FINAL JEE–MAIN EXAMINATION – APRIL, 2023
Held On Tuesday 11th April, 2023
TIME : 09:00 AM to 12:00 PM

SECTION - A

61. Which of the following complex has a possibility to exist as meridional isomer?

(1) $[Co(en)_2Cl_2]$
(2) $[Pt(NH_3)_2Cl_2]$
(3) $[Co(en)_3]$
(4) $[Co(NH_3)_3(NO_2)_3]$

Sol. 4

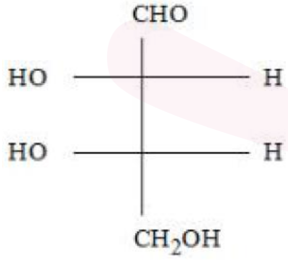
$[MA_3B_3]$ type of compound exists as facial and meridional isomer.

62. L-isomer of tetrose X ($C_4H_8O_4$) gives positive schiff's test and has two chiral carbons. On acetylation. 'X' yields triacetate. 'X' undergoes following reactions

$$'A' \xleftarrow{HNO_3} 'X' \xrightarrow{NaBH_4} 'B'$$

Chiral compound

'X' is

(1)


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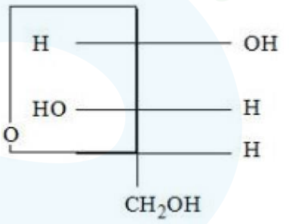

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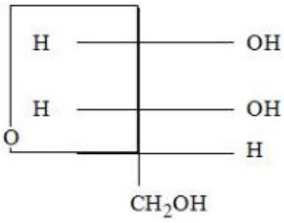

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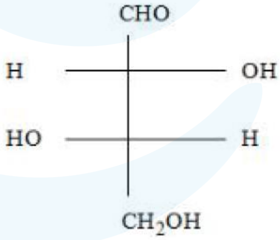
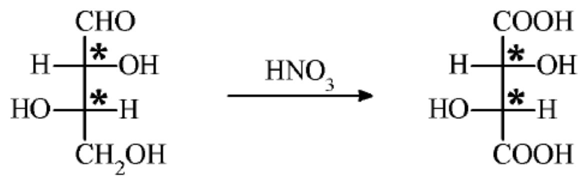
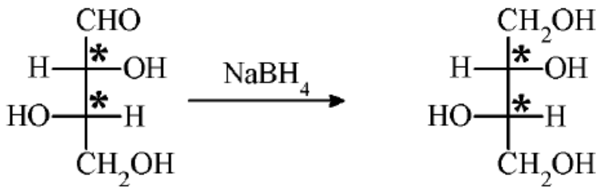


Sol. 4



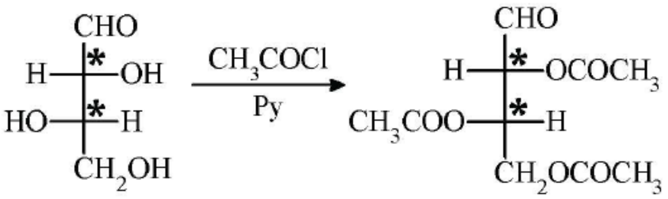
(x) (A)

L-tetrose with two chiral centre



(B)

Optically active



(x) gives positive schiff's test due –CHO group
(x) is L-tetrose.

63. Match list I with list II:

List I	List II
A. K	I. Thermonuclear ractions
B. KCl	II. Fertilizer
C. KOH	III. Sodium potassium pump
D. Li	IV. Absorbent of CO_2

Choose the correct answer from the options given below:
(1) A-III, B-IV, C-II, D-I (2) A-IV, B-III, C-I, D-II
(3) A-III, B-II, C-IV, D-I (4) A-IV, B-I, C-III, D-II

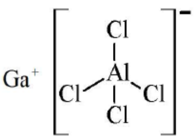
Sol. **3**
K^+ –Sodium- Potassium Pump
KCl – Fertiliser
KOH – absorber of CO_2
Li – used in thermonuclear reactions

64. For compound having the formula $GaAlCl_4$, the correct option form the following is
(1) Cl forms bond with both Al and Ga in $GaAlCl_4$
(2) Ga is coordinated with Cl in $GaAlCl_4$
(3) Ga is more electronegative than Al and is present as a cationic part of the salt
(4) Oxidation state of Ga in the salt $GaAlCl_4$ is +3

Sol. **3**
Gallous tetrachloro aluminate $Ga^+AlCl_4^-$

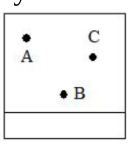
$$2Ga + Ga^+Cl_4^- + 2Al_2Cl_6 \xrightarrow{190^\circ} 4Ga^+AlCl_4^-$$

Structure of $Ga^+AlCl_4^-$



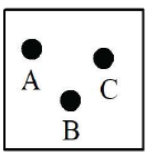
Ga is cationic part of salt $GaAlCl_4$.

