JEE Main September 2020

Question Paper With Text Solution

4 September| Shift-2

CHEMISTRY

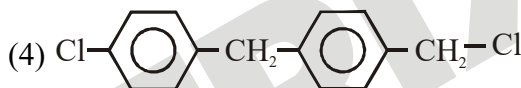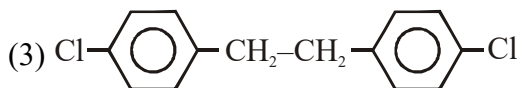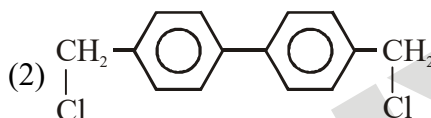## JEE MAIN SEP 2020 | 4 SEP SHIFT-2

1. In the following reaction sequence, [C] is :

(1) $CH_3 - \bigcirc - \bigcirc - CH_3$

(2) $CH_2(Cl) - \bigcirc - \bigcirc - CH_2(Cl)$

(3) $Cl - \bigcirc - CH_2 - CH_2 - \bigcirc - Cl$

(4) $Cl - \bigcirc - CH_2 - \bigcirc - CH_2 - Cl$
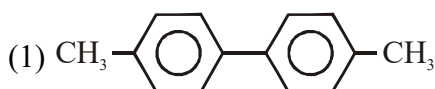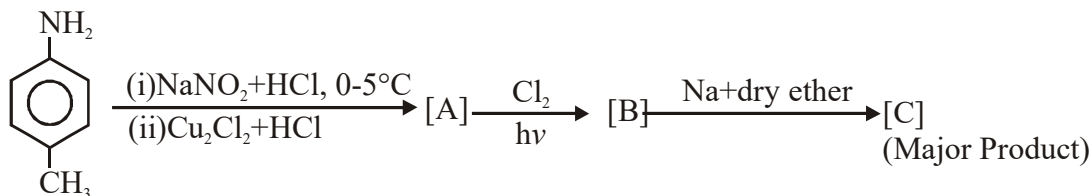
Ans. (3)
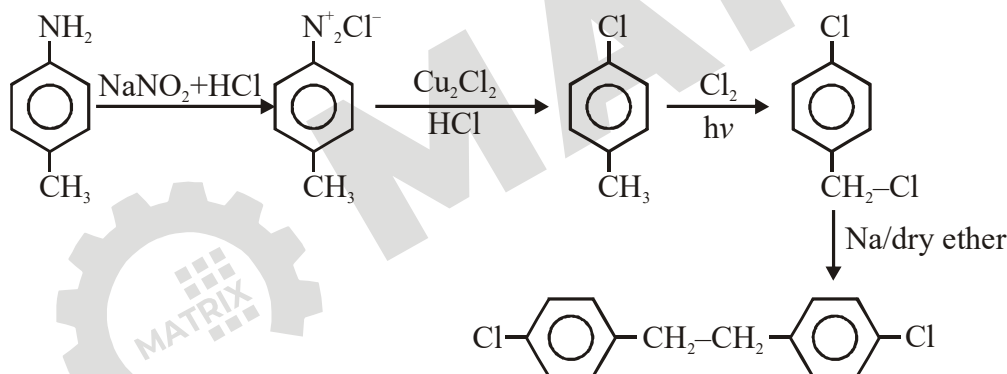
Sol.

2. The process that is NOT endothermic in nature is :
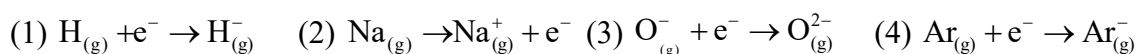
(1) $H_{(g)} + e^- \rightarrow H^-_{(g)}$ (2) $Na_{(g)} \rightarrow Na^+_{(g)} + e^-$ (3) $O^-_{(g)} + e^- \rightarrow O^{2-}_{(g)}$ (4) $Ar_{(g)} + e^- \rightarrow Ar^-_{(g)}$

Ans. (1)

Sol. $H_{(g)} + e^- \xrightarrow{\text{exothermic}} H^-_{(g)}$ $\Delta H_{eg} = -7 KJ/mol$ (Exothermic)

