 octahedral splitting



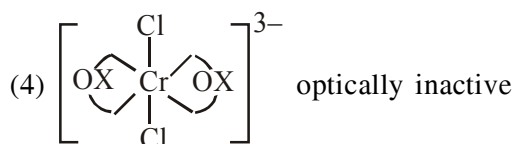
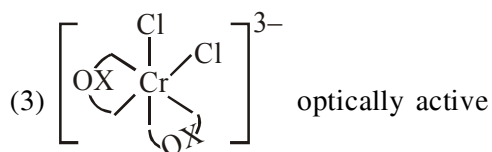
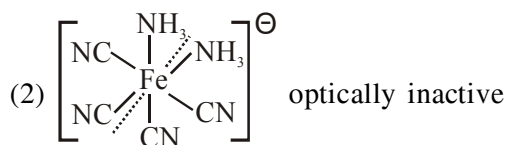
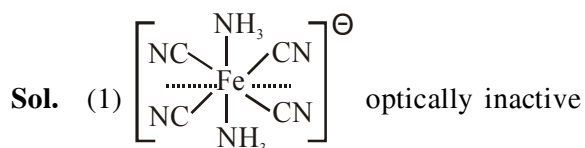
27. Official Ans. by NTA (4)

Sol. CFSE = 0.4 Δ₀

$$= 0.4 \times \frac{20300}{83.7}$$

$$= 97 \text{ kJ/mol}$$

28. Official Ans. by NTA (3)



29. Official Ans. by NTA (2)

Sol. $[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$ is tetrahedral complex, therefore does not show geometrical and optical isomerism.

$[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$ does not show structural isomerism

$[\text{Ni}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$ & $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ show geometrical isomerism

$[\text{Ni}(\text{en})_3]^{2+}$ show optical isomerism

30. Official Ans. by NTA (3)

Sol. (I) Under weak field ligand, octahedral Mn(II) and tetrahedral Ni(II) both the complexes are high spin complex.

(II) Tetrahedral Ni(II) complex can very rarely be low spin because square planar (under strong ligand) complexes of Ni(II) are low spin complexes.

(III) With strong field ligands Mn (II) complexes can be low spin because they have less number of unpaired electron (unpaired electron = 1)

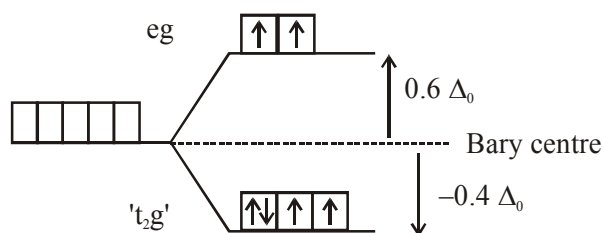
While with weak field ligands Mn(II) complexes can be high spin because they have more number of unpaired electron (unpaired electron = 5)

(IV) Aqueous solution of Mn(II) ions is pink in colour.

31. Official Ans. by NTA (2)

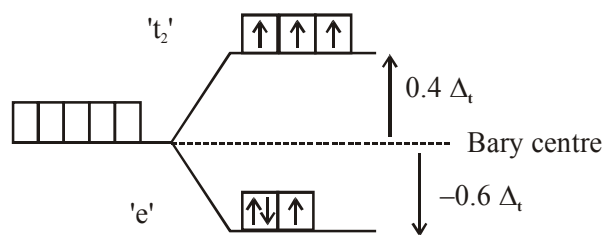
Sol. If spin only magnetic moment of the complex is 4.90 BM, it means number of unpaired electrons should be 4.

(A) In octahedral complex : $[\text{M}(\text{H}_2\text{O})_6]^{2+}$
 d^6



$$\text{C.F.S.E.} = (-0.4 \Delta_0) \times 4 + (+0.6 \Delta_0) \times 2 + 0 \times P = -0.4 \Delta_0$$

(B) In tetrahedral complex : $[\text{M}(\text{H}_2\text{O})_4]^{2+}$
 d^6



$$\text{C.F.S.E.} = (-0.6 \Delta_t) \times 3 + (+0.4 \Delta_t) \times 3 + 0 \times P = -0.6 \Delta_t$$

