# Exercise-1

**Marked questions are recommended for Revision.**

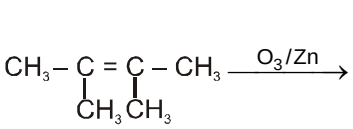
## PART - I : SUBJECTIVE QUESTIONS

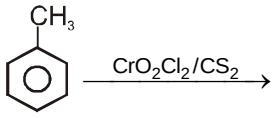
### Section (A) : Preparation of carbonyl compounds

**A-1.** Write the products of following reactions

(a) $2CH_3COOH \xrightarrow[\Delta]{Ca(OH)_2}$

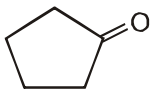
(b) $PhCN + CH_3MgBr \xrightarrow{Ether} \xrightarrow{H_2O}$

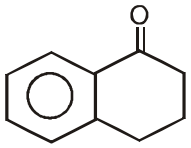
(c) 

(d) 

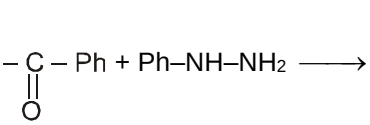
### Section (B) : Nucleophilic addition reactions

**B-1.** Write the product of the following reaction

(a)  $+ HO - NH_2 \xrightarrow{H^\oplus}$

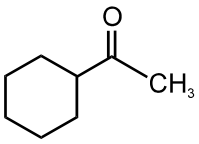
(b)  $+ NH_2 - NH_2 \xrightarrow{H^\oplus}$

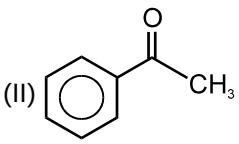
(c) $Ph-CH_2-CH_2-CHO + H_2\ddot{N} - \overset{\overset{O}{\|}}{C} - NH - NH_2 \longrightarrow$

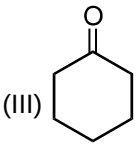
(d) 

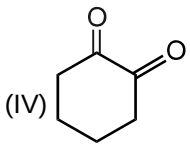
**B-2.** (a) Cis-1,2-Cyclopentanediol reacts with acetone in the presence of dry HCl to yield compound K, $C_8H_{14}O_2$, which is resistant to boiling alkali, but which is readily converted into the starting material by aqueous acids. What is structure of K ?
(b) Trans-1,2-Cyclopentanediol does not form an analogous compound. Explain why ?

**B-3.** Arrange the following compounds in decreasing orders of nucleophilic addition with semicarbazide $NH_2NHCONH_2$ i.e., $\ddot{N}H_2 - \ddot{Z}:$

(I) 

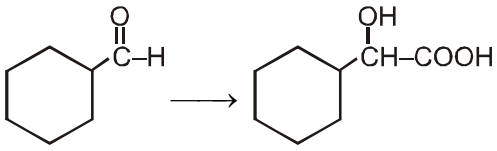
(II) 

(III) 

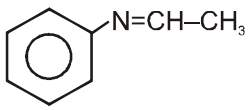
(IV) 

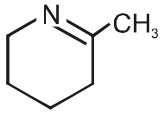
**B-4.** How the following conversions takes place?

(a) Acetophenone $\longrightarrow$ Acetophenone cyanohydrin

(b) 

**B-5.** Give the structure of the carbonyl compound and amine used to form the following imines.

(a) 

(b) 

## Section (C) : Condensation reactions

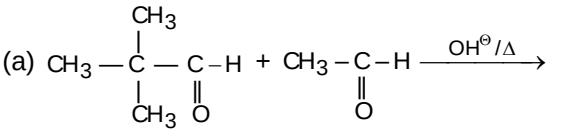
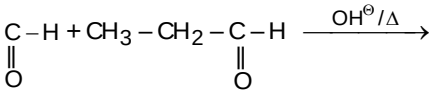
**C-1.** Predict the product of following aldol condensation reaction :

(a) $CH_3–CH_2–CHO \xrightarrow{OH^-/\Delta}$ (b) $Ph–CO–CH_3 \xrightarrow{OH^-/\Delta}$

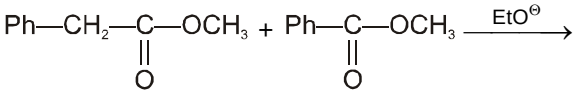
**C-2.** Indicate the starting aldehyde or ketone from which each of the following compounds are formed by an aldol condensation reaction.

(a) 2-Ethyl-3-hydroxy hexanal (b) 4-Hydroxy-4-methyl-2-pentanone

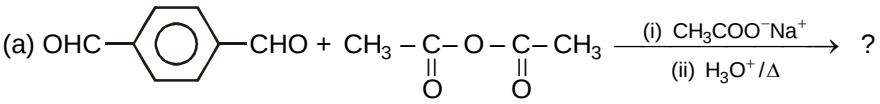
**C-3.** Predict the products of following cross condensation reactions.

(a)  (b) 

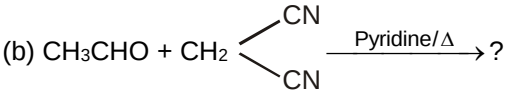
**C-4.** Predict the product from claisen condensation of the following pair of esters.



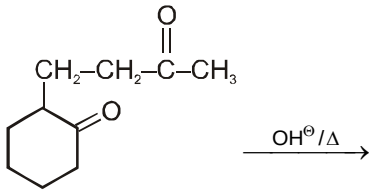
**C-5.** Predict the product for each of the following reactions.

(a) 

excess

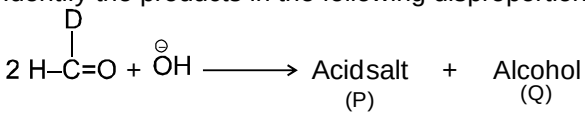
(b) 

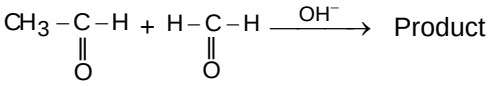
**C-6.** Predict the product for each of the following reactions.



## Section (D) : Cannizzaro's reactions

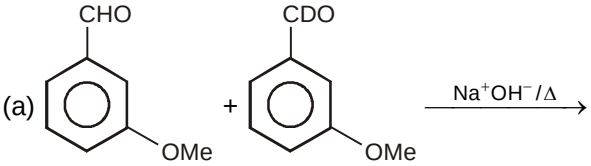
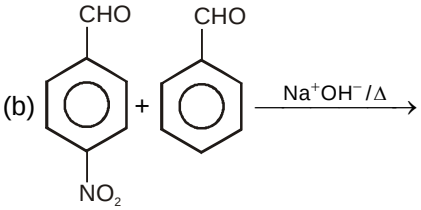
**D-1.** Identify the products in the following disproportionation reaction and also mention rate determining step.



**D-2.** 

(1 eq.) excess

**D-3.** Write the product of the following reaction,

(a)  (b) 

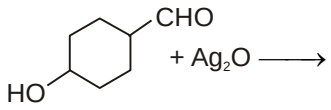
**D-4.** $PhCOCHBr_2 \xrightarrow[S_N2]{OH^-(2eq.)} A \xrightarrow{OH^-} B \xrightarrow{H^+} C$

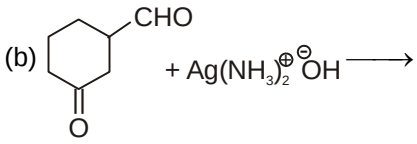
The compound 'C' is :

**D-5.** Glyoxal (CHOCHO) on being heated with concentrated NaOH forms.

## Section (E) : Redox reactions

**E-1.** Write the product of following reaction :

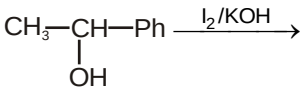
(a) 

(b) 

## Section (F) : α-Halogenation, haloform, α-deuteration reactions

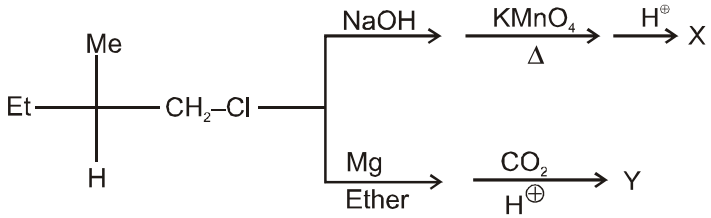
**F-1.** Write the product of following reaction,

(a) $CH_3–CH_2–OH \xrightarrow{I_2/KOH}$ (b) $Ph–CH_2–CO–CH_3 \xrightarrow{I_2/KOH}$

(c) 

## Section (G) : Carboxylic acid (Preparation Methods)

**G-1.** In the following reactions products X & Y are



**G-2.** A benzenoid compound D($C_8H_{10}O$) upon treatment with alkaline solution of iodine gives a yellow precipitate. The filtrate on acidification gives a white solid E ($C_7H_6O_2$). Write the structures of D.E and explain the formation of E.

## Section (H) : Carboxylic acid (Chemical Properties)

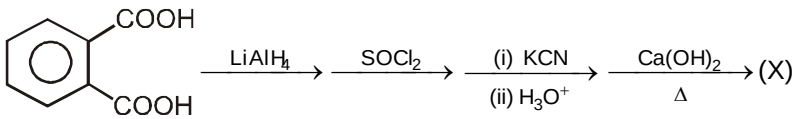
**H-1.** The product P of the following reaction is

$CH_3–COOH \xrightarrow{LiAlH_4} \xrightarrow{SOCl_2} \xrightarrow{KCN} \xrightarrow{H_3O^\oplus} P$ (14)

**H-2.** $CH_3COOH \xrightarrow[(ii)\ H_2O]{(i)\ PCl_3+Cl_2(excess)} (X) \xrightarrow{SOCl_2} (Y) \xrightarrow{H_2\ /\ Pd\ /\ BaSO_4} (Z) \xrightarrow{OH^-} W + S$

Write the structure of X, Y, Z, W and S.

**H-3.** The product (X) for the following conversion reaction is :

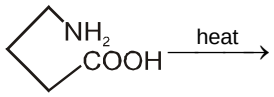


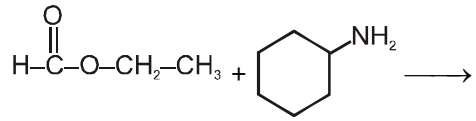
## Section (I) : Acid Derivatives (Acid Halide, Ester, Anhydride & Amide)

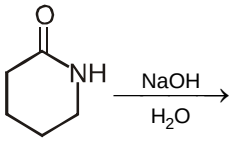
**I-1.** Give the product of each of the following reactions :

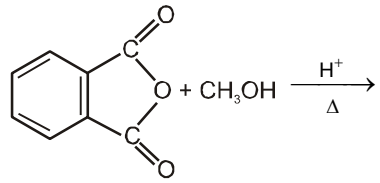
phthalic acid + $NH_3$ $\longrightarrow$ D $\xrightarrow{300^oC}$ E ,

**I-2.** Predict the products of the following reactions.

**(a)** 

**(b)** 

**(c)** 

**(d)** 

phthalic anhydride

# PART - II : ONLY ONE OPTION CORRECT TYPE

## Section (A) : Preparation of carbonyl compounds

**A-1.** On heating calcium propionate, the product formed is

(A) 3-Pentanone (B) 2-Pentanone

(C) 3-Methyl-2-butanone (D) Propanone

**A-2.** A mixed salt of calcium acetate formate on dry distillation gives

(A) ethanal (B) methanal

(C) propanone (D) All the three above.

**A-3.** Acetic acid when heated (300ºC) with MnO gives

(A) formaldehyde (B) acetaldehyde (C) acetone (D) butaone

**A-4.** Ethylidene chloride on treatment with aq. KOH gives

(A) $CH_3CHO$ (B) $(CH_2OH)_2$ (C) HCHO (D) $(CHO)_2$

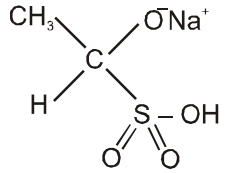
## Section (B) : Nucleophilic addition reactions

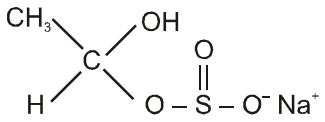
**B-1.^** Arrange the following compounds in decreasing orders of rate of hydration.

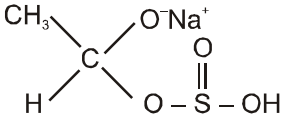
(X) $CCl_3CHO$ (Y) $CH_3CHO$ (Z) $CH_3COCH_3$ (W) $CF_3CHO$

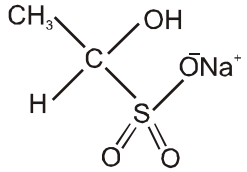
(A) W > Z > X > Y (B) W > X > Y > Z (C) W > Y > Z > X (D) W > Z > Y > X

**B-2.** Acetaldehyde on reaction with sodium hydrogen sulphite produces

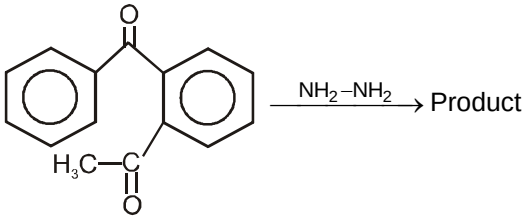
(A) 

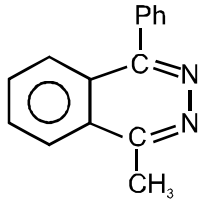
(B) 

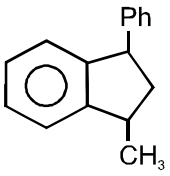
(C) 

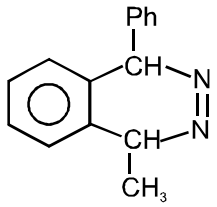
(D) 

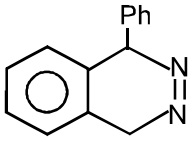
**B-3.** Write the product of following reaction :

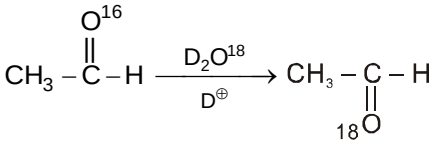



(A) 

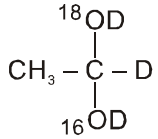

(B) 

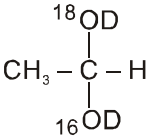

(C) 

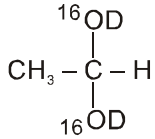

(D) 

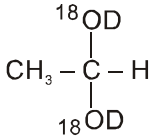

**B-4.** 


Given the following reaction intermediate is :

(A) 


(B) 


(C) 


(D) 


## Section (C) : Condensation reactions

**C-1.** (X) is the product of cross aldol condensation between benzaldehyde ($C_6H_5CHO$) and acetone. What is its structure ?

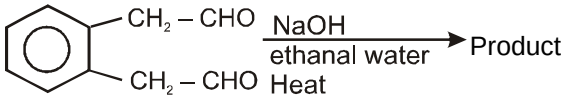
(A) $C_6H_5–CH=CH–\overset{\overset{O}{\|}}{C}–CH_3$

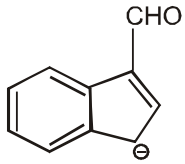
(B) $C_6H_5–CH=C–(CH_3)_2$

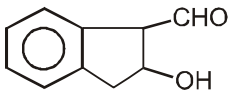
(C) $C_6H_5–CO–CH_2–C=(CH_3)_2$

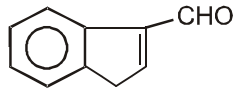
(D) None of these

**C-2.** What is the principal product of the follwoing reaction ?




(A) 


(B) 


(C) 


(D) None of these

## Section (D) : Cannizzaro's reactions

**D-1.** In the reaction, $(CH_3)_3CCHO + HCHO \xrightarrow[\text{heat}]{NaOH} A + B.$

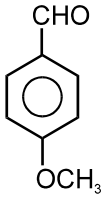
the products (A) and (B) are respectively :

(A) $(CH_3)_3CCH_2OH$ and $HCOO^- Na^+$.

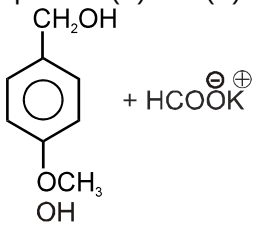
(B) $(CH_3)_3CCOONa$ and $CH_3OH$.

