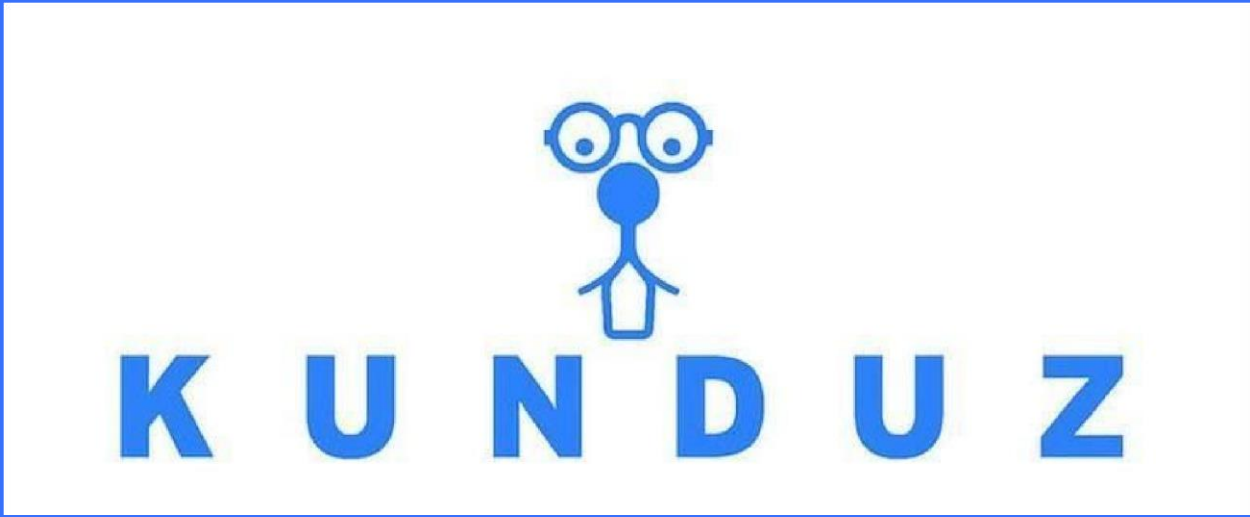


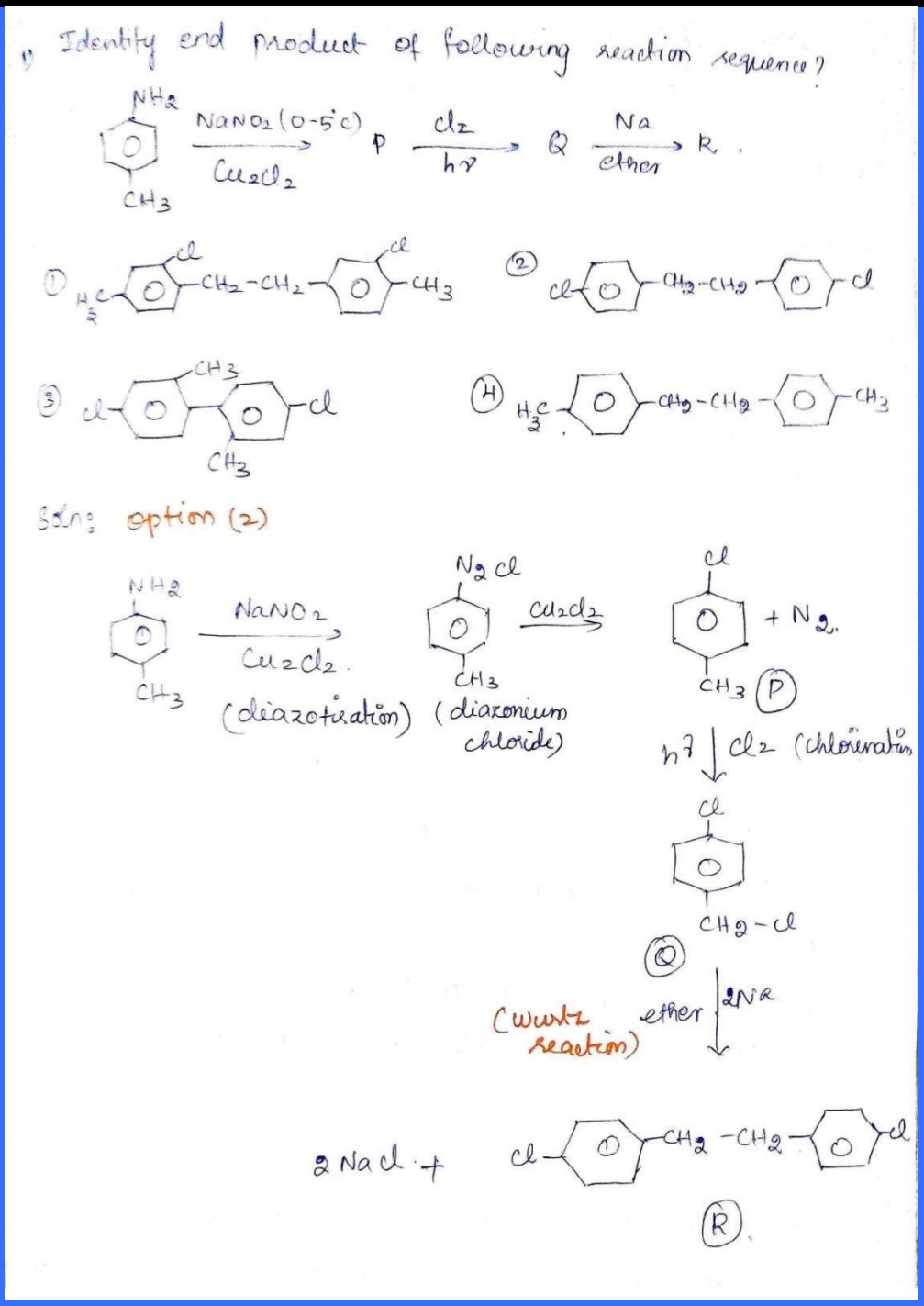
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Question number

