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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2023

COMPUTER BASED TEST (CBT)
Questions & Solutions

Date: 13 April, 2023 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

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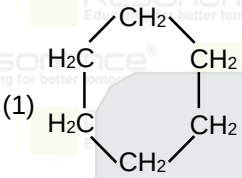
PART : CHEMISTRY

61. In the following reaction 'X' is

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

(1) 

(2) $Cl–CH_2–(CH_2)_4–CH_2Cl$

(3) $CH_3CH(CH_3)–(CH_2)_2CH_3$

(4) $CH_3(CH_2)_4CH_2Cl$

Ans. **NTA (3)**

Sol. This is Isomerisation reaction of alkane.

62. The energy of an electron in the first Bohr orbit of hydrogen atom is $-(2)18 \times 10^{-18}$ J. Its energy in the third Bohr orbit is _____

(1) One third of this value

(2) Three times of this value

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

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

Ans. **NTA (4)**

Sol. $(E_H)_{n=1} = -2.18 \times 10^{-18}$J

$(E_H)_{nth} = (E_H)_{n=1} \times \frac{1}{n^2}$

$(E_H)_{n=3} = (E_H)_{n=1} \times \frac{1}{9}$

Ans. 4

63. 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

Ans. **NTA (3)**

Sol. ClF_5 is colourless liquid with square pyramidal geometry. (Refer to NCERT class XII Page No. = 206)

Table 7.11: Some Properties of Interhalogen Compounds

Type	Formula	Physical state and colour	Structure
XX'_1	ClF	colourless gas	–
	BrF	pale brown gas	–
	IF[a]	detected spectroscopically	–
	$BrCl$[b]	gas	
	ICl	ruby red solid (α-form)	–
		brown red solid (β-form)	–
	IBr	black solid	–
XX'_3	ClF_3	colourless gas	Bent T-shaped
	BrF_3	yellow green liquid	Bent T-shaped
	IF_3	yellow powder	Bent T-shaped (?)
	ICl_3[c]	orange solid	Bent T-shaped (?)
XX'_5	IF_5	colourless gas but solid below 77 K	Square pyramidal
	BrF_5	colourless liquid	Square pyramidal
	ClF_5	colourless liquid	Square pyramidal
XX'_7	IF_7	colourless gas	Pentagonal bipyramidal

[a]*Very unstable;* [b]*The pure solid is known at room temperature;* [c]*Dimerises as Cl–bridged dimer* (I_2Cl_6)

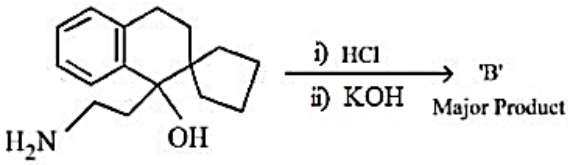
64. The pair of lanthanides in which both elements have high third-ionization energy is:
(1) Eu, Yb
(2) Eu, Gd
(3) Dy, Gd
(4) Lu, Yb

Ans. **NTA (1)**

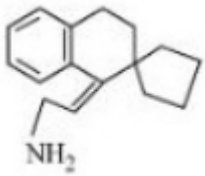
Sol.

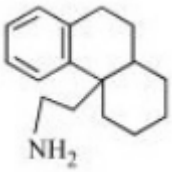
Element	Electronic configuration
Europium (Eu)	[Xe] $4f^7 6s^2$
Gadolinium (Gd)	[Xe] $4f^7 5d^1 6s^2$
Dysprosium (Dy)	[Xe] $4f^{10} 6s^2$
Ytterbium (Yb)	[Xe] $4f^{14} 6s^2$
Lutetium (Lu)	[Xe] $4f^{14} 5d^1 6s^2$

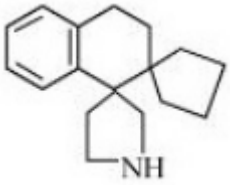
65. In the reaction given below

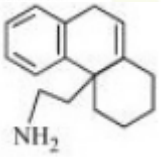


'B' is :