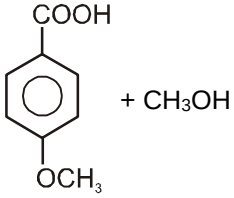
(C) $(CH_3)_3CCH_2OH$ and $CH_3OH$.

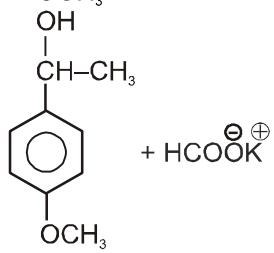
(D) $(CH_3)_3COONa$ and $HCOO^- Na^+$.

**D-2.**  + HCHO $\xrightarrow[\Delta]{KOH}$ (A) + (B)

The product (A) and (B) are respectively :

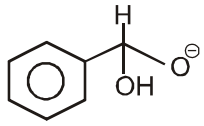
(A) 

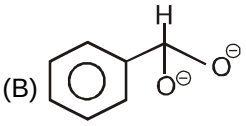
(B) 

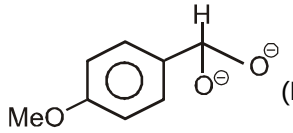
(C) 

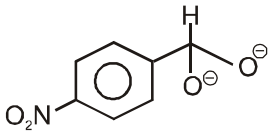
(D) Both (A) and (B)

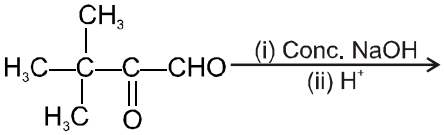
**D-3.** In the cannizzaro's reaction the intermediate that will be the best hydride donor ?

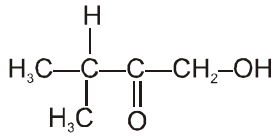
(A) 

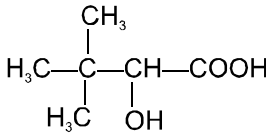
(B) 

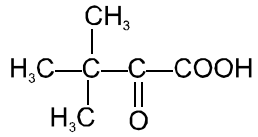
(C) 

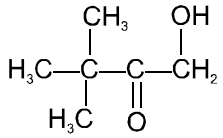
(D) 

**D-4.** In the given reaction  Product is

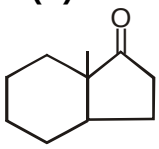
(A) 

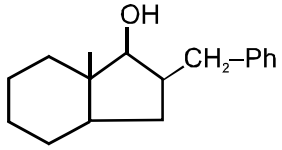
(B) 

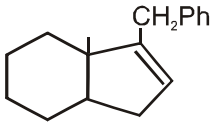
(C) 

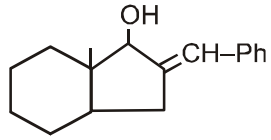
(D) 

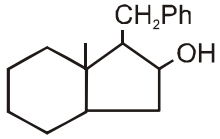
## Section (E) : Redox reactions

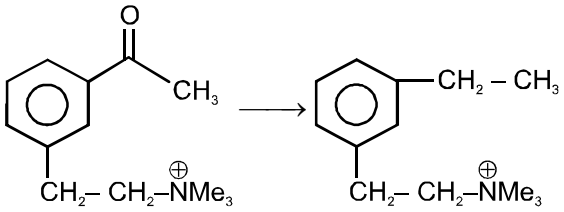
**E-1.**  $\xrightarrow[\Theta\ OH/\Delta]{Ph-CHO}$ $\xrightarrow{LiAlH_4}$ [X], Product (X) in this reaction is :

(A) 

(B) 

(C) 

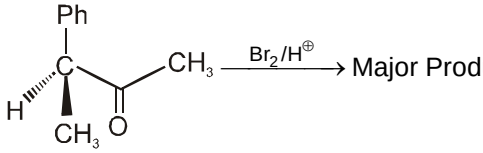
(D) 

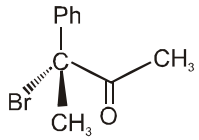
**E-2.** 

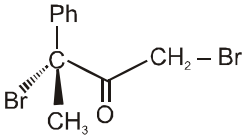
Above conversion can be achieved by

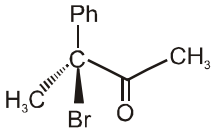
(A) $NH_2–NH_2$/ NaOH (B) Zn–Hg/HCl (C) $LiAlH_4$ (D) $NaBH_4$.

## Section (F) : α-Halogenation, haloform, α-deuteration reactions

**F-1.**  Major Product is :

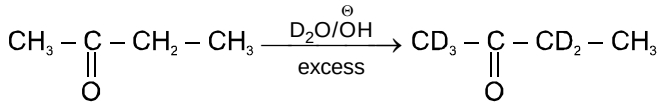
(A) 

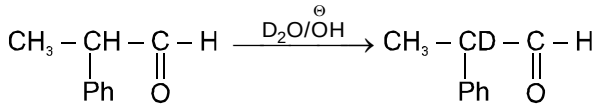
(B) 

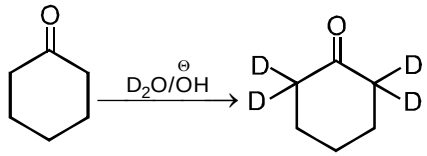
(C) 

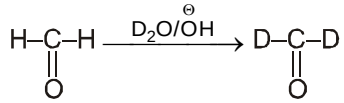
(D) Both A and C

**F-2.** In which of the following reaction deuterium exchange is not observed ?

(A) 

(B) 

(C) 

(D) 

## Section (G) : Carboxylic acid (Preparation Methods)

**G-1.** In the following reaction final product is :

$C_6H_5MgBr + CO_2 \xrightarrow{\text{Ether}} \xrightarrow{H^{\oplus}}$ Find product

(A) Benzoic acid (B) Benzaldehyde (C) Benzamide (D) Benzene

**G-2.** Which of the following does not give benzoic acid salt on oxidation with hot alkaline $KMnO_4$.

(A) Ph–$CH_3$ (B) Ph–CH=CH–$CH_3$ (C) Ph–C≡C–$CH_3$ (D) Ph–$C(CH_3)_3$

**G-3.** The acid D obtained through the following sequence of reactions is

$$C_2H_5Br \xrightarrow{\text{Alc. KOH}} A \xrightarrow[CCl_4]{Br_2} B \xrightarrow[\text{(excess)}]{KCN} C \xrightarrow{H_3O^+} D$$

(A) Succinic acid (B) Malonic acid (C) Maleic acid (D) Oxalic acid

**G-4.** In which of the following reaction the final product is neither an acid nor an acid salt.

(A) $Ph–CHO \xrightarrow{\text{Tollen's reagent}}$ (B) $CH_3–CH_2–OH \xrightarrow{KMnO_4/\bar{O}H}$

(C) $Ph–CHO \xrightarrow{\text{Fehling solution}}$ (D) $Ph–CH_2–OH \xrightarrow{K_2Cr_2O_7/H^+}$

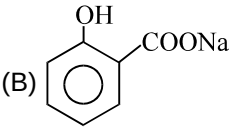
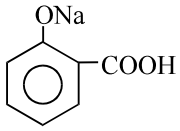
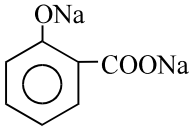
## Section (H) : Carboxylic acid (Chemical Properties)

**H-1.** Formic acid can be distinguish from acetic acid because formic acid :

(A) release $H_2$ with sodium (B) gives ester with alcohol

(C) reduces ammonical $AgNO_3$ (D) turns red litmus to blue

**H-2.** Sodium bicarbonate reacts with salicylic acid to form:

(A) $C_6H_5ONa$ (B)  (C)  (D) 

**H-3.** Which of the following will not undergo Hell-Volhard Zelinsky (HVZ) reaction ?

(A) HCOOH (B) $CH_3COOH$ (C) $CH_3CH_2COOH$ (D) $CH_3CHBrCOOH$.

**H-4.** $CH_3–CH_2–CH_2–COOH \xrightarrow{\text{Red P} + Br_2} CH_3-CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-COOH$

This reaction is called

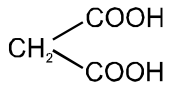
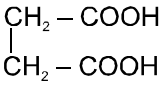
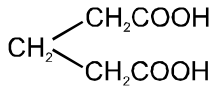
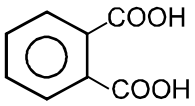
(A) Cannizzaro reaction (B) Aldol condensation reaction

(C) Hell Volhard Zelinsky reaction (D) Reimer tiemann reaction

**H-5.** What product is formed when acetic acid heated with $P_2O_5$ .

(A) Acetyl chloride (B) Acetate ester (C) Acetic anhydride (D) Acetaldehyde

**H-6.** Which of the following will not yield a cyclic compound on heating :

(A)  (B)  (C)  (D) 

**H-7.** The reaction : $RCOOAg + Br_2 \xrightarrow{CCl_4,\ \text{Reflux}} R–Br + AgBr + CO_2$

is called

(A) Wurtz reaction (B) Hunsdiecker bromo decarboxylation reaction

(C) Friedel-Crafts reaction (D) Kolbe's reaction

**H-8.** $RCOOH \longrightarrow RCH_2COOH$. This conversion is known as reaction :

(A) Arndt-Eistert reaction (B) Hunsdicker reaction

(C) HVZ reaction (D) Cannizaro reaction

## Section (I) : Acid Derivatives (Acid Halide, Ester, Anhydride & Amide)

**I-1.** Acetic anhydride is prepared in the laboratory by heating sodium acetate with

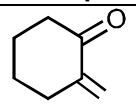
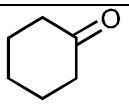
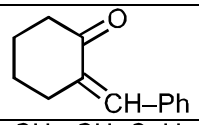
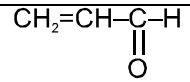
(A) ethyl chloride (B) acetyl chloride (C) conc. $H_2SO_4$ (D) zinc dust

**I-2.** A compound with molecular formula $C_4H_{10}O_4$ on acylation with acetic anhydride gives a compound with molecular formula $C_{12}H_{18}O_8$. How many hydroxyl groups are present in the compound ?

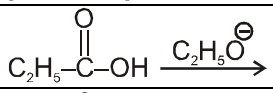
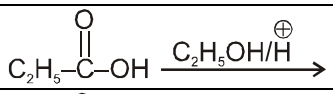
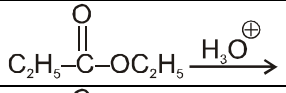
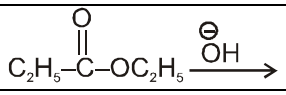
(A) one (B) Two (C) Three (D) Four

## PART - III : MATCH THE COLUMN

**1.** Match the column :

| | **Column-I** | | **Column-II** |
|---|---|---|---|
| | **Aldol product** | | **Reactant required** |
| (A) |  | (p) |  |
| (B) |  | (q) | HCHO |
| (C) |  | (r) | Ph–CHO |
| (D) | Ph–CH=CH–CHO | (s) | $CH_3$–CHO |

**2.** Match the column :

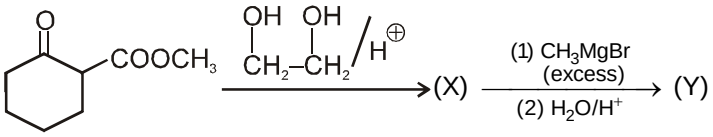
| | **Column-I** | | **Column-II** |
|---|---|---|---|
| | **(Reaction)** | | **(Reactions involved)** |
| (A) |  | (p) | Hydrolysis |
| (B) |  | (q) | Esterification |
| (C) |  | (r) | Saponification |
| (D) |  | (s) | Acid base reaction |

# Exercise-2

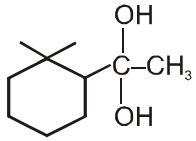
**Marked questions are recommended for Revision.**

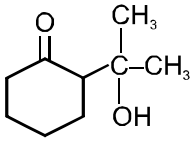
## PART - I : ONLY ONE OPTION CORRECT TYPE

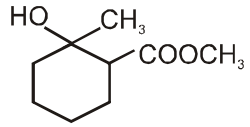
### ALDEHYDES & KETONES

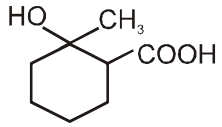
**1.** In the given reaction, 

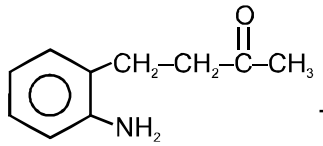
(Y) is

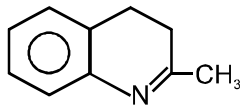
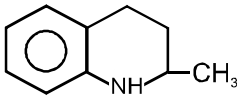
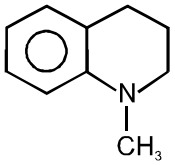
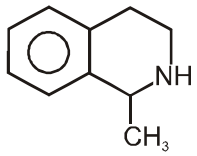
(A) 

(B) 

(C) 

(D) 

**2.**  $\xrightarrow{H^{\oplus}}$ $\xrightarrow{H_2/Ni}$ Product is :

(A)  (B)  (C)  (D) 

**3.** $Ph-CH=CH-\underset{\underset{O}{\|}}{C}-H \xrightarrow{\text{(i) } CH_3CH_2MgBr} \xrightarrow{\text{(ii) } H_3O^{\oplus}} (X) \xrightarrow{Cu,\ \Delta} (Y)$

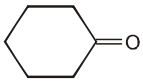
(A) X is 1, 4-addition product ; Y is $Ph-\underset{\underset{O}{\|}}{C}-CH=CH-CH_2-CH_3$

(B) X is 1, 2-addition product ; Y is $Ph-CH=CH-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$

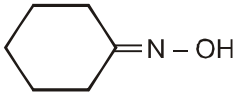
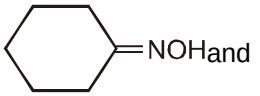
(C) X is 1, 4-addition product ; Y is $Ph-CH=CH-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$

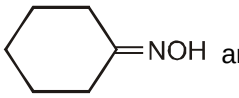
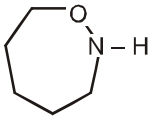
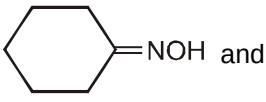
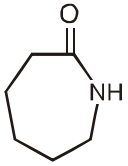
(D) X is 1, 2-addition product ; Y is $Ph-\underset{\underset{O}{\|}}{C}-CH=CH-CH_2-CH_3$

**4.** Consider the following sequence of reactions :

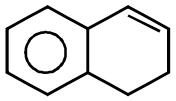
 $+ H_2NOH \xrightarrow{\text{Heat}} A \xrightarrow[\text{Heat}]{H_2SO_4} B.$

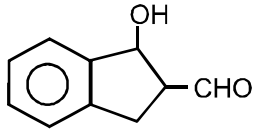
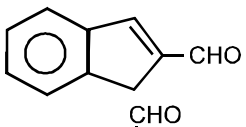
The products (A) and (B) are, respectively :

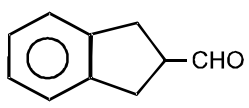
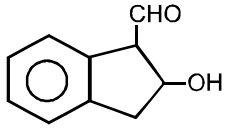
(A)  and  (B)  and 

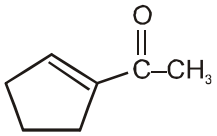
(C)  and  (D)  and 

**5.** In the given reaction sequence B is

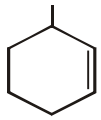
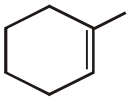
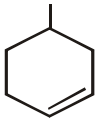
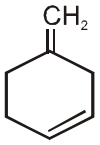
 $\xrightarrow[(2)\ Zn/H_2O]{(1)\ O_3}$ (A) $\xrightarrow{\ominus OH/\Delta}$ (B)

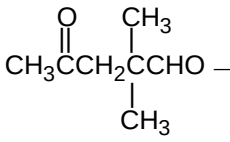
(A)  (B) 

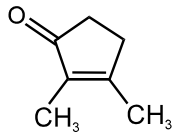
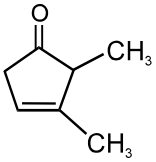
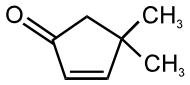
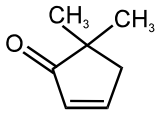
(C)  (D) 

