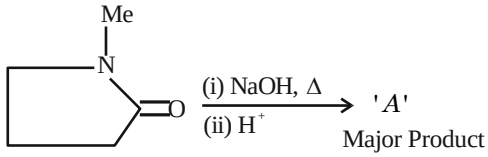
FINAL JEE–MAIN EXAMINATION – APRIL, 2023

(Held On Thursday 13th April, 2023) **TIME: 9: 00 AM to 12 : 00 NOON**

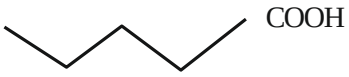
CHEMISTRY — TEST PAPER WITH SOLUTIONS

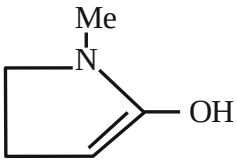
SECTION-A

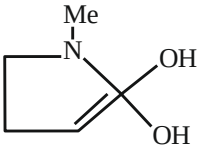
61. In the reaction given below

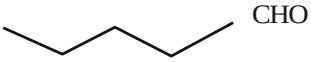


'A' is

(1) 

(2) 

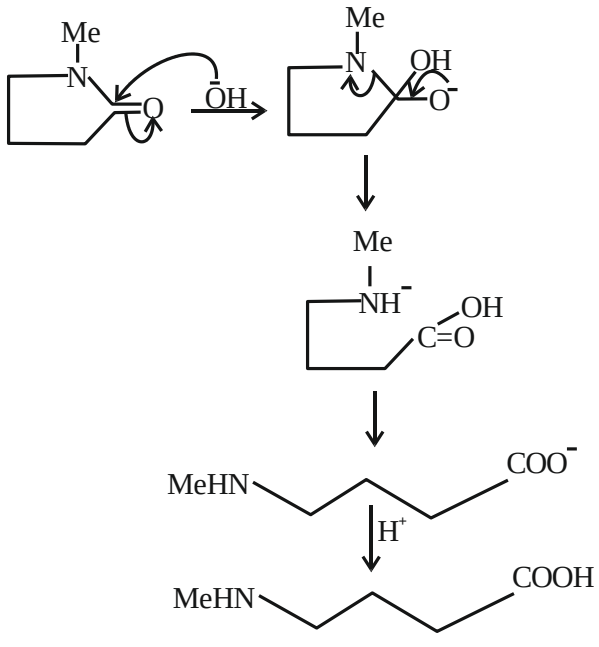
(3) 

(4) 

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.



62. Given below are two statements:

Statement-I Permutit process is more efficient compared to the synthetic resin method for the softening of water.

Statement-II: Synthetic resin method results in the formation of soluble sodium salts.

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) Statement I is correct but Statement II is incorrect

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

(4) Both the Statements I and II are incorrect

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Nowadays hard water is softened by using synthetic ion exchangers. This method is more efficient than zeolite process/Permutit process

63. The mismatched combinations are

A. Chlorophyll - Co

B. Water hardness - EDTA

C. Photography - $\left[Ag(CN)_2\right]^-$

D. Wilkinson catalyst - $\left[(Ph_3P)_3\,RhCl\right]$

E. Chelating ligand – D - Penicillamine

Choose the correct answer from the options given below:

(1) A and C Only

(2) A and E Only

(3) D and E Only

(4) A, C and E Only

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Mg is present in chlorophyll and in black and white photography the developed film is fixed by washing with hypo solution which dissolves the undecomposed AgBr to form a complex ion $[Ag(S_2O_3)_2]^{3-}$

64. In which of the following processes, the bond order increases and paramagnetic character changes to diamagnetic one?

(1) $O_2 \rightarrow O_2^{2-}$

(2) $NO \rightarrow NO^+$

(3) $N_2 \rightarrow N_2^+$

(4) $O_2 \rightarrow O_2^+$

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. NO is paramagnetic with BO = 2.5, NO^+ is diamagnetic with BO = 3

65. The incorrect statement from the following for borazine is:

(1) It has electronic delocalization

(2) It contains banana bonds.