(1) 

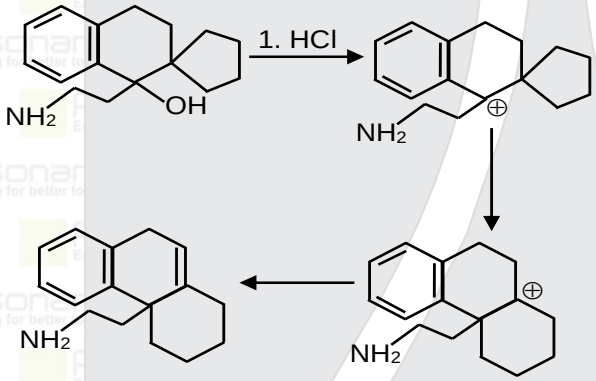
(2) 

(3) 

(4) 

Ans. **NTA (4)**

Sol.



66. Match the following

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

Choose the correct answer from options given below :

(1) a → III, b → II, c → I, d → IV

(2) a → II, b → III, c → IV, d → I

(3) a → III, b → IV, c → I, d → II

(4) a → IV, b → III, c → II, d → I

Ans. **NTA (1)**

Sol. NCERT based

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

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

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

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

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

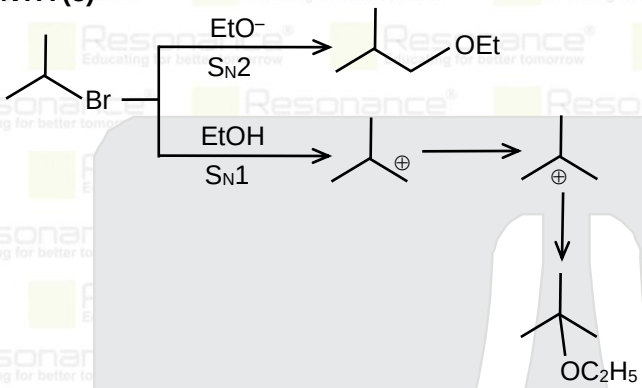
Ans. **NTA (4)**

Sol. $\underset{\text{base}}{Sr(OH)_2} + \underset{\substack{\text{acid}\\(\text{amphotericinnature})}}{Be(OH)_2} \longrightarrow Sr[Be(OH)_4]$ or $SrBeO_2$

68. 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_N1, A = tert-butyl ethyl ether; S_N2, B = iso-butyl ethyl ether
(2) S_N2, A = 2-butyl ethyl ether; S_N2, B = iso-butyl ethyl ether
(3) S_N2, A = iso-butyl ethyl ether; S_N1 B = tert-butyl ethyl ether
(4) S_N1, A = tert-butyl ethyl ether; S_N1 B = 2-butyl ethyl ether

Ans. **NTA (3)**

Sol.



69. What happens when a lyophilic sol is added to a lyophobic sol?
(1) Film of lyophobic sol is formed over lyophilic sol.
(2) Lyophobic sol is coagulated
(3) Film of lyophilic sol is formed over lyophobic sol.
(4) Lyophilic sol is dispersed in lyophobic sol.

Ans. **NTA (3)**

Sol. Lyophilic colloids have a unique property of protecting lyophobic colloids. When a lyophilic sol is added to the lyophobic sol, the lyophilic particles form a layer around lyophobic particles and thus protect the latter from electrolytes.