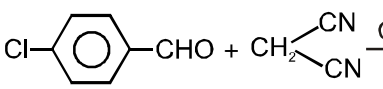
**6.** (A) $\xrightarrow{O_3/Zn/H_2O}$ (B) $\xrightarrow[\Delta]{NaOH}$ 

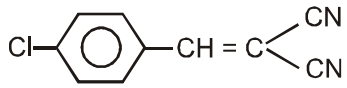
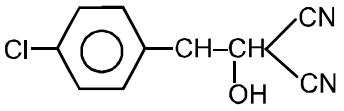
The reactant (A) will be :

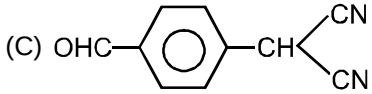
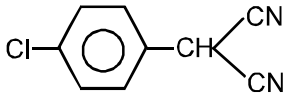
(A)  (B)  (C)  (D) 

**7.**  $\xrightarrow[\Delta]{KOH,\ H_2O}$ Product ($C_7H_{10}O$) :

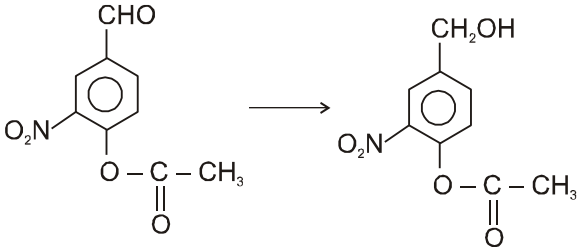
(A)  (B)  (C)  (D) 

**8.** 

(A)  (B) 

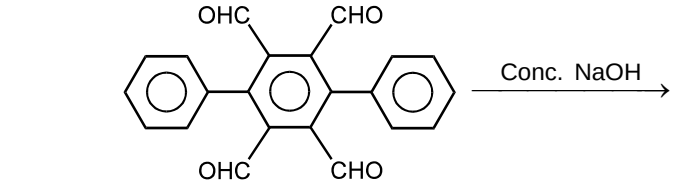
(C)  (D) 

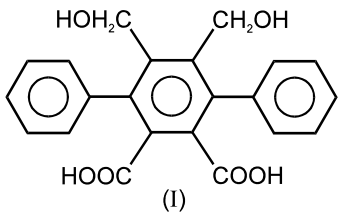
**9.** The suitable reagent for the following reaction is :



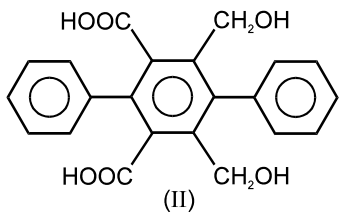
(A) $LiAlH_4$ (B) $Na / C_2H_5OH$ (C) $H_2 / Ni$ (D) $CH_2 = O/\overline{O}H$

**10.** Which of the following can be the product/s of following reaction.

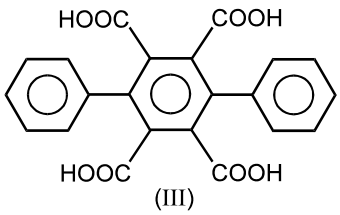


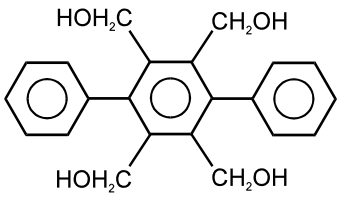

(I)



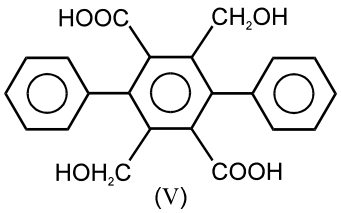

(II)




(III)



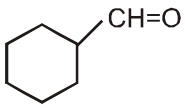

(IV)



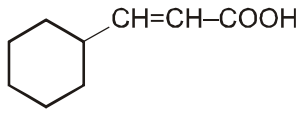

(V)

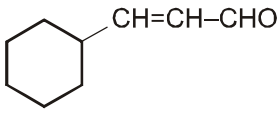
(A) I, II, IV (B) III, IV (C) II, V (D) I, V

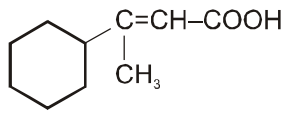
**11.^**

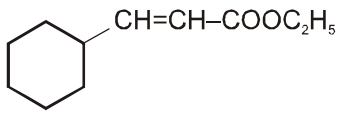


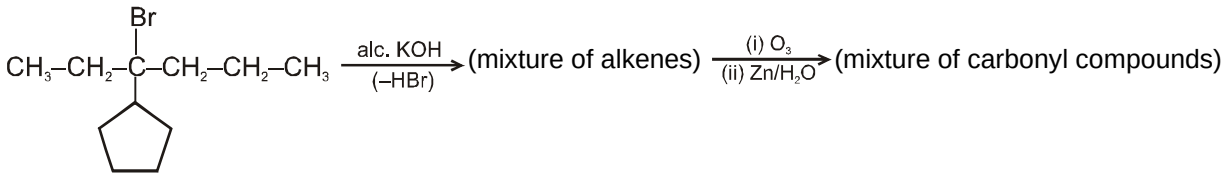

$\xrightarrow[\text{(ii) } OH^-, H_2O, \Delta]{\text{(i) } CH_2(COOC_2H_5)_2 \text{ / Pyridine}}$ (P) is

(A) 


(B) 


(C) 


(D) 


**12.** 


The incorrect statement is

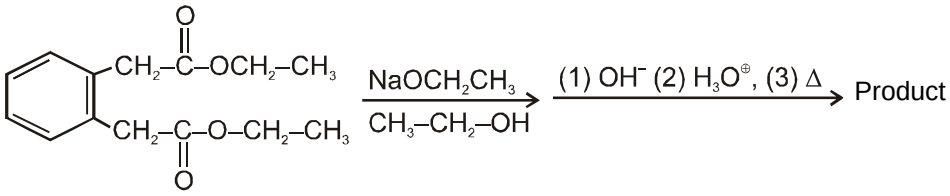
(A) Total five alknes are obtained.

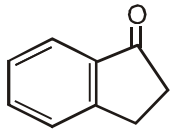
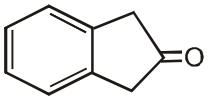
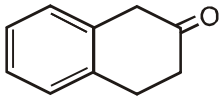
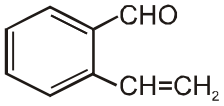
(B) Total six different carbonyl compounds are obtained on ozonolysis.

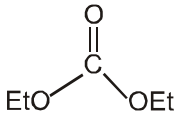
(C) All carbonyl compounds can give aldol reaction when treated with dil KOH.

(D) Only two carbonyl compounds give positive iodoform test.

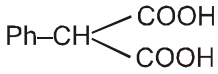
**13.** What is the final product of this sequence of reactions ?

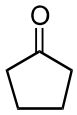


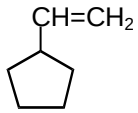
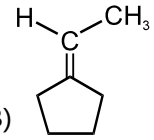
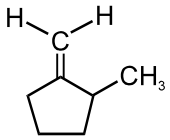
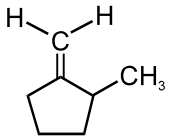

(A)  (B)  (C)  (D) 

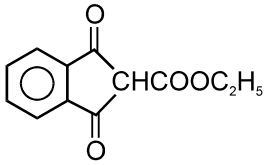

**14.** Ph–$CH_2$–COOEt +  $\xrightarrow[EtOH]{NaOEt}$ (A) $\xrightarrow{H_3O^+, \Delta}$ (B)

Product B is :

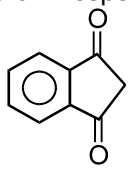
(A) Ph–$CH_2$–COOH (B) Ph–$CH_2$–COOEt (C)  (D) None of these

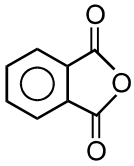
**15.**  + $(C_6H_5)_3P = CHCH_3 \longrightarrow$ Product

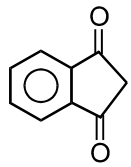
(A)  (B)  (C)  (D) 

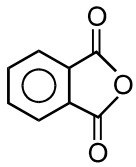
**16.** In the following reaction, A + B $\xrightarrow{C_2H_5O^{\ominus}Na^{\oplus}}$ 


A and B respectively are :

(A)  + $CH_3COOC_2H_5$

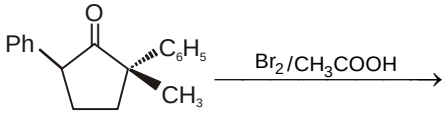
(B)  + $CH_3-\underset{\underset{O}{\|}}{C}-OC_2H_5$

(C)  + $C_2H_5O-\underset{\underset{O}{\|}}{C}-OC_2H_5$

(D)  + $C_2H_5O-\underset{\underset{O}{\|}}{C}-CH_2-\underset{\underset{O}{\|}}{C}-OC_2H_5$

**17.** Aromatic carbonyl compounds having molecular formula $C_8H_8O$ react with $NH_2OH$ how many oximes can be formed :

(A) 8 (B) 10 (C) 12 (D) 6

**18.** 

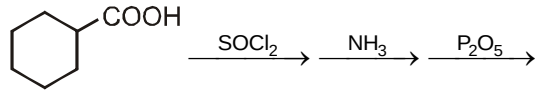
Products with stereochemical relation

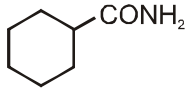
(A) Enantionmer (B) Diastereomer
(C) Structural isomer (D) Identical

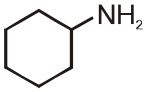
## CARBOXYLIC ACID & DERIVATIVES

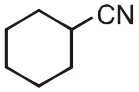
**19.** Which of the following does not give benzoic acid on hydrolysis ?
(A) Phenyl cyanide (B) Benzoyl chloride (C) Benzyl chloride (D) Methyl benzoate

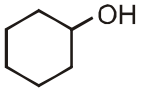
**20.** Identify the final product in the following sequence of reaction.

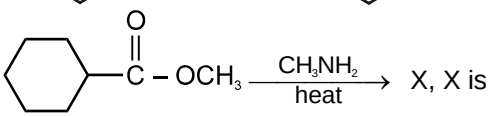



(A) 

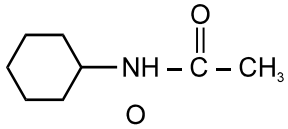
(B) 

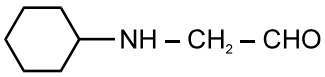
(C) 

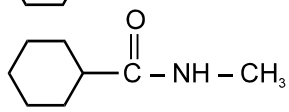
(D) 

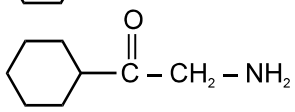

**21.** 

X, X is

(A) 

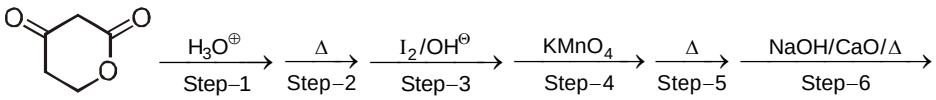
(B) 

(C) 

(D) 


**22.** $CH_3CH_2CH_2CONH_2$ is boiled with aqueous NaOH, then the reaction mixture is acidified with HCl. The products obtained are
(A) $CH_3CH_2CH_2COO^- + NH_3$ (B) $CH_3CH_2CH_2COONa + NH_3$
(C) $CH_3CH_2CH_2COOH + NH_4Cl$ (D) $CH_3CH_2CH_2COO^- + NH_4Cl$.

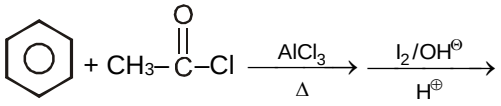
**23.** In how many steps decarboxylation reaction is taking place.

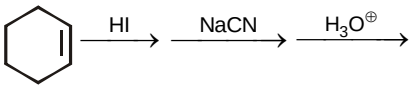



(A) 1 (B) 2 (C) 3 (D) 4

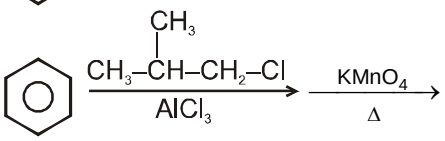
## PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

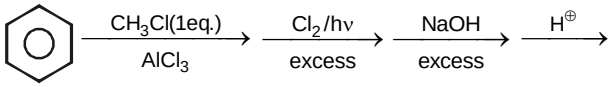
**1.** How many reactions will produce carboxylic acid, as their end product.

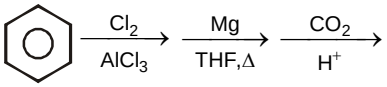
(1) 

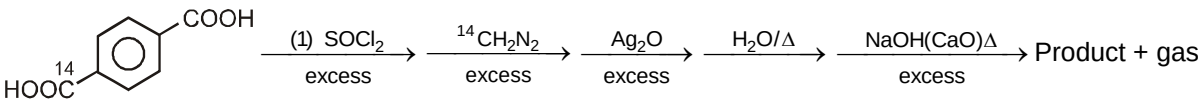

(2) 


(3) 


(4) 


(5) 

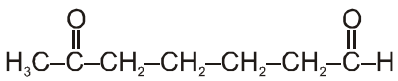

(6) 

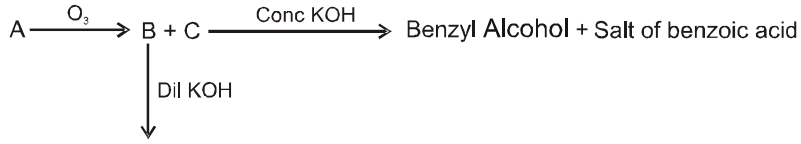

**2.** 

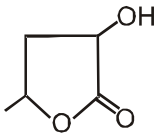
Product + gas

How many $C^{14}$ atoms are present in the product.

**3.** Number of possible intra molecular aldol condensation products on heating with NaOH.



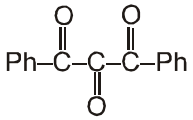
**4.** 

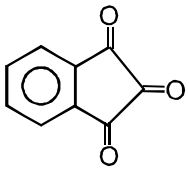
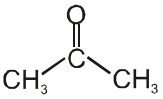
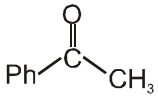

Aldol (β-Hydroxy carbonyl compound) $\xrightarrow{HCN}$ D $\xrightarrow[\Delta]{H_3O^+}$ 

No. of carbon atoms is structure of A is ?

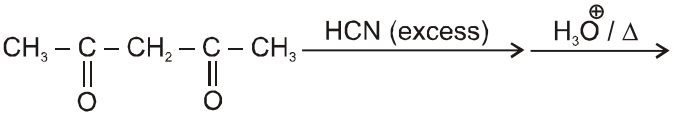
**5.** Total aldol condensation products (including stereoisomers) formed by the reaction between acetaldehyde and acetophenone is :

**6.** How many of the following will form stable hydrate :

(1) $CH_3CHO$ (2) $CCl_3CHO$ (3) $CF_3CHO$ (4) 

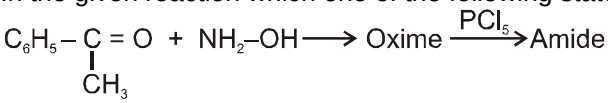
(5)  (6)  (7)  (8) 

## PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

**1.** Observe the following reaction  Products.

The correct statement is
(A) The product is a mixture of two compounds
(B) The product is optically inactive
(C) The product is a mixture of two chiral and one achiral stereoisomer
(D) The product is a mixture of three stereoisomers.

**2.** In the given reaction which one of the following statement is correct –

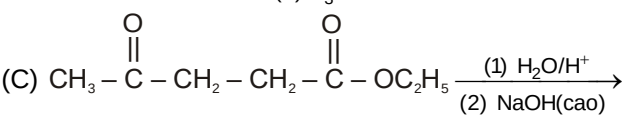


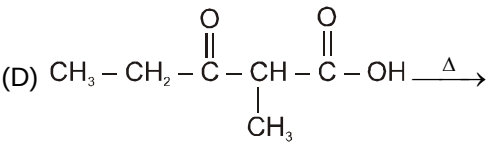
(A) Oxime may be E/Z.
(B) Amide on hydrolysis gives a mixture acetic acid, benzoic acid, Aniline and methylamine.
(C) Preparation of oxime is nucleophilic addition followed by elimination reaction.
(D) Oxime and amides are isomers.