Question and Answers

1



2

2) During Roasting and calcination emitted gases produce which of the following effects.

(1) photochemical smog, acid rain (2) Global warming, Acid rain.

(3) photochemical smog, Global warming (4) Acid rain, Ozone depletion

Soln: option (2)

Roasting: Sulfide $\longrightarrow$ Oxide + $SO_2\uparrow$

Calcination: Limestone ($CaCO_3$) $\xrightarrow{\Delta}$ $CaO + CO_2\uparrow$

CO_2 and SO_2 gases (greenhouse gases) causes global warming and Acid rain.

3

3) Synthetic drugs (Seldane) Terfenadine work with histamine

(1) Increase stimulation of Histamine.

(2) Drugs that bind to receptor site and inhibit its natural function.

(3) Increase reactivity of Histamine.

(4) This drugs mimic the natural messenger by switching on the receptor.

Soln: option (2)

Seldane (Terfenadine) is an antihistamines which prevent sneezing running nose, itching, allergic symptoms etc. This antihistamine (seldane) competes with natural action of histamine in our body for binding sites of receptor.

4

4) $CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{C}}H-CH_2-O-CH_2CH_3 \xrightarrow{HI} A \xrightarrow[\Delta]{\text{con.}\ H_2SO_4} B.$

(alcohol)

Find out major product of following reaction sequence.

(1) $CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2$

(2) $CH_3-CH=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH_3$

(3) $CH_2=CH-\underset{\displaystyle CH_3}{\overset{|}{C}}H-CH_3$

(4) $CH_3CH_2CH=CH-CH_3$.

Soln: Option (2)

$$CH_3CH_2\underset{\displaystyle CH_3}{\overset{|}{C}}H-CH_2O-CH_2CH_3 \xrightarrow[(S_N2\ \text{reaction})]{HI} CH_3CH_2\underset{\displaystyle CH_3}{\overset{|}{C}}H-CH_2OH\ (A) + CH_3CH_2I.$$

$$CH_3CH_2\underset{\displaystyle CH_3}{\overset{|}{C}}HCH_2OH\ (A) \xrightarrow[\Delta]{\text{con.}\ H_2SO_4} CH_3CH_2\underset{\displaystyle CH_3}{\overset{|}{C}}H-CH_2-\overset{\oplus}{O}H_2$$

$$\downarrow$$

$$CH_3CH_2\underset{\displaystyle CH_3}{\overset{|}{C}}H-\overset{\oplus}{C}H_2$$

$$\downarrow \text{rearrangement}$$

$$CH_3CH_2-\underset{\displaystyle CH_3}{\overset{|}{\underset{\oplus}{C}}}-CH_3$$

