FINAL JEE–MAIN EXAMINATION – APRIL, 2023

(Held On Tuesday 11th April, 2023) **TIME : 9 : 00 AM to 12 : 00 NOON**

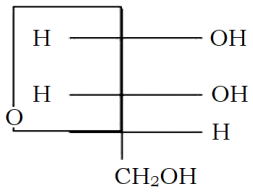
CHEMISTRY — TEST PAPER WITH SOLUTION

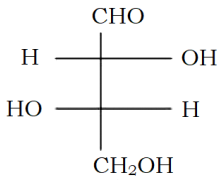
SECTION-A

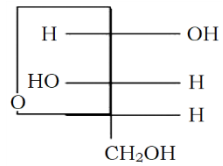
61. L –isomer of tetrose X ($C_4H_8O_4$) gives positive Schiff's test and has two chiral carbons. On acetylation. 'X' yields triacetate. 'X' also undergoes following reactions

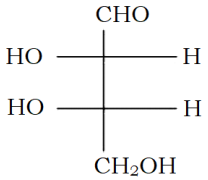
$$'A' \xleftarrow{HNO_3} 'X' \xrightarrow{NaBH_4} \underset{\text{Chiral compound}}{'B'}$$

'X' is

(1) 

(2) 

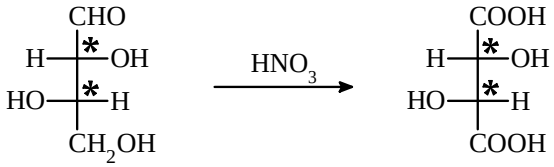
(3) 

(4) 

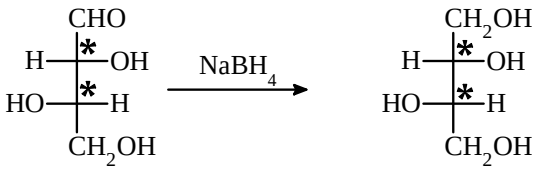
Official Ans. by NTA (2)

Allen Ans. (2)

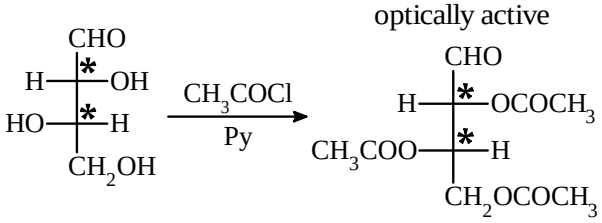
Sol.



L-tetrose with two chiral centre



optically active



(x) gives positive schiff's test due –CHO group

(x) is L–tetrose.

62. The polymer X – consists of linear molecules and is closely packed. It is prepared in the presence of triethylaluminium and titanium tetrachloride under low pressure. The polymer X is –

(1) Polyacrylonitrile

(2) Low density polythene

(3) Polytetrafluoroethane

(4) High density polythene

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. 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.

63. 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) CH_3COO^- & NO_3^-

(2) $C_2O_4^{2-}$ & NO_3^-

(3) SO_3^{2-} & CH_3COO^-

(4) SO_3^{2-} & $C_2O_4^{2-}$

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $CH_3COO^- + FeCl_3 \rightarrow Fe(CH_3COO)_3$ or

$$\left[Fe_3(OH)_2(CH_3COO)_6\right]^+$$

Blood red colour

$\downarrow \Delta$

$Fe(OH)_2(CH_3COO)\downarrow$

Red–brown precipitate

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

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

64. 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, the 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) Both A and R are correct but R is NOT the correct explanation of A

(2) A is correct but R is not correct

(3) Both A and R are correct and R is the correct explanation of A

(4) A is not correct but R is correct

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. There is a characteristic minimum frequency, or "threshold frequency," for each metal below which the photoelectric effect is not seen. The ejected electrons leave with a specific amount of kinetic energy at a frequency $v > v_0$ with an increase in light frequency of these electron kinetic energies also rise.