**3.** Which of the following will give 3-pentanone.

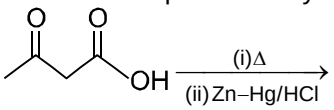
(A) $(CH_3–CH_2COO)_2Ca \xrightarrow{\Delta}$

(B) $CH_3–CH_2–C\equiv N \xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ CH_3–CH_2–MgBr}$

(C) 

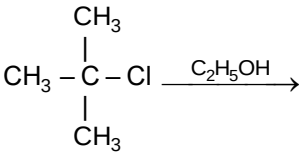
(D) 

**4.** In which reaction product is hydrocarbon?

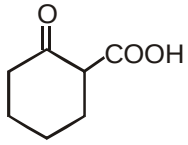
(A)  $\xrightarrow[(ii)\,Zn-Hg/HCl]{(i)\,\Delta}$

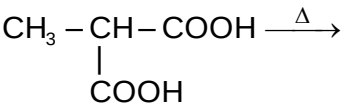
(B) $CH_3COOAg \xrightarrow{Br_2/CCl_4}$

(C) $Ph-COOH \xrightarrow[CaO,\ \Delta]{NaOH}$

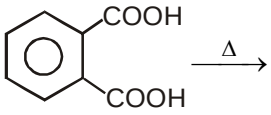
(D) 

**5.** Which of them liberate a gas which turns lime water milky.

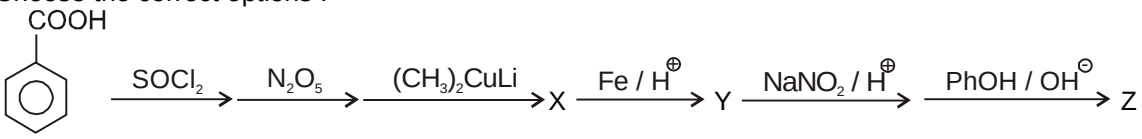
(A) 

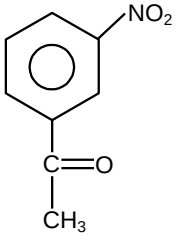
(B) 

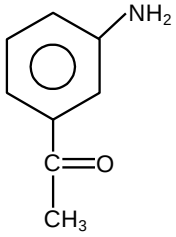
(C) $HOOC-(CH_2)_5-COOH \xrightarrow{Ca(OH)_2/\Delta}$

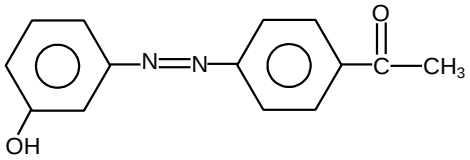
(D) 

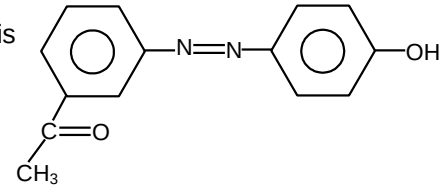
**6.** Choose the correct options :



(A) X is 

(B) Y is 

(C) Z is 

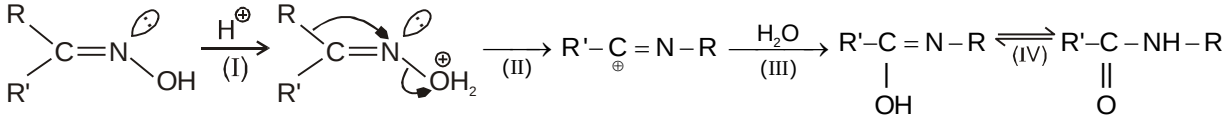
(D) Z is 

## PART - IV : COMPREHENSION

**Read the following passage carefully and answer the questions.**

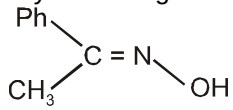
### Comprehension # 1

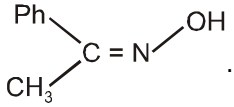
Aldehydes and Ketones reacts with $NH_2OH$ to form Aldoximes and Ketoximes respectively. Configuration of these can be determined by Beckmann rearrangement as that group migrates which is anti w.r.t –OH.

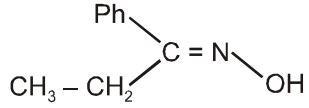


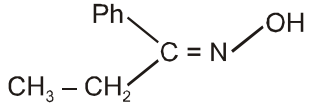
**1.** [X] $\xrightarrow{H_2SO_4}$ $\xrightarrow{H_2O}$ $Ph - NH_2 + CH_3 - \underset{\underset{O}{\|}}{C} - OH$

Identify the configuration of [X] compound :

(A) 

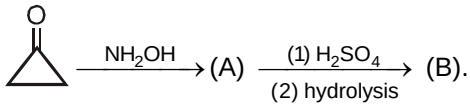
(B) 

(C) 

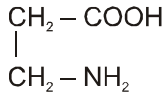
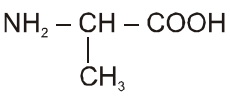
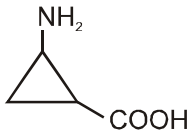
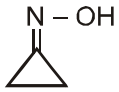
(D) 

**2.** Which step is Rate determening step ?

(A) I (B) II (C) III (D) IV

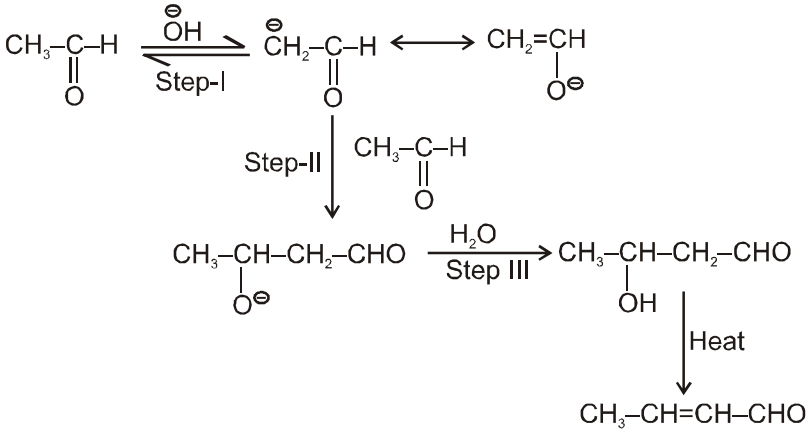
**3.** 

The product (B) is :

(A)  (B)  (C)  (D) 

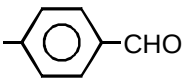
## Comprehension # 2

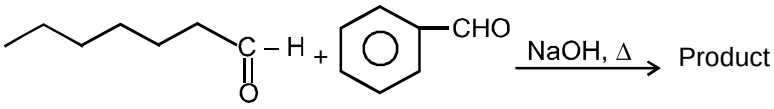
Carbonyl compound which contains $\alpha$–H gives aldol condenation reaction in presence of alkaline medium. The reaction between two molecules of acetaldehyde take place as follows in presence of base.



**4.** Aldol condensation reaction is given by

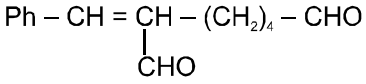
(A) $C_6H_5$–CHO (B) $CX_3$ – CHO

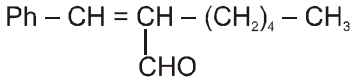
(C) $O_2N$–  (D) $C_6H_5$–$CH_2$–CHO

**5.** 


(A) Ph – CH = CH – $(CH_2)_5$ – CHO

(B) Ph – $(CH_2)_5$ – CH = CH – CHO

(C) 


(D) 


**6.** Intramolecular aldol condensation reaction is given by

(A) 2,5-diketone

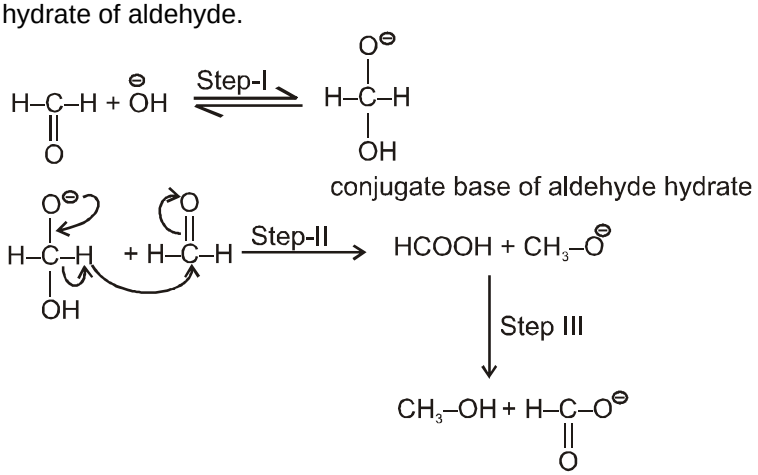
(B) 2,7-diketone

(C) 2,6 and 2,8-diketone

(D) All of these

## Comprehension # 3

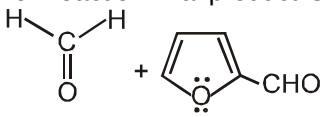
The conversion of aldehyde having no alpha hydrogen to a mixture of carboxylic acid and primary alcohol is known as cannizzaro reaction. The most important feature of this reaction is the conjugate base of hydrate of aldehyde.

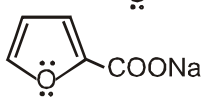


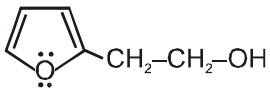

**7.** Which step is rate determining step

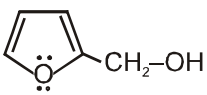
(A) step I (B) step II (C) step III (D) step I and II both

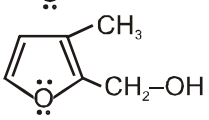
**8.** In the given reaction final product is :




(A) $CH_3OH$ + 

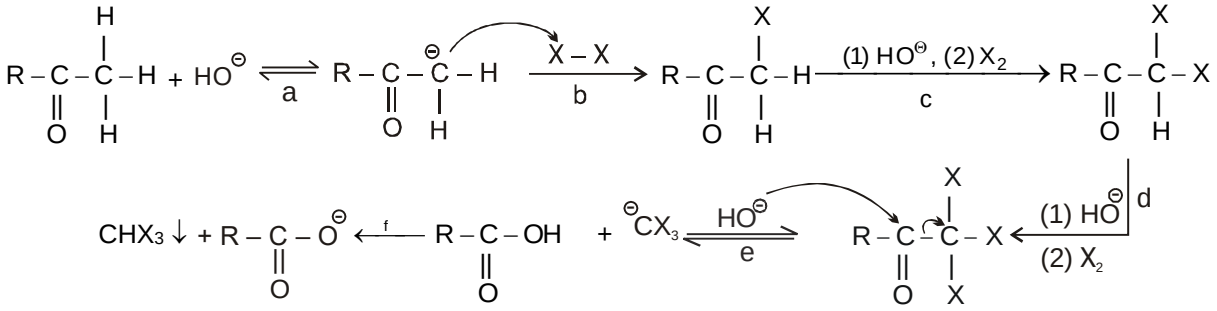

(B) HCOONa + 


(C) HCOONa + 


(D) HCOONa + 

**Comprehension # 4**

Study following mechanism of haloform reaction.



**9.** Which step is RDS

(A) a (B) b (C) c (D) f

**10.^** Which of the following compound(s) give haloform reaction ?

(A) $Cl-\underset{\underset{O}{\|}}{C}-CH_3$ (B) $CH_3-\underset{\underset{O}{\|}}{C}-OEt$

(C) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-Ph$ (D) $CH_3-\underset{\underset{O}{\|}}{C}-O-\underset{\underset{O}{\|}}{C}-CH_3$

**11.** Which step produces most acidic compound

(A) a (B) c (C) d (D) b

**Comprehension # 5**

**Answer Q.12, Q.13 and Q.14 by appropriately matching the information given in the three columns of the following table.**

Column-1, 2 & 3 containing reactions, intermediate/mechanism & product on completion respectively.

| Column-1 | | Column-2 | | Column-3 | |
|---|---|---|---|---|---|
| (I) | $H-\underset{\underset{O}{\|}}{C}-H + OH^- \xrightarrow{\Delta}$ | (i) | Hydride shift | (P) | Product with same no. of carbon as it is an reactant. |
| (II) | $CH_3-\underset{\underset{O}{\|}}{C}-H + OH^- \longrightarrow$ | (ii) | Carbanion | (Q) | Product with lesser no. of carbon than reactant. |
| (III) | $CH_3-\underset{\underset{O}{\|}}{C}-H + I_2 / OH^- \longrightarrow$ | (iii) | Enolate anion | (R) | Product with greater no. of carbon than reactant. |
| (IV) | $CH_3-\underset{\underset{O}{\|}}{C}-O-CH_3 + OH^- \longrightarrow$ | (iv) | $sp^3$ hybrid intermediate | (S) | Product shows stereoisomerism. |

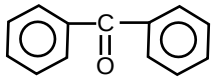
**12.** Which of the given combination is correct ?

(A) (I) (i) (Q) (B) (II) (ii) (P) (C) (III) (iii) (S) (D) (IV) (iv) (Q)

**13.** In which of the following combination, β-hydroxy carbonyl is obtained ?

(A) (I) (i) (P) (B) (II) (ii) (S) (C) (III) (ii) (P) (D) (IV) (ii) (Q)

**14.** Which of the following reactant will give the same product as (III), (ii), (Q) with NaOI ?

(A) 

(B) $CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$

(C) $CH_3O-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OCH_3$

(D) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

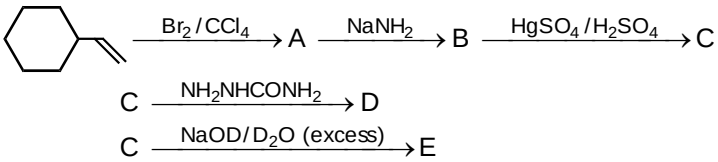
# Exercise-3

*** Marked Questions are having more than one correct option.**

## PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

## ALDEHYDES & KETONES

**1.** Identify (A), (B), (C), (D) and (E) in the following schemes and write their structures : **[IIT-JEE 2001(M), 5/100]**




**2.** An alkene (A) $C_{16}H_{16}$ on ozonolysis gives only one product (B) $C_8H_8O$. Compound (B) on reaction with NaOH / $I_2$ yields sodium benzoate. Compound (B) reacts with KOH / $NH_2NH_2$ yielding a hydrocarbon (C) $C_8H_{10}$. Write the structures of compound (B) & (C). Based on this information to isomeric structures can be proposed for alkene (A). Write their structure and identify the isomer which on catalytic hydrogenation ($H_2$/Pd–C) gives a racemic mixture. **[IIT-JEE 2001(M), 5/60]**

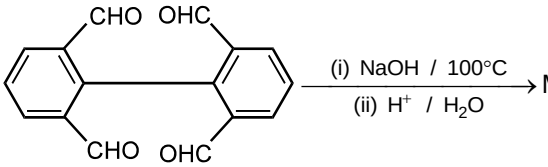
**3.** Compound 'A' (molecular formula $C_3H_8O$) is treated with acidified potassium dichromate to form a product 'B' (mol. Formula $C_3H_6O$). 'B' forms a shining silver mirror on warming with ammonical $AgNO_3$. 'B' when treated with an aqueous solution of $H_2NCONHNH_2$, HCl & sodium acetate gives a product 'C'. Identify the structure of 'C'. **[IIT-JEE 2002(S), 3/90]**

(A) $CH_3CH_2CH = NNHCONH_2$

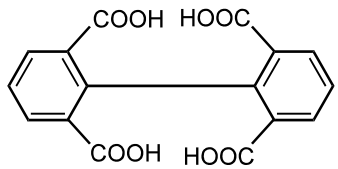
(B) $CH_3-\overset{CH_3}{\overset{|}{C}}=N-CONHNH_2$

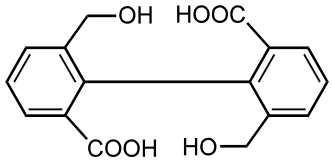
(C) $CH_3-CH = N.NH-CONH_2$

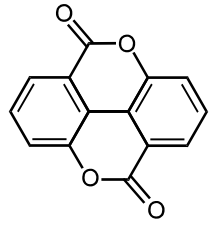
(D) $CH_3CH_2CH = NCONHNH_2$

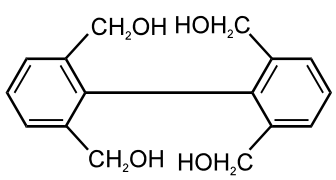
**4.** 

Major Product is **[IIT-JEE 2003(S), 3/84]**

(A) 


(B) 


(C) 


(D) 

**5.** $A\ (C_6H_{12}) \xrightarrow{HCl} B + C$
$(C_6H_{13}Cl)$

$B \xrightarrow{alc\ KOH} D$ (isomer of A)

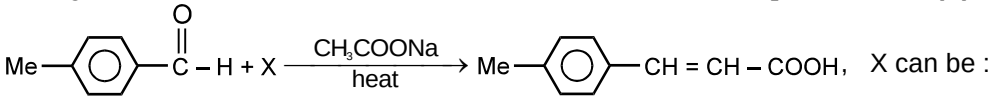
$D \xrightarrow{ozonolysis} E$ (it gives negative test with Fehling solution but responds to iodoform test).