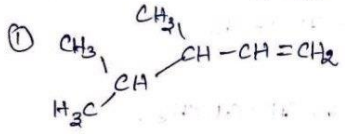
$$CH_3CH_2\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2 + CH_3CH=C(CH_3)_2 \xleftarrow[-H^{\oplus}]{\Delta}$$

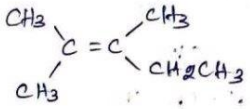
(major product)

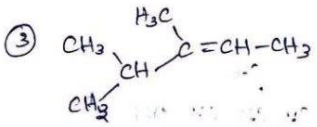
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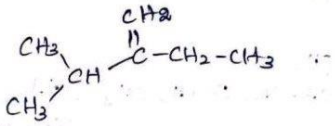
5. find product of following reaction sequence?

$CH \equiv CH \xrightarrow[2)\ CH_3-CH(Cl)-CH(CH_3)_2]{1)\ LiNH_2/ether} \xrightarrow[H_2SO_4]{HgSO_4} \xrightarrow{NaBH_4} \xrightarrow{conc.\ H_2SO_4} ?$

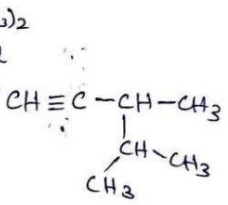
(1) 

(2) 

(3) 

(4) 

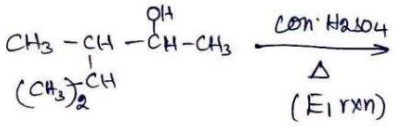
Soln: option (2)

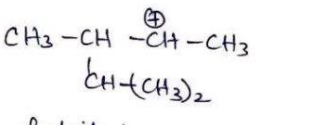
$CH \equiv CH \xrightarrow[ether]{LiNH_2} CH \equiv C^{\ominus}$ (carbanion) acetylide ion $\xrightarrow{CH_3CH(CH_3)-Cl}$ 

(Hydration) $\downarrow Hg^{2+}/H_2SO_4$

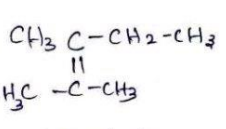


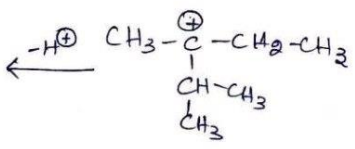
reduction $\downarrow NaBH_4$





hydride shift ↓ rearrangement

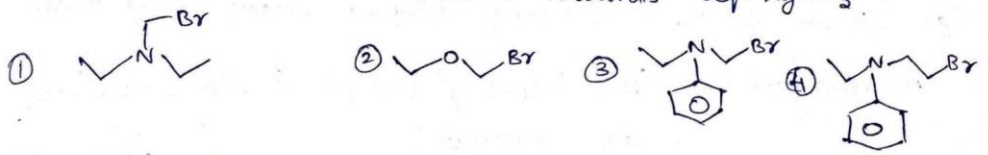




product

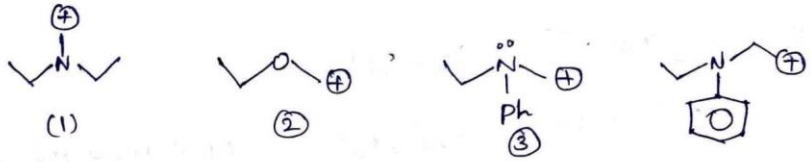
6

6) which one is most effective towards aq. $AgNO_3$



Soln: Option (1)

Reaction of alkyl halides with aq. $AgNO_3$ follows SN1 mechanism. Rate of the reaction depends on stability of carbocation.

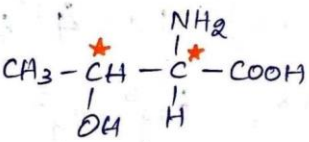


compound (1) is most stable by +M effect of 3° (amin

7

7) How many chiral centres are present in Threonine

Soln: Option (2)

Structure of Threonine 

Threonine have two chiral carbon atom.

8

8) which of the following complex show maximum paramagnetism? [PPh_3 - triphenyl phosphine, Ox^{2-} - oxalato, gly^- - glycinato].

