

REDUCTION, OXIDATION & HYDROLYSIS REACTIONS

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JEE(Advanced) Syllabus

Reduction of Alkenes, Alkynes, Alcohols, Aldehydes, Ketones, Acids, Acid halides, Esters, Amides Cyanide & Anhydrides.

Oxidation of Alkenes, Alkynes, Alcohols, Aldehydes, Ketones, Acids, Acid halides, Esters, Amides & Anhydrides.

Hydrolysis reaction of Acid halides, Esters, Amides, Anhydrides, Cyanides, Ethers etc.

JEE(Main) Syllabus

Reduction and oxidation reactions of Alkenes, Alkynes, Alcohols, Aldehydes, Ketones Cyanides, Acids & Acid derivatives.



Reduction, Oxidation & Hydrolysis Reactions

Section (A) : Reduction-1

Introduction :

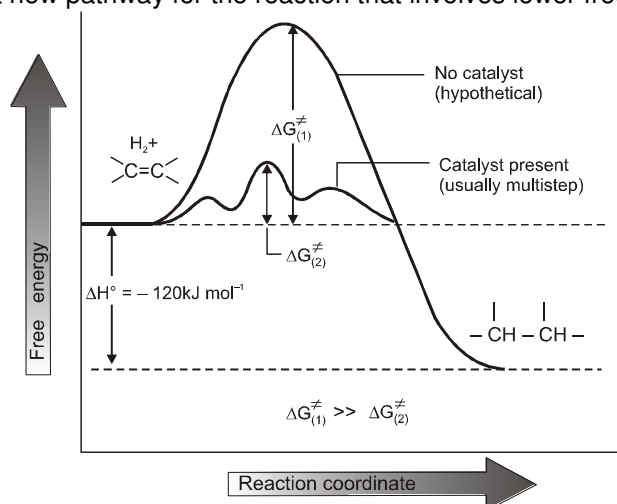
Reduction covers both the addition of hydrogen (or deuterium) to a double bond and the replacement of an atom or group by hydrogen (or deuterium). In other words, reduction means hydrogenation or hydrogenolysis.

Reduction can be carried out in following ways:

- | | |
|-------------------------------------|--|
| (a) Catalytic hydrogenation | (b) Metal/proton (acid) reduction |
| (c) Metal hydrides reduction | (d) Miscellaneous Reductions |

1.1 Catalytic hydrogenation :

Hydrogenation using $H_2(g)$ on metal surface or other suitable catalyst is called catalytic hydrogenation. A catalyst provides a new pathway for the reaction that involves lower free energy of activation.



Heterogeneous hydrogenation catalysts typically involve finely divided platinum.

The catalysts used can be divided into two broad classes, (a) Heterogeneous catalysts (b) Homogeneous catalysts. Both of which mainly consist of transition metals and their compounds :

(i) Heterogeneous catalysts : (catalysts insoluble in the reaction medium)

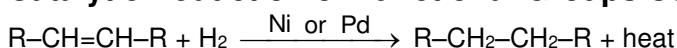
In heterogeneous catalytic hydrogenation catalysts are used in powdered form. Raney nickel (Ni), Palladium on charcoal (Pd/C), Platinum metal or its oxide are common heterogeneous catalysts.

Facts of catalysis :

- Substrate molecules are assumed to undergo homolysis into atoms at the surface of the catalyst.
- The substrate is chemisorbed on the surface of the catalyst and hydrogenation takes place.
- The process is exothermic.

Note : (If H_2 and D_2 mixture is used with a Pt catalyst, the two isotopes quickly scramble to produce a random mixture of HD, H_2 and D_2 . (No scrambling occurs in the absence of the catalyst.) The product has both D and H atoms).

Catalytic Reduction of Functional Groups Using $H_2/Pd(C)$ or H_2/Pt or H_2/Ni



Substrate	Product
$RCOCl$	RCH_2OH
RNO_2	RNH_2
$RC \equiv CR$	RCH_2CH_2R
$RCHO$	RCH_2OH
$RCH=CHR$	RCH_2CH_2R
$RCOR$	$RCHOHR$
RCN	RCH_2NH_2



Note : (i) Generally RCOOH, RCOOR, RCONH₂ groups are **not reduced** by catalytic hydrogenation.

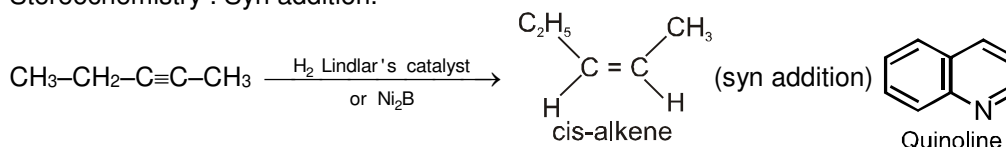
(ii) **Stereochemistry of catalytic hydrogenation:** The above reaction is syn addition (addition takes place from the same side of alkene or alkyne).

(ii) **Homogeneous catalysis :** (catalysts soluble in the reaction medium). It uses reactants and catalyst in the same phase. Both hydrogen atoms **usually** add from the same side of the molecule. Common example : Use of Wilkinson catalyst Rh [(C₆H₅)₃P]₃Cl.

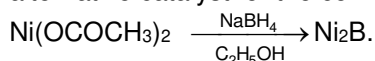
(iii) **Lindlar's catalyst : [H₂/Pd, CaCO₃, quinoline]**

It is a poisoned palladium catalyst. It is composed of powdered calcium carbonate coated with palladium and poisoned with quinoline. It is used to carry out partial reduction of alkyne to alkene and acid chloride to aldehyde.

Stereochemistry : Syn addition.

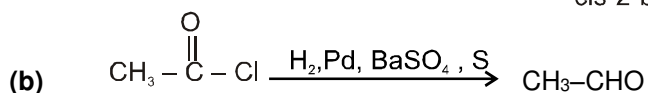
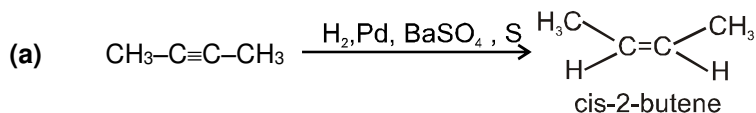


Note : Nickel boride Ni₂B (**P-2 catalyst**) (made from Nickel acetate and sodium borohydride) is an excellent alternative catalyst for the conversion of alkyne into alkene. Stereochemistry : Syn addition.



(iv) **Rosenmund catalyst : [H₂/Pd, BaSO₄, quinoline]** Hydrogenation in presence of H₂/Pd/BaSO₄ is called **Rosenmund Reduction**. It reduces alkyne to alkene and acid halide to aldehyde. It is poisoned palladium catalyst, composed of powdered barium sulphate coated with palladium, poisoned with quinoline or sulphur.

Stereochemistry : Syn addition.

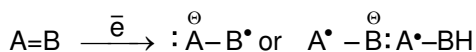


1.2 Metal/proton (acid) reduction :

Reduction by dissolving metals is based on the fact that the metal acts as a source of electrons.

Step-1 : Metals give electrons to the electrophilic species and form anion