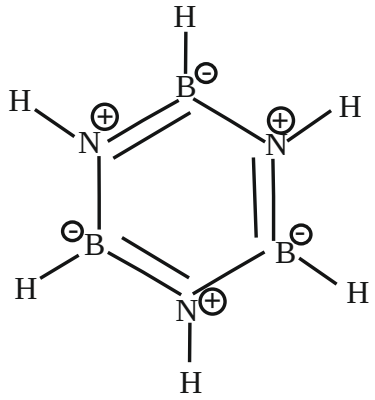
(3) It can react with water.

(4) It is a cyclic compound.

Official Ans. by NTA (3)

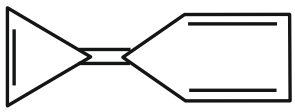
Allen Ans. (2)

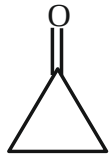
Sol. Borazine is $B_3N_3H_6$

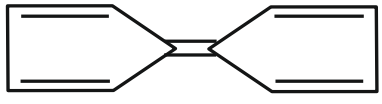


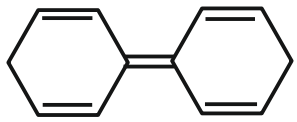
$$B_3N_3H_6 + 9H_2O \rightarrow 3NH_3 + 3H_3BO_3 + 3H_2$$

66. Among the following compounds, the one which shows highest dipole moment is

(1) 

(2) 

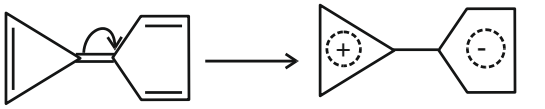
(3) 

(4) 

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Among the given compounds, the following compound has the highest dipole moment because both the +ve and –ve ends acquire aromaticity.



(Aromatic) (Aromatic)

67. Match the following

Column –A		Column-B	
a	Nylon 6	**I**	Natural Rubber
b	Vulcanized Rubber	**II**	Cross Linked
c	cis-1,4-polyisoprene	**III**	Caprolactam
d	Polychloroprene	**IV**	Neoprene

Choose the correct answer from option given below:

(1) a $\rightarrow$ IV,b-III, c $\rightarrow$ II,d $\rightarrow$ I

(2) a $\rightarrow$ III, b $\rightarrow$ IV, c $\rightarrow$ I,d $\rightarrow$ II

(3) a $\rightarrow$ II, b $\rightarrow$ III, c $\rightarrow$ IV, d $\rightarrow$ I

(4) a $\rightarrow$ III, b $\rightarrow$ II, c $\rightarrow$ I, d $\rightarrow$ IV

Official Ans. by NTA (4)

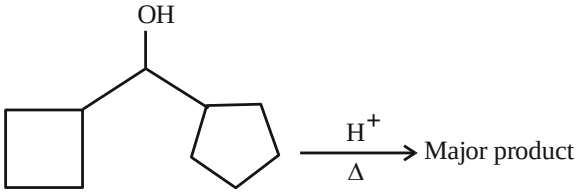
Allen Ans. (4)

Sol. Nylon-6 – Caprolactum (Monomer)

Natural rubber – Isoprene (Monomer)

Vulcanized rubber – Sulphur containing rubber

Neoprene – Chloroprene (Monomer)

68. 

In the above reaction. Left hand side and right hand side rings are named as 'A' and 'B' respectively. They undergo ring expansion. The correct statement for this process is:

(1) Finally both rings will become six membered each.

(2) Finally both rings will become five membered each.