① $[Co(Ox)_2(NH_3)_2]^-$ ② $[Fe(en)(bipy)(NH_3)_2]^{2+}$

③ $[Pd(gly)(pph_3)_2]^+$ ④ $[Ti(H_2O)_6]^{3+}$

Soln: option (4)

① $[Co(Ox)_2(NH_3)_2]^-$ $Co - 3d^7 4s^2$

$Co^{3+} - 3d^6 \Rightarrow t_{2g}^6, e_g^0$ no of unpaired e⊖, $n=0$

② $[Fe(en)(bipy)(NH_3)_2]^{2+}$ $Fe - 3d^6 4s^2$

$Fe^{2+} - 3d^6 \Rightarrow t_{2g}^6, e_g^0$ $n=0$.

③ $[Pd(gly)(PPh_3)_2]^+$ $Pd = 4d^8 5s^2$

$Pd^{2+} - 4d^8$; t_{2g}^6, e_g^2; $n=0$

④ $[Ti(H_2O)_6]^{3+}$ $Ti = 3d^2 4s^2$.

$Ti^{3+} - 3d^1 \Rightarrow t_{2g}^1 e_g^0$ $\boxed{n=1}$

$[Ti(H_2O)_6]^{3+}$ is paramagnetic.

9

a) Identify the complex in which only one d-orbital is used in the hybridisation.

(1) $[Ni(CN)_4]^{2-}$ (2) $[Fe(CN)_6]^{3-}$

(3) $[Co(en)_3]^{3+}$ (4) $[FeF_6]^{3-}$

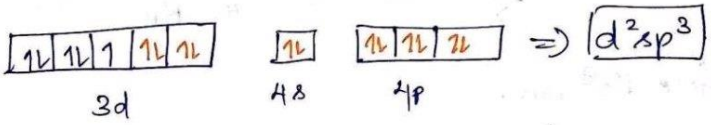
Soln: option (1)

(1) $[Ni(CN)_4]^{2-}$ $Ni^{2+} - 3d^8$

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

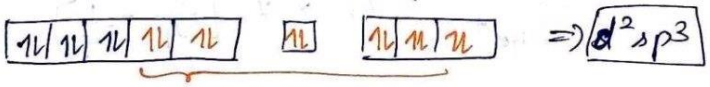
$\Rightarrow dsp^2$ (only one d-orbital)

(2) $[Fe(CN)_6]^{3-}$ $Fe^{3+} = 3d^5$



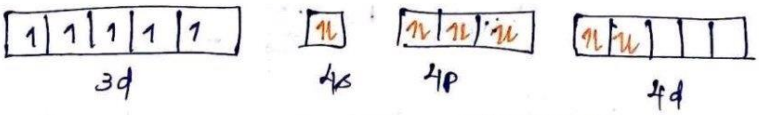
$\Rightarrow d^2sp^3$

(3) $[Co(en)_3]^{3+}$ $Co^{3+} = 3d^6$


$\Rightarrow d^2sp^3$

3 en ligand co-ordinating through 6 Nitrogen atoms.

(4) $[FeF_6]^{3-}$ $Fe^{3+} = 3d^5$



sp^3d^2

10

10) In hydrogen spectrum shortest wavelength for Lyman series line is λ, then find longest wave length of Balmer series line in He^+ ion spectrum.

(1) λ (2) $9/5\,\lambda$ (3) $5/9\,\lambda$ 4) $4/9\,\lambda$

Soln: option (2)

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

for Hydrogen atom $\Big\} \frac{1}{\lambda} = R_H\left[\frac{1}{n_1} - \frac{1}{n_2}\right]$.

$$\frac{1}{\lambda} = R_H\left[\frac{1}{1} - \frac{1}{\infty}\right).$$

$$\frac{1}{\lambda} = R_H \Rightarrow \lambda_H = \frac{1}{R_H} \quad \text{--- (1)}$$

for $He^{\oplus}$ ion,

Balmer series, $n_1 = 2$ & $n_2 = 3$. $\boxed{Z=2}$

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

$$\frac{1}{\lambda_{He^{\oplus}}} = R_H \times 4 \times \frac{5}{36}.$$

$$\frac{1}{\lambda_{He^{\oplus}}} = R_H \times \frac{20}{36}.$$

$$\frac{1}{\lambda_{He^{\oplus}}} = R_H \times \frac{5}{9}. \quad \text{--- (2)}$$

We know from eqn (1), $\frac{1}{\lambda} = R_H$.

sub in (2),

$$\frac{1}{\lambda_{He^{\oplus}}} = \frac{1}{\lambda}\left(\frac{5}{9}\right).$$

$$\lambda_{He^{\oplus}} = \left(\frac{9}{5}\lambda\right)$$

11

(11) which of the following process is not endothermic?