65. Thin layer chromatography of a mixture shows the following observation :



The correct order of elution in the silica gel column chromatography is
(1) B, A, C (2) C, A, B (3) A, C, B (4) B, C, A

Sol. **3**



According to the observation, A is more mobile and interacts with the mobile phase more than C, and C is more drawn to the mobile phase than B.
Hence, the correct order of elution in the silica gel column chromatography is - B < C <A

66. When a solution of mixture having two inorganic salts was treated with freshly prepared ferrous sulphate in acidic medium, a dark brown ring was formed whereas on treatment with neutral $FeCl_3$. it gave deep red colour which disappeared on boiling and a brown red ppt was formed. The mixture contains

(1) $C_2O_4^{2-}$ & NO_3^-
(2) SO_3^{2-} & $C_2O_4^{2-}$
(3) CH_3COO^- & NO_3^-
(4) SO_3^{2-} & CH_3COO^-

Sol. **3**

$CH_3COO^- + FeCl_3 \rightarrow Fe(CH_3COO)_3$ or $[Fe_3(OH)_2(CH_3COO)_6]^+$
Blood red colour
$\downarrow \Delta$
$Fe(OH)_2(CH_3COO)\downarrow$
Red-brown precipitate

$2NO_3^- + 4H_2SO_4 + 6Fe^{2+} \rightarrow 6Fe^{3+} + 2NO\uparrow + 4SO_4^{2-} + 4H_2O$

$[Fe(H_2O)_6]^{2+} + NO \rightarrow [Fe(H_2O)_5(NO)]^{2+} + H_2O$
Brown

67. The polymer X-consists of linear molecules and is closely packed. It prepared in the presence of triethylaluminium and titranium tetrachloride under low pressure. The polymer X is-

(1) Polyacrylonitrile
(2) Polytetrafluoroethane
(3) High density polythene
(4) Low density polythene

Sol. **3**

Ethene undergoes addition polymerisation to high density polythene in the presence of catalyst such as $AlEt_3$ and $TiCl_4$ (Ziegler – Natta catalyst) at a temperature of 333 K to 343 K and under a pressure of 6–7 atmosphere.

68. Match list I with list II

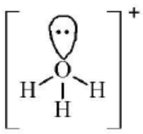
List I Species	List II Geometry/ Shape
A. H_3O^+	I. Tetrahedral
B. Acetylide anion	II. Linera
C. NH_4^+	III. Pyramidal
D. ClO_2^-	IV. Bent

Choose correct answer from the options given below:

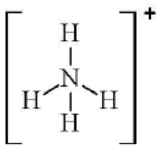
(1) A-III, B-IV, C-I, D-II
(2) A-III, B-IV, C-II, D-I
(3) A-III, B-I, C-II, D-IV
(4) A-III, B-II, C-I, D-IV

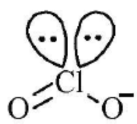
Sol. **4**

Molecule/Ion Hybridisation Shape

H_3O^+ sp^3 Pyramidal 

Acelylide sp linear $\overline{C}\equiv\overline{C}$

NH_4^+ sp^3 tetrahedral 

ClO_2^- sp^3 Bent 

69. Given below are two statement :

Statement I : Methane and steam passed over a heated Ni catalyst produces hydrogen gas

Statement II : Sodium nitrite reacts with NH_4Cl to give H_2O, N_2 and NaCl

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both the statement I and II are incorrect

(2) Statement I is incorrect but statement II is correct

(3) Statement I is correct but statement II is incorrect

(4) Both the statements I and II are correct

Sol. **4**

$$CH_4(g) + \underset{\text{Steam}}{H_2O(g)} \xrightarrow[1270K]{Ni} CO(g) + 3H_2(g)$$

$$NaNO_2(aq) + NH_4Cl(aq) \rightarrow N_2(g) + NaCl(aq) + 2H_2O(\ell)$$

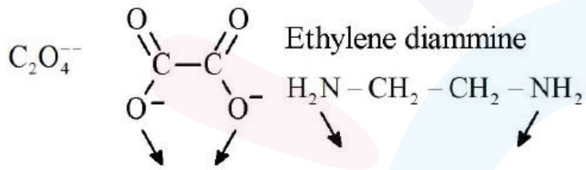
70. The set which does not have ambidentate ligand (s) is