$A \xrightarrow{ozonolysis} F + G$ (both give positive Tollen's test but do not give iodoform test).

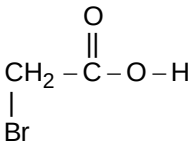
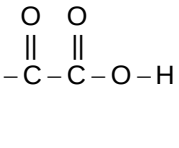
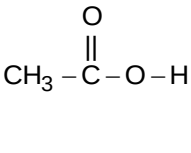
$F + G \xrightarrow{conc.\ NaOH} HCOONa$ + a primary alcohol

Identify to A to G. **[IIT-JEE 2003(M), 4/60]**

**6.** In the following reaction **[IIT-JEE 2005(S), 3/84]**

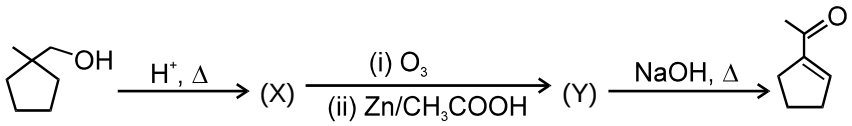



X can be :

(A)  (B)  (C)  (D) $(CH_3CO)_2O$

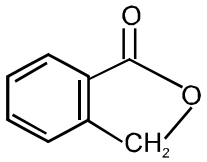
**7.** In conversion of 2-butanone to propanoic acid which reagent is used. **[IIT-JEE 2005(S), 3/84]**

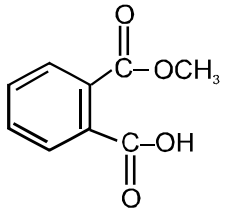
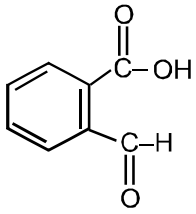
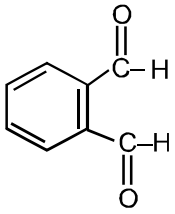
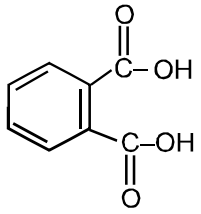
(A) NaOH, NaI / $H^{\oplus}$ (B) Fehling solution (C) NaOH, $I_2$ / $H^{\oplus}$ (D) Tollen's reagent

**8.** 

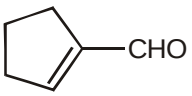
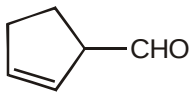
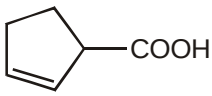
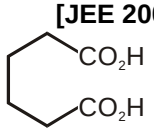

Identify X and Y. **[IIT-JEE-2005(M), 2/60]**

**9.** Which of the following reagent on reaction with conc. NaOH followed by acidification gives following lactone as the : **[IIT-JEE 2006, 5/184]**



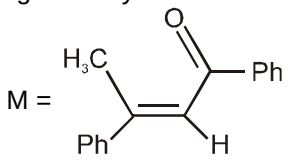

(A)  (B)  (C)  (D) 

**10.** Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatment with aqueous KOH yields compound F. Compound F is : **[JEE 2007, 3/162]**

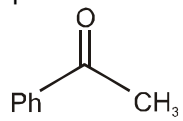
(A)  (B)  (C)  (D) 

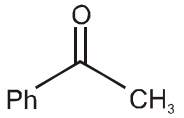
**Comprehension # 1**

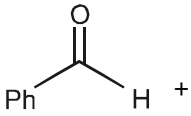
A tetriary alcohol **H** upon acid catalysed dehydration gives a product **I**. Ozonolysis of **I** leads to compounds **J** and **K**. Compound **J** upon reaction with KOH gives benzyl alcohol and compound **L**, whereas **K** on reaction with KOH gives only **M**.

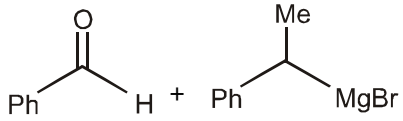
M = 

**11.** Compound **H** is formed by the reaction of **[JEE 2008, 4/163]**

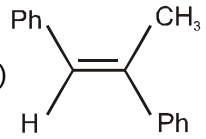
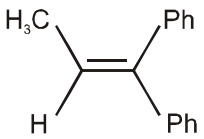
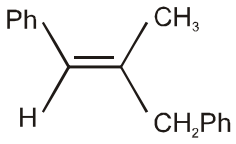
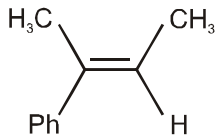
(A)  + PhMgBr

(B)  + $PhCH_2MgBr$

(C)  + $PhCH_2MgBr$

(D) 

**12.** The structure of compound **I** is **[JEE 2008, 4/163]**

(A)  (B)  (C)  (D) 

**13.** The structure of compounds **J**, **K** and **L** respecitvely, are : **[JEE 2008, 4/163]**

(A) $PhCOCH_3$, $PhCH_2COCH_3$ and $PhCH_2COO^-K^+$

(B) PhCHO, $PhCH_2CHO$ and $PhCOO^-K^+$

(C) $PhCOCH_3$, $PhCH_2CHO$ and $CH_3COO^-K^+$

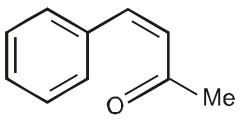
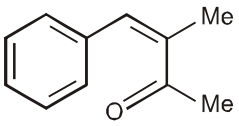
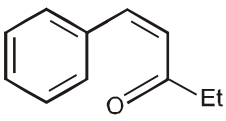
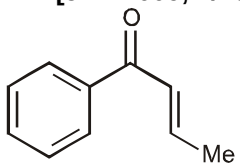
(D) PhCHO, $PhCOCH_3$ and $PhCOO^-K^+$

**Comprehension # 2**

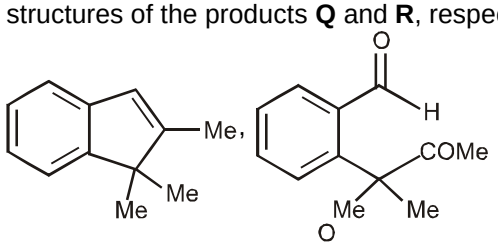
A carbonyl compound **P**, which gives positive iodoform test, undergoes reaction with MeMgBr followed by dehydration to give an olefin **Q**. Ozonolysis of **Q** leads to a dicarbonyl compound **R**, which undergoes intramolecular aldol reaction to give predominantly **S**.

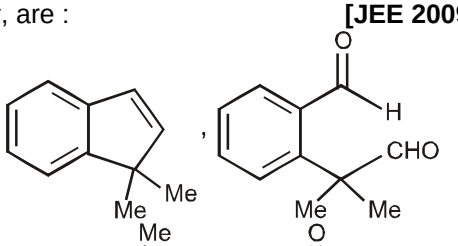
$$\mathbf{P} \xrightarrow[2.\ H^+,\ H_2O \\ 3.\ H_2SO_4,\ \Delta]{1.\ MeMgBr} \mathbf{Q} \xrightarrow[2.\ Zn,\ H_2O]{1.\ O_3} \mathbf{R} \xrightarrow[2.\ \Delta]{1.\ OH^-} \mathbf{S}$$

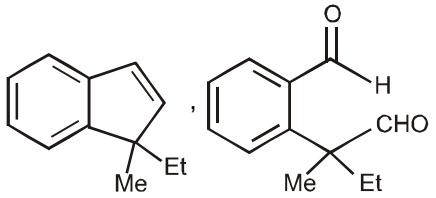
**14.** The structure of the carbonyl compound **P** is : **[JEE 2009, 4/160]**

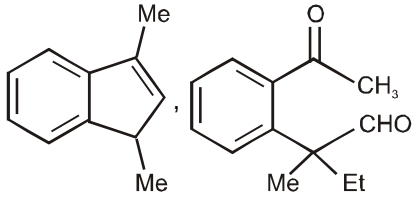
(A)  (B)  (C)  (D) 

**15.** The structures of the products **Q** and **R**, respectively, are : **[JEE 2009, 4/160]**

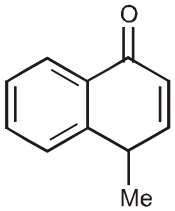
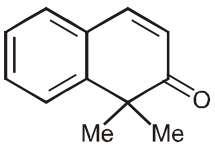
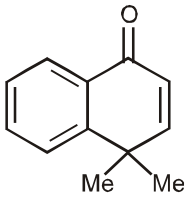
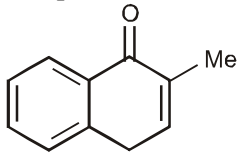
(A) 

(B) 

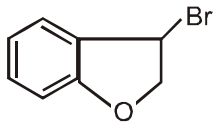
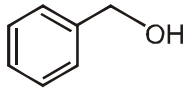
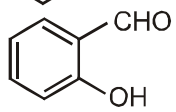
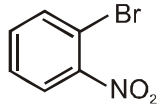
(C) 

(D) 

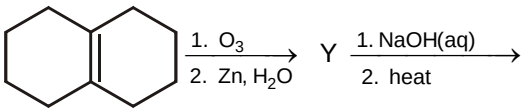
**16.** The structure of the product **S** is : **[JEE 2009, 4/160]**

(A)  (B)  (C)  (D) 

**17.** Match each of the compounds given in **Column I** with the reaction(s), that they can undergo, given in **column II.** **[JEE-2009, 8/160]**

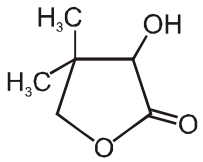
| **Column I** | | **Column II** | |
|---|---|---|---|
| (A) |  | (p) | Nucleophilic substitution |
| (B) |  | (q) | Elimination |
| (C) |  | (r) | Nucleophilic addition |
| (D) |  | (s) | Esterification with acetic anhydride |
| | | (t) | Dehydrogenation |

**18.** In the scheme given below, the total number of intramolecular aldol condensation products formed from 'Y' is: **[JEE 2010, 3/163]**

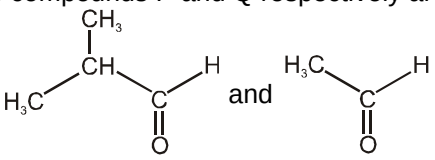


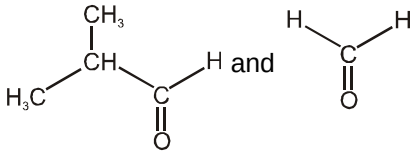

**Comprehension # 3**

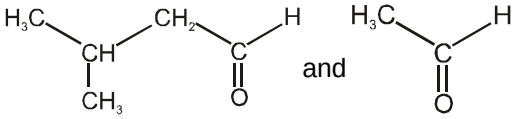
Two aliphatic aldehydes P and Q react in the presence of aqueous $K_2CO_3$ to give compound R, which upon treatment with HCN provides compound S. On acidification and heating, S gives the product shown below :

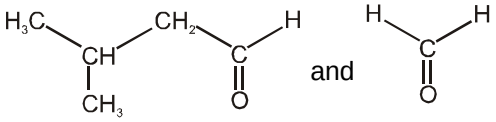


**19.** The compounds P and Q respectively are : **[JEE 2010, 3/163]**

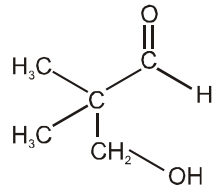
(A)  and

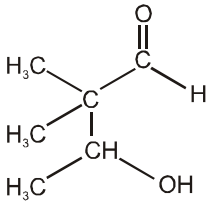
(B)  and

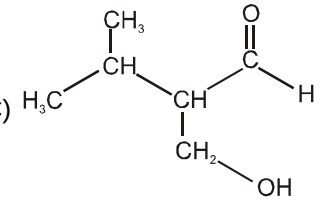
(C)  and

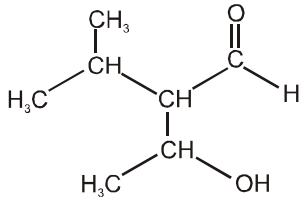
(D)  and

**20.** The compound R is : **[JEE 2010, 3/163]**

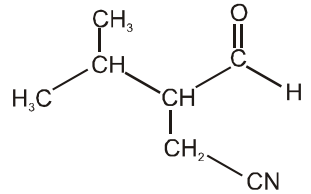
(A) 

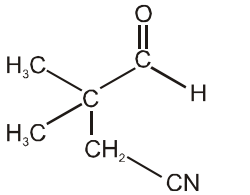
(B) 

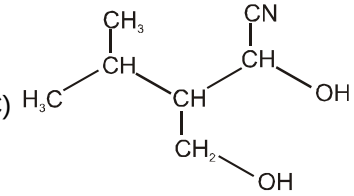
(C) 

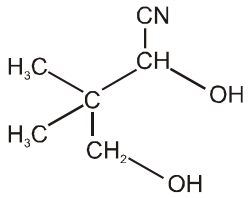
(D) 

**21.** The compound S is : **[JEE 2010, 3/163]**

(A) 

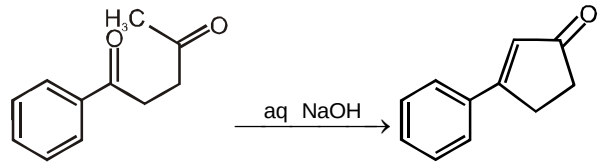
(B) 

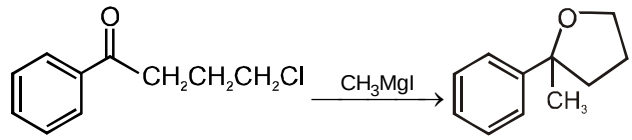
(C) 

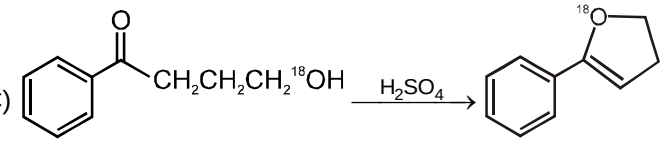
(D) 

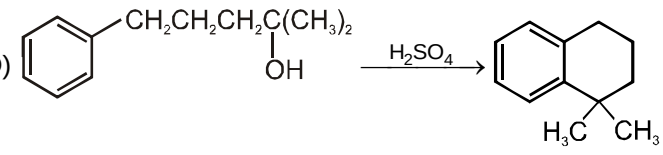
**22.** Match the reactions in **column I** with appropriate type of steps/reactive intermediate involved in these reactions as given in **column II** **[JEE 2011, 8/160]**

**Column I**

(A) 

(B) 

(C) 

(D) 

**Column II**

(p) Nucleophilic substitution

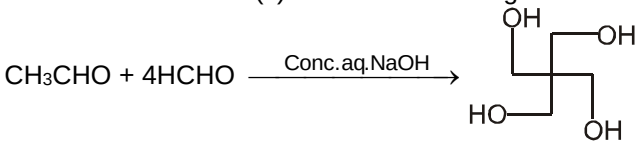
(q) Electrophilic substitution

(r) Dehydration

(s) Nucleophilic addition

(t) Carbanion

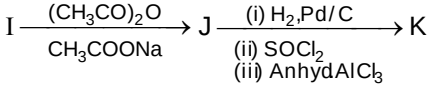
**23.** The number of aldol reaction (s) that occurs in the given transformation is : **[IIT-JEE 2012, 3/136]**




(A) 1 (B) 2 (C) 3 (D) 4

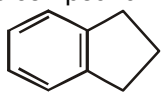
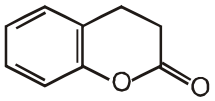
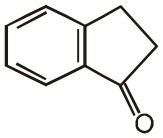
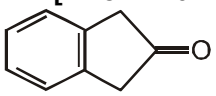
**Comprehension # 4**

In the following reactions sequence, the compound J is an intermediate.

