

**FINAL JEE-MAIN EXAMINATION – APRIL, 2024**

 (Held On Friday 05<sup>th</sup> April, 2024)

TIME : 3 : 00 PM to 6 : 00 PM

**CHEMISTRY**
**TEST PAPER WITH SOLUTION**
**SECTION-A**
**61. Match List - I with List - II.**
**List - I**

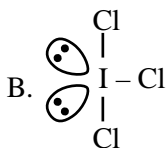
- (A) ICl  
(B) ICl<sub>3</sub>  
(C) ClF<sub>5</sub>  
(D) IF<sub>7</sub>

**List - II**

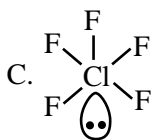
- (I) T-Shape  
(II) Square pyramidal  
(III) Pentagonal bipyramidal  
(IV) Linear

 Choose the **correct** answer from the options given below:

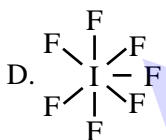
- (1) (A)–(I), (B)–(IV), C–(III), D–(II)  
(2) (A)–(I), (B)–(III), C–(II), D–(IV)  
(3) (A)–(IV), (B)–(I), C–(II), D–(III)  
(4) (A)–(IV), (B)–(III), C–(II), D–(I)

**Ans. (3)**
**Sol.** A. I – Cl (iv) linear


(I) T-shape



(II) Square pyramidal

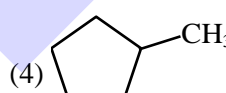
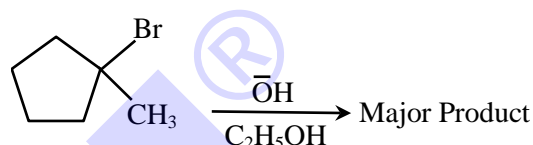
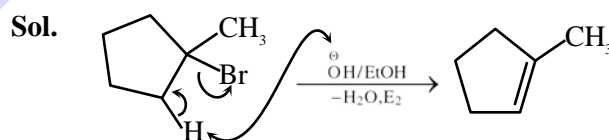
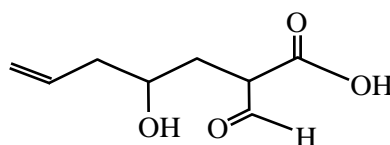


(III) Pentagonal bipyramidal

**62.** While preparing crystals of Mohr's salt, dil. H<sub>2</sub>SO<sub>4</sub> is added to a mixture of ferrous sulphate and ammonium sulphate, before dissolving this mixture in water, dil. H<sub>2</sub>SO<sub>4</sub> is added here to:

- (1) prevent the hydrolysis of ferrous sulphate  
(2) prevent the hydrolysis of ammonium sulphate  
(3) make the medium strongly acidic  
(4) increase the rate of formation of crystals

**Ans. (1)**
**Sol.** Fe<sup>+2</sup> ions undergoes hydrolysis, therefore while preparing aqueous solution of ferrous sulphate and ammonium sulphate in water dilute sulphuric acid is added to prevent hydrolysis of ferrous sulphate.

**63.** Identify the major product in the following reaction.

**Ans. (3)**

**64.** The correct nomenclature for the following compound is:


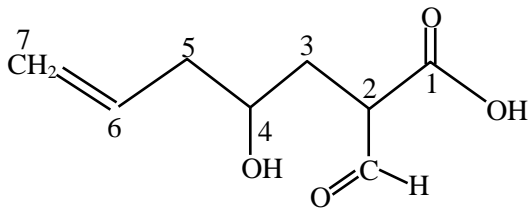
- (1) 2-carboxy-4-hydroxyhept-6-enal  
(2) 2-carboxy-4-hydroxyhept-7-enal  
(3) 2-formyl-4-hydroxyhept-6-enoic acid  
(4) 2-formyl-4-hydroxyhept-7-enoic acid

**Ans. (3)**


Download the new **ALLEN** app  
& enroll for **Online Programs**

CLICK HERE TO  
DOWNLOAD

Sol.