(1) $C_2O_4^{2-}$, NO_2^-, NCS^- (2) $EDTA^{4-}$, NCS^-, $C_2O_4^{2-}$

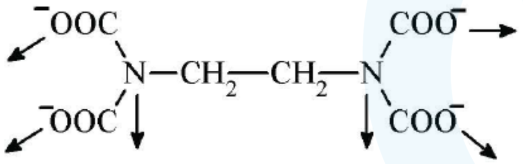
(3) NO_2^-, $C_2O_4^{2-}$, $EDTA^{4-}$ (4) $C_2O_4^{2-}$, ethylene diamine, H_2O

Sol. **4**

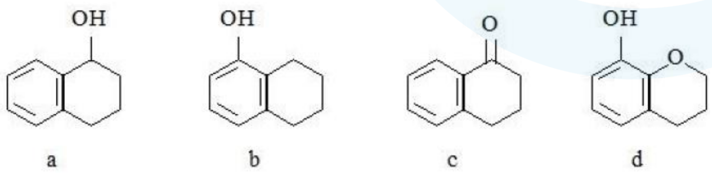
NO_2^- NCS^- are ambidentate ligand



EDTA Ethylene diamine tetra acetate



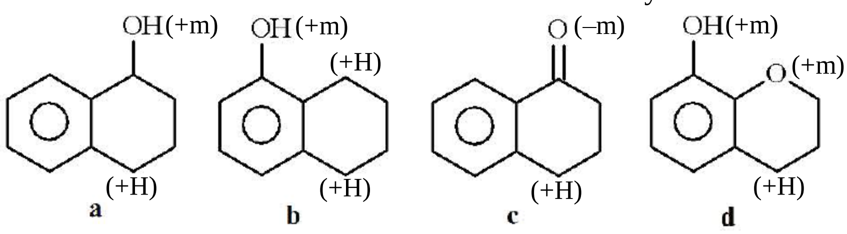
71. Arrange the following compounds in increasing order of rate of aromatic electrophilic substitution reaction



(1) c, a, b, d (2) d, b, c, a (3) d, b, a, c (4) b, c, a, d

Sol. **1**

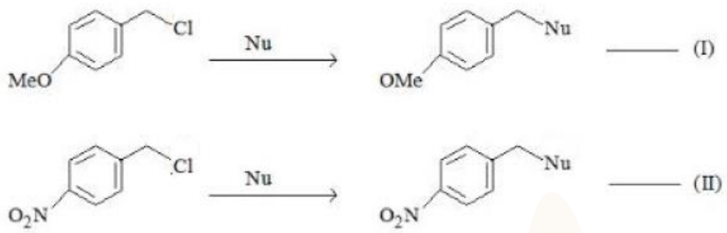
Benzene becomes more reactive towards EAS when any substituent raises the electron density.



Correct order

c < a < b < d

72.



Where Nu = Nucleophile

Find out the correct statement from the options given below for the above 2 reactions.

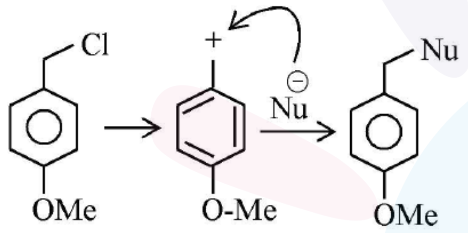
(1) Reaction (I) is of 1st order and reaction (II) is of 2nd order

(2) Reaction (I) and (II) both are 2nd order

(3) Reaction (I) and (II) both are 1st order

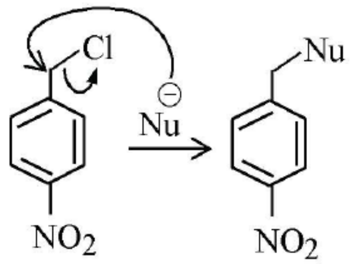
(4) Reaction (I) is of 2nd order and reaction (II) is of 1st order