$O^-_{(g)} + e^- \xrightarrow{\text{endothermic}} O^{2-}_{(g)}$ $\Delta H_{eg} = +744 KJ/mol$ (Endothermic)

$Ar_{(g)} + e^- \xrightarrow{\text{endothermic}} Ar^-_{(g)}$ $\Delta H_{eg} = +495.8 KJ/mol$ (Endothermic)

$Na_{(g)} \xrightarrow{\text{endothermic}} Na^+_{(g)} + e^-$ $IE = 495.8 KJ/mol$ (Endothermic)

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3. The major product [C] of the following reaction sequence will be :

$$CH_2=CH-CHO \xrightarrow[\text{(ii) SOCl}_2]{\text{(I) NaBH}_4} [A] \xrightarrow[\substack{\text{Anhy.}\\ \text{AlCl}_3}]{\bigcirc} [B] \xrightarrow{\text{DBr}} [C]$$

(1) [Benzene ring with CH₂–CH(Br)–CH₂D chain]

(2) [Benzene ring with CH₂–CH(D)–CH₂Br chain]

(3) [Benzene ring with CH(Br)–CH(D)–CH₃ chain]

(4) [Benzene ring with CH(Br)–CH₂–CH₂D chain]

Ans. (4)

Sol.

$$CH_2=CH-CH=O \xrightarrow{\text{NaBH}_4} CH_2=CH-CH_2-OH$$

$$\downarrow \text{SOCl}_2$$

$$CH_2=CH-CH_2-Cl$$
[A]

Friedel craft alkylation $\downarrow$ [Benzene]

[Benzene]–CH₂–CH=CH₂ [B]

$\xleftarrow{\text{DBr}}$

[Benzene with ⊕ and CH₂–CH⁺–CH₂–D]

Carbocation rearrangement $\downarrow$

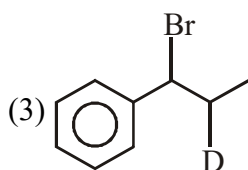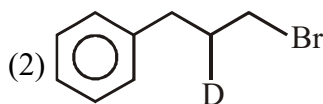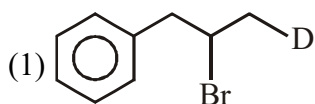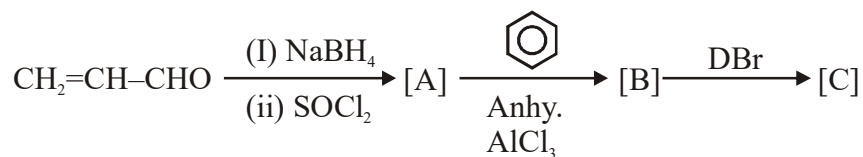[Benzene with ⊕ CH⁺–CH₂–CH₂–D] → [Benzene with CH(Br)–CH₂–CH₂–D] [C]