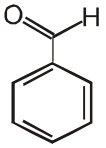
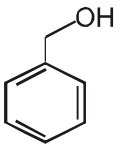
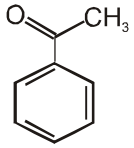
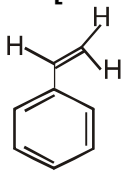



J ($C_9H_8O_2$) gives effervescence on treatment with $NaHCO_3$ and positive Baeyer's test

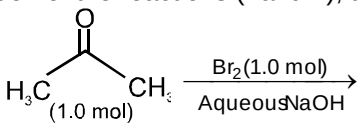
**24.** The compound K is **[IIT-JEE 2012, 3/136]**

(A)  (B)  (C)  (D) 

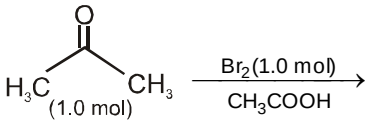
**25.** The compound I is **[IIT-JEE 2012, 3/136]**

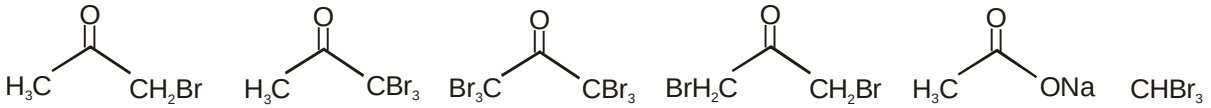
(A)  (B)  (C)  (D) 

**26.** After completion of the reactions (**I** and **II**), the organic compound(s) in the reaction mixtures is (are)

**Reaction I :** 

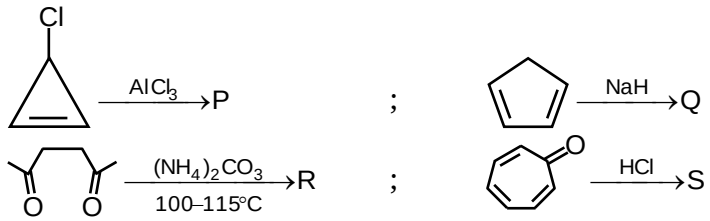
**[IIT-JEE 2013, 3/120]**

**Reaction II :** 


**P** **Q** **R** **S** **T** **U**

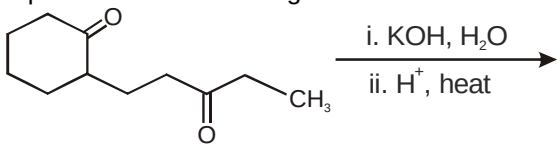
(A) Reaction **I** : **P** and Reaction **II** : **P**
(B) Reaction **I** : **U**, acetone and Reaction **II** : **Q**, acetone
(C) Reaction **I** : **T**, **U**, acetone and Reaction **II** : **P**
(D) Reaction **I** : **R**, acetone and Reaction **II** : **S**, acetone

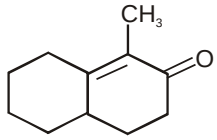
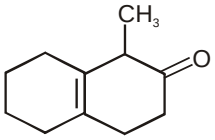
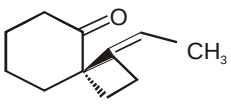
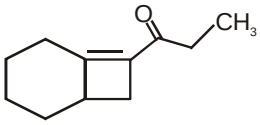
**27.*** 


Among **P**, **Q**, **R** and **S**, the aromatic compound(s) is/are : **[IIT-JEE 2013, 4/120]**

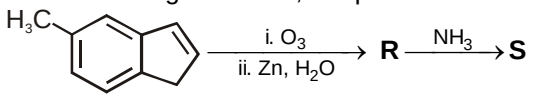
(A) P (B) Q (C) R (D) S

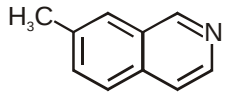
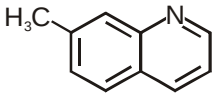
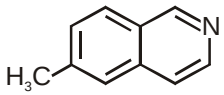
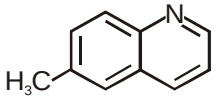
**28.** The major product of the following reaction is : **[JEE(Adv.)-2015, 4/168]**



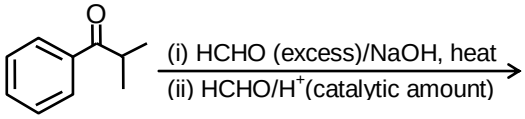

(A)  (B)  (C)  (D) 

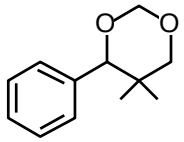
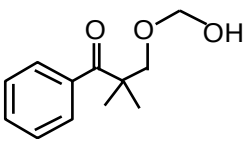
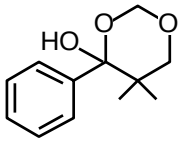
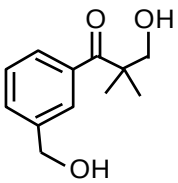
**29.** In the following reactions, the product **S** is **[JEE(Adv.)-2015, 4/168]**



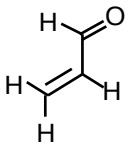
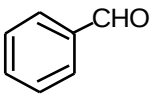
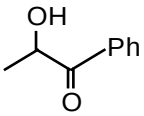
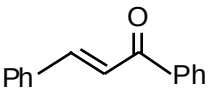

(A)  (B)  (C)  (D) 

**30.** The major product of the following reaction sequence is **[JEE(Adv.)-2016, 3/124]**

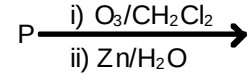


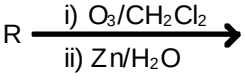

(A)  (B)  (C)  (D) 

**31.*** Positive Tollen's test is observed for : **[JEE(Adv.)-2016, 4/124]**

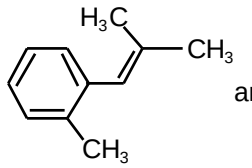
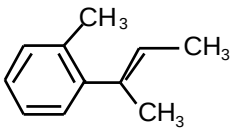
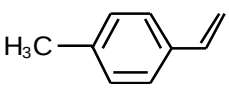
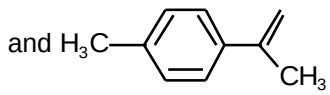
(A)  (B)  (C)  (D) 

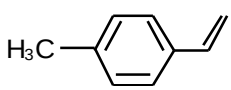
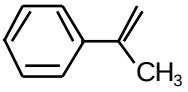
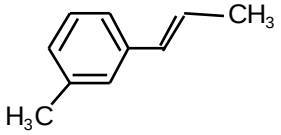
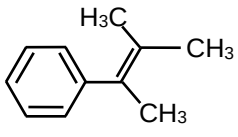
**32.*** Compound **P** and **R** upon ozonolysis produce **Q** and **S**, respectively. The molecular formula of **Q** and **S** is $C_8H_8O$. **Q** undergoes Cannizzaro reaction but not haloform reaction, whereas S undergoes haloform reaction but not Cannizzaro reaction.

(i) 


(ii) 

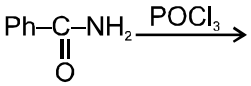

The options(s) with suitable combination of **P** and **R**, respectively, is(are) : **[JEE(Adv.)-2017, 4/122]**

(A)  and  (B)  and 

(C)  and  (D)  and 

## CARBOXYLIC ACID & DERIVATIVES

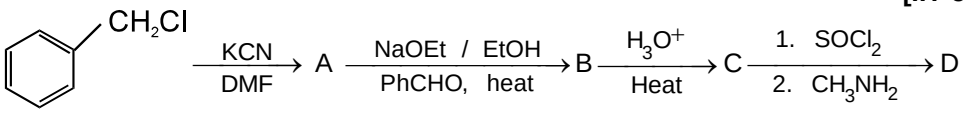
**33.** There is a solution of p-hydroxy benzoic acid and p-amino benzoic acid. Discuss one method by which we can separate them and also write down the confirmatory test of the functional groups present.
**[JEE-2003, 4/60]**

**34.**  Product,

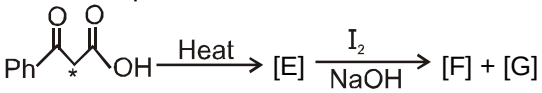
product is : **[IIT-JEE 2004, 3/84]**

(A) Benzonitrile (B) Benzamine
(C) Chloro benzene (D) Aniline

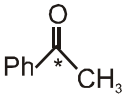
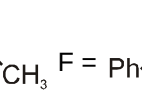
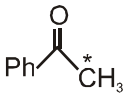
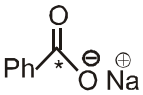
**35.** Identify the structure of the major products A, B, C and D formed in the following sequence of reactions
**[IIT-JEE 2004(M), 2/60]**

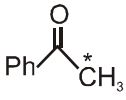
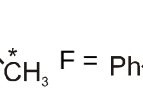
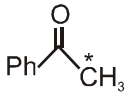
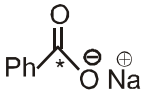


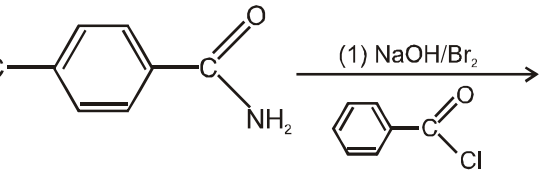
**36.** In the following reaction sequence, the correct structures of E, F and G are : **[JEE 2008, 3/163]**



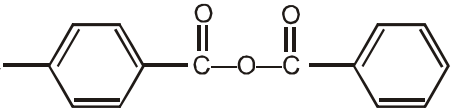
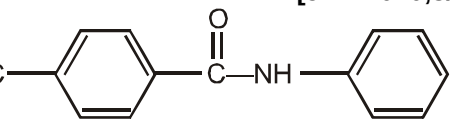
(*implies $^{13}C$ labelled carbon)

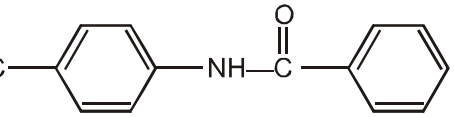
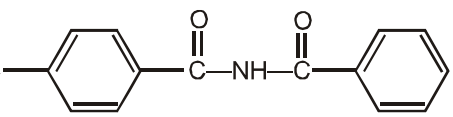
(A) E =  F =  G = $CHI_3$ (B) E =  F =  G = $CHI_3$

(C) E =  F =  G = $\overset{*}{C}HI_3$ (D) E =  F =  G = $CH_3I$

**37.** In the reaction  T, the strucutre of the Product T is :

**[JEE-2010,3/163]**

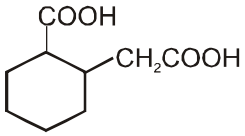
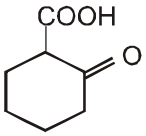
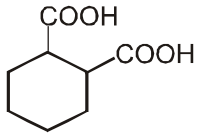
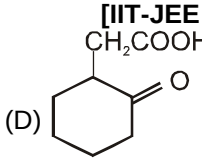
(A)  (B) 

(C)  (D) 

**38.** The carboxyl functional group (– COOH) is present in : **[JEE-2012]**

(A) picric acid (B) barbituric acid (C) ascorbic acid (D) aspirin

**39.** The compound that undergoes decarboxylation most readily under mild condition is
**[IIT-JEE 2012, 3/136]**

(A)  (B)  (C)  (D) 

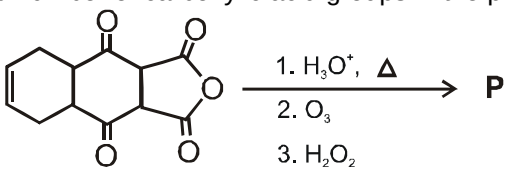
**40.** The major product H in the given reaction sequence is **[IIT-JEE 2012, 3/136]**

$$CH_3–CH_2–CO–CH_3 \xrightarrow{\ominus CN} G \xrightarrow[\text{Heat}]{95\%\ H_2SO_4} H$$

(A) $CH_3–CH=C(CH_3)–COOH$ (B) $CH_3–CH=C(CH_3)–CN$

(C) $CH_3–CH_2–C(OH)(CH_3)–COOH$ (D) $CH_3–CH=C(CH_3)–CO–NH_2$

**41.** The total number of carboxylic acid groups in the product **P** is : **[JEE(Advanced)-2013, 4/120]**




**Answer Q.42, Q.43 and Q.44 by appropriately matching the information given in the three columns of the following table.**

Columns 1, 2 and 3 contain starting materials, reaction conditions, and type of reactions, respectively.

| **Column 1** | **Column 2** | **Column 3** |
|---|---|---|
| (I) Toluene | (i) $NaOH/Br_2$ | (P) Condensation |
| (II) Acetophenone | (ii) $Br_2/h\nu$ | (Q) Carboxylation |
| (III) Benzaldehyde | (iii) $(CH_3CO)_2O/CH_3COOK$ | (R) Substitution |
| (IV) Phenol | (iv) $NaOH/CO_2$ | (S) Haloform |

**42.** The only CORRECT combination in which the reaction proceeds through radical mechanism is : **[JEE(Adv.)-2017, 3/122]**

(A) (IV) (i) (Q) (B) (III) (ii) (P) (C) (II) (iii) (R) (D) (I) (ii) (R)

**43.** For the synthesis of benzoic acid, the only CORRECT combination is : **[JEE(Adv.)-2017, 3/122]**

(A) (II) (i) (S) (B) (I) (iv) (Q) (C) (IV) (ii) (P) (D) (III) (iv) (R)

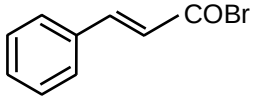
**44.** The only CORRECT combination that gives two different carboxylic acids is : **[JEE(Adv.)-2017, 3/122]**

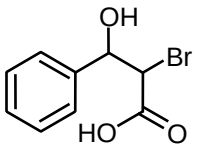
(A) (IV) (iii) (Q) (B) (II) (iv) (R) (C) (I) (i) (S) (D) (III) (iii) (P)

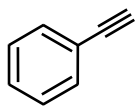
**Comprehension # 5**

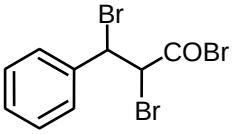
Treatment of benzene with CO/HCl in the presence of anhydrous $AlCl_3/CuCl$ followed by reaction with $Ac_2O/NaOAc$ gives compound **X** as the major product. Compound **X** upon reaction with $Br_2/Na_2CO_3$, followed by heating at 473 K with moist KOH furnishes **Y** as the major product. Reaction of **X** with $H_2$/Pd-C, followed by $H_3PO_4$ treatment gives **Z** as the major product.

**45.** The compound **Y** is **[JEE(Advanced)-2018, 3/120]**

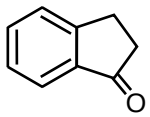
(A) 

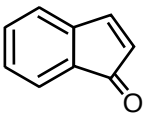

(B) 

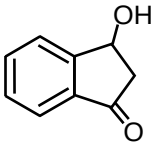

(C) 

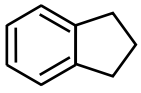
(D) 


**46.** The compound **Z** is **[JEE(Advanced)-2018, 3/120]**

(A) 

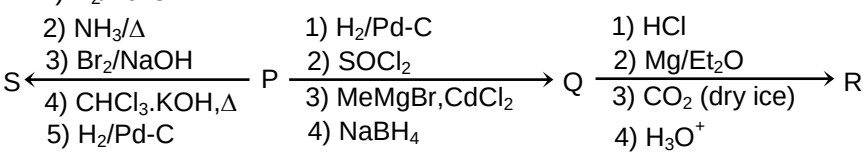

(B) 


(C) 

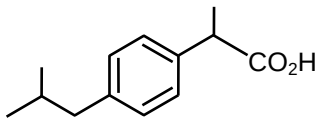

(D) 

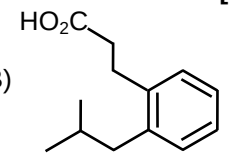
**Comprehension # 6**

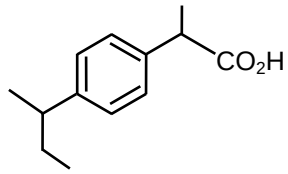
An organic acid **P** ($C_{11}H_{12}O_2$) can easily be oxidized to a dibasic acid which reacts with ethyleneglycol to produce a polymer Dacron. Upon ozonolysis, **P** gives an aliphatic ketone as one of the products. **P** undergoes the following reaction sequences to furnish **R** *via* **Q**. The compound **P** also undergoes another set of reactions to produce **S**.