Sol. **1**



Electron Donating group

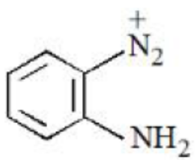
$S_N{}^1$ Mech. : Ist order

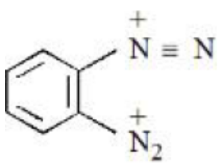


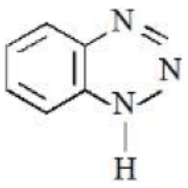
Electron withdrawing group

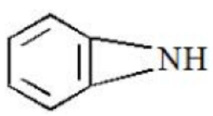
$S_N{}^2$ Mech: 2nd order

73. o-Phenylenediamine $\xrightarrow{HNO_2}$ 'X' Major Product 'X' is

(1) 

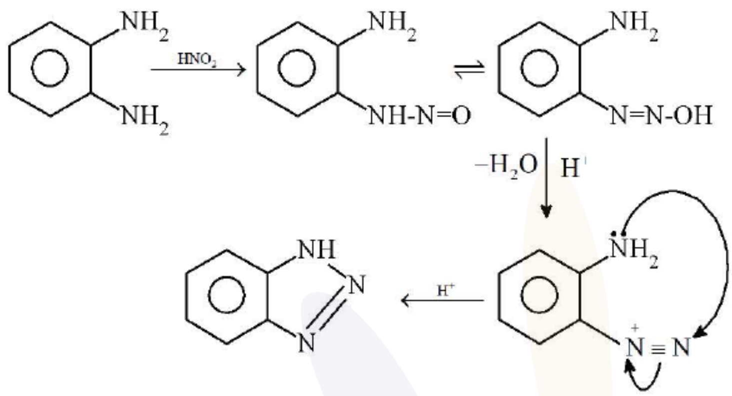
(2) 

(3) 

(4) 

Sol. **3**

o-Phenylenediamine



74. For elements B, C, N, Li, Be, O and F, the correct order of first ionization enthalpy is

(1) B>Li>Be>C>N>O>F (2) Li<Be<B<C<N<O<F

(3) Li<Be<B<C<O<N<F (4) Li<B<Be<C<O<N<F

Sol. **4**

First I.E.

F > N > O > C > Be > B > Li

Li – 520 kJ/mol

Be – 899 kJ/mol

B – 801 kJ/mol

C – 1086 kJ/mol

N – 1402 kJ/mol

O – 1314 kJ/mol

F – 1681 kJ/mol

75. In the extraction process of copper, the product obtained after carrying out the reactions

(i) $2Cu_2S+3O_2 \rightarrow 2Cu_2O+2SO_2$

(ii) $2Cu_2O+Cu_2S \rightarrow 6Cu+SO_2$ is called

(1) Reduced copper (2) Blister copper

(3) Copper matte (4) Copper scrap

Sol. **2**

$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 3SO_2$

$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

Blister copper

Due to evolution of SO_2, the solidified copper formed has a blistered look and is referred to as blister copper.

76. 25 mL of silver nitrate solution (1M) is added dropwise to 25 mL of potassium iodide (1.05 M) solution. The ion(s) present in very small quantity in the solution is/are

(1) NO_3^- only (2) Ag^+ and I^- both (3) K^+ only (4) I^- only

Sol. **2**

On adding $AgNO_3$ into KI, AgI will form and solubility of AgI is very low.

So, $[Ag^+]$ and $[I^-]$ will be present in very small quantity.

77. Given below are two statements:

Statement I : If BOD is 4 ppm and dissolved oxygen is 8 ppm, it is a good quality water.

Statement II : If the concentration of zinc and nitrate salts are 5 ppm each, than it can be good quality water.

In the light of the above statements choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but statement II is correct

(2) Statement I is correct but statement II is incorrect

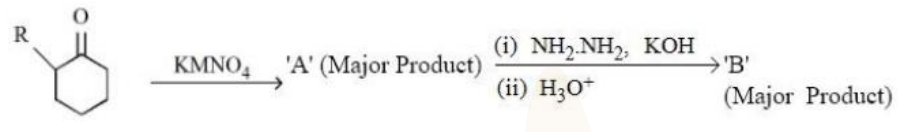
(3) Both the statements I and II are incorrect

(4) Both the statement I and II are correct

Sol. **4**

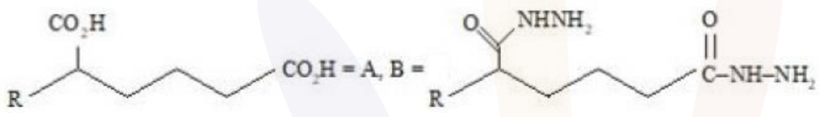
Clean water would have BOD value of less than 5 ppm.
Maximum limit of Zn in clean water = 5.0 ppm or mg dm^{-3}
Maximum limit of NO_3^- in clean water = 50 ppm or mg dm^{-3}

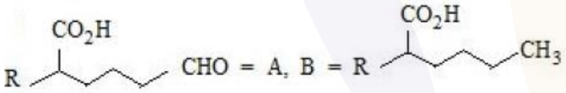
78.