2-formyl-4-hydroxyhept-6-enoic acid

65. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

**Assertion (A)** :  $\text{NH}_3$  and  $\text{NF}_3$  molecule have pyramidal shape with a lone pair of electrons on nitrogen atom. The resultant dipole moment of  $\text{NH}_3$  is greater than that of  $\text{NF}_3$ .

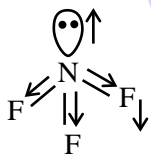
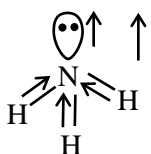
**Reason (R)** : In  $\text{NH}_3$ , the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N-H bonds. F is the most electronegative element.

In the light of the above statements, choose the **correct** answer from the options given below:

- (1) Both (A) and (R) are true and (R) is the correct explanation of (A)
- (2) (A) is false but (R) is true
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

Ans. (1)

Sol.


 Resultant dipole moment =  $0.80 \times 10^{-30}$  Cm

 Resultant dipole moment =  $4.90 \times 10^{-30}$  cm

66. Given below are two statements:

**Statement I** : On passing  $\text{HCl}_{(g)}$  through a saturated solution of  $\text{BaCl}_2$ , at room temperature white turbidity appears.

**Statement II** : When  $\text{HCl}$  gas is passed through a saturated solution of  $\text{NaCl}$ , sodium chloride is precipitated due to common ion effect.

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

- (1) **Statement I** is correct but **Statement II** is incorrect
- (2) Both **Statement I** and **Statement II** are incorrect
- (3) **Statement I** is incorrect but **Statement II** is correct
- (4) Both **Statement I** and **Statement II** are correct

Ans. (1)

**Sol.**  $\text{BaCl}_2$ ,  $\text{NaCl}$  are soluble but on adding  $\text{HCl}_{(g)}$  to  $\text{BaCl}_2$ ,  $\text{NaCl}$  solutions, Sodium or Barium chlorides may precipitate out, as a consequence of the law of mass action.

67. The metal atom present in the complex  $\text{MABXL}$  (where A, B, X and L are unidentate ligands and M is metal) involves  $sp^3$  hybridization. The number of geometrical isomers exhibited by the complex is:

- (1) 4
- (2) 0
- (3) 2
- (4) 3

Ans. (2)

**Sol.** Tetrahedral complex does not show geometrical isomerism.

68. Match **List - I** with **List - II**.

<b>List - I</b> (Pair of Compounds)	<b>List - II</b> (Isomerism)
(A) n-propanol and Isopropanol	(I) Metamerism
(B) Methoxypropane and ethoxyethane	(II) Chain Isomerism
(C) Propanone and propanal	(III) Position Isomerism
(D) Neopentane and Isopentane	(IV) Functional Isomerism

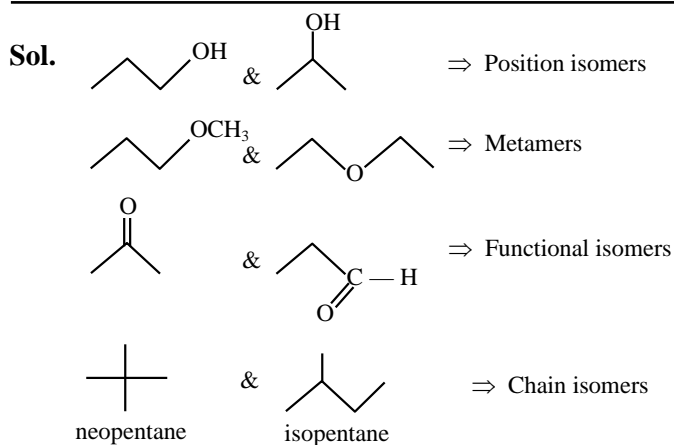
(1) (A)–(II), (B)–(I), (C)–(IV), (D)–(III)  
 (2) (A)–(III), (B)–(I), (C)–(II), (D)–(IV)  
 (3) (A)–(I), (B)–(III), (C)–(IV), (D)–(II)  
 (4) (A)–(III), (B)–(I), (C)–(IV), (D)–(II)