70. The radical which mainly causes ozone depletion in the presence of CV radiations is :
(1) $\dot{O}H$
(2) $\dot{C}H_3$
(3) $NO^{\bullet}$
(4) $Cl^{\bullet}$

Ans. **NTA (4)**

Sol. $CF_2\underset{(g)}{Cl_2} \xrightarrow{UV} \dot{C}l(g) + \dot{C}IF_2Cl_2(g)$

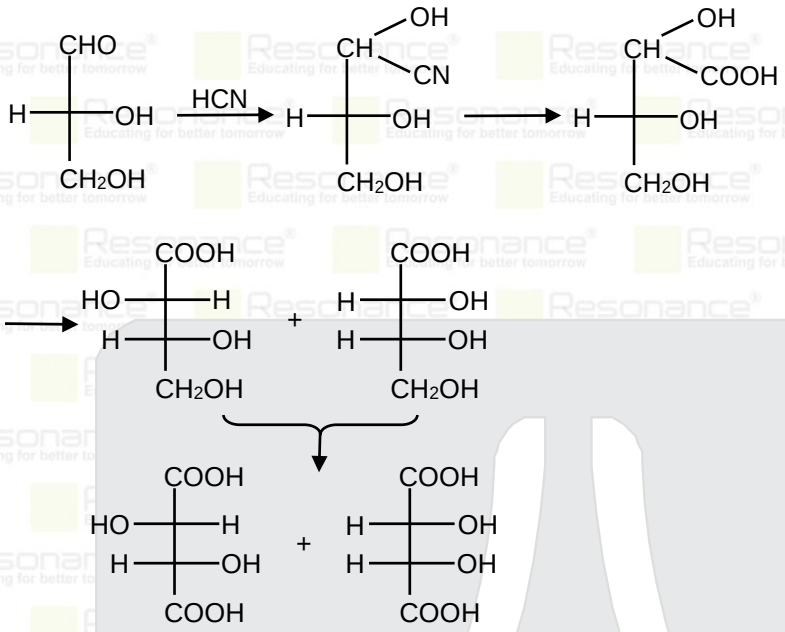
The chlorine radicals are continuously Regenerated and cause of breakdown of ozone layer.

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

The products formed in the above reaction are
(1) One optically active and one meso product
(2) Two optically inactive products
(3) One optically inactive and one meso product.
(4) Two optically active products

Ans. **NTA (1)**

Sol.



72. 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) B and D Only

(2) A, B, C and D

(3) A, B and D Only

(4) A, C and D Only

Ans. **NTA (4)**

RESO (3)

Sol. Option (A)

Element	ΔH_{eg} (KJ/mole)
F	–328
Cl	–349

So option (A) is incorrect.

Option (B) ionisation enthalpy always not decreases in a group in periodic table. (exception in Boron family & d-block groups). So option (B) is incorrect.

Option (C) The electronegativity of an element depends upon the atoms bounded to it. (Reference NCERT Class XI Topic periodic table Page no. 88) option (C) is correct. That portion put in Red colour box.

widely used is the Pauling scale. Linus Pauling, an American scientist, in 1922 assigned arbitrarily a value of 4.0 to fluorine, the element considered to have the greatest ability to attract electrons. Approximate values for the electronegativity of a few elements are given in Table 3.8(a)

The electronegativity of any given element is not constant; it varies depending on the element to which it is bound. Though it is not a measurable quantity, it does provide a means of predicting the nature of force that holds a pair of atoms together – a relationship that you will explore later.

Electronegativity generally increases across a period from left to right (say from lithium to fluorine) and decrease down a group (say from fluorine to astatine) in the periodic table. How can these trends be explained? Can the electronegativity be related to atomic radii, which tend to decrease across each period from left to right, but increase down each group ? The attraction between the outer (or valence) electrons and the nucleus increases as the atomic radius decreases in a period. The electronegativity also increases. On the same account electronegativity values decrease with the increase in atomic radii down a group. The trend is similar to that of ionization enthalpy.

Knowing the relationship between electronegativity and atomic radius, can you now visualise the relationship between electronegativity and non-metallic properties?