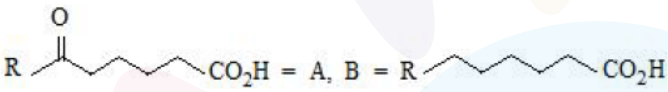


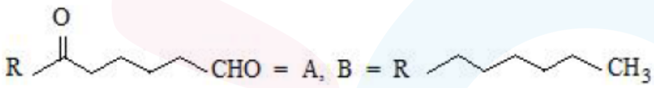
(R = alkyl)

'A' and 'B' in the above reactions are :

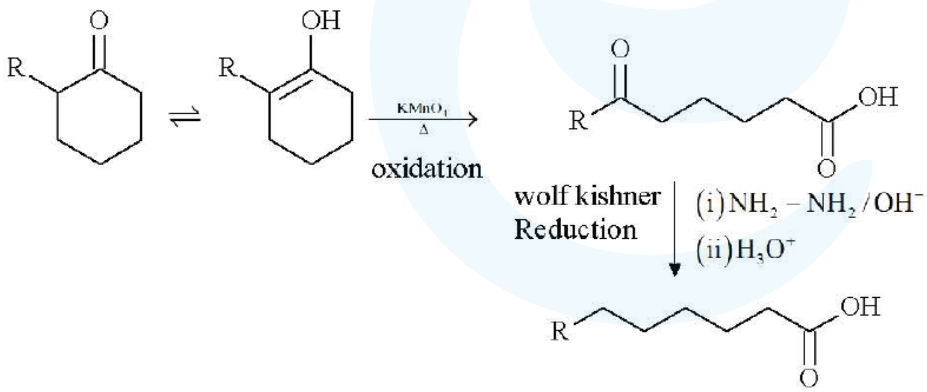
(1) 

(2) 

(3) 

(4) 

Sol. **3**



79. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R:
Assertion A : In the photoelectric effect electrons are ejected from the metal surface as soon as the beam of light of frequency greater than threshold frequency strikes the surface.
Reason R : When the photon of any energy strikes an electron in the atom transfer of energy from the photon to the electron takes place.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) A is correct but R is not correct
(2) A is not correct but R is correct
(3) Both A and R correct and R is the correct explanation of A
(4) Both A and R are correct but R is NOT the correct explanation of A

Sol. **1**

Assertion A is correct but Reason is not correct.

80. The complex that dissolves in water is
(1) $[Fe_3(OH)_2(OAc)_6]Cl$
(2) $Fe_4[Fe(CN)_6]_3$
(3) $K_3[Co(NO_2)_6]$
(4) $(NH_4)_3[As(Mo_3O_{10})_4]$

Sol. **1**

$Fe_4[Fe(CN)_6]_3$ Prussian Blue-water insoluble
$K_3[Co(NO_2)_6]$ very poorly water soluble
$(NH_4)_3\ [As(MO_3O_{10})_4]$ water insoluble
ammonium arseno molybdate
$[Fe_3\ (OH)_2(OAc)_6]$ Cl is water soluble.

SECTION - B

81. Solid fuel used in rocket is a mixture of Fe_2O_3 and Al (in ratio 1 : 2) the heat evolved (KJ) per gram of the mixture is _______ (Nearest integer)

Givne $\Delta H_f^\theta(Al_2O_3) = -1700$ KJ mol^{-1}

$\Delta H_f^\theta(Fe_2O_3) = -840$ KJ mol^{-1}

Sol. **4**

$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

$\Delta H_r = (\Delta H_f)\ Al_2O_3 - \Delta H_f°(Fe_2O_3)$

$= -1700 - (-840)$

$= -860$ kJ

Fe_2O_3 & Al $\rightarrow$ 1 : 2

Fe_2O_3 = 1 mole = (2 × 25 + 48)