32. Official Ans. by NTA (6)

Sol. (A) $\text{Na}_4[\text{Fe}(\text{CN})_5(\text{NOS})]$
 $(+1)4 + x + (-1)5 + (-1)1 = 0$

$$x = +2$$

(B) $\text{Na}_4[\text{FeO}_4]$
 $(+1)4 + y + (-2)4 = 0$

$$y = +4$$

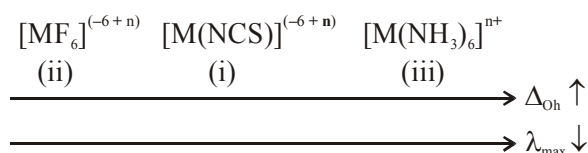
(C) $[\text{Fe}_2(\text{CO})_9]$
 $2z + 0 \times 9 = 0$

$$z = 0$$

$$\text{so } (x + y + z) = +2 + 4 + 0 = 6$$

33. Official Ans. by NTA (2)

Sol. Strength of ligand $\text{F}^- < \text{NCS}^- < \text{NH}_3$



As given in graph : $A < B < C$ (λ_{max})

∴ Correct matching is A–(iii), B–(i), C–(ii)

METALLURGY

- NTA Ans. (2)**
Sol. Wrought iron is purest form of commercial iron.
- NTA Ans. (2)**
Sol. Liquation method is used when the melting point of metal is less compare to the melting point of the associated impurity.
- NTA Ans. (1)**
Sol. In blast furnace (metallurgy of iron) involved reactions are
(a) $\text{CaO} + \text{SiO}_2 \longrightarrow \text{CaSiO}_3$
(b) $3\text{Fe}_2\text{O}_3 + \text{CO} \longrightarrow 2\text{Fe}_3\text{O}_4 + \text{CO}_2$
- NTA Ans. (2)**
Sol. A reduces BO_2 when temperature is above 1400°C because above 1400°C A has more –ve ΔG° for AO_2 formation than B to BO_2 formation.
- Official Ans. by NTA (2)**
Sol. Impure zinc is refined by distillation method.
- Official Ans. by NTA (4)**
Sol. "Boron" and "Silicon" of very high purity can be obtained through :-
zone refining method only.
While other methods are used for other metals/elements i.e.
(i) Vapour phase refining
(ii) electrolytic refining
(iii) liquation etc.
- Official Ans. by NTA (3)**
Sol. Ellingham diagram provides information about temperature dependence of the standard gibbs energies of formation of some metal oxides.
- Official Ans. by NTA (1)**
Sol. Due to industrial process SO_2 gas is released which is responsible for acid rain & global warming.
- Official Ans. by NTA (4)**
Sol. (a) $\text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2$ {In Blast furnace}
lime stone
(b) Ag form cyanide complex $[\text{Ag}(\text{CN})_2]^-$ during cyanide process



- (c) Ni is purified by mond's process
(d) Zr and Ti are purified by van arkel method
All (a), (b), (c), (d) are correct statements
Thus correct option is (4)

10. Official Ans. by NTA (2)

- Sol.** Cast iron is used for manufacturing of wrought iron and steel.

HYDROGEN & IT'S COMPOUND

1. Official Ans. by NTA (1)

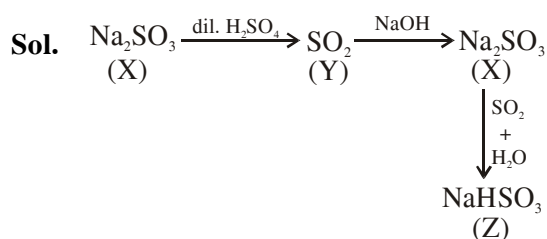
- Sol.** High purity (>99.95%) dihydrogen is obtained by electrolysing warm aqueous barium hydroxide solution between nickel electrodes.