Ans. (4)



Download the new **ALLEN** app  
& enroll for **Online Programs**

CLICK HERE TO  
DOWNLOAD



- 69.** The quantity of silver deposited when one coulomb charge is passed through  $\text{AgNO}_3$  solution:
- (1) 0.1 g atom of silver
  - (2) 1 chemical equivalent of silver
  - (3) 1 g of silver
  - (4) 1 electrochemical equivalent of silver

**Ans. (4)**

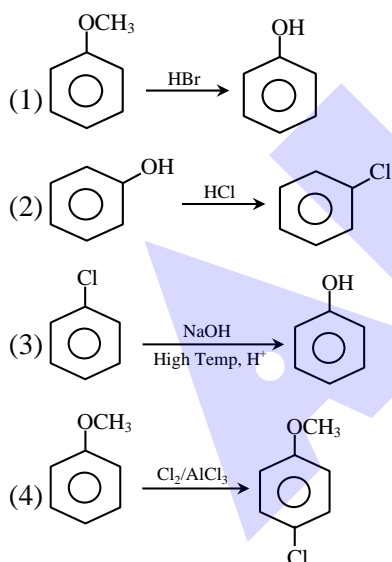
**Sol.**  $W = ZIt$

$W = ZQ$

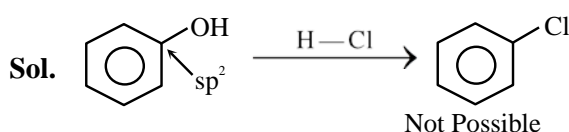
$Q = \frac{W}{Z}$

$W = ZQ = (\text{electrochemical equivalent})$

- 70.** Which one of the following reactions is NOT possible?



**Ans. (2)**



- 71.** Given below are two statements :

**Statement I :** The metallic radius of Na is  $1.86 \text{ \AA}$  and the ionic radius of  $\text{Na}^+$  is lesser than  $1.86 \text{ \AA}$ .

**Statement II :** Ions are always smaller in size than the corresponding elements.

In the light of the above statements, choose the **correct** answer from the options given below :

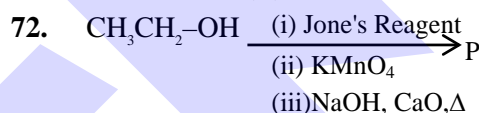
- (1) **Statement I** is correct but **Statement II** is false
- (2) Both **Statement I** and **Statement II** are true
- (3) Both **Statement I** and **Statement II** are false
- (4) **Statement I** is incorrect but **Statement II** is true

**Ans. (1)**

**Sol.**  $r_{\text{Na}} > r_{\text{Na}^+}$

So, Statement (I) is correct but size of anions are greater than size of neutral atoms.

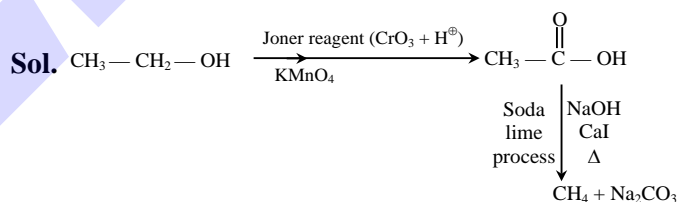
So statement (II) is incorrect.



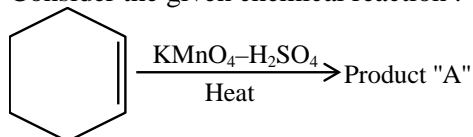
Consider the above reaction sequence and identify the major product P.