= 112 + 48 = 160 gm

Al = 2 mole = 2 × 27 = 54 gm

Total mass = 160 + 54 = 214 gm

Heat evolved per gm = $\frac{-860}{214}$ kJ = –4.01 ≈ 4 kJ

82. $KClO_3 + 6FeSO_4 + 3H_2SO_4 \rightarrow KCl + 3Fe_2(SO_4)_3 + 3H_2O$

The above reaction was studied at 300 K by monitoring the concentration of $FeSO_4$ in which initial concentration was 10 M and after half an hour became 8.8 M. The rate of production of $Fe_2(SO_4)_3$ is______ $\times 10^{-6}$ mol L^{-1} s^{-1}

Sol. **333**

$$\frac{-\Delta FeSO_4}{\Delta t} = \frac{10-8.8}{30\times 60} = \frac{1.2}{1800}$$

From given equation :

$$-\frac{1}{6}\frac{\Delta FeSO_4}{\Delta t} = \frac{1}{3} \times (\text{Rate of production of } Fe_2(SO_4)_3)$$

Rate of production of $Fe_2(SO_4)_3 = \frac{3}{6}\times\frac{1.2}{1800}$

$= \frac{1}{3}\times 10^{-3}$

$= \frac{1000}{3}\times 10^{-6}$

$= 333.33 \times 10^{-6}$

83. 0.004 M K_2SO_4 solution is isotonic with 0.01 M glucose solution. Percentage dissociation of K_2SO_4 is________ (Nearest integer)

Sol. **75**

For isotonic solution

$(ic)_{glucose} = (ic)_{K_2SO_4}$

$0.01 = i\ (0.004)$

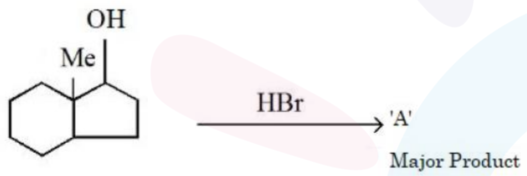
$i = \frac{0.01}{0.004} = \frac{10}{4} = \frac{5}{2}$

$1 + (n-1)\alpha = \frac{5}{2}$

$1 + (3-1)\alpha = \frac{5}{2}$ $\quad (\because n = 3 \text{ for } K_2SO_4)$

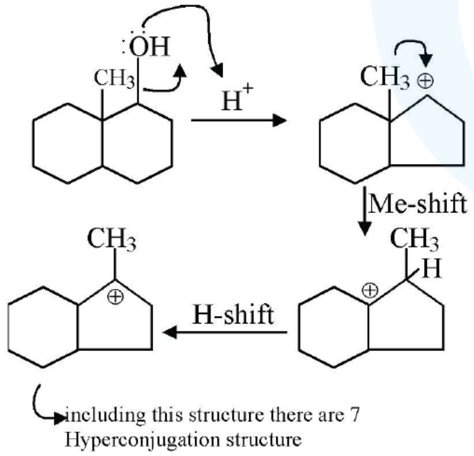
$2\alpha = \frac{3}{2}$

$\alpha = \frac{3}{4} \rightarrow 75\%$

84. 

The number of hyperconjugation structures involved to stabilize carbocation formed in the above reaction is______

Sol. **7**



85. A mixture of 1 mole of H_2O and 1 mole of CO is taken in a 10 litre container and heated to 725 K. At equilibrium 40% of water by mass reacts with carbon monoxide according to the equation : $CO(g)+H_2O(g) \rightleftharpoons CO_2(g)+H_2(g)$. The equilibrium constant $K_c \times 10^2$ for the reaction is_________ (Nearest integer)

Sol. **44**

	$CO(g)$	+ $H_2O(g)$	$\rightleftharpoons CO_2(g)$	+ $H_2(g)$
	1mole	1mole		
At equilibrium	1–0.4	1–0.4	0.4	0.4

$K_c = \frac{0.4 \times 0.4}{0.6 \times 0.6} = \frac{4}{9}$

$K_c \times 10^2 = \frac{4}{9} \times 100 = \frac{400}{9} = 44.44 \approx 44$

86. An atomic substance A of molar mass 12 g mol^{-1} has a cubic crystal structure with edge length of 300 pm. The no. of atoms present in one unit cell of A is ________ (Nearest integer)
Given the density of A is 3.0 g mL^{-1} and $N_A = 6.02\times10^{23}$ mol^{-1}