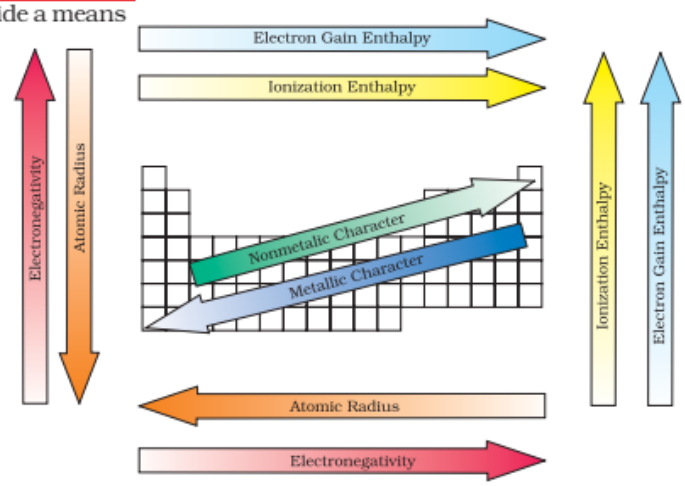
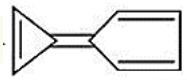
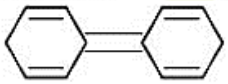
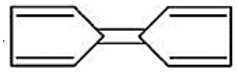


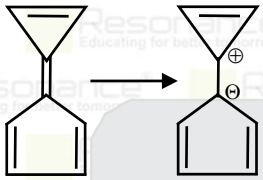
Fig. 3.7 *The periodic trends of elements in the periodic table*

Option (D) Al_2O_3 is Amphoteric but NO is neutral oxide so option 'D' is incorrect.

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

(1)  (2)  (3)  (4) 

Ans. **NTA (1)**

Sol.  Both ring become Aromatic, that why most polar compound.

74. 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 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

Ans. **NTA (1)**
Reso (2)

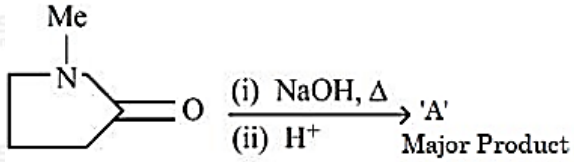
Sol. $S_1 \Rightarrow$ Synthetic resins method is more efficient than zeolite process or Permutit process.
$S_2 \Rightarrow$ Synthetic resins method results soluble sodium salt with insoluble compound of Ca^{2+} or Mg^{2+}.
$2RNa(s) + M^{2+}(aq) \rightarrow R_2M(s) + 2Na^{\oplus}(aq)$ **Reference NCERT Class XI Topic Hydrogen Page No.284**

(iv) Synthetic resins method: Nowadays hard water is softened by using synthetic cation exchangers. This method is more efficient than zeolite process. Cation exchange resins contain large organic molecule with - SO_3H group and are water insoluble. Ion exchange resin (RSO_3H) is changed to RNa by treating it with NaCl. The resin exchanges Na^+ ions with Ca^{2+} and Mg^{2+} ions present in hard water to make the water soft. Here R is resin anion.

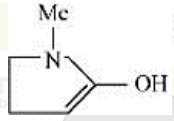
$$2RNa(s) + M^{2+}(aq) \rightarrow R_2M(s) + 2Na^+(aq)$$

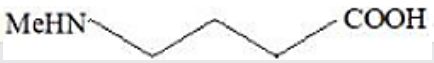
So correct answer (2)

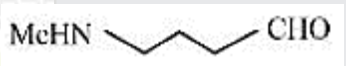
75. In the reaction given below

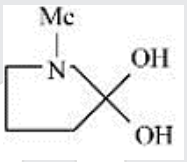


'A' is

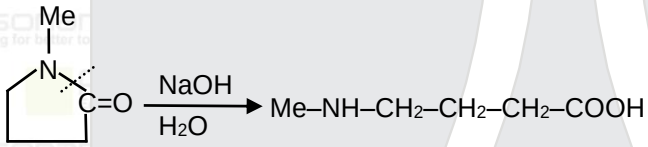
(1) 

(2) 

(3) 

(4) 

Ans. **NTA (2)**

Sol. 