- (1) Methane
- (2) Methanal
- (3) Methoxymethane
- (4) Methanoic acid

**Ans. (1)**



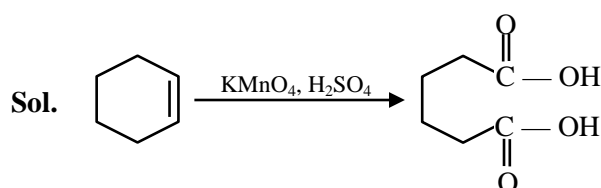
- 73.** Consider the given chemical reaction :



Product "A" is :

- (1) picric acid
- (2) oxalic acid
- (3) acetic acid
- (4) adipic acid

**Ans. (4)**



Download the new **ALLEN** app  
 & enroll for **Online Programs**

CLICK HERE TO  
 DOWNLOAD

74. For the electro chemical cell  
 $M|M^{2+}||X|X^{2-}$   
 If  $E^0_{(M^{2+}/M)} = 0.46\text{ V}$  and  $E^0_{(X/X^{2-})} = 0.34\text{ V}$ .

Which of the following is **correct** ?

- (1)  $E_{\text{cell}} = -0.80\text{ V}$   
 (2)  $M + X \rightarrow M^2 + X^{2-}$  is a spontaneous reaction  
 (3)  $M^{2+} + X^{2-} \rightarrow M + X$  is a spontaneous reaction  
 (4)  $E_{\text{cell}} = 0.80\text{ V}$

Ans. (3)

Sol.  $M | M^{2+} || X / X^{2-}$

$$E_{\text{cell}}^0 = E^0_{M/M^{2+}} + E^0_{X/X^{2-}}$$

$$= -0.46 + 0.34 = -0.12\text{ V}$$

As  $E_{\text{cell}}^0$  is negative so anode becomes cathode and cathode become anode. Spontaneous reaction will be  
 $M^{2+} + X^{2-} \rightarrow M + X$

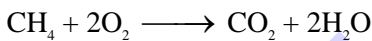
75. The number of moles of methane required to produce 11g  $\text{CO}_2(\text{g})$  after complete combustion is:

(Given molar mass of methane in  $\text{g mol}^{-1}$  : 16)

- (1) 0.75                      (2) 0.25  
 (3) 0.35                      (4) 0.5

Ans. (2)

Sol.  $\text{C}_n\text{H}_{2n+2} + \frac{3n+1}{2}\text{O}_2 \rightarrow n\text{CO}_2 + (n+1)\text{H}_2\text{O}$



4gm                      11gm

0.25 mole              0.25 mole

0.25 mole  $\text{CH}_4$  gives 0.25 mole (or 11gm)  $\text{CO}_2$

76. The number of complexes from the following with no electrons in the  $t_2$  orbital is \_\_\_\_\_.

$\text{TiCl}_4$ ,  $[\text{MnO}_4]^-$ ,  $[\text{FeO}_4]^{2-}$ ,  $[\text{FeCl}_4]^-$ ,  $[\text{CoCl}_4]^{2-}$

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

Ans. (1)

Sol.  $\text{TiCl}_4 \Rightarrow \text{Ti}^{+4} \quad e^0 t_2^0$

$\text{MnO}_4^- \Rightarrow \text{Mn}^{+7} \quad e^0 t_2^0$

$\text{FeO}_4^{2-} \Rightarrow \text{Fe}^{+6} \quad e^2 t_2^0$

$\text{FeCl}_4^{2-} \Rightarrow \text{Fe}^{+2} \quad e^3 t_2^3$

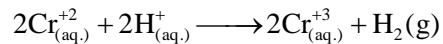
$\text{CoCl}_4^{2-} \Rightarrow \text{Co}^{+2} \quad e^4 t_2^3$

77. The number of ions from the following that have the ability to liberate hydrogen from a dilute acid is \_\_\_\_\_.  $\text{Ti}^{2+}$ ,  $\text{Cr}^{2+}$  and  $\text{V}^{2+}$