(1) $H(g) + e^{\ominus} \longrightarrow H^{-}(g)$ (2) $Ar(g) + e^{\ominus} \longrightarrow Ar^{\ominus}(g)$

(3) $O^{\ominus} + e^{\ominus} \longrightarrow O^{2-}(g)$ (4) $Na(g) \longrightarrow Na^{+}(g) + e^{\ominus}$

Soln: Option (1)

$H(g) + e^{\ominus} \longrightarrow H^{\ominus}(g)$, is an exothermic reaction. Since it has $\Delta H = -72\ KJ/mol$ (negative value).

12

(12) Calculate CFSE for complex $[Co(H_2O)_3F_3]$ given $\Delta_o < P$.

(1) $-0.8\Delta_o + 2P$ (2) $-0.4\Delta_o + P$.

(3) $-0.8\Delta_o$ (4) $-0.4\Delta_o$

Soln: Option (4)

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

$CFSE = [-0.4 n_{t_{2g}} + 0.6 n_{e_g}]\Delta_o + nP.$

$= [-0.4 \times 4 + 0.6 \times 2)\Delta_o + 0.$

$= -0.4\Delta_o$

Note: If Δ_o is lesser than P, pairing will not take place $\Rightarrow$ weak field ligands. H_2O and F are weak field ligands.

13

13) 5 mole of an ideal gas of volume V is expanded against vacuum to make its volume 2 times, then work done by the gas is:

(1) $-RT(V_2-V_1)$ (2) $-RT\ln\left(\frac{V_2}{V_1}\right)$ (3) zero (4) $C_V(T_2-T_1)$

Soln: Option (3)

Formula : $W = -P_{ext}\,\Delta V$

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

$\Rightarrow W = 0$

If an ideal gas expands into a vacuum, it does no work. Hence internal energy and temperature is unchanged.

14

14. 100 mL solution of each 0.1M AuCl and 0.1M AgCl is electrolyzed by passing 1amp current for 15 min, then which of the following will be deposited?

(given $Au^+(aq) + e^\ominus \longrightarrow Au \quad E^\circ = 1.69V$

$Ag^+(aq) + e^\ominus \longrightarrow Ag \quad E^\circ = 0.80\,V$

(1) Only Au (2) only Ag (3) Both Au & Ag (4) None of Au & Ag.

Soln: Option (1)

$$Q = \frac{It}{nF} = \frac{1\times 15\times 60}{1\times 96500} = \frac{9}{965} = 0.0093\,F.$$

Species with higher standard Reduction potential will get deposited first at cathode.

$Au^\oplus + e^\ominus \longrightarrow Au \quad E^\circ = 1.69$.

0.01 0.0093.

So only Au will be deposited. The Quantity of electricity is the no. of moles of Au got deposited.

15

15) An alkaline earth metal, sulphate is soluble in water while its hydroxide is not soluble in water and its oxide does not form rock salt structure, then metal is

① Be ② Mg ③ Ca ④ Sr.

Ans: option ①

soln: $BeSO_4$ is soluble in water but $Be(OH)_2$ is insoluble in water. Structure of BeO (Beridyium oxide) is hexagonal Wurtzite (Rock-salt structure).

16

16) In which of the following reaction, hybridisation of underline atom gets changed.

① $XeF_4 + SbF_5 \longrightarrow$ ② $H_3PO_2 \xrightarrow{\text{disproportionation}}$

③ $H_2SO_4 + NaCl \longrightarrow$ ④ $NH_3 + BF_3 \longrightarrow$

Soln: option (1)

① $XeF_4 + SbF_5 \longrightarrow [XeF_3]^+[SbF_6]^-$
sp^3d^2 sp^3d.

② $H_3PO_2 \longrightarrow H_3PO_4 + PH_3$.
sp_3. sp_3

③ $H_2SO_4 + 2NaCl \longrightarrow Na_2SO_4 + 2HCl$
sp^3 sp^3

④ $NH_3 + BF_3 \longrightarrow NH_3 \rightarrow BF_3$
sp^3. sp^3

hybridization of XeF_4 is changed.