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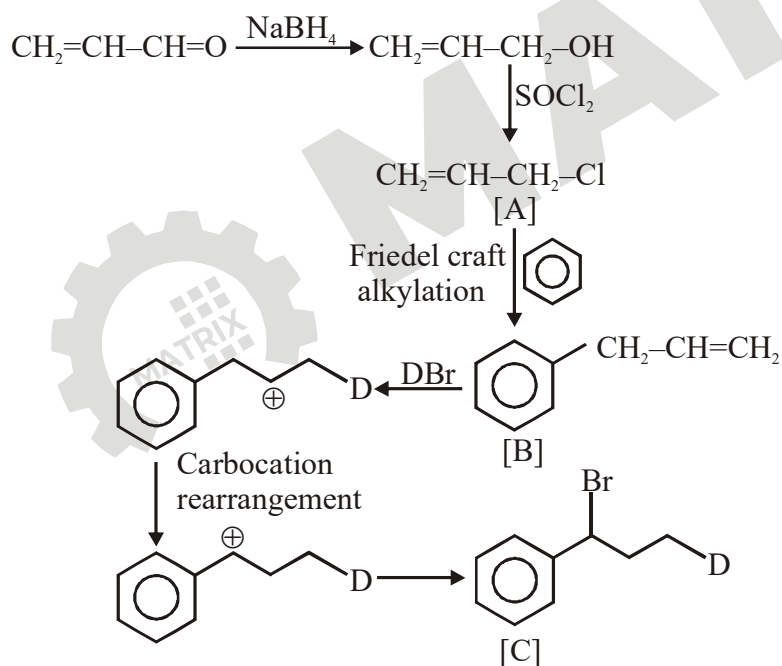**Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911**
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in
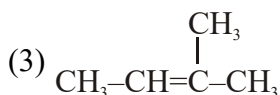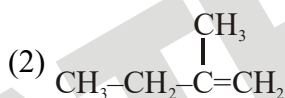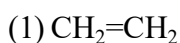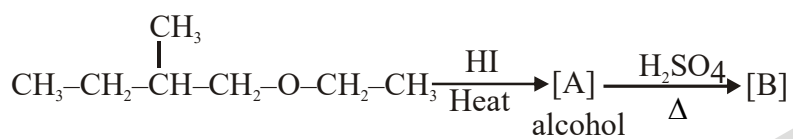
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4. The mechanism of action of "Terfenadine" (Seldane) is :

(1) Inhibits the secretion of histamine

(2) Inhibits hte action of histamine receptor

(3) Helps in the secretion of histamine

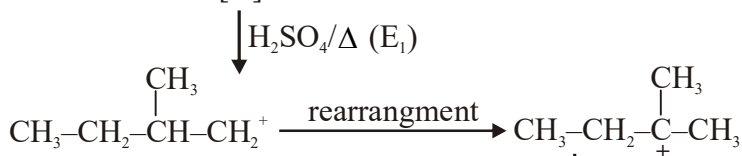(4) Activates the histamine receptor

Ans. (2)

Sol. Terfenadine act as antihistamines and interfere with the natural action of histamine by competing with histamine for binding sites of receptor.

5. The major product [B] in the following reactions is :

$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-O-CH_2-CH_3 \xrightarrow[\text{Heat}]{HI} [A] \xrightarrow[\Delta]{H_2SO_4} [B]$$
alcohol

(1) $CH_2=CH_2$

(2) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{C}=CH_2$

(3) $CH_3-CH=\underset{\underset{CH_3}{|}}{C}-CH_3$

(4) $CH_3-CH_2-CH=CH-CH_3$

Ans. (3)

Sol.

$$CH_3=CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-O-CH_2-CH_3$$

$\downarrow$ HI(attack of H^+ followed by S_N^2)

$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-OH + CH_3-CH_2-1$$
[A]

$\downarrow H_2SO_4/\Delta \ (E_1)$

$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2^+ \xrightarrow{\text{rearrangment}} CH_3-CH_2-\underset{\underset{\overset{CH_3}{|}}{+}}{C}-CH_3$$

$\downarrow \Delta$

$$CH_3-CH_2-C\overset{\diagup CH_3}{\underset{\diagdown CH_2}{}} \quad + CH_3-CH=C\overset{\diagup CH_3}{\underset{\diagdown CH_3}{}}$$

Major product
[B]

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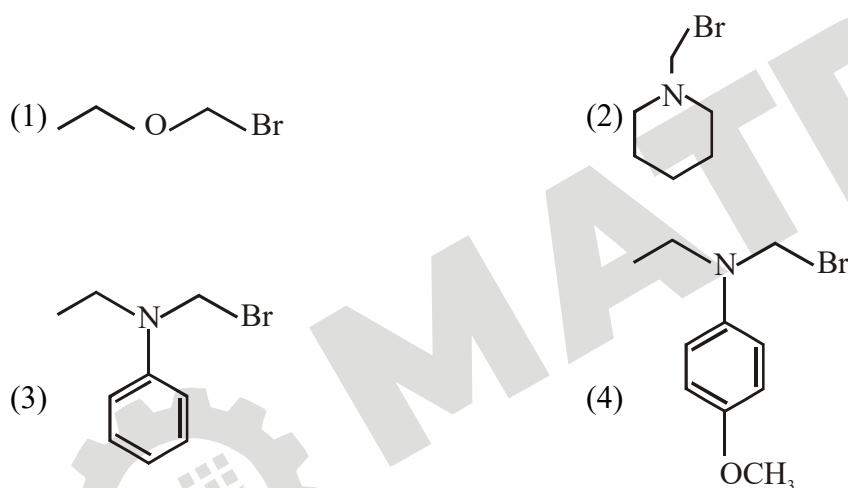**6.** The processes of calcination and roasting in metallurgical industries, respectively, can lead to :