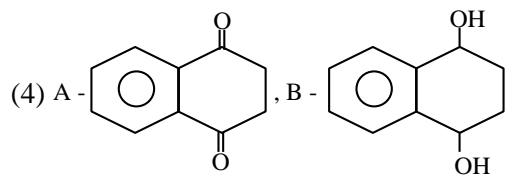
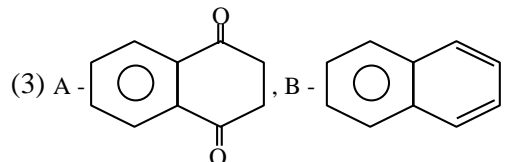
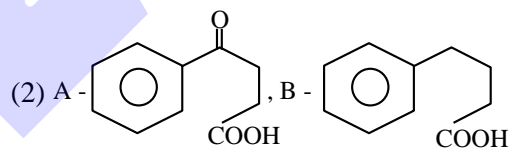
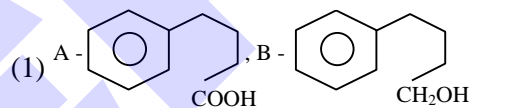
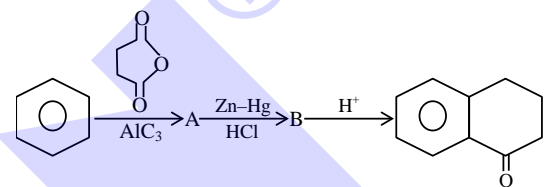
- (1) 0                      (2) 2  
 (3) 3                      (4) 1

Ans. (3)

Sol. The ions  $\text{Ti}^{2+}$ ,  $\text{V}^{2+}$ ,  $\text{Cr}^{2+}$  are strong reducing agents and will liberate hydrogen from a dilute acid, eg.

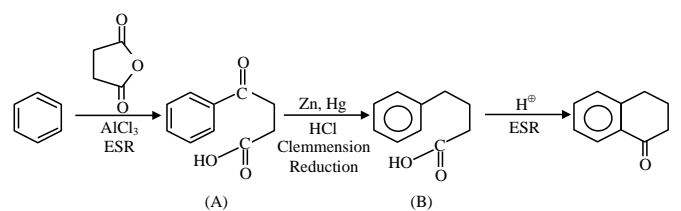


78. Identify A and B in the given chemical reaction sequence :-



Ans. (2)

Sol.



79. The correct statements from the following are :

- (A) The decreasing order of atomic radii of group 13 elements is  $Tl > In > Ga > Al > B$ .
- (B) Down the group 13 electronegativity decreases from top to bottom.
- (C) Al dissolves in dil. HCl and liberate  $H_2$  but conc.  $HNO_3$  renders Al passive by forming a protective oxide layer on the surface.
- (D) All elements of group 13 exhibits highly stable +1 oxidation state.
- (E) Hybridisation of Al in  $[Al(H_2O)_6]^{3+}$  ion is  $sp^3d^2$ .

Choose the **correct** answer from the options given below :

- (1) (C) and (E) only
- (2) (A), (C) and (E) only
- (3) (A), (B), (C) and (E) only
- (4) (A) and (C) only

**Ans. (1)**

**Sol.** A. size order  $Tl > In > Al > Ga > B$

B. Electronegativity order  $B > Al < Ga < In < Tl$

D. B, Al are more stable in +3 oxidation state

So, only C, E statements are correct.

80. Coagulation of egg, on heating is because of :

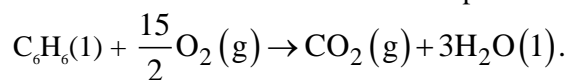
- (1) Denaturation of protein occurs
- (2) The secondary structure of protein remains unchanged
- (3) Breaking of the peptide linkage in the primary structure of protein occurs
- (4) Biological property of protein remains unchanged

**Ans. (1)**

**Sol.** Coagulation of egg give primary structure of protein, which is known as denaturation of protein

### SECTION-B

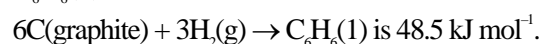
81. Combustion of 1 mole of benzene is expressed at



The standard enthalpy of combustion of 2 mol of benzene is  $-x$  kJ.

$x =$  \_\_\_\_\_.