2. Official Ans. by NTA (3)

- Sol.** Temporary hardness of water is removed by clark method and boiling. While permanent hardness of water is removed by treatment with sodium carbonate (Na_2CO_3), calgons method and ion-exchange method

SALT ANALYSIS

1. Official Ans. by NTA (2)

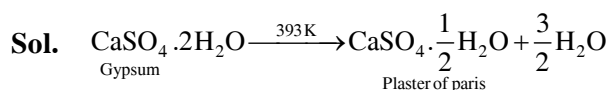


COMPLETE S-BLOCK

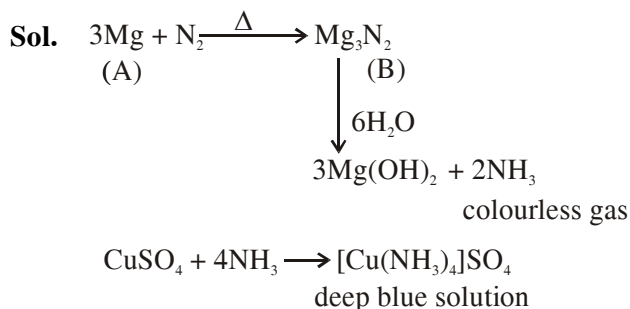
1. NTA Ans. (1)

- Sol.** $6\text{NaOH} + 3\text{Cl}_2 \longrightarrow \text{NaClO}_3 + 5\text{NaCl} + 3\text{H}_2\text{O}$
(hot and conc.) (A) side product
 $2\text{Ca}(\text{OH})_2 + 2\text{Cl}_2 \longrightarrow \text{Ca}(\text{OCl})_2 + \text{CaCl}_2 + 2\text{H}_2\text{O}$
dry (B) side product

2. NTA Ans. (4)



3. NTA Ans. (1)



4. NTA Ans. (3)

Sol. Lithium has highest hydration enthalpy among alkali metals due to its small size.

LiCl is soluble in pyridine because LiCl have more covalent character.

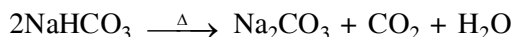
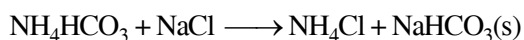
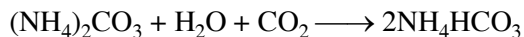
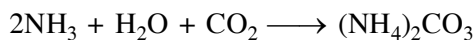
Li does not form ethynide with ethyne.

Both Li and Mg reacts slowly with H₂O

5. Official Ans. by NTA (4)

Sol. (I) Ca(OH)₂ is used in white wash

(II) NaCl is used in preparation of washing soda



(III) CaSO₄ · $\frac{1}{2}$ H₂O (Plaster of Paris) is used for

making casts of statues

(IV) CaCO₃ is used as an antacid

6. Official Ans. by NTA (2)

Sol. [Be]

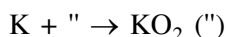
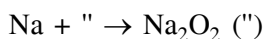
BeSO₄ is water soluble

Be(OH)₂ is water insoluble

BeO is stable to heat

7. Official Ans. by NTA (3)

Sol. Li + O₂ → Li₂O (Major Oxides)
excess



8. Official Ans. by NTA (3)

Sol. Toilet cleaning liquid has about 10.5% w/v HCl; to neutralise its affect aqueous NaHCO₃ is used while NaOH is avoid for this purpose because its highly corrosive in nature and can burn body.

9. Official Ans. by NTA (4)

Sol. Cs used in photoelectric cell as it has least ionisation energy.

10. Official Ans. by NTA (2)

Sol. Both Li and Mg form nitride when reacts directly with nitrogen.

The hydrogen carbonate of both Li and Mg does not exist in solid state.

All alkali metal hydrogen carbonate exist in solid state except LiHCO₃.

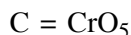
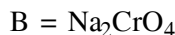
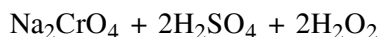
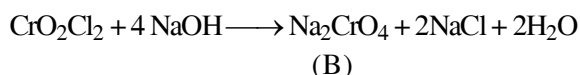
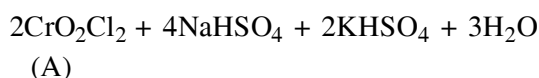
COMPLETE D-BLOCK

1. NTA Ans. (3)

Sol. Atomic radius of Ag and Au is nearly same due to lanthanide contraction.