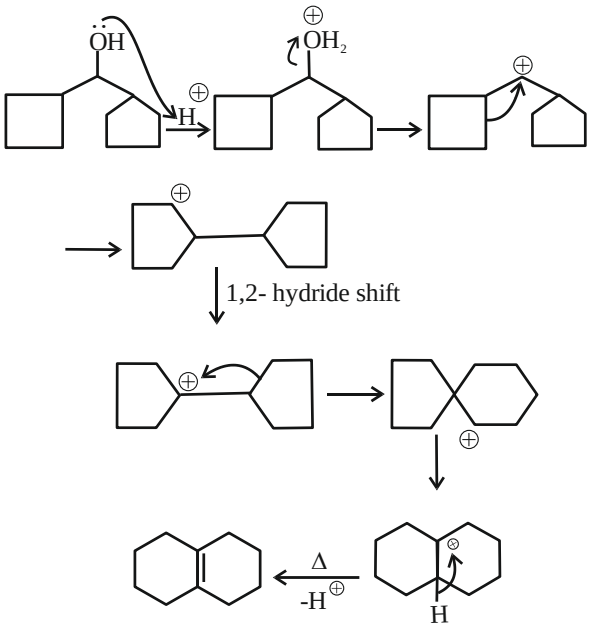
(3) Only 'A' will become 6 membered.

(4) Ring expansion can go upto seven membered rings

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.



69. The radical which mainly causes ozone depletion in the presence of UV radiations is:

(1) $CH_3^{\bullet}$ (2) $NO^{\bullet}$

(3) $Cl^{\bullet}$ (4) $\dot{O}H$

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $O_2(g) \xrightarrow{UV} O(g) + O(g)$

$O_2(g) + O(g) \longrightarrow O_3(g)$

$CF_2Cl_2(g) \xrightarrow{UV} \dot{C}l(g) + \dot{C}F_2Cl(g)$

$\dot{C}l(g) + O_3(g) \longrightarrow Cl\dot{O}(g) + O_2(g)$

$Cl\dot{O}(g) + O(g) \longrightarrow \dot{C}l(g) + O_2(g)$

70. In the following reaction 'X' is

$$CH_3(CH_2)_4CH_3 \xrightarrow[HCl,\,\Delta]{Anhy.AlCl_3} \underset{\text{major product}}{'X}$$

(1) $CH_3(CH_2)_4CH_2Cl$

(2) $Cl-CH_2-(CH_2)_4-CH_2-Cl$

(3) $CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}H-(CH_2)_2CH_3$

(4) 

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. n-alkanes on heating in this presence of anhydrous $AlCl_3$ and hydrogen chloride gas isomerise to branched chain alkanes. The major product has one methyl side chain.

$$CH_3-(CH_2)_4-CH_3 \xrightarrow[HCl,\Delta]{Anhy.AlCl_3} CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}H-(CH_2)_2-CH_3$$

2 – methylpentane
(major)

71. 2-Methyl propyl bromide reacts with $C_2H_5O^-$ and gives 'A' whereas on reaction with C_2H_5OH it gives 'B'. The mechanism followed in these reactions and the products 'A' and 'B' respectively are:

(1) S_N2. A = iso-butyl ethyl ether; S_N1, B = tert-butyl ethyl ether

(2) S_N1, A = tert-butyl ethyl ether; S_N1, B = 2-butyl ethyl ether

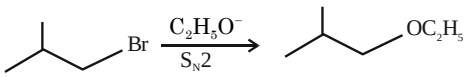
(3) S_N1, A = tert-butyl ethyl ether; S_N2, B = iso-butyl ethyl ether

(4) S_N2, A =2-butyl ethyl ether; S_N2, B = iso-butyl ethyl ether

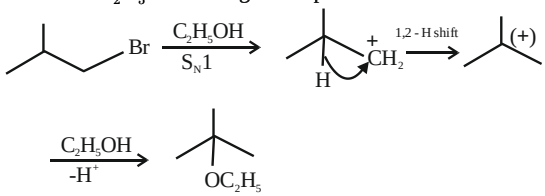
Official Ans. by NTA (1)

Allen Ans. (1)

Sol.

(i) 

$C_2H_5O^-$ is strong nucleophile.

(ii) 

C_2H_5OH is weak nucleophile.