65. 25 mL of silver nitrate solution (1 M) 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) K^+ only

(3) Ag^+ and I^- both

(4) I^- only

Official Ans. by NTA (3)

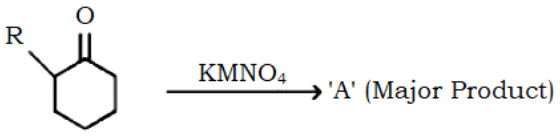
Allen Ans. (3)

Sol. $AgNO_3 + KI \rightarrow AgI\downarrow + KNO_3$

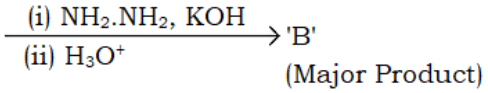
$$AgI \rightarrow \underset{S}{Ag^+} + \underset{S+0.625}{I^-}$$

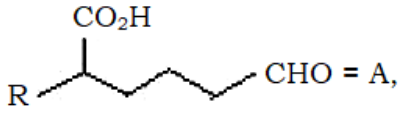
AgI is a insoluble salt so concentration Ag^+ and I^- will be negligible.

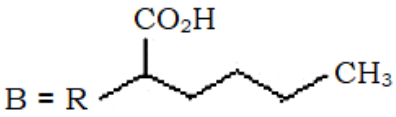
66. 'A' and 'B' in the below reactions are :

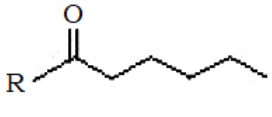


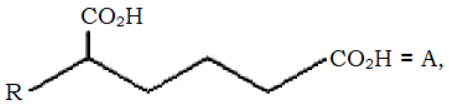
(R = alkyl)

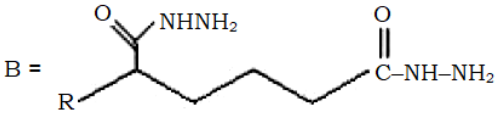


(1) 



(2) 

(3) 

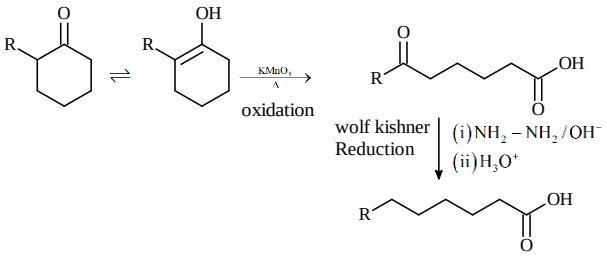


(4) 

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.



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

(1) $C_2O_4^{2-}$, ethylene diammine, H_2O

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

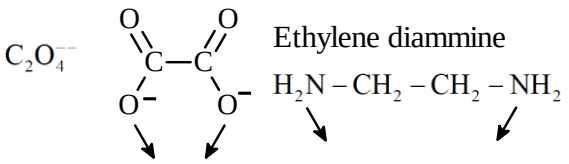
(3) NO_2^-, $C_2O_4^{2-}$, $EDTA^{4-}$

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

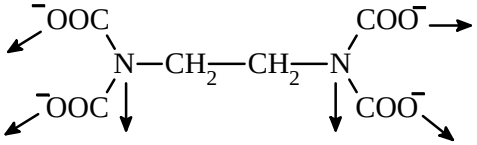
Official Ans. by NTA (1)

Allen Ans. (1)

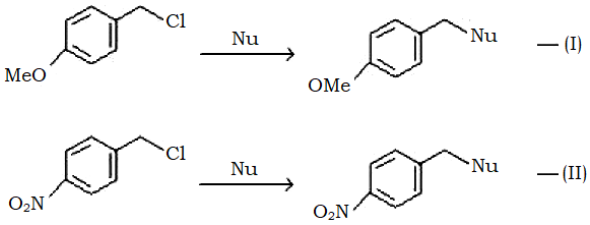
Sol. NO_2^-, NCS^- are ambidentate ligand



EDTA Ethylene diamine tetra acetate



68.