(Hydrolysis)

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

(1) It has electronic delocalization.

(2) It contains banana bonds.

(3) It is a cyclic compound.

(4) It can react with water.

Ans. **NTA** = 4

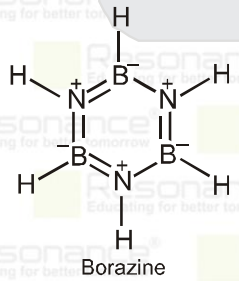
Reso = 2

Sol. Borazine $\Rightarrow B_3N_3H_6$

(i) the structure of borazine is similar to that of benzene. so it has electronic delocalization.

(ii) It does not contain bonana bonds

(iii) It is a cyclic compound.

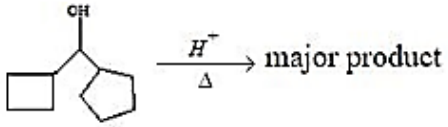


Borazine

(iv) It react with water. Borazine decompose slowly and hydrolysed to NH_3 and boric acid

$$B_3N_3H_6 + 9H_2O \longrightarrow 3NH_3 + 3H_3BO_3 + 3H_2O$$

77.

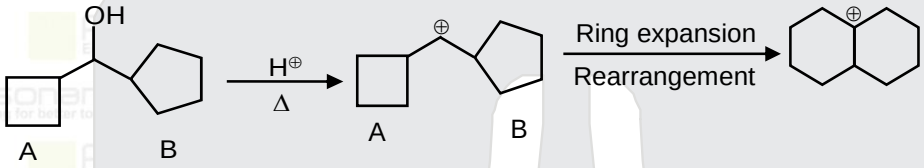


In the above reaction, left hand side and right hand side rings are named as 'A' and 'B respectively. They undergo ring expansion. The correct statement for this process is:

(1) Only A will become 6 membered.
(2) Finally both rings will become five membered each.
(3) Ring expansion can go upto seven membered rings
(4) Finally both rings will become six membered each.

Ans. **NTA (4)**

Sol.



78. The mismatched combinations are

A. Chlorophyll - Co
B. Water hardness - EDTA
C. Photography - $[Ag(CN)_2]^-$
D. Wilkinson catalyst - $[(Ph_3P)_3RhCl]$
E. Chelating ligand - D-Penicillamine

Choose the correct answer from the options given below :

(1) D and E Only
(2) A, C, and E Only
(3) A and C Only
(4) A and E Only

Ans. **NTA (3)**

Sol. Chlorophyll is complex of Mg

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

(1) Titanium - van Arkel Method
(2) Zinc - Liquation
(3) Copper - Electrolysis
(4) Nickel - Mond process

Ans. **NTA (2)**
Reso (drop)

Sol. All four option are correctly match

Titanium – Van Arkel Method.
Zinc – Liquation
Copper – Electrolysis
Nickel – Mond process

"**Purification or Refining of metals :**

Physical methods : These methods include the following processes :

(i) **Liquation process :** This process is used for the purification of the metal, which itself is readily fusible, but the impurities present in it are not, i.e., the impurities are infusible. In other words, we can say that the melting point of the metal to be purified should be lower than that of each of the impurities associated with the metal. This process is used for the purification of Sn and Zn.

Example: Purification of crude zinc : The crude zinc or the spelter is melted on the slopping hearth of a reverberatory furnace. Molten zinc flows down while the non-fusible impurities are left on the hearth.

(ii) **Fractional distillation process:** *This process is used to purify those metals which themselves are volatile and the impurities in them are nonvolatile and vice-versa. Zn, Cd and Hg are purified by this process.*

Result zinc can be refine using Liquation process, Fractional distillation process

So question must be "Drop"

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

(1) $O_2 \rightarrow O_2^+$ (2) $N_2 \rightarrow N_2^+$ (3) $O_2 \rightarrow O_2^{2-}$ (4) $NO \rightarrow NO^+$

Ans. **NTA (4)**

Sol.