(1) Photochemical smog and global warming

(2) Global warming and acid rain

(3) Photochemical smog and ozone layer depletion
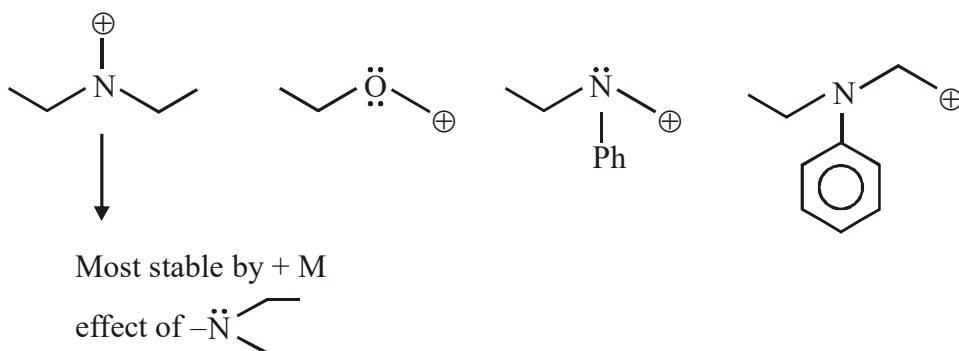
(4) Global warming and photochemical smog

Ans. (2)

Sol. In Calcination and roasting CO_2 and SO_2 are released which are responsible for Global waring and acid rain.

7. Which of the following compounds will form the precipitate with aq.$AgNO_3$ solution most readily ?

(1) [structure: CH3CH2–O–CH2–Br]

(2) [structure: piperidine N–CH2Br]

(3) [structure: N,N–(ethyl)(CH2Br) aniline]

(4) [structure: N,N–(ethyl)(CH2Br)–4–methoxyaniline with OCH3]

Ans. (2)

Sol. Reaction of aq. $AgNO_3$ with given compounds is S_N1 type reaction , Rate of Which depends upon stability of carbocation.

[structures of four carbocations]

Most stable by + M effect of $-\ddot{N}$

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8. 250 mL of a waste solution obtained from the workshop of a goldsmith contains 0.1 M $AgNO_3$ and 0.1M AuCl. The solution was electrolyzex at 2 V by passing a current of 1 A for 15 minutes. The metal/metals electrodeposited will be :

$$\left(E^0_{Ag^+/Ag} = 0.80V, E^0_{Au^+/Au} = 1.69V\right)$$

(1) Only silver

(2) silver and gold in proportion to their atomic weights

(3) silver and gold in equal mass proportion

(4) Only gold

Ans. (4){answer given by NTA is (2)}

Sol. Total Charge supplied (in Faraday) $= \dfrac{it}{96500}F = \dfrac{1 \times 15 \times 60}{96500} = \dfrac{900}{96500} = \dfrac{9}{965}F = 0.0093\ F$

No. of moles of $Au^+ = 0.1 \times 250/1000 = 0.025$ & similarly , No. of moles of $Ag^+ = 0.025$

Species with higher value of SRP will get deposited first at cathode.

(i) Au^+(aq.) + e^- $\longrightarrow$ $Au(s)$

    0.025   0.0093 mole
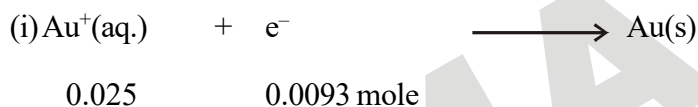
so only Au will get deposited.