Where Nu = Nucleophile

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

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

(2) Reaction (I) and (II) both are of 2^{nd} order

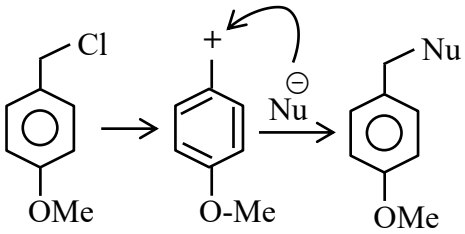
(3) Reaction (I) is of 1^{st} order and reaction (II) is of 2^{nd} order

(4) Reactions (I) and (II) both are of 1^{st} order

Official Ans. by NTA (3)

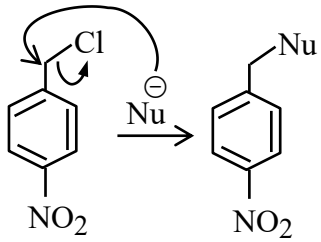
Allen Ans. (3)

Sol.



Electron Donating group

S_N1 Mech. : I^{st} order



Electron withdrawing group

S_N2 Mech : 2^{nd} order

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

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

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

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

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

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. 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

70. Match List-I with List-II :

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

Choose the correct answer from the options given below :

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

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

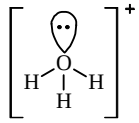
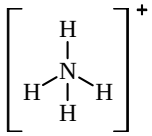
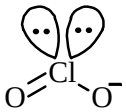
(3) A-III, B-IV, C-I, D-II

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

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Molecule/Ion Hybridisation Shape

H_3O^+	sp^3	Pyramidal	
Acelylide	sp	linear	$\bar{C}\equiv\bar{C}$
NH_4^+	sp^3	tetrahedral	
ClO_2^-	sp^3	Bent	

71. For compound having the formula $GaAlCl_4$, the correct option from the following is

(1) Ga is more electronegative than Al and is present as a cationic part of the salt $GaAlCl_4$

(2) Oxidation state of Ga in the salt $GaAlCl_4$ is +3.

(3) Cl forms bond with both Al and Ga in $GaAlCl_4$

(4) Ga is coordinated with Cl in $GaAlCl_4$

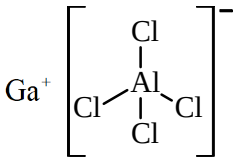
Official Ans. by NTA (1)

Allen Ans. (1)

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

$$2Ga + Ga^+GaCl_4^- + 2Al_2Cl_6 \xrightarrow{190^\circ} 4Ga^+AlCl_4^-$$

Structure of $\overset{+}{G}a\overset{-}{A}lCl_4$



Ga is cationic part of salt $GaAlCl_4$.

72. 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) Blister copper

(2) Copper scrap

(3) Reduced copper

(4) Copper matte

Official Ans. by NTA (1)

Allen Ans. (1)

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

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

Blister copper

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

73. Match List-I with List-II :

List-I	List-II
A. K	I. Thermonuclear reactions
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-II, C-IV, D-I

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

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

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

Official Ans. by NTA (1)

Allen Ans. (1)

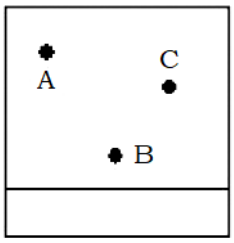
Sol. K^+ – Sodium – Potassium Pump

KCl – Fertiliser

KOH – absorber of CO_2

Li – used in thermonuclear reactions

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



The correct order of elution in the silica gel column chromatography is

(1) A, C, B

(2) B, C, A

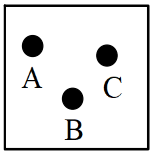
(3) C, A, B

(4) B, A, C

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.