Molecule /Ion	Electronic configuration	Bond order	Magnetic behaviour
N_2	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\sigma 2p_z)^2$	1/2(10 – 4) = 3	Diamagnetic
N_2^+	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\sigma 2p_z)^1$	1/2(9 – 4) = 2.5	Paramagnetic
O_2	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\sigma 2p_z)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\pi^*2p_x^1 = \pi^*2p^1_y)$	1/2(10 – 6) = 2	Paramagnetic
O_2^+	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\sigma 2p_z)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\pi^*2p_x^1 = \pi^*2p^0_y)$	1/2(10 – 5) = 2.5	Paramagnetic
O_2^{2-}	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\sigma 2p_z)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\pi^*2p_x^2 = \pi^*2p^2_y)$	1/2(10 – 8) = 1.0	Diamagnetic
NO	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\sigma 2p_z)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\pi^*2p_x^1 = \pi^*2p^0_y)$	1/2(10 – 5) = 2.5	Paramagnetic
NO^+	$(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\sigma 2p_z)^2$	1/2(10 – 4) = 3	Diamagnetic

81. A metal surface of 100cm^2 area has to be coated with nickel layer of thickness 0.001 mm. 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 g mL^{-1} Molar mass of Nickel is 60 g mol^{-1} F=96500 C mol^{-1})

Ans. **NTA (16)**

Sol. Mass of Ni deposited = [A × thickness] density

= [100 × 10^{-4}] × 10

= 0.1 gram.

w = Z it.

$$0.1 = \left(\frac{E}{96500}\right) \times i \times t$$

$$0.1 = \left(\frac{60}{2 \times 96500}\right) \times 2 \times t$$

t = 16.08 sec.

Ans. 16

82. $KMnO_4$ 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_____

Ans. **NTA (68)**

Sol. $KMnO_4 + FeSO4.(NH_4)_2\ SO_4.\ 6H_2O$

$MnO4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

$Fe^{2+} \longrightarrow Fe^{3+} + e^-$

$MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 2Fe^{3+} + 4H_2O$

2 mole 10 mole 8 mole

Total water molecule produced

(i) From 10 molecule of used $(FeSO4.(NH_4)_2\ SO_4.\ 6H_2O) = 10 \times 6 = 60$

(ii) From redox reaction = 8

Total produced water molecule = 68.

83. 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 % of hydrogen is _____ $\times\ 10^{-1}$ (Nearest integer)

Ans. **NTA (56)**

Sol. $nCO_2 \Rightarrow \dfrac{0.220}{44} = 0.005 \longrightarrow nC = 0.005$

$nH_2O \Rightarrow \dfrac{0.126}{18} = 0.007 \longrightarrow nH = 0.014$

$m_C = 0.06$ $\qquad \dfrac{mC}{mH} = \dfrac{0.06}{0.014} = \dfrac{24}{x\%}$

$x\% = 5.6\% = 56 \times 10^{-1}$

84. $t_{87.5}$ 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} foi' a first order reaction is. $t_{87.5} = x \times t_{50}$.The value of x is . (Nearest integer)

Ans. **NTA (3)**

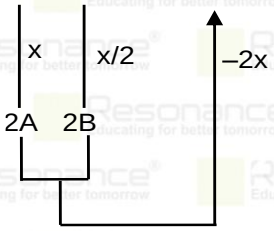
Sol. $T_{87.5\,\%} = 3 \times T_{50\%}$

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

AB, A_2 and B_2 are diatomic molecules. 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 _____kJ mol^{-1} (Nearest integer)

Ans. **NTA (400)**

Sol. $A_2 + B_2 \longrightarrow 2AB$



$\Delta H = x + x/2 - 2x = -200$

$= -x/2 = -200$

$x = 400\ J$

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 MHCl 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)