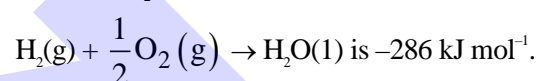
(1) standard Enthalpy of formation of 1 mol of  $C_6H_6(l)$ , for the reaction



(2) Standard Enthalpy of formation of 1 mol of  $CO_2(g)$ , for the reaction

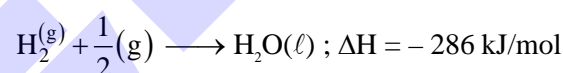
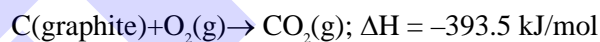


(3) Standard and Enthalpy of formation of 1 mol of  $H_2O(l)$ , for the reaction



**Ans. (6535)**

**Sol.**  $6C(\text{graphite}) + 3H_2(g) \rightarrow C_6H_6(l); \Delta H = 48.5 \text{ kJ/mol}$



equation  $-(1) \times 1 + (2) \times 6 + (3) \times 3$

$$-48.5 - 6 \times 393.5 - 3 \times 286$$

$$= -3267.5 \text{ kJ for 1 mol}$$

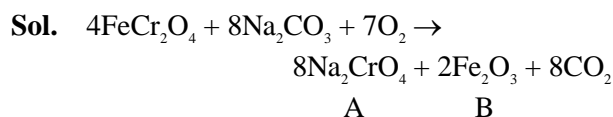
$$= -6535 \text{ kJ for 2 mol}$$

**Ans. 6535 kJ**

82. The fusion of chromite ore with sodium carbonate in the presence of air leads to the formation of products A and B along with the evolution of  $CO_2$ . The sum of spin-only magnetic moment values of A and B is \_\_\_ B.M. (Nearest integer)

(Given atomic number : C : 6, Na : 11, O : 8, Fe : 26, Cr : 24]

**Ans. (6)**



Spin only magnetic moment

$$\text{For } Na_2CrO_4 \quad \mu_B = 0$$

$$\text{For } Fe_2O_3 \quad \mu_B = 5.9$$

$$\text{sum} = 5.9$$

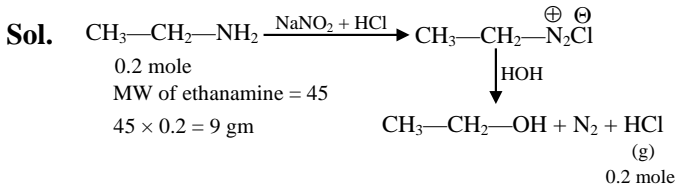


Download the new **ALLEN** app  
& enroll for **Online Programs**

CLICK HERE TO  
DOWNLOAD

83. X of ethanamine was subjected to reaction with  $\text{NaNO}_2/\text{HCl}$  followed by hydrolysis to liberate  $\text{N}_2$  and  $\text{HCl}$ . The  $\text{HCl}$  generated was completely neutralised by 0.2 moles of  $\text{NaOH}$ . X is \_\_\_\_\_ g.

Ans. (9)



84. In an atom, total number of electrons having quantum numbers  $n = 4$ ,  $|m_l| = 1$  and  $m_s = -\frac{1}{2}$  is

Ans. (6)

Sol.  $n = 4$

$l$                        $m_l$

0                      0

1                      -1, 0, +1

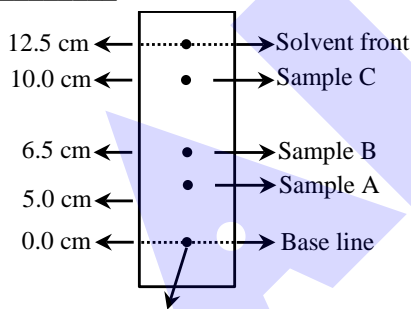
2                      -2, -1, 0, +1, +2, +3

So number of orbital associated with

$n = 4$ ,  $|m_l| = 1$  are 6

Now each orbital contain one  $e^-$  with  $m_s = -\frac{1}{2}$

85. Using the given figure, the ratio of  $R_f$  values of sample A and sample C is  $x \times 10^{-2}$ . Value of x is \_\_\_\_\_.