Sol. **4**

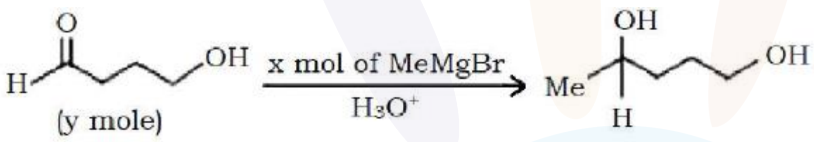
$$d = \frac{\frac{Z}{N_A}\times M}{a^3}$$

$$3 = \frac{Z}{6.02\times10^{23}}\times\frac{12}{(300\times10^{-10})^3}$$

$$Z = \frac{3\times6.02\times27\times10^{6}\times10^{-30}\times10^{23}}{12}$$

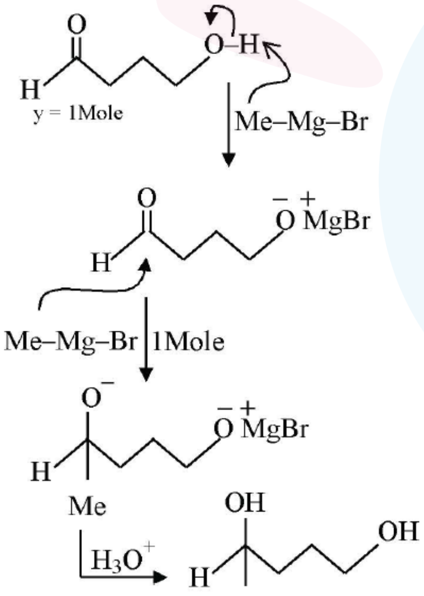
$= 40.635 \times 10^{-1}$ $= 4.0635 \approx 4$

87.



The ratio x/y on completion of the above reaction is_______

Sol. **2**



$\therefore$ x = 2 mole

$$\frac{x}{y}=\frac{2}{1}=2$$

88. The ratio of spin-only magnetic moment values $\mu_{eff}[Cr(CN)_6]^{3-}/\mu_{eff}[Cr(H_2O)_6]^{3+}$ is_____

Sol. **1**

Spin magnetic moment of $[Cr(CN)_6]^{3-}(t_{2g}^3\, e_g^0)$

$$\mu_1 = \sqrt{3(3+2)} = \sqrt{15}BM$$

Spin magnetic moment of $[Cr(H_2O)_6]^{3+}(t_{2g}^3\, e_g^0)$

$$\mu_2 = \sqrt{3(3+2)} = \sqrt{15}BM$$

$$\frac{\mu_1}{\mu_2} = \frac{\sqrt{51}}{\sqrt{51}} = 1$$

89. In an electrochemical reaction of lead, at standard temperature, if $E^o_{(Pb^{2+}/Pb)} = m$ volt and $E^o_{(Pb^{4+}/Pb)} = n$ volt, then the value of $E^o_{(Pb^{2+}/Pb^{4+})}$ is given by m – xn. The value of x is ________ (Nearest integer)

Sol. **2**

$Pb^{2+} + 2e^- \rightarrow Pb$ $\quad E^\circ = m \quad \Delta G_1^o = -2Fm$

$Pb^{4+} + 4e^- \rightarrow Pb$ $\quad E^\circ = n \quad \Delta G_2^o = -4Fn$

$Pb^{2+} \rightarrow Pb^{4+} + 2e^-$ $\quad \Delta G_3^o = \Delta G_1^o - \Delta G_2^o$

$-2FE^\circ = -2Fm + 4Fn$

$\boxed{E^\circ = m - 2n}$

$\boxed{x = 2}$

90. A solution of sugar is obtained by mixing 200g of its 25% solution and 500g of its 40% solution (both by mass). The mass percentage of the resulting sugar solution is_______(Nearest integer)

Sol. **36**

Solution (I) $\rightarrow$ Mass of sugar = $200 \times \frac{25}{100} = 50$ gm

Mass of solution = 200 gm

Solution (II) $\rightarrow$ Mass of solution = 500 gm

Mass of sugar = $\frac{40}{100} \times 500 = 200$ gm

Final % w/w = $\frac{\text{Total mass of sugar}}{\text{Total mass of solution}} \times 100$

$= \frac{50+200}{200+500} \times 100 = \frac{250}{7}$

$= 35.71\% \approx 36$