9. A sample of red ink (a colloidal suspension) is prepared by mixing eosin dye, egg white, HCHO and water. The component which ensures stability of the ink sample is :

(1) Egg white   (2) Water   (3) Eosin   (4) HCHO

Ans. (1)

Sol. Red ink is a colloidal sol, so it can be stabilised by material like natural gum or Egg white /albumen.

10. Five moles of an ideal gas at 1 bar and 298 K is expanded into vacuum to double the volume. The work done is :

(1) $-RT(V_2 - V_1)$ (2) $-RT\ \text{In}\ V_2/V_1$ (3) $C_V(T_2 - T_1)$ (4) zero
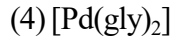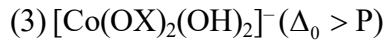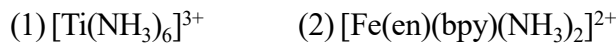
Ans. (4)

Sol. $W = -P_{ext}\ \Delta V$

In expansion against vacuum $P_{ext} = 0$

So work done is zero.
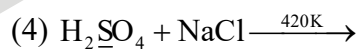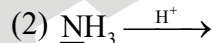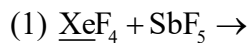
11. The one that can exhibit highest paramagnetic behaviour among the following is :

gly = glycinato ; bpy = 2, 2'-bipyridine

(1) $[Ti(NH_3)_6]^{3+}$ (2) $[Fe(en)(bpy)(NH_3)_2]^{2+}$

(3) $[Co(OX)_2(OH)_2]^- (\Delta_0 > P)$

(4) $[Pd(gly)_2]$

Ans. (3)

Sol.

Complex	EC	Unpaired electrons
(1) $[Fe(en)(bpy)(NH_3)_2]^{2+}$	$Fe^{2+} = 3d^6$	0
(2) $[Pd(gly)_2]$	$Pd^{2+} = 4d^8$	0
(3) $[Ti(NH_3)_6]^{3+}$	$Ti^{3+} = 3d^1$	1
(4) $[Co(OX)_2(OH)_2]^- (\Delta_0 > P)$	$Co^{5+} \Rightarrow 3d^4$	2

12. The reaction in which the hybridisation of the underlined atom is affected is :

(1) $\underline{X}eF_4 + SbF_5 \rightarrow$ (2) $\underline{N}H_3 \xrightarrow{H^+}$

(3) $H_3\underline{P}O_2 \xrightarrow{Disproportionation}$ (4) $H_2\underline{S}O_4 + NaCl \xrightarrow{420K}$

Ans. (1)

Sol.

(1) $\underset{sp^3}{H_2SO_4} + 2NaCl \rightarrow \underset{sp^3}{Na_2SO_4} + 2HCl$

(2) $\underset{sp^3}{NH_3} + H^+ \longrightarrow H-\underset{\underset{sp^3}{H}}{\overset{H}{\underset{|}{\overset{|}{N}}}}\!\!:\!\!\rightarrow H^+$

(3) $\underset{sp^3}{H_3PO_2} \rightarrow \underset{sp^3}{H_2PO_4} + PH_3$

(4) $\underset{sp^3d^2}{XeF_4} + SbF_5 \rightarrow [\underset{sp^3}{XeF_3}]^+ [SbF_6]^-$
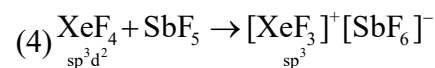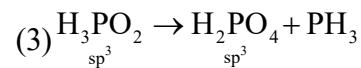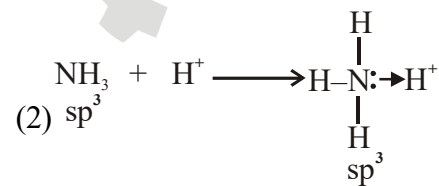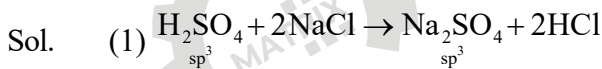
13. The incorrect statement(s) among(a)-(c) is (are):

(a) W(VI) is more stable than Cr(VI)

(b) In the presence of HCl, permanganate titrations provide satisfactory results.