72. D- (+)- Glyceraldehyde $\xrightarrow[(ii)\ H_2O/H^+]{(i)\ HCN}{(iii)\ HNO_3}$

The products formed in the above reaction are

(1) Two optically active products

(2) One optically active and one meso product

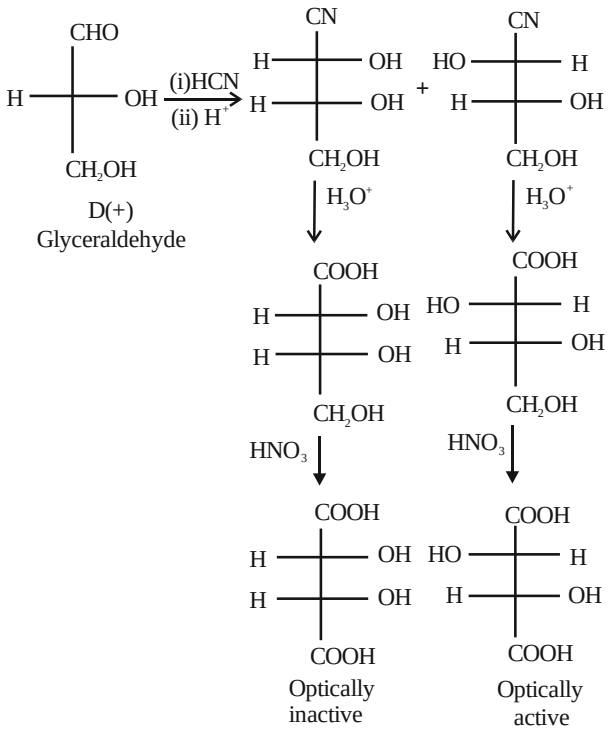
(3) One optically inactive and one meso product.

(4) Two optically inactive products

Official Ans. by NTA (2)

Allen Ans. (2)

Sol.



73. Which one of the following is most likely a mismatch?

(1) Zinc- Liquation

(2) Titanium – van Arkel method

(3) Nickel – Mond process

(4) Copper - Electrolysis

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Zinc is refined by distillation method, which is used for metals having low boiling point.

74. ClF_5 at room temperature is a:

(1) Colourless gas with trigonal bipyramidal geometry.

(2) Colourless gas with square pyramidal geometry

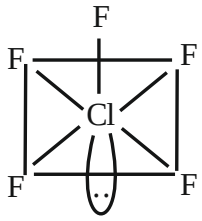
(3) Colourless liquid with square pyramidal geometry

(4) Colourless liquid with trigonal bipyramidal geometry.

Official Ans. by NTA (3)

Allen Ans. (3)

Sol.



ClF_5 is colourless liquid.

75. $Be(OH)_2$ react with $Sr(OH)_2$ to yield an ionic salt. Choose the incorrect option related to this reaction from the following:

(1) Be is tetrahedrally coordinated in the ionic salt.

(2) The reaction is an example of acid - base neutralization reaction.

(3) Both Sr and Be elements are present in the ionic salt.

(4) The elements Be is present in the cationic part of the ionic salt.

Official Ans. by NTA (4)

Allen Ans. (4)

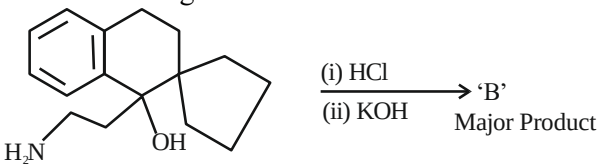
Sol. $Be(OH)_2$ is amphoteric in nature.

$Sr(OH)_2$ is basic in nature.

These two undergo acid – base reaction to form a salt.