17

17) Given

(i) $A \rightleftharpoons B+C$ K_{eq} ①

(ii) $B+C \rightleftharpoons P$ $K_{eq}(2)$

then K_{eq} for reaction $A \rightleftharpoons P$ is

① $K_{eq}(1) \cdot K_{eq}(2)$ ② $\frac{K_{eq}(1)}{K_{eq}(2)}$ ③ $K_{eq}(1) + K_{eq}(2)$

④ $K_{eq}(1) - K_{eq}(2)$

Soln: option (1)

On adding ① and ② we get

$A \rightleftharpoons P$;

∴ its equilibrium constant must be multiplied.

$K_{eq} = K_{eq}(1) \cdot K_{eq}(2)$.

18

18) In colloidal solution of blue ink following reagent are mixed H_2O, egg, CH_3COOH and Hcl. then which of the above reagent ensure the stability of Blue ink.

(1) H_2O (2) Egg albumen ③ CH_3COOH ④ Hcl.

Soln: optim (2)

Blue ink is a colloidal sol. It can be stabilized by natural gum (or) Egg albumen.

19

19. Osmotic pressure of NaCl solution is 0.1 atm and glucose solution is 0.2 atm. If 1L of NaCl solution and 2L of glucose solution is mixed at same temperature, then osmotic pressure of resulting solution is 'x' $\times 10^{-3}$ atm. then value of 'x' in nearest integer is.

Soln:

$\pi = iCRT$ where $C = \frac{n}{V} = \frac{\text{no. of moles}}{\text{volume}}$.

$\pi = i\left(\frac{n}{V}\right)RT$.

$\pi_{final} = \frac{\pi_1 V_1 + \pi_2 V_2}{V_1 + V_2}$.

$= \frac{(0.1 \times 1) + (0.2 \times 2)}{3} = \frac{0.1 + 0.4}{3} = \frac{0.5}{3}$

(Given) $\pi_{final} = x \times 10^{-3} = \frac{0.5}{3} \Rightarrow x = \frac{500}{3}$

$\boxed{x = 167}$.

20

20) If temperature changes from 27°C to 42°C then no. of molecule having energy greater than threshold energy becomes five times, then find activation energy (E_a) of reaction in (KJ). (given: $\ln 5 = 1.6094$ and $R = 8.314 \frac{J}{Mole \times K}$).

Soln:

$T_1 = 27°C = 300K$

$T_2 = 42°C = 315K$

$K = Ae^{-Ea/RT}$.

$\ln\left(\frac{K_2}{K_1}\right) = \frac{Ea}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$ given $\left(\frac{K_2}{K_1} = 5\right)$

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

$\left(\frac{15}{300 \times 315}\right) Ea = 8.314 \times 1.6094$

$Ea = 84297.55\ J$

$Ea = 84.2975\ KJ$.

Ans: $\boxed{Ea \sim 84.3\ KJ}$

21

21) In 100 mL, 0·1N $Na_2CO_3 \cdot x H_2O$ solution. Mass of solute is 1·43 g. then value of x is :

Solⁿ:

Equivalent of solute = Normality × Volume in L

$= 0·1 \times 0·1 = 0·01$

Mole of solute ($Na_2CO_3 \cdot xH_2O$) $= 0·01 \times \frac{1}{2}$.

$= 5 \times 10^{-3}$.

Mass of $Na_2CO_3 \cdot xH_2O$ = No. of moles × Mol. wt

Mass $= 5 \times 10^{-3} \times (106 + 18x) = 1·43$ (given)

$106 + 18x = 286$.

$18x = 180$

$\boxed{x = 10}$

22

22) for the following redox reactions.

(1) $2Fe^{2+} + H_2O_2 \longrightarrow xA + yB.$

(2) $2MnO_4^- + 6H^+ + 5H_2O_2 \longrightarrow x'A' + y'B' + z'C'$

Find the sum of co-efficient $(x+y+x'+y'+z')$

Soln: The reactions are

(i) $2Fe^{2+} + H_2O_2 + 2H^+ \longrightarrow 2Fe^{3+} + 2H_2O.$

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

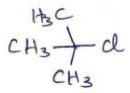
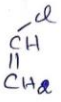
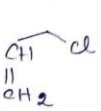
Sum of co-efficient $(x+y+x'+y'+z') = 2+2+2+5+8$

$= 19.$

Ans = 19

23

23) Among the following compounds, which one has the shortest C-Cl bond?

(1)  (2)  (3)  (4) CH_3-Cl.

Soln: option (2)

Electronegativity and resonance decreases the bond length.