Samples (A,B,C)

Fig : Paper chromatography of Samples

Ans. (50)

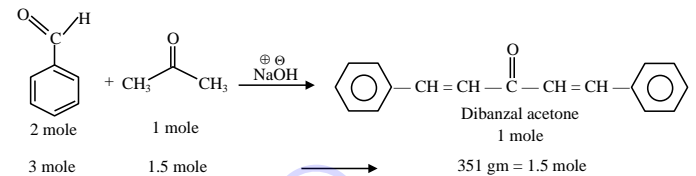
Sol.  $R_f$  of A =  $\frac{5}{12.5}$                        $R_f$  of C =  $\frac{10}{12.5}$

$$\text{Ratio} = \frac{R_{f(A)}}{R_{f(C)}} = \frac{1}{2} = 0.5 \text{ or } 50 \times 10^{-2}$$

86. In the Claisen-Schmidt reaction to prepare 351 g of dibenzalacetone using 87 g of acetone, the amount of benzaldehyde required is \_\_\_\_\_ g. (Nearest integer)

Ans. (318)

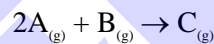
Sol. Claisen Schmidt reaction



mw of benzaldehyde = 106

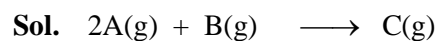
$106 \times 3 = 318 \text{ gm}$ . Benzaldehyde is required to give 1.5 mole (or 351 gm) product

87. Consider the following single step reaction in gas phase at constant temperature.



The initial rate of the reaction is recorded as  $r_1$  when the reaction starts with 1.5 atm pressure of A and 0.7 atm pressure of B. After some time, the rate  $r_2$  is recorded when the pressure of C becomes 0.5 atm. The ratio  $r_1 : r_2$  is \_\_\_\_\_  $\times 10^{-1}$ . (Nearest integer)

Ans. (315)



$r_1$     1.5 atm    0.7 atm

$r_2$     0.5 atm    0.2 atm                      0.5 atm

$$\therefore r = K [P_A]^2 [P_B]$$

$$r_1 = K [1.5]^2 [0.7]$$

$$r_2 = K [0.5]^2 [0.2]$$

$$\frac{r_1}{r_2} = 9 \times \frac{7}{2} = 31.5 = 315 \times 10^{-1}$$

Ans. 315

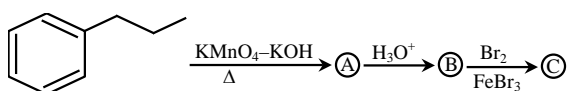


Download the new **ALLEN** app  
 & enroll for **Online Programs**

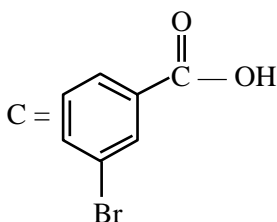
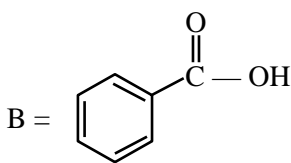
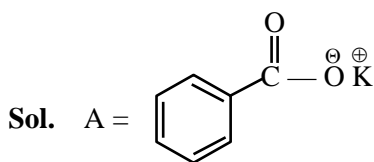
CLICK HERE TO  
 DOWNLOAD



88. The product © in the following sequence of reactions has \_\_\_\_\_  $\pi$  bonds.



Ans. (4)



$\pi$  bonds = 4

89. Considering acetic acid dissociates in water, its dissociation constant is  $6.25 \times 10^{-5}$ . If 5 mL of acetic acid is dissolved in 1 litre water, the solution will freeze at  $-x \times 10^{-2} \text{ }^\circ\text{C}$ , provided pure water freezes at  $0 \text{ }^\circ\text{C}$ .

$x =$  \_\_\_\_\_. (Nearest integer)

Given :  $(K_f)_{\text{water}} = 1.86 \text{ K kg mol}^{-1}$ .