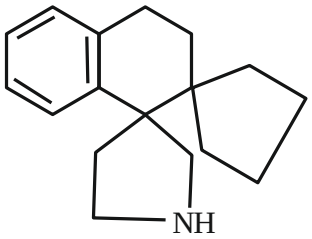
$$Be(OH)_2 + Sr(OH)_2 \rightarrow \underset{\text{(salt)}}{Sr[Be(OH)_4]}$$

76. In the reaction given below



'B' is:

(1)



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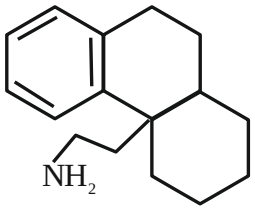

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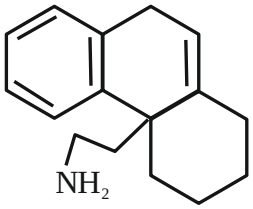

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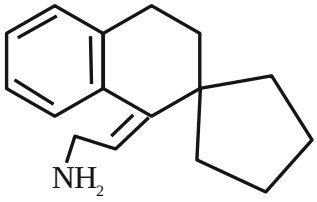
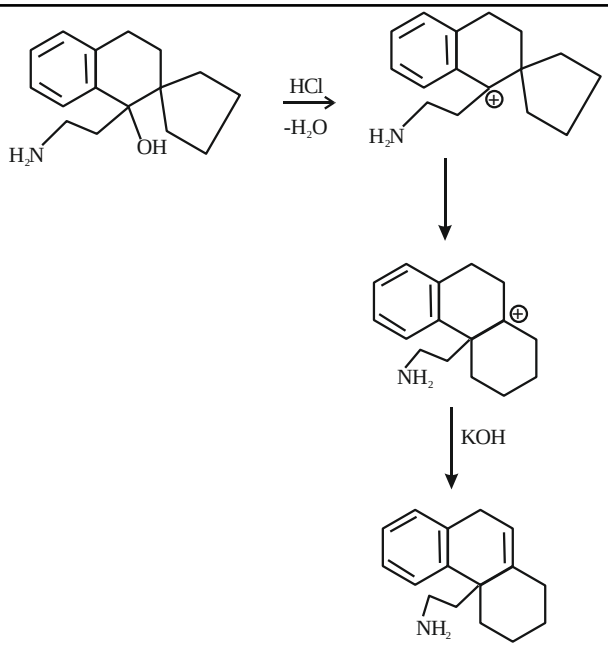


Official Ans. by NTA (3)

Allen Ans. (3)

Sol.



77. Which of the following statements are **not** correct?

A. The electron gain enthalpy of F is more negative than that of Cl

B. Ionization enthalpy decreases in a group of periodic table

C. The electronegativity of an atom depends upon the atoms bonded to it.

D. Al_2O_3 and NO are examples of amphoteric oxides.

Choose the most appropriate answer from the options given below:

(1) A, B, C, and D

(2) A, C and D Only

(3) B and D Only

(4) A, B and D Only

Official Ans. by NTA (2)

Allen Ans. (A&D, Bonus)

Sol. Electronegativity of an element depends on the atom with which it is attached.

NO = neutral oxide

Al_2O_3 = amphoteric oxide

78. The energy of an electron in the first Bohr orbit of hydrogen atom is $-2.18\times10^{-18}\,J$. Its energy in the third Bohr orbit is_____.

(1) $\frac{1}{27}$ of this value

(2) One third of this value

(3) Three times of this value

(4) $\frac{1}{9}$ th of this value

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.

$$E_n = \frac{-2.18\times10^{-18}Z^2}{n^2}$$

$$\text{i.e. } E_n \propto \frac{1}{n^2}$$

79. What happens when a lyophilic sol is added to a lyophobic sol?

(1) Lyophilic sol is dispersed in lyophobic sol.

(2) Film of lyophobic sol is formed over lyophilic sol.

(3) Lyophobic sol is coagulated

(4) Film of lyophilic sol is formed over lyophobic sol.

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Lyophilic sol is used as protective action for lyophobic sol. It forms a layer / film around the lyophobic sol.