In compound (2) the lone pair on chlorine is in conjugation with double bond, so C-Cl bond gets partial double character. thereby decreasing the bond length.



bond length decreases.

24

24) 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) (a) only (2) (a) and (c) only (3) (b) only (4) (a) and (b) only

Soln: Option (3)

$KMnO_4$ can oxidise chloride into chlorine, so it will give incorrect results. $KMnO_4$ is not used when strong acid like Hcl is present. Option (a) and (c) are correct statements. due to Lanthanide and actinide contractions, on moving down the group higher oxidation states are more stable due to smaller size.

25

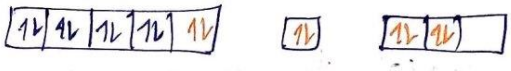
25) The molecule in which hybrid MOs involve only one d-Orbital of the central atom is :

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

Soln: Option (1)

(1) $[Ni(CN)_4]^{2-}$ - Ni^{+2} - $3d^8$.

CN^- is a strong ligand

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

3d 4s 4p

(2) XeF_4 . $\Rightarrow Xe = 4d^{10}5s^2 5p^6$

$Xe^{+4} = 4d^{10}5p^3$

XeF_4 - sp^3d^2.

(3) $[CrF_6]^{3-}$ $\Rightarrow Cr^{3+} = 3d^3$.

$[Cr(F_6)]^{3-}$  $\Rightarrow d^2sp^3$.

(4) BrF_5 - sp^3d^2.

$[Ni(CN)_4]^{2-}$ has only 1 'd' orbital.

26

26) The one that can exhibit highest paramagnetic behaviour among the following is : gly = glycinato ; bpy = 2,2'bipyridine

(1) $[Fe(en)(bpy)(NH_3)_2]^{2+}$ (2) $[Pd(gly)_2]$

(3) $[Ti(NH_3)_6]^{3+}$ (4) $[Co(OX)_2(OH)_2]^{-1}$ $(\Delta_o > P)$

Soln: option (4)

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

$Fe^{2+} = 3d^6$.

$= t_{2g}^{2,2,2}, eg^{0,0}$

unpaired electrons $\boxed{n=0}$

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

$Pd^{2+} - 4d^8 \Rightarrow t_{2g}^{2,2,2}, eg^2$

$\boxed{n=0}$

(3) $[Ti(NH_3)_6]^{3+}$

$Ti^{3+} - 3d^1 \Rightarrow t_{2g}^{1,0,0}\, eg^0$.

$\boxed{n=1}$

(4) $[Co(OX)_2(OH)_2]^-$ $(\Delta_o > P)$

$Co^{5+} \Rightarrow 3d^4$

$= t_{2g}^{2,1,1}\, eg^{0,0}$.

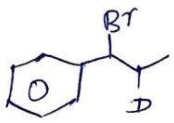
$\boxed{n=2}$

Complex (4) has highest no. of unpaired electron. Hence exhibit paramagnetism.

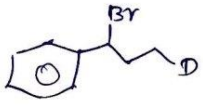
27

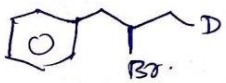
27) the major product [C] of the following reaction sequence will be :

$CH_2=CH-CHO \xrightarrow[SOCl_2]{NaBH_4} [A] \xrightarrow[Anhyd.\ AlCl_3]{\bigcirc} [B] \xrightarrow{DBr} [C]$

① 

② 

③ 

④ 

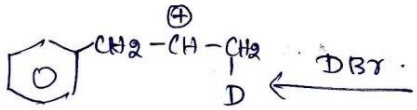
Soln: option (3)

$CH_2=CH-CHO \xrightarrow[Reduction]{NaBH_4} CH_2=CH-CH_2OH$

$\downarrow SOCl_2$

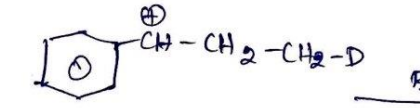
$CH_2=CH-CH_2Cl$ (A)

$\downarrow$ anhyd $AlCl_3$, $\bigcirc$ (Friedel craft's alkylation)



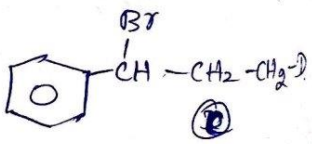
(B)

$\xrightarrow{DBr}$



(hydride shift) $\downarrow$ Rearrangement

$\xrightarrow{Br^{\ominus}}$



(C)

option (3)

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