(c) Some lanthanoid oxides can be used as phosphors.

(1) (b) and (c) only   (2) (a) Only   (3) (b) Only   (4) (a) and (b) only

Ans. (3)

Sol. (a) In transition metals on moving down the group higher oxidation states are more stable due to smaller size of atoms, which is due to lanthanide and actinide contractions.

(b) $KMnO_4$ can oxidise chloride into chlorine, so it will give incorrect results

(c) its a fact

14. The Crystal Field Stabilization Energy (CFSE) of $[CoF_3(H_2O)_3]\,(\Delta_0 < p)$ is :

(1) $-0.4\ \Delta_0$ (2) $-0.8\,\Delta_0 + 2P$ (3) $-0.8\ \Delta_0$ (4) $-0.4\,\Delta_0 + P$

Ans. (1)

Sol. $[Co(H_2O)_3F_3]$ $Co^{3+} = 3d^6 4s^0 \Rightarrow t_{2g}^{2,1,1},\ eg^{1,1}$

$CFSE = [-0.4nt_{2g} + 0.6ne_g]\,\Delta_0 + n(P)$; where n is number of electrons

$= [-0.4 \times 4 + 0.6 \times 2]\,\Delta_0 + 0$

$= -0.4\,\Delta_0$

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15. The shortest wavelength of H atom in the Lyman series is λ_1. The longest wavelength in the Balmer series of He^+ is :

(1) $\dfrac{9\lambda_1}{5}$ (2) $\dfrac{27\lambda_1}{5}$ (3) $\dfrac{5\lambda_1}{9}$ (4) $\dfrac{36\lambda_1}{5}$

Ans. (1)

Sol. For hydrogen atom :

For Lyman series $n_1 = 1$ & $n_2 = \infty$

$\dfrac{1}{\lambda_H} = R_H\left[\dfrac{1}{1} - \dfrac{1}{\infty}\right]$ So, $\lambda = \dfrac{1}{R_H}$

For He^+ ion

Balmer series $n_1 = 2$ & $n_2 = 3$

$\dfrac{1}{\lambda_{He^+}} = R_H \times Z^2 \left[\dfrac{1}{4} - \dfrac{1}{9}\right]$

$\dfrac{1}{\lambda_{He^+}} = R_H \times 4 \times \dfrac{5}{36}$

$\dfrac{1}{\lambda_{He^+}} = \dfrac{5}{9}R_H = \left(\dfrac{5}{9}\right)\dfrac{1}{\lambda}$

$\left(\lambda_{He^+}\right) = \dfrac{9}{5}\lambda$

16. An alkaline earth metal 'M' readily forms water soluble sulphate and water insoluble hydroxide. Its oxide MO is very stable to heat and does not have rock-salt structure. M is :

(1) Mg   (2) Be   (3) Ca   (4) Sr

Ans. (2)

Sol. $BeSO_4$ is Soluble in water

$Be(OH)_2$ is Insoluble in water

Structure of BeO is Hexagonal Wurtzite.

17. If the equilibrium constant for $A \rightleftharpoons B + C$ is $K_{eq}^{(1)}$ and that of $B + C \rightleftharpoons P$ is $K_{eq}^{(2)}$, the equilibrium constant for $A \rightleftharpoons P$ is :

(1) $K_{eq}^{(1)} \, K_{eq}^{(2)}$ (2) $K_{eq}^{(1)} - K_{eq}^{(2)}$ (3) $K_{eq}^{(1)} + K_{eq}^{(2)}$ (4) $K_{eq}^{(1)} / K_{eq}^{(2)}$

Ans. (1)

Sol. On adding Reaction 1st and Reaction 2nd we get.