80. The pair of lanthanides in which both elements have high third –ionization energy is:

(1) Eu, Gd

(2) Eu, Yb

(3) Lu, Yb

(4) Dy, Gd

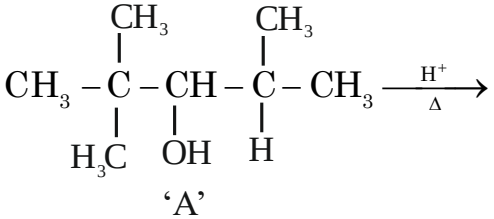
Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $Eu^{+2}:[Xe]4f^7$, $Yb^{+2}:[Xe]4f^{14}$ } High IE due to half filled & fully filled configurations

SECTION-B

81. For the given reaction



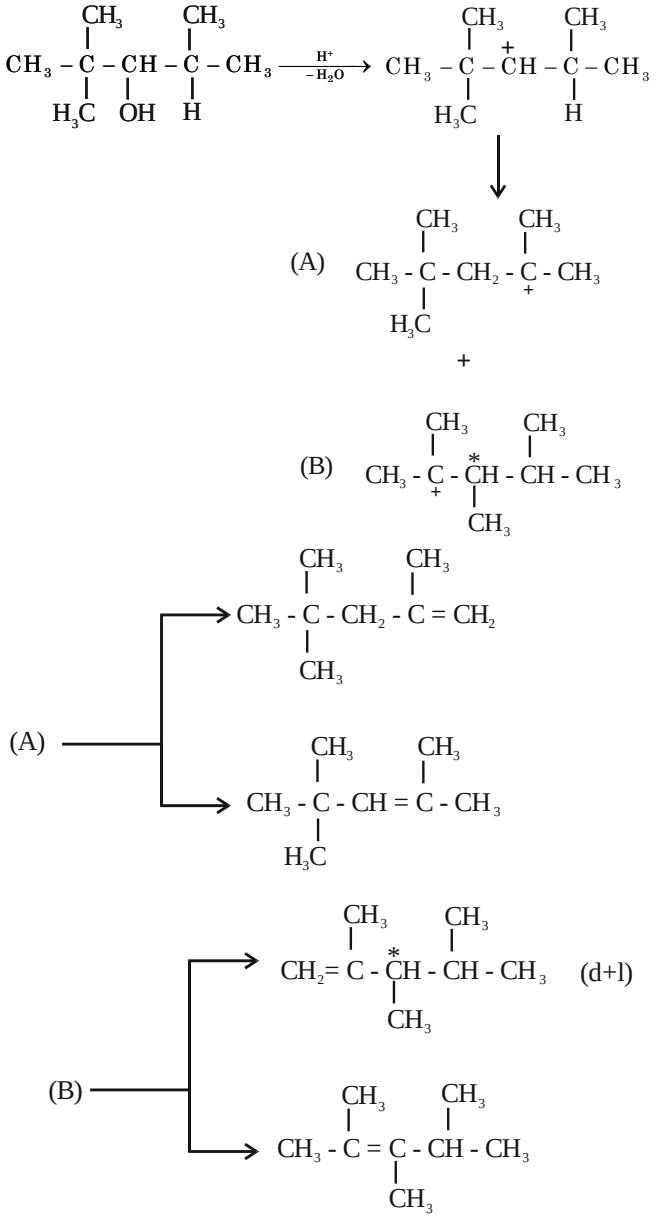
'A'

The total number of possible products formed by tertiary carbocation of A is _____.

Official Ans. by NTA (4)

Allen Ans. (5)

Sol.



82. Solution of 12 g of non – electrolyte (A) prepared by dissolving it in 1000 mL of water exerts the same osmotic pressure as that of 0.05 M glucose solution at the same temperature. The empirical formula of A is CH_2O. The molecular mass of A is _____ g. (Nearest integer)

Official Ans. by NTA (240)

Allen Ans. (240)

Sol. For Isotonic solutions

$\pi_1 = \pi_2$

$\Rightarrow C_1 = C_2$

$\frac{12}{x} = 0.05\left[x \rightarrow \text{Molar Mass of A}\right]$

$X = 240$

83. 25.0 mL of 0.050 M $Ba(NO_3)_2$ is mixed with 25.0 mL of 0.020 M NaF. K_{sp} of BaF_2 is 0.5×10^{-6} at 298 K. The ratio of $\left[Ba^{2+}\right]\left[F^-\right]^2$ and K_{sp} is _____ (Nearest integer)