2. NTA Ans. (18.00)

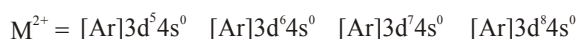
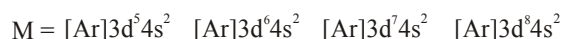
Sol. $4\text{NaCl} + \text{K}_2\text{Cr}_2\text{O}_7 + 6\text{H}_2\text{SO}_4$



Total number of atom in A + B + C = 18

3. NTA Ans. (1)

Sol. Electronic configuration of

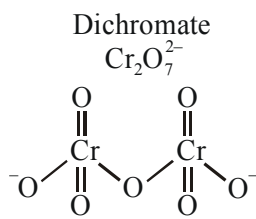
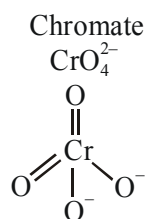


So third ionisation energy is minimum for Fe.

4. NTA Ans. (12.00)

ALLEN Ans. (18.00)

Sol.



$$\begin{array}{l} \text{Total Cr-O bonds} = 6 \\ (4\sigma + 2\pi) \end{array} \quad \begin{array}{l} \text{Total Cr-O bonds} = 12 \\ (8\sigma + 4\pi) \end{array}$$

Total number of bonds between chromium and oxygen in both structures are 18.

Note :- But answer of NTA is 12. They consider only linkages between Chromium and Oxygen but in question total no. of bonds are asked so σ and π bonds must be considered separately.

5. Official Ans. by NTA (2)

6. Official Ans. by NTA (4)

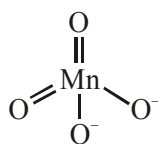
Sol. KMnO_4 will not give satisfactory result when it is titrated by HCl.

7. Official Ans. by NTA (2)

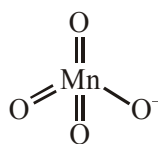
8. Official Ans. by NTA (3)

Sol. Option 1) Manganate $\Rightarrow \text{MnO}_4^{2-}$,

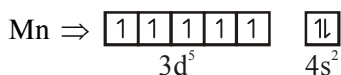
Permanganate $\Rightarrow \text{MnO}_4^-$



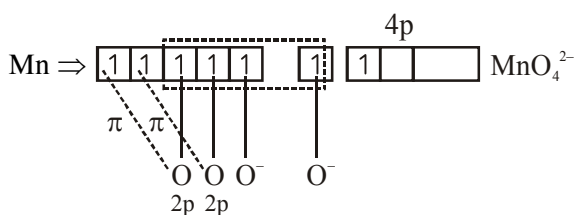
hybridisation
of Mn $\Rightarrow d^3s$



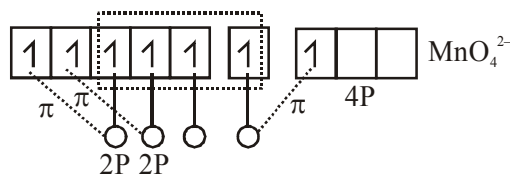
hybridisation
of Mn $\Rightarrow d^3s$



After excitation



$$2 \times 2p_{\pi} - 3d_{\pi\sigma}$$



$$2 \times 2p_{\pi} - 3d_{\pi}$$

$$1 \times 2p_{\pi} - 4p_{\pi}$$

(2) $\text{MnO}_4^{2-} \Rightarrow$ green

$\text{MnO}_4^- \Rightarrow$ purple/violet

(3) Manganate contains 1 unpaired electron hence it is paramagnetic

where as permanganate contains no unpaired electrons hence it is diamagnetic.

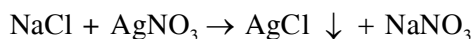
(4) Both have d^3s hybridisation hence both have tetrahedral geometry.

COMPLETE P-BLOCK

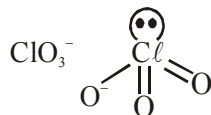
1. NTA Ans. (1.66 to 1.67)

Sol. $3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$

(X) (X)



(X)



$$\begin{aligned} \text{Bond order of Cl-O Bond} &= 1 + \frac{2}{3} = \frac{5}{3} \\ &= 1.66 \text{ or } 1.67 \end{aligned}$$

2. NTA Ans. (1)

Sol. (i) $\text{N}_2 + \text{O}_2 \xrightarrow{2000 \text{ K}} 2\text{NO}$ (Redox reaction)

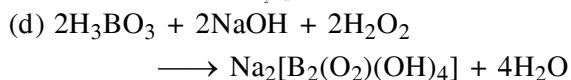
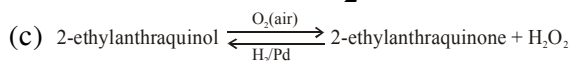
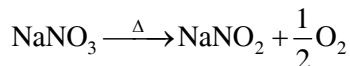
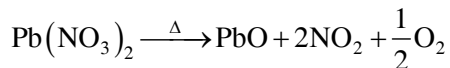
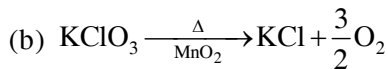
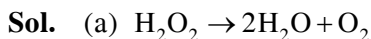
during the reaction, oxidation of nitrogen take place from 0 to 2 and reduction of oxygen take place from 0 to -2. It means this reaction is redox reaction.