$A \rightleftharpoons P$ $K_{eq} = k_{eq}(1).K_{eq}(2)$

18. The major procuct [R] in the following sequence of reactions is :

$$CH\equiv CH \xrightarrow[\text{(ii) } H_3C]{\text{(i)LiNH}_2/\text{ether}} [P]$$

with H_3C and $(CH_3)_2CH$ attached to $CH-Br$

$$\xrightarrow[\text{(ii) NaBH}_4]{\text{(i)HgSO}_4/\text{H}_2\text{SO}_4} [Q] \xrightarrow[\Delta]{\text{Conc.H}_2\text{SO}_4} [R]$$

(1) $H_2C=\underset{CH(CH_3)_2}{\overset{}{C}}-CH_2-CH_3$

(2) $\underset{(CH_3)_2CH}{\overset{H_3C}{\diagdown}}CH-CH=CH_2$

(3) $\underset{(CH_3)_2CH}{\overset{H_3C}{\diagdown}}CH=CH-CH_3$

(4) $\underset{H_3CCH_2}{\overset{H_3C}{\diagdown}}CH=C(CH_3)_2$

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Ans. (4)

Sol.

$$H-C\equiv C-H \xrightarrow{\text{LiNH}_2/\text{ether}} H-C\equiv C^- \xrightarrow[\substack{\text{CH}_3-\text{CH}-\text{Cl} \\ | \\ \text{CH(CH}_3)_2}]{}$$

$$\underset{\text{H}_3\text{C}}{\overset{\text{CH}_3}{\underset{\underset{\text{CH}_3}{|}}{\overset{|}{C}H}}}\overset{\text{CH}_3}{\underset{}{C}}-C\equiv C-H \xrightarrow[\substack{\text{H}_2\text{SO}_4 \\ \text{(Hydration)}}]{\text{Hg}^{+2}} \underset{\text{H}_3\text{C}}{\overset{\text{CH}_3}{\underset{\underset{\text{CH}_3}{|}}{\overset{|}{C}H}}}-\overset{\overset{O}{\parallel}}{C}-CH_3$$

(NaBH₄ step)

$$\xrightarrow[\substack{\Delta \\ \text{E}_1 \text{ of alcohol}}]{\text{Conc. H}_2\text{SO}_4} \underset{\text{H}_3\text{C}}{\overset{\text{CH}_3}{\underset{\underset{\text{CH}_3}{|}}{\overset{|}{C}H}}}-\overset{+}{C}H-CH_3 \xleftarrow{} \underset{\text{H}_3\text{C}}{\overset{\text{CH}_3}{\underset{\underset{\text{CH}_3}{|}}{\overset{|}{C}H}}}-\overset{\overset{OH}{|}}{C}H-CH_3$$

(Carbocation Rearrangement)

$$\underset{\substack{\text{H}_3\text{C} \\ \text{H}_3\text{C}}}{\overset{\text{CH}_3}{\overset{|}{C}H}}\overset{+}{C}-CH_2-CH_3 \longrightarrow \underset{\substack{\text{H}_3\text{C} \\ \text{H}_3\text{C}}}{\overset{\text{CH}_3}{\underset{}{C}}}=\overset{}{C}-CH_2-CH_3$$

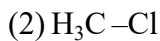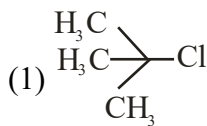**19.** Among the following compounds, which one has the shortest C–Cl bond ?

(1) $\begin{array}{c} H_3C \\ H_3C \end{array}\!\!\!>\!\!\!\begin{array}{c} Cl \\ CH_3 \end{array}$ (2) H_3C-Cl (3) $\begin{array}{c} HC \quad Cl \\ \| \\ CH_2 \end{array}$ (4) $\begin{array}{c} Cl \\ | \\ CH \\ \| \\ CH_2 \end{array}$
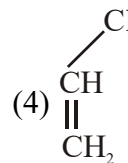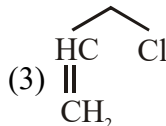
Ans. (4)

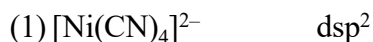Sol. Due to conjugation of lone pair of chlorine with π bond of C=C, partial double bond character decrease bond length that's why CH_2=CH–Cl have shortest C–Cl bond length.