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 silico gel column chromatography is – $B < C < A$

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

(1) $[Co(NH_3)_3(NO_2)_3]$

(2) [Co (en)$_3$]

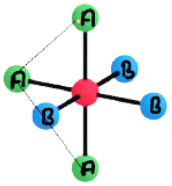
(3) [Co (en)$_2$ Cl$_2$]

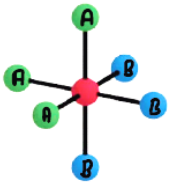
(4) [Pt (NH$_3$)$_2$ Cl$_2$]

Official Ans. by NTA (1)

Allen Ans. (1)

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





76. Given below are two statements :

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 statements I and II are correct

(2) Both the statements I and II are incorrect

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

(4) Statement I is correct but Statement II is incorrect

Official Ans. by NTA (1)

Allen Ans. (1)

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

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

77. Given below are two statements :

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

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

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

(1) Both the statements I and II are incorrect

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

(3) Both the statements I and II are correct

(4) Statement I is correct but Statement II is incorrect

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Clean water would have BOD value of less than 5 ppm.

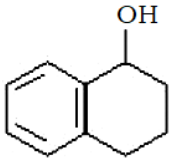
Maximum limit of Zn in clean water

= 5.0 ppm or mg dm^{-3}

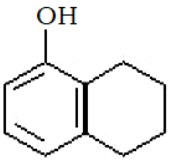
Maximum limit of NO_3^- in clean water

= 50 ppm or mg dm^{-3}

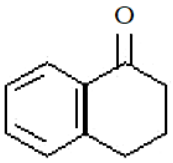
78. Arrange the following compounds in increasing order of rate of aromatic electrophilic substitution reaction



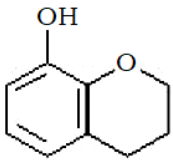
(a)



(b)



(c)



(d)

(1) d, b, c, a

(2) b, c, a, d

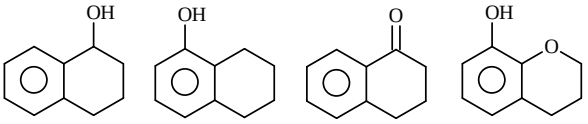
(3) c, a, b, d

(4) d, b, a, c

Official Ans. by NTA (3)

Allen Ans. (3)

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



a
-CH_2 has +H effect

b
-OH has +R while -CH_2- group has +H effect.

c
$-\overset{O}{\overset{\|}{C}}-$ has -R effect

d
-OH and -O- both show +R effect

Correct order

$c < a < b < d$

79. The complex that dissolves in water is

(1) $Fe_4[Fe(CN)_6]_3$

(2) $[Fe_3(OH)_2(OAc)_6]Cl$

(3) $K_3[Co(NO_2)_6]$

(4) $(NH_4)_3[As(Mo_3O_{10})_4]$

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $Fe_4\left[Fe(CN)_6\right]_3$ Prussian Blue–water insoluble

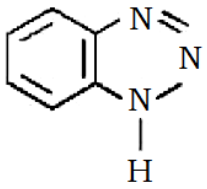
$K_3\left[Co(NO_2)_6\right]$ very poorly water soluble

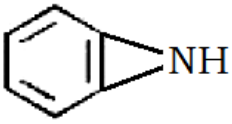
$(NH_4)_3[\ As\ (MO_3O_{10})_4\ ]$ water insoluble ammonium arseno molybdate

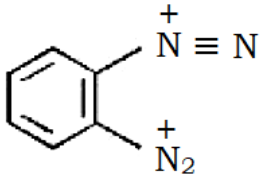
$\left[Fe_3(OH)_2(OAc)_6\right]Cl$ is water soluble.

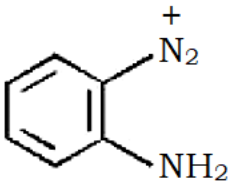
80. o-Phenylenediamine $\xrightarrow{HNO_2}$ 'X'
Major Product

'X' is

(1) 

(2) 

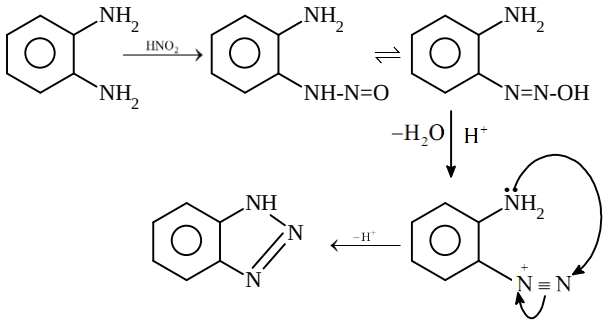
(3) 

(4) 

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Orthophenyl amine.