(ii) $3\text{O}_2 \xrightarrow{h\nu} 2\text{O}_3$ (Non-redox reaction)

(iii) $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$
(neutralization reaction)

(iv) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3 + 3\text{AgNO}_3$
 $\rightarrow 3\text{AgCl} \downarrow + [\text{Co}(\text{H}_2\text{O})_6](\text{NO}_3)_3$
 (White ppt.)

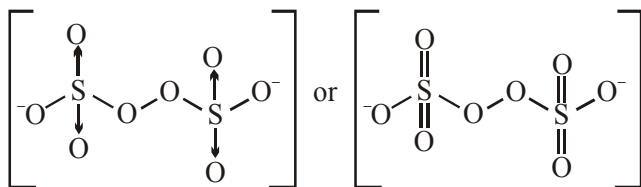
3. NTA Ans. (3)



All statements are correct

4. NTA Ans. (3)

Sol. $\text{S}_2\text{O}_8^{2-}$:



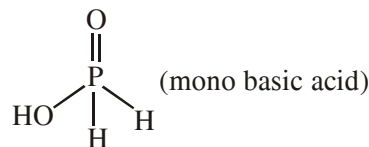
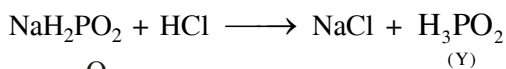
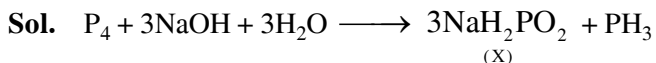
8 bonds are present between sulphur and oxygen. (It is best answer in given options)

Rhombic sulphur :



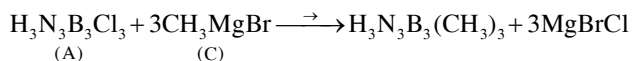
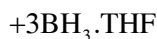
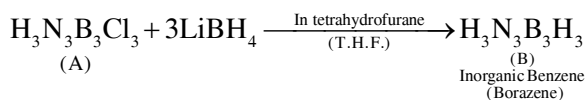
8 bonds are present between sulphur and sulphur atoms.

5. NTA Ans. (2)

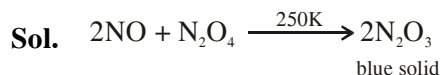


6. NTA Ans. (2)

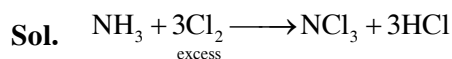
Sol.



7. Official Ans. by NTA (4)



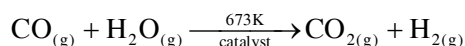
8. Official Ans. by NTA (4)



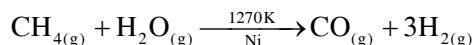
9. Official Ans. by NTA (2)

10. Official Ans. by NTA (1)

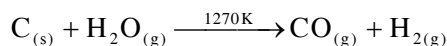
Sol. (1) Water gas shift reaction



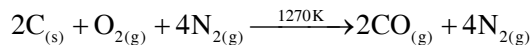
(2) Water gas is produced by this reaction.



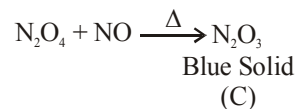
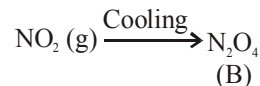
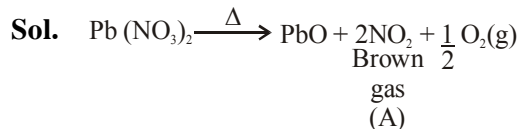
(3) Water gas is produced by this reaction



(4) producer gas is produced by this reaction.