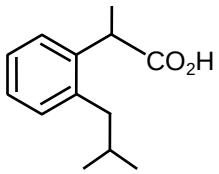



**47.** The compound **R** is **[JEE(Advanced)-2018, 3/120]**

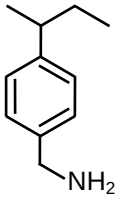
(A) 

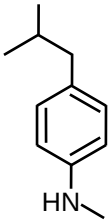
(B) 

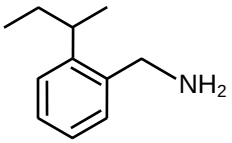
(C) 

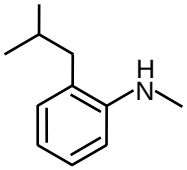
(D) 

**48.** The compound **S** is **[JEE(Advanced)-2018, 3/120]**

(A) 

(B) 

(C) 

(D) 

# PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

## OFFLINE JEE-MAIN

## ALDEHYDES & KETONES

**1.** Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid ? **[AIEEE-2004, 3/225]**

(1) Phenol (2) Benzoic acid (3) Butanal (4) Benzaldehyde

**2.** The compound formed on heating chlorobenzene with chloral in the presence of concentrated sulphuric acid is **[AIEEE-2004, 3/225]**

(1) gammexene (2) DDT (3) freon (4) hexachloroethane.

**3.** Reaction of cyclohexanone with dimethylamine in the presence of catalytic amount of an acid forms a compound if water during the reaction is continuously removed. The compound formed is generally known as **[AIEEE-2005, 4½/225]**

(1) Amine (2) Imine (3) Enamine (4) Schiff's base

**4.** In the following sequence of reactions, **[AIEEE-2007, 3/120]**

$CH_3CH_2OH \xrightarrow{P+I_2} A \xrightarrow[Ether]{Mg} B \xrightarrow{HCHO} C \xrightarrow{H_2O} D$. The compound 'D' is

(1) n-propyl alcohol (2) propanal (3) butanal (4) n-butyl alcohol

**5.** In Cannizzaro reaction given below **[AIEEE-2009, 4/144]**

$$2Ph\,CHO \xrightarrow{\overset{\Theta}{:}OH} PhCH_2OH + PhCO_2^{\Theta}$$

the slowest step is :

(1) the transfer of hydride to the carbonyl group (2) the abstraction of proton from the carboxylic group

(3) the deprotonation of $PhCH_2OH$ (4) the attack of : $\overset{\Theta}{O}H$ at the carboxyl group

**6.** Trichloroacetaldehyde was subjected to Cannizzaro's reaction by using NaOH. The mixture of the products contains sodium trichloroacetate ion and another compound. The other compound is : **[AIEEE 2011, 4/120]**

(1) 2, 2, 2–Trichloroethanol (2) Trichloromethanol

(3) 2, 2, 2–Trichloropropanol (4) Chloroform

**7.** Ozonolysis of an organic compound 'A' produces acetone and propionaldehyde in equimolar mixture. Identify 'A' from the following compounds : **[AIEEE 2011, 4/120]**

(1) 1-Pentene (2) 2-Pentene

(3) 2-Methyl-2-pentene (4) 2-Methyl-1-pentene

**8.** Iodoform can be prepared from all except : **[AIEEE 2012, 4/120]**

(1) Ethyl methyl ketone (2) Isopropyl alcohol

(3) 3-Methyl-2-butanone (4) Isobutyl alcohol

## CARBOXYLIC ACID & DERIVATIVES

**9.** On vigorous oxidation by permangnate solution $(CH_3)_2C = CHCH_2CHO$ gives **[AIEEE-2002, 3/225]**

(1) $(CH_3)_2CO$ and $OHCCH_2CHO$ (2) $(CH_3)_2C(OH)-CH(OH)CH_2CHO$

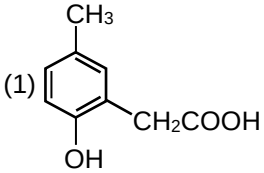
(3) $(CH_3)_2CO$ and $OHCCH_2COOH$ (4) $(CH_3)_2CO$ and $CH_2(COOH)_2$

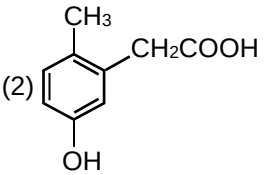
**10.** End product of the following reaction is : **[AIEEE-2002, 3/225]**

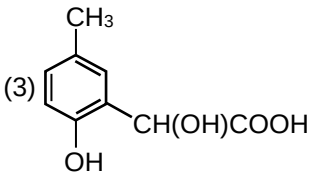
$$CH_3CH_2COOH \xrightarrow[\text{red P}]{Cl_2} \xrightarrow{\text{alcoholic KOH}}$$

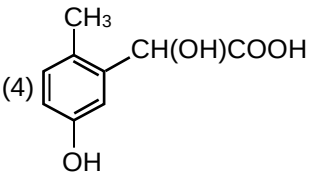
(1) $CH_3CH(OH)COOH$ (2) $CH_2(OH)CH_2COOH$ (3) $CH_2 = CHCOOH$ (4) $CH_2(Cl)CH(OH)COOH$

**11.** p-cresol reacts with chloroform in alkaline medium to give the compound A which adds hydrogen cyanide to form, the compound B. The latter on acidic hydrolysis gives chiral carboxylic acid. The structure of the carboxylic acid is : **[AIEEE-2005, 4½/225]**

(1) 

(2) 

(3) 

(4) 

**12.** An organic compound having molecular mass 60 is found to be contain C = 20%, H = 6.67% and N = 46.67% while rest is oxygen. On heating it gives $NH_3$ along with a solid residue. The solid residue give violet colour with alkaline copper sulphate solution. The compound is : **[AIEEE-2005, 4½/225]**

(1) $CH_3CH_2CONH_2$ (2) $(NH_2)_2CO$ (3) $CH_3CONH_2$ (4) $CH_3NCO$

**13.** A liquid was mixed with ethanol and a drop of concentrated $H_2SO_4$ was added. A compound with a fruity smell was formed. The liquid was : **[AIEEE-2009, 4/144]**

(1) HCHO (2) $CH_3COCH_3$ (3) $CH_3COOH$ (4) $CH_3OH$

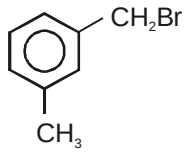
**14.** A compound with molecular mass 180 is acylated with $CH_3COCl$ to get a compound with molecular mass 390. The number of amino groups present per molecule of the former compound is :

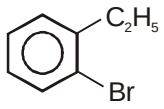
**[JEE(Main)-2013, 4/120]**

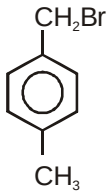
(1) 2 (2) 5 (3) 4 (4) 6

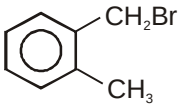
**15.** Compound (A), $C_8H_9Br$, gives a white precipitate when warmed with alcoholic $AgNO_3$. Oxidation of (A) gives an acid (B), $C_8H_6O_4$. (B) easily forms anhydride on heating. Identify the compound (A).

**[JEE(Main)-2013, 4/120]**

(1) 

(2) 

(3) 

(4) 

## JEE(MAIN) ONLINE PROBLEMS

## ALDEHYDES & KETONES

**1.** Which one of the following reactions will not result in the formation of carbonation bond ?

**[JEE(Main) 2014 Online (09-04-14), 4/120]**

(1) Reimer-Tieman reaction (2) Friedel Craft's acylation

(3) Wurtz reaction (4) Cannizzaro reaction

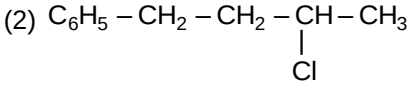
**2.** Tischenko reaction is a modification of **[JEE(Main) 2014 Online (11-04-14), 4/120]**

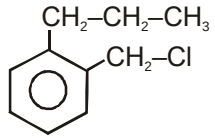
(1) Aldol condensation (2) Claisen condensation

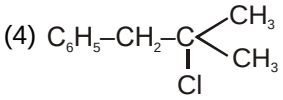
(3) Cannizzaro reaction (4) Pinacol-pinacolone reaction

**3.** A compound A with molecular formula $C_{10}H_{13}Cl$ give a white precipitate on adding silver nitrate solution. A on reacting with alcoholic KOH gives compound B as the main product. B on ozonolysis gives C and D. C gives Cannizaro reaction but not aldol condensation. D gives aldol condensation but not Cannizaro reaction. A is : **[JEE(Main) 2015 Online (10-04-15), 4/120]**

(1) $C_6H_5–CH_2–CH_2–CH_2–CH_2–Cl$

(2) 

(3) 

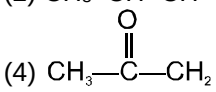
(4) 

**4.** In the reaction sequence

$2CH_3CHO \xrightarrow{OH^-} A \xrightarrow{\Delta} B$; the product B is :

**[JEE(Main) 2015 Online (11-04-15), 4/120]**

(1) $CH_3–CH_2–CH_2–CH_2–OH$ (2) $CH_3–CH=CH–CHO$

(3) $CH_3–CH_2–CH_2–CH_3$ (4) 

**5.** The correct statement about the synthesis of erythritol ($C(CH_2OH)_4$) used in the preparation of PETN is:

**[JEE(Main) 2016 Online (10-04-16), 4/120]**

(1) The synthesis requires two aldol condensations and two Cannizzaro reactions.

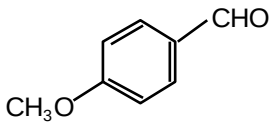
(2) Alpha hydrogens of ethanol and methanol are involved in this reaction.

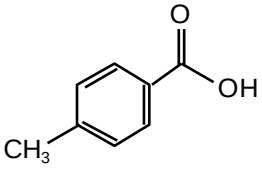
(3) The synthesis requires four aldol condensations between methanol and ethanol.

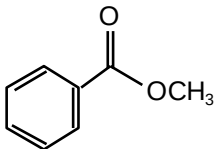
(4) The synthesis requires three aldol condensations and one Cannizzaro reaction.

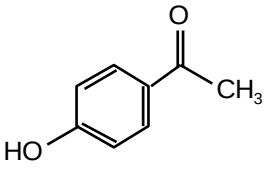
**6.** A compound of molecular formula $C_8H_8O_2$ reacts with acetophenone to form a single cross-aldol product in the presence of base. The same compound on reaction with conc. NaOH forms benzyl alcohol as one of the products. The structure of the compound is :

**[JEE(Main) 2017 Online (09-04-17), 4/120]**

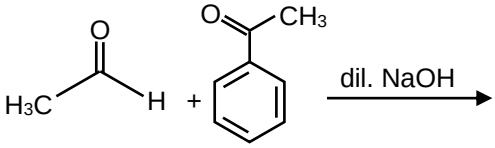
(1) 

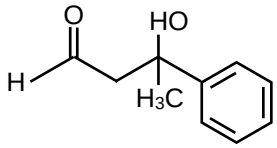
(2) 

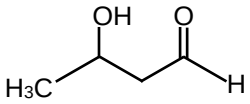
(3) 

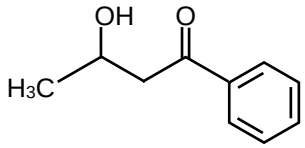
(4) 

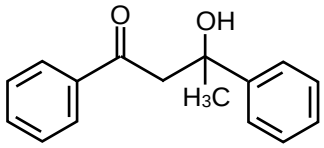
**7.** The major product formed in the following reaction is : **[JEE(Main) 2019 Online (09-01-19), 4/120]**



(1) 

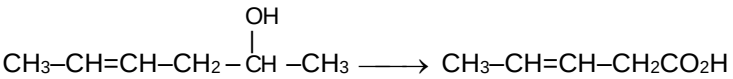
(2) 

(3) 

(4) 

**8.** Which is the most suitable reagent for the following transformation?

**[JEE(Main) 2019 Online (10-01-19), 4/120]**

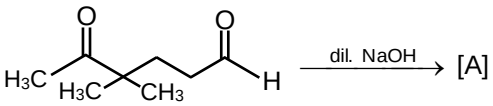


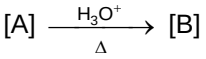
(1) $CrO_2Cl_2/CS_2$ (2) alkaline $KMnO_4$

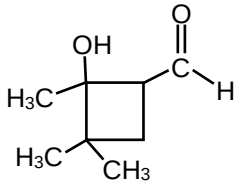
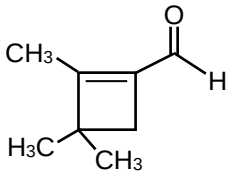
(3) Tollen's reagent (4) $I_2$/NaOH

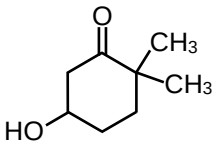
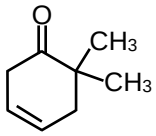
**9.** In the following reactions, products A and B are :

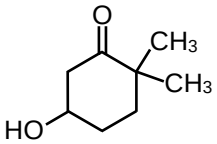
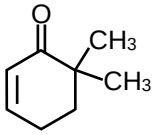
**[JEE(Main) 2019 Online (12-01-19), 4/120]**

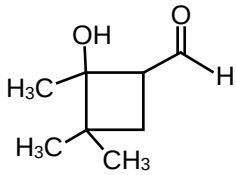
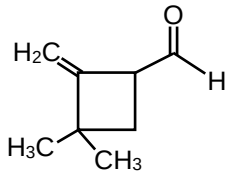



(1) (A) =  ; (B) = 

(2) (A) =  ; (B) = 

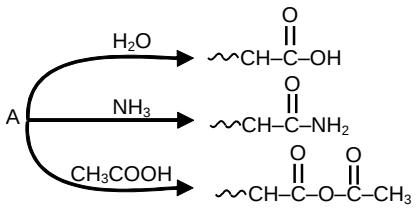
(3) (A) =  ; (B)= 

(4) (A) =  ; (B) = 

## CARBOXYLIC ACID & DERIVATIVES

**10.** An organic compound A, $C_5H_8O$; reacts with $H_2O$, $NH_3$ and $CH_3COOH$ as described below, A is :

**[JEE(Main) 2014 Online (11-04-14), 4/120]**




(1) $CH_3CH=\underset{\displaystyle CH_3}{\overset{|}{C}}-CHO$

(2) $CH_2=CH\underset{\displaystyle CH_3}{\overset{|}{C}}H-CHO$

(3) $CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{|}{C}}=C=O$

(4) $CH_3-CH_2-\underset{\displaystyle CH_2}{\overset{||}{C}}-\underset{\displaystyle H}{\overset{|}{C}}=O$

**11.** Among the following organic acids, the acid present in rancid butter is :

**[JEE(Main) 2014 Online (19-04-14), 4/120]**

(1) Pyruvic acid (2) Lactic acid (3) Butyric acid (4) Acetic acid

**12.** In the presence of small amount of phosphorous, aliphatic carboxylic acids react with chlorine or bromine to yield a compound in which $\alpha$-hydrogen has been replaced by halogen. This reaction is known as :

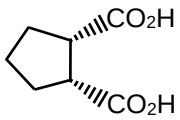
**[JEE(Main) 2015 Online (10-04-15), 4/120]**

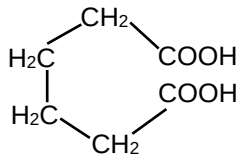
(1) Wolff-Kishner reaction (2) Etard reaction

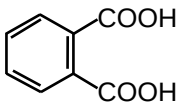
(3) Rosenmund reaction (4) Hell-Volhard-Zelinsky reaction

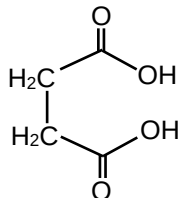
**13.** Which dicarboxylic acid in presence of a dehydrating agent is least reactive to give an anhydride?