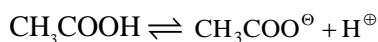
density of acetic acid is  $1.2 \text{ g mol}^{-1}$

molar mass of water =  $18 \text{ g mol}^{-1}$ .

molar mass of acetic acid =  $60 \text{ g mol}^{-1}$ .

density of water =  $1 \text{ g cm}^{-3}$

Acetic acid dissociates as



Ans. (19)

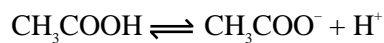
Sol. Mass of  $\text{CH}_3\text{COOH} = V \times d$

$$= 5 \text{ ml} \times 1.2 \text{ g/ml}$$

$$= 6 \text{ gm}$$

$$n_{\text{CH}_3\text{COOH}} = \frac{6}{60} = 0.1 \text{ mol}$$

$$m_{\text{CH}_3\text{COOH}} \approx M_{\text{CH}_3\text{COOH}} = \frac{0.1}{1} = 0.1 \text{ M}$$



C

C -  $\text{C}_\alpha$                        $\text{C}_\alpha$                        $\text{C}_\alpha$

$$K_a = \frac{C\alpha^2}{1-\alpha}$$

$$1 - \alpha \approx 1 \Rightarrow K_a = C\alpha^2$$

$$\alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{6.25 \times 10^{-5}}{0.1}} = 25 \times 10^{-3}$$

$$\text{V.f. (i)} = 1 + \alpha(n-1) = 1 + \alpha(2-1) = 1 + \alpha$$

$$= 1 + 25 \times 10^{-3} = 1.025$$

$$\Delta T_f = iK_f m$$

$$= (1.025)(1.86)(0.1)$$

$$= 0.19$$

$$= 19 \times 10^{-2}$$

90. Number of compounds from the following with zero dipole moment is \_\_\_\_\_.

HF,  $\text{H}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{CO}_2$ ,  $\text{NH}_3$ ,  $\text{BF}_3$ ,  $\text{CH}_4$ ,  $\text{CHCl}_3$ ,  $\text{SiF}_4$ ,  $\text{H}_2\text{O}$ ,  $\text{BeF}_2$

Ans. (6)

Sol.  $\text{H}_2$ ,  $\text{CO}_2$ ,  $\text{BF}_3$ ,  $\text{CH}_4$ ,  $\text{SiF}_4$ ,  $\text{BeF}_2$

are symm. molecule so dipole moment is zero



Download the new ALLEN app  
& enroll for Online Programs

CLICK HERE TO  
DOWNLOAD



# Are you targeting **JEE 2025** ?

## Ace it with **ALLEN's** **Leader Course**

Online Program 18 APRIL '24

Offline Program 24 APRIL '24



# ALLEN

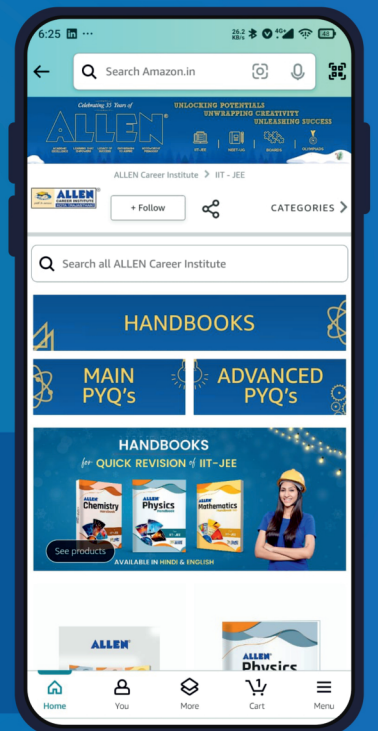
Get The Latest  
**IIT-JEE** Special Books  
at Your Door Steps...!!

**JOIN THE JOURNEY OF LEARNING**

*with*

**SCORE TEST PAPERS | HANDBOOKS**  
**JEE-MAIN PYQ's | JEE-Adv. PYQ's**

**SHOP NOW**



Available in  
**HINDI & ENGLISH**