Official Ans. by NTA (5)

Allen Ans. (5)

Sol. $\left[Ba^{+2}\right] = \frac{25\times0.05}{50} = 0.025M$

$\left[F^-\right] = \frac{25\times0.02}{50} = 0.01M$

$\left[Ba^{+2}\right]\left[F^-\right]^2 = 25\times10^{-7}$

$K_{sp} = 5\times10^{-7}$ (given)

$\text{Ratio} = \frac{\left[Ba^{+2}\right]\left[F^-\right]^2}{K_{sp}} = 5$

84. $A_2 + B_2 \rightarrow 2AB.\ \Delta H_f^0 = -200\ kJmol^{-1}$

AB, A_2 and B_2 are diatomic molecule. If the bond enthalpies of A_2, B_2 and AB are in the ratio 1:0.5:1, then the bond enthalpy of A_2 is _____ $kJmol^{-1}$ (Nearest integer)

Official Ans. by NTA (400)

Allen Ans. (800)

Sol. $A_2 + B_2 \rightarrow 2AB\ ;\ \Delta H_f^0 = -200\ kJ\ mol^{-1}$

$\Rightarrow \Delta H_f^0(AB) = -200\ kJ\ mol^{-1}$

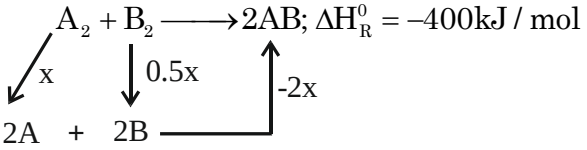
$\therefore \Delta H_R^0$ for reaction $A_2 + B_2 \rightarrow 2AB$ is $-400\ kJ\ mol^{-1}$

Given: Bond Enthalpy of A_2, B_2 and AB is 1 : 0.5 : 1

Assuming bond enthalpy of A_2 be x kJ mol^{-1}

$\therefore$ Bond enthalpy $B_2 = 0.5$ x kJ mol^{-1}

$\therefore$ Bond enthalpy $AB = (x)$ kJ mol^{-1}



-400 = x + 0.5 x -2 x

-400 = – 0.5 x

$\therefore$ x = 800 kJ / mol

85. An organic compound gives $0.220\,g$ of CO_2 and $0.126\,g$ of H_2O on complete combustion. If the % of carbon is 24 then the % hydrogen is _____ $\times 10^{-1}$. (Nearest integer)

Official Ans. by NTA (56)

Allen Ans. (56)

Sol. Moles of $CO_2 = \frac{0.22}{44} = \frac{1}{200}$

$\therefore$ Moles of carbon

$= (\text{Moles of } CO_2) \times 1$

$= \frac{1}{200}$

$\therefore$ wt. of C $= \frac{1}{200} \times 12 = 0.06$

% of C $= \frac{0.06}{W} \times 100 = 24$

(W = Wt. of Organic Compound)

$W = 0.25$

Moles of $H_2O = \frac{0.126}{18} = 0.007$

$\therefore$ Moles of H atom $= 2 \times 0.007 = 0.014$

% of Hydrogen $= \frac{0.014 \times 1}{W} \times 100$

$= \frac{0.014 \times 1}{0.25} \times 100$

$= 5.6$

$= 56 \times 10^{-1}$

86. 20 mL of calcium hydroxide was consumed when it was reacted with 10 mL of unknown solution of H_2SO_4. Also 20 mL standard solution of 0.5 M HCl containing 2 drops of phenolphthalein was titrated with calcium hydroxide the mixture showed pink colour when burette displayed the value of 35.5 mL whereas the burette showed 25.5 mL initially. The concentration of H_2SO_4 is _____ M (Nearest integer)

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Reaction with HCl

$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

Volume of $Ca(OH)_2 = 10$ ml

Volume of HCl = 20 ml

Concentration of HCl = 0.5 M.