SECTION-B

81. 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)

Official Ans. by NTA (44)

Allen Ans. (44)

Sol. $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

t = 0	1 mol	1 mol	0	0
at equ.	1–x	1–x	x	x

at equilibrium 40% by mass water reacts with CO

$x = 0.4 \qquad 1 - x = 0.6$

$$K_C = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{0.4\times0.4}{0.6\times0.6} = 0.44$$

$$K_C \times 10^2 = 44$$

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

Official Ans. by NTA (1)

Allen Ans. (1)

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

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

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

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

$$\frac{\mu_1}{\mu_2} = \frac{\sqrt{15}}{\sqrt{15}} = 1$$

83. 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 $\times 10^{23}$ mol^{-1}

Official Ans. by NTA (4)

Allen Ans. (4)

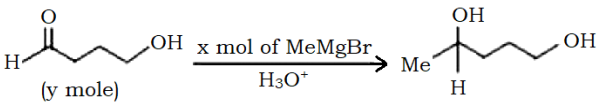
Sol. d = 3 g/cc M = 12 g/mol

a = 300 pm = 3×10^{-8} cm

$$Z = \frac{d \times N_A \times a^3}{M} = \frac{3 \times 6.02 \times 10^{23} \times (3 \times 10^{-8})^3}{12}$$

$= 4.06 \approx 4$

84.

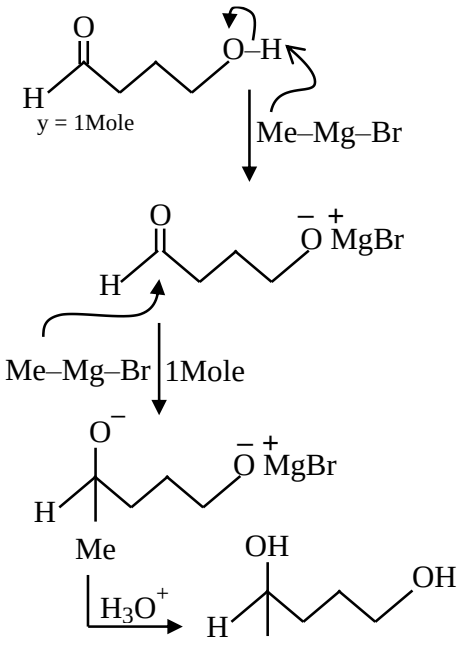


The ratio x/y on completion of the above reaction is _____.

Official Ans. by NTA (2)

Allen Ans. (2)

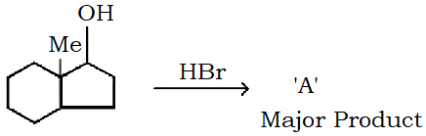
Sol.



$\therefore$ x = 2 mole

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

85.

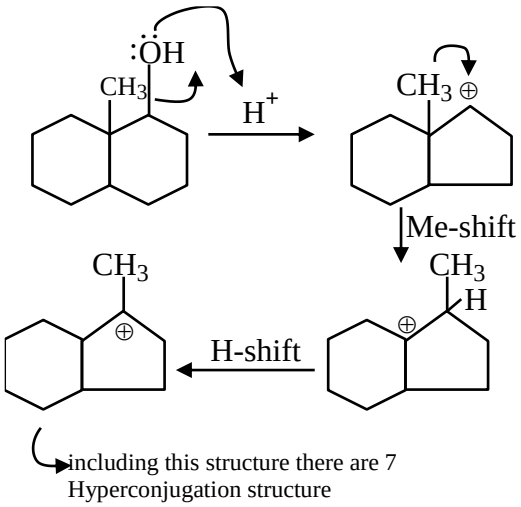


The number of hyperconjugation structures involved to stabilize carbocation formed in the above reaction is _____.

Official Ans. by NTA (7)

Allen Ans. (7)

Sol.