11. Official Ans. by NTA (4)



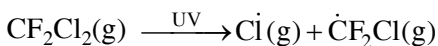
O.S. of nitrogen in N_2O_3 is + 3

$\text{N}_2\text{O}_3 \quad 2x + 3(-2) = 0$

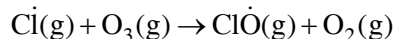
$x = + 3$

12. Official Ans. by NTA (4)

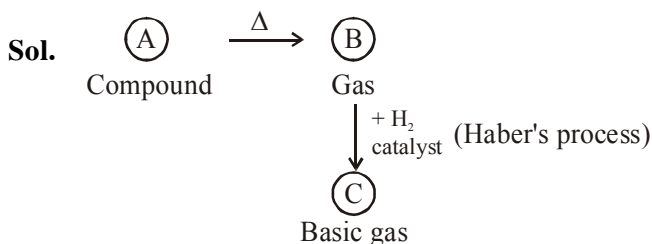
Sol. In the stratosphere, CFCs release chlorine free radical (Cl)



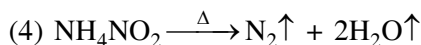
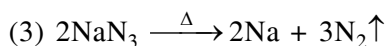
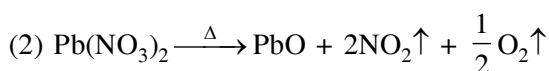
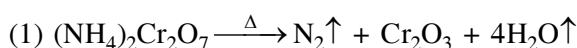
which react with O_3 to give chlorine oxide (ClO) radical not chlorine dioxide (ClO₂) radical.



13. Official Ans. by NTA (2)



Basic gas (C) must be ammonia (NH_3).
It means (B) gas should be N_2 which is formed by heating of compound (A).

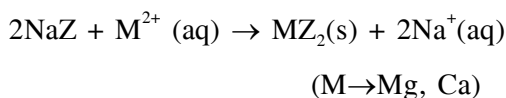


So, (A) should not be $\text{Pb}(\text{NO}_3)_2$

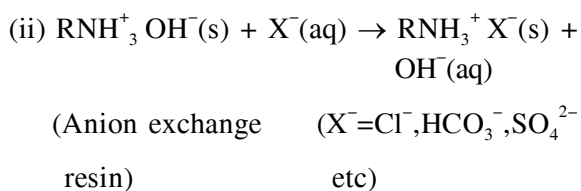
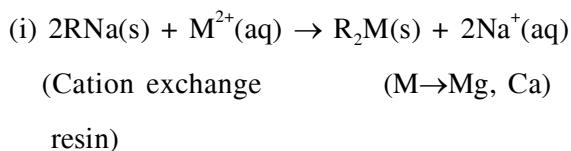
HYDROGEN AND ITS COMPOUND

1. NTA Ans. (4)

Sol. (a) Zeolite method removes only cations (Ca^{2+} and Mg^{2+} ion) present in hard water



(b) Synthetic resin method removes cations (Ca^{2+} and Mg^{2+} ion) and anions (like Cl^- , HCO_3^- , SO_4^{2-} etc.)



2. NTA Ans. (2)

Sol. Hydrogen has three isotopes

Isotopes	Number of neutrons
Protium (${}^1_1\text{H}$)	0
Deuterium (${}^2_1\text{H}$)	1
Tritium (${}^3_1\text{H}$)	2

Hence the sum of neutrons are 3

ENVIRONMENTAL CHEMISTRY

1. NTA Ans. (4)

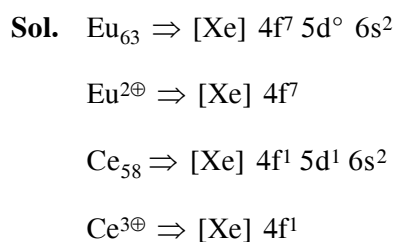
Sol. CO_2 , H_2O , CFCs and O_3 are green house gases.

2. NTA Ans. (3)

Sol. Biochemical oxygen demand (BOD) is amount of oxygen required by bacteria to break down organic waste in a certain volume of water sample.

F-BLOCK

1. NTA Ans. (2)



2. Official Ans. by NTA (2)

3. Official Ans. by NTA (1)

Sol. Alloys of lanthanides with Fe are called Misch metal, which consists of a lanthanoid metal (~95%) and iron (~5%) and traces of S, C, Ca and Al.