No. of milli moles of HCl= 10

No. of milli moles of $Ca(OH)_2 = 5$.

i.e. $M_{Ca(OH)_2} = \frac{\text{no. of milli moles}}{V(ml)} = \frac{5}{10}$

$= 0.5$ M.

Reaction with H_2SO_4

$Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$.

No. of milli moles of $Ca(OH)_2 = 20 \times 0.5$

$= 10$

i.e. no. of milli moles of $H_2SO_4 = 10$

$\Rightarrow M_{H_2SO_4} = \frac{\text{no. of mil lim oles}}{V(ml)}$

$= \frac{10}{10}$

$= 1$ M

87. A certain quantity of real gas occupies a volume of 0.15 dm^3 at 100 atm and 500 K when its compressibility factor is 1.07. Its volume at 300 atm and 300K (When its compressibility factor is 1.4) is _____ $\times 10^{-4}\,dm^3$ (Nearest integer)

Official Ans. by NTA (392)

Allen Ans. (392)

Sol. $z = \frac{PV}{nRT}$; $n = \frac{PV}{ZRT}$

$Z_1 = 1.07, P_1 = 100 atm, V_1 = 0.15 L, T_1 = 500 K$

$Z_2 = 1.4, P_2 = 300 atm, T_2 = 300 K, V_2 = ?$

$\frac{P_1V_1}{Z_1RT_1} = \frac{P_2V_2}{Z_2RT_2} = n$

$V_2 = \frac{1.4}{1.07} \times .03$

$= 392 \times 10^{-4}\ dm^3$

88. $t_{87.5}$ is the time required for the reaction to undergo 87.5% completion and t_{50} is the time required for the reaction to undergo 50% completion. The relation between $t_{87.5}$ and t_{50} for a first order reaction is $t_{87.5} = x \times t_{50}$

The value of x is_____ (Nearest integer)

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $A_t = A_0 \times \frac{12.5}{100} = \frac{A_0}{8}$ [87.5% complete]

$A_0 \xrightarrow{t_{1/2}} \frac{A_0}{2} \xrightarrow{t_{1/2}} \frac{A_0}{4} \xrightarrow{t_{1/2}} \frac{A_0}{8}$

$t_{87.5} = 3t_{1/2}$

$\therefore \ x = 3$

89. $KMnO_4$ is titrated with ferrous ammonium sulphate hexahydrate in presence of dilute H_2SO_4. Number of water molecules produced for 2 molecules of $KMnO_4$ is _____.

Official Ans. by NTA (68)

Allen Ans. (68)

Sol. By balancing the redox reaction we get

$$10\left[FeSO_4.(NH_4)_2SO_4.6H_2O\right] + 2KMnO_4 + 8H_2SO_4$$

$$\downarrow$$

$$5Fe_2(SO_4)_3 + 2MnSO_4 + 10(NH_4)_2SO_4 + K_2SO_4 + 68H_2O$$

90. A metal surface of $100\ cm^2$ area has to be coated with nickel layer of thickness 0.001mm. A current of 2A was passed through a solution of $Ni(NO_3)_2$ for 'x' seconds to coat the desired layer. The value of x is _____ (Nearest integer)

(ρ_{Ni} (density of Nickel) is $10\ gmL^{-1}$, Molar mass of Nickel is $60\ gmol^{-1}$ $F = 96500\ C\ mol^{-1}$)

Official Ans. by NTA (161)

Allen Ans. (161)

Sol. $W = z \times i \times t.$

$$\text{Density} \times \text{volume} = \frac{E \times i \times t}{96500}$$

$$10 \times 100 \times 0.0001 = \frac{\left(\frac{\text{atomic wt.}}{\text{v.f}}\right) \times 2 \times x}{96500} \quad (\text{v.f} = 2)$$

$\therefore$ x = 161 sec.