20. The molecule in which hybrid MOs involve only d-orbital of the central atom is :

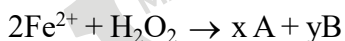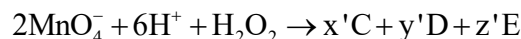(1) BrF_5 (2) XeF_4 (3) $[Ni(CN)_4]^{2-}$ (4) $[CrF_6]^{3-}$
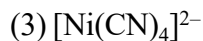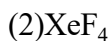
Ans. (3)

Sol. Complex   Hybridisation

(1) $[Ni(CN)_4]^{2-}$ dsp^2

(2) XeF_4 sp^3d^2

(3) $[CrF_6]^{3-}$ sp^3d^2

(4) BrF_5 sp^3d^2

21. Consider the following equations :

$2Fe^{2+} + H_2O_2 \rightarrow x\,A + yB$

(in basic medium)
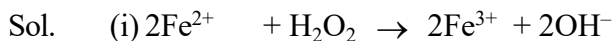
$2MnO_4^- + 6H^+ + H_2O_2 \rightarrow x'C + y'D + z'E$

(in acidic medium)

The sum of the stoichiometric coefficients

x, y, x', y' and z' for products A, B, C, D and E, respectively, is _____.

Ans. (19)

Sol. (i) $2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2OH^-$

(ii) $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$

So sum of $(x + y + x^1 + y^1 + z^1) = 2 + 2 + 2 + 5 + 8 = 19$

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22. The osmotic pressure of a solution of NaCl is 0.10 atm and that of a glucose solution is 0.20 atm. The osmotic pressure of a solution formed by mixing 1 L of the sodium chloride solution with 2 L of the glucose solution is $x \times 10^{-3}$ atm. x is _____ . (nearest integer)

Ans. (167)

Sol. $\Pi = i\,CRT = i\left[\dfrac{n}{V}\right]RT$
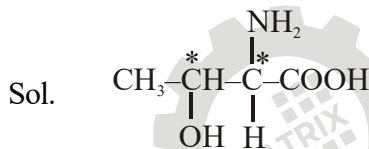
$\Pi_{final} = \dfrac{(\pi_1\,V_1) + (\pi_2\,V_2)}{V_1 + V_2}$

$\Pi_{final} = \dfrac{(0.1 \times 1) + (0.2 \times 2)}{3}$

$= \dfrac{(0.1 + 0.4)}{3} = \dfrac{0.5}{3} = \dfrac{500}{3} \times 10^{-3}\,atm = 166.67 \times 10^{-3}\,atm$

so, x = 167

23. The number of chiral centres present in threonine is _____ .

Ans. (2)

Sol.

$$\underset{\substack{\\ }}{CH_3} - \overset{*}{\underset{OH}{CH}} - \overset{NH_2}{\underset{H}{\overset{*}{C}}} - COOH$$

Threonine has two chiral carbon atoms.

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24. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3.xH_2O$. The normality of the solution is 0.1N. The value of x is _____ .

(The atomic mass of Na is 23 g/mol)

Ans. (10)

Sol. Number of gram Equivalent of solute $= 0.1 \times 100/1000 = 0.01$

Mole of solute $(Na_2CO_3.xH_2O) = 0.01 \times \dfrac{1}{2}$

Mass of $Na_2CO_3.xH_2O = 0.01 \times \dfrac{1}{2} \times [106 + 18x] = 1.43$

$\Rightarrow 106 + 18x = 286$

$18x = 180$

$x = 10$

25. The number of molecules with energy greater than the threshold energy for a reaction increases five fold by a rise of temperature from 27°C to 42°C. Its energy of activation in J/mol is _____ .(Take In 5 = 1.6094 ; R= 8.314 J mol^{-1}K^{-1})

Ans. (84297.47)

Sol. $k = Ae^{-\dfrac{Ea}{RT}}$

$\ln\left(\dfrac{K_2}{K_1}\right) = \dfrac{Ea}{R}\left[\dfrac{1}{T_1} - \dfrac{1}{T_2}\right]$

$\ln(5) = \dfrac{Ea}{8.314}\left[\dfrac{1}{300} - \dfrac{1}{315}\right]$

$1.6094 = \dfrac{Ea}{8.314}\left[\dfrac{15}{300 \times 315}\right]$

Ea = 84297.47J

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