**[JEE(Main) 2019 Online (10-01-19), 4/120]**

(1) 

(2) 

(3) 

(4) 

**14.** In the following reaction

Aldehyde + Alcohol $\xrightarrow{HCl}$ Acetal

| Aldehyde | Alcohol |
|---|---|
| HCHO | $^{t}$BuOH |
| $CH_3CHO$ | MeOH |

The best combination is :

**[JEE(Main) 2019 Online (12-01-19), 4/120]**

(1) HCHO and $^{t}$BuOH

(2) $CH_3CHO$ and $^{t}$BuOH

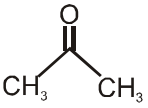
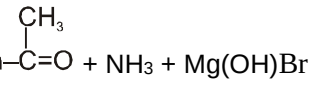
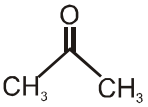
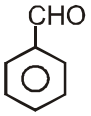
(3) HCHO and MeOH

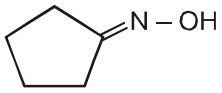
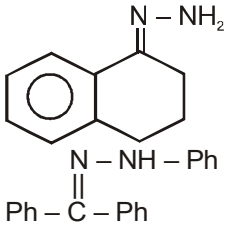
(4) $CH_3CHO$ and MeOH

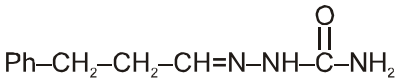
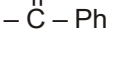
# Answers

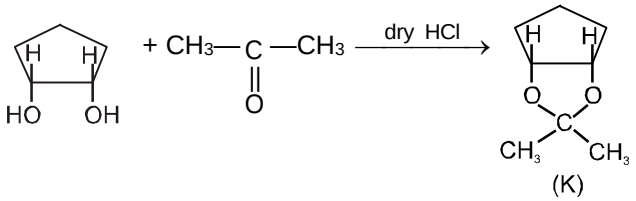
## EXERCISE - 1

### PART - I

**A-1.** (a)  (b)  (c)  (d) 

**B-1.** (a)  (b) 

(c)  (d) 

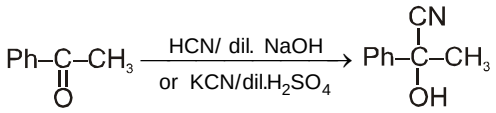
**B-2.** (a) 

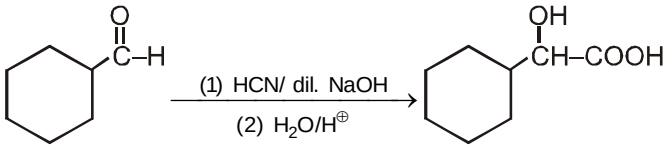
(K)

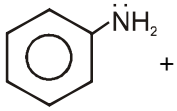
A cyclic ketal

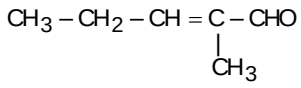
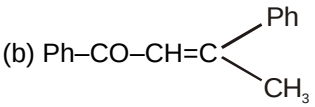
(b) The – OH groups in the trans isomer are too far apart to form cyclic structure.

**B-3.** IV > III > I > II

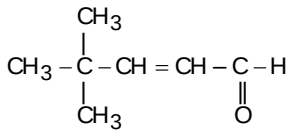
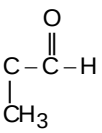
**B-4.** (a) 

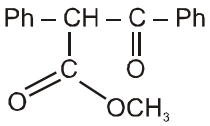
(b) 

**B-5.** (a)  + $CH_3–CHO$ (b) $H_2N – CH_2 – CH_2–CH_2–CH_2–CO–CH_3$

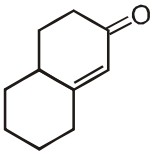
**C-1.** (a)  (b) 

**C-2.** (a) $CH_3CH_2CH_2CHO$ (b) $CH_3COCH_3$

**C-3.** (a)  (b) 

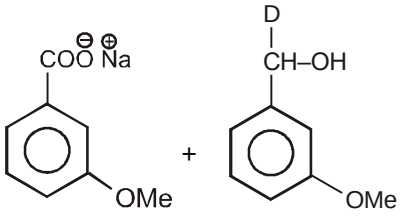
**C-4.** 

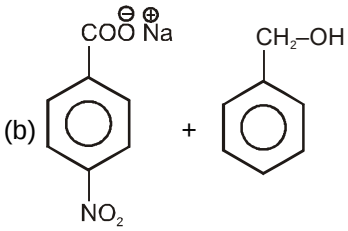
**C-5.** (a) HOOC–CH=HC–C$_6$H$_4$–CH=CH–COOH (b) $CH_3–CH=C(CN)_2$

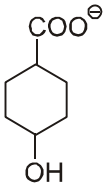
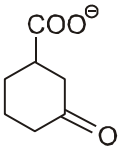
**C-6.** 

**D-1.** (P) = $D–C(=O)–O^{\ominus}$ (Q) = $D–CH_2–OH$

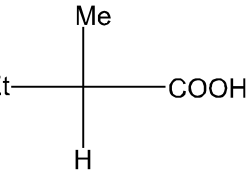
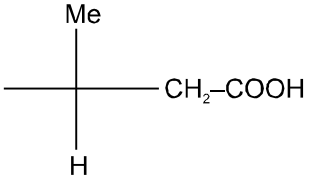
**D-2.** $HO–CH_2–C(CH_2–OH)_2–CH_2–OH + HCOO^-Na^+$

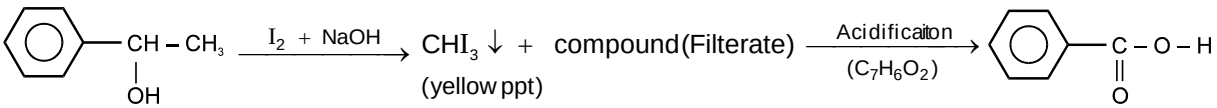
**D-3.** (a) 

(b) 

**D-4.** PhCH(OH)COOH **D-5.** HO–CH$_2$–COONa. **E-1.** (a)  (b) 

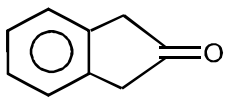
**F-1.** (a) $CHI_3 + HCOO^{\ominus}K^{\oplus}$ (b) $CHI_3 + PhCH_2COO^{\ominus}K^{\oplus}$ (c) $CHI_3$ + Ph–COOK

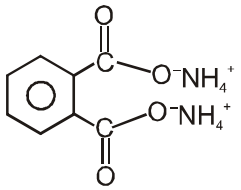
**G-1.** (X):  (Y) : 

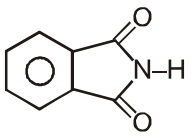
**G-2.** 

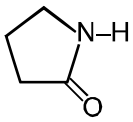
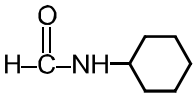
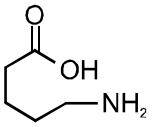
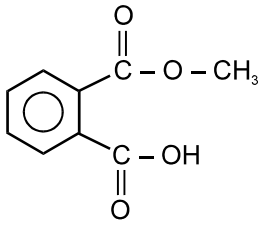

**H-1.** $CH_3–CH_2–\overset{14}{C}OOH$

**H-2.** X = $Cl_3C–C(=O)–OH$, Y = $Cl_3C–C(=O)–Cl$, Z = $Cl_3C–C(=O)–H$, W = $CHCl_3$, S = $HCOO^{\ominus}$

**H-3.** (X) = 

**I-1.** D = 
Ammonium phthalate

E = 
Phthalimide (a cyclic imide)

**I-2.** (a)  (b)  + $C_2H_5OH$ (c)  (d) 

## PART – II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **A-1.** | (A) | **A-2.** | (A) | **A-3.** | (C) | **A-4.** | (A) | **B-1.** | (B) |
| **B-2.** | (D) | **B-3.** | (A) | **B-4.** | (B) | **C-1.** | (A) | **C-2.** | (A) |
| **D-1.** | (A) | **D-2.** | (A) | **D-3.** | (C) | **D-4.** | (B) | **E-1.** | (A) |
| **E-2.** | (B) | **F-1.** | (D) | **F-2.** | (D) | **G-1.** | (A) | **G-2.** | (D) |
| **G-3.** | (A) | **G-4.** | (C) | **H-1.** | (C) | **H-2.** | (B) | **H-3.** | (A) |
| **H-4.** | (C) | **H-5.** | (C) | **H-6.** | (A) | **H-7.** | (B) | **H-8.** | (A) |
| **I-1.** | (B) | **I-2.** | (D) | | | | | | |

## PART – III

**1.** (A - p,q) ; (B - p,r) ; (C - q,s) ; (D - r,s) **2.** (A - s) ; (B - q) ; (C - p) ; (D - p, r)

# EXERCISE - 2

## PART - I

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (B) | **2.** | (B) | **3.** | (B) | **4.** | (D) | **5.** | (B) |
| **6.** | (B) | **7.** | (C) | **8.** | (A) | **9.** | (D) | **10.** | (C) |
| **11.** | (A) | **12.** | (D) | **13.** | (B) | **14.** | (A) | **15.** | (B) |
| **16.** | (C) | **17.** | (B) | **18.** | (B) | **19.** | (C) | **20.** | (C) |
| **21.** | (C) | **22.** | (C) | **23.** | (C) | | | | |

## PART - II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | 5(1,2,3,5,6) | **2.** | 2 | **3.** | 3 | **4.** | 9 | **5.** | 8 |
| **6.** | 5 (2,3,4,5,6) | | | | | | | | |

## PART - III

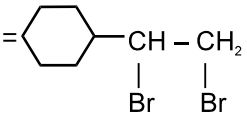
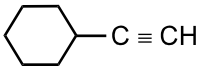
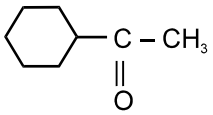
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (BCD) | **2.** | (ABCD) | **3.** | (ABD) | **4.** | (AC) | **5.** | (ABC) |
| **6.** | (ABD) | | | | | | | | |

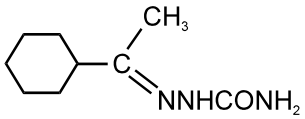
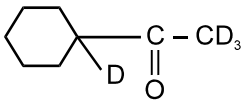
## PART - IV

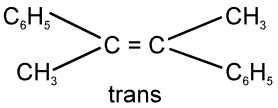
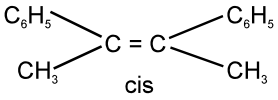
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (A) | **2.** | (B) | **3.** | (A) | **4.** | (D) | **5.** | (D) |
| **6.** | (D) | **7.** | (B) | **8.** | (C) | **9.** | (A) | **10.** | (C) |
| **11.** | (B) | **12.** | (D) | **13.** | (B) | **14.** | (D) | | |

# EXERCISE - 3

## PART - I

**1.** (A) =  (B) =  (C) = 

(D) =  (E) = 

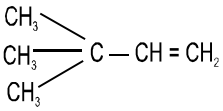
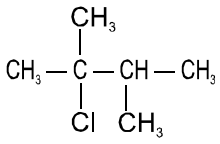
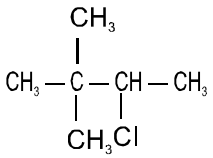
**2.** A =  or 

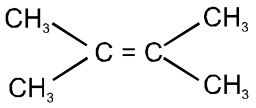
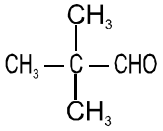
B = $C_6H_5 - \underset{\underset{O}{\|}}{C} - CH_3$

C = $C_6H_5 - CH_2 - CH_3$

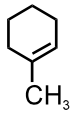
Trans isomer give racemic mixture.

**3.** (A) **4.** (B)

**5.** A =  B =  C = 

D =  E = $2\,CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$ F & G are HCHO , 

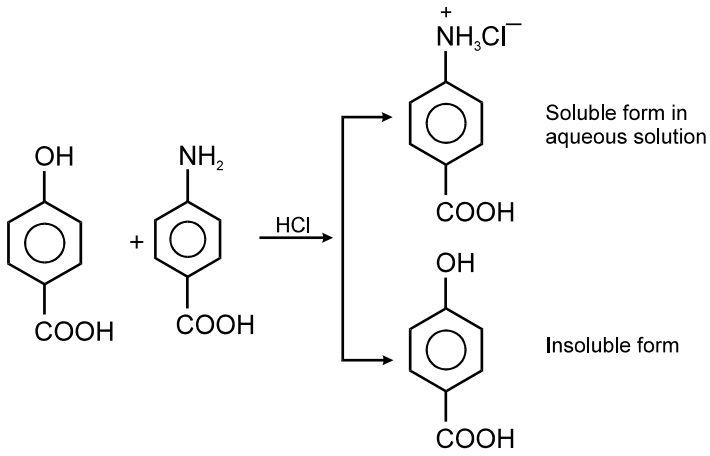
**6.** (D) **7.** (C)

**8.**  and $CH_3 - \underset{\underset{(Y)}{\|}}{\overset{O}{C}} - (CH_2)_4 - CH = O$

(X)

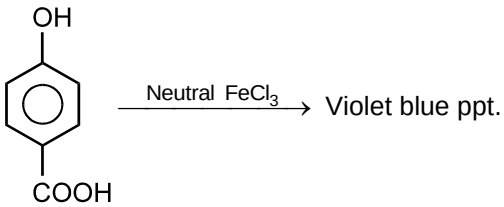
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **9.** | (C) | **10.** | (A) | **11.** | (B) | **12.** | (A) | **13.** | (D) |
| **14.** | (B) | **15.** | (A) | **16.** | (B) | | | | |
| **17.** | (A) - p, q, t ; (B) - p, s, t ; (C) - r, s ; (D) - p | | | | | **18.** | 1 | **19.** | (B* |
| **20.** | (A) | **21.** | (D) | **22.** | (A-r, s, t) ; (B-p, s) ; (C-r, s) ; (D-q, r) | | | **23.** | (C) |
| **24.** | (C) | **25.** | (A) | **26.** | (C) | **27.** | (ABCD) | **28.** | (A) |
| **29.** | (A) | **30.** | (A) | **31.** | (ABC) | **32.** | (CD) | | |

**33.**

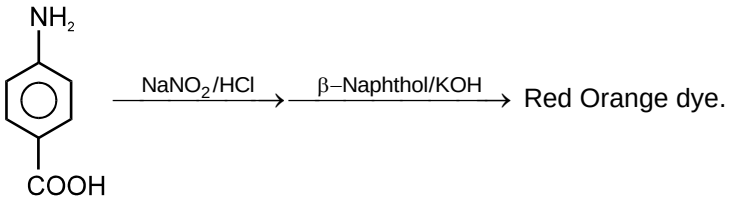



These can be separated by aq. HCl.

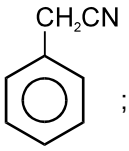
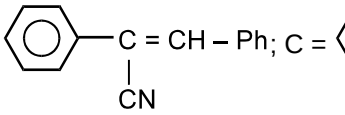
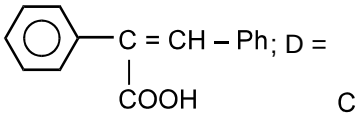
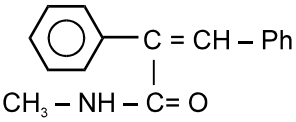
**Test : (1)**




**Test : (2)**




**34.** (A)

**35.** A =  ; B =  ; C =  ; D = 

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **36.** | (C) | **37.** | (C) | **38.** | (D) | **39.** | (B) | **40.** | (A) |
| **41.** | 2 | **42.** | (D) | **43.** | (A) | **44.** | (D) | **45.** | (C) |
| **46.** | (A) | **47.** | (A) | **48.** | (B) | | | | |

## PART - II
## JEE(MAIN) OFFLINE PROBLEMS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (4) | **2.** | (2) | **3.** | (3) | **4.** | (1) | **5.** | (1) |
| **6.** | (1) | **7.** | (3) | **8.** | (4) | **9.** | (4) | **10.** | (3) |
| **11.** | (3) | **12.** | (2) | **13.** | (3) | **14.** | (2) | **15.** | (4) |

## JEE(MAIN) ONLINE PROBLEMS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (4) | **2.** | (3) | **3.** | (4) | **4.** | (2) | **5.** | (4) |
| **6.** | (1) | **7.** | (3) | **8.** | (4) | **9.** | (3) | **10.** | (3) |
| **11.** | (3) | **12.** | (4) | **13.** | (2) | **14.** | (3) | | |