Ans. **NTA (1)**

Sol. (i) $CaCOHl_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$

Milimole $M_1 \times 10$ $(2\times M_1)10$

Milimole of HCl = $(2 \times M_1)10 = 0.5 \times 20$

$M_{Ca(OH)_2} = 0.5M$

(ii) with $H_2SO_4 \Rightarrow Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$

0.5×2 $(M_2\times 10)$

$M_2 \times 10 = 0.5 \times 20$

$M_2 = 1$

Molarity of $H_2SO_4 = 1$

Ans. 1

87. 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 $[Ba^{2+}] [F^-]^2$ and K_{sp} is (Nearest integer)

Ans. NTA = 5

Reso = 1

Sol. On mixing equal volume concentration is Half.

$[Ba^{2+}] = \frac{0.05}{2} = 0.025$

$[F^-] = \frac{0.02}{2} = 0.01$

$K_{IP}[BaF_2] = [Ba^{2+}] [F^-]^2$

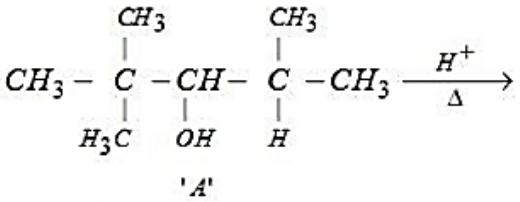
$= 2.5 \times 10^{-2} \times (10^{-2})^2$

$= 2.5 \times 10^{-6}$

as $K_{IP} > K_{SP}$ so precipitation occur. as solution is super saturated so maximum possible value of K_{IP} is equal to K_{SP}

so $\frac{[Ba^{2+}][F^-]}{K_{SP}} = 1$

88. For the given reaction



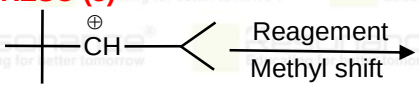
'A'

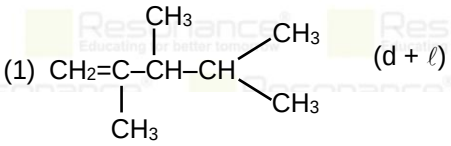
The total number of possible products formed by tertiary carbocation of A is _____.

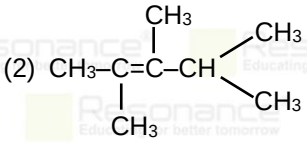
Ans. **NTA (4)**

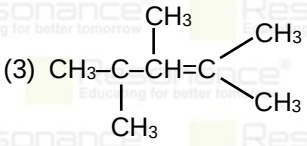
RESO (5)

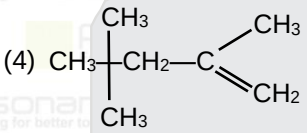
Sol.





(2)  (1)

(3)  (1)

(4)  (1)

89. 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 300 K (When its compressibility factor is 1.4) is _____ x 10^{-4} dm^3 (Nearest integer)

Ans. NTA = 292

Reso = 393

Sol. For real gas

$PV = ZnRT$

$$\frac{P_1V_1}{P_2V_2} = \frac{Z_1(nR)T_1}{Z_1(nR)T_2}$$

$$\Rightarrow \frac{100 \times 0.15}{300 \times V_2} = \frac{1.07 \times 500}{1.4 \times 300}$$

$V_2 = 392.5234$ dm^3

on roundingof the Nearest integer = 393

90. Solution of 12 g of non-electrolyte (A) prepared by dissolving it in 1000 mL of water exerts the saine 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)

Ans. **NTA (240)**

Sol. For isotomic solution

$\pi_1 = \pi_2$

$C_1 = C_2$ (For nonelectrolyte)

$$\left(\frac{12}{M_A \times 1}\right) = 0.05$$

$M_A = 240$