86. 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 _____ (Neatest integer)

Given : $\Delta H_f^0(Al_2O_3) = -1700\ kJ\ mol^{-1}$

$\Delta H_f^0(Fe_2O_3) = -840\ kJ\ mol^{-1}$

Molar mass of Fe, Al and O are 56, 27 and 16 g mol^{-1} respectively.

Official Ans. by NTA (4)

Allen Ans. (4)

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

Molar mass 160g 27g

$$\left(\Delta H_f^0\right)_{reaction} = \left[\left(\Delta H_f^0\right)_{Al_2O_3} + 2\left(\Delta H_f^0\right)_{Fe}\right] - \left[\left(\Delta H_f^0\right)_{Fe_2O_3} + 2\left(\Delta H_f^0\right)_{Al}\right]$$

= [– 1700 + 0] – [– 840 + 0]

= – 860 kJ/mol

Total mass of mixture = Fe_2O_3 + Al (1 : 2 molar ratio)

= 160 + 2 × 27

= 214 g/mol

Heat evolved per gram $= \frac{860}{214} = 4\ kJ/g$

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

Official Ans. by NTA (36)

Allen Ans. (36)

Sol. Total mass of sugar in mixture of 25% of 200 and 40% of 500 g

Sugar solution = $0.25 \times 200 + 0.40 \times 500$

$= 50 + 200 = 250$ g

Total mass of solution = 200 + 500 = 700 g

Mass of sugar in solution = $\frac{250}{700} \times 100 = 35.7\%$

$\approx 36\%$

88. $KClO_3 + 6FeSO_4 + 3H_2SO_4 \rightarrow$

$KCl + 3Fe_2(SO_4)_3 + 3H_2O$

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}.

(Nearest integer)

Official Ans. by NTA (333)

Allen Ans. (333)

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

$$ROR = -\frac{\Delta[KClO_3]}{\Delta t} = \frac{-1}{6}\frac{\Delta[FeSO_4]}{\Delta t} = \frac{+1}{3}\frac{\Delta[Fe_2(SO_4)_3]}{\Delta t}$$

$$\frac{\Delta[Fe_2(SO_4)_3]}{\Delta t} = \frac{1}{2}\frac{-\Delta[FeSO_4]}{\Delta t}$$

$$= \frac{1}{2}\frac{(10-8.8)}{30\times 60}$$

$$= 0.333 \times 10^{-3}$$

$$= 333 \times 10^{-6} \text{ mol litre}^{-1} \text{ sec}^{-1}$$

89. 0.004 M K_2SO_4 solution is isotonic with 0.01 M glucose solution. Percentage dissociation of K_2SO_4 is _____ (Nearest integer)

Official Ans. by NTA (75)

Allen Ans. (75)

Sol. Isotonic solutions,

$\pi_{K_2SO_4} = \pi_{Glucose}$

$i \times 0.004 \times RT = 0.01 \times RT$

$i = 2.5$

For K_2SO_4 {for dissociation $i = 1 + (n-1)\alpha$}

$$DOD(\alpha) = \frac{i-1}{n-1} = \frac{2.5-1}{3-1} = 0.75$$

% dissociation = 75

90. In an electrochemical reaction of lead, at standard temperature, if $E^0_{(Pb^{2+}/Pb)} = m$ Volt and $E^0_{(Pb^{4+}/Pb)} = n$ Volt, then the value of $E^0_{(Pb^{2+}/Pb^{4+})}$ is given by m – xn. The value of x is _____.

(Nearest integer)

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $Pb^{2+} + 2e^- \rightarrow Pb \quad \Delta G^0_1 = -2F E^0_1$

$Pb^{4+} + 4e^- \rightarrow Pb \quad \Delta G^0_2 = -4F E^0_2$

$Pb^{2+} \rightarrow Pb^{4+} + 2e^- \quad \Delta G^0_3 = -2F E^0_3$

$\Delta G^0_3 = \Delta G^0_1 - \Delta G^0_2$

$-2F E^0_3 = 2F(2n - m)$

$E^0_3 = m - 2n = m - xn$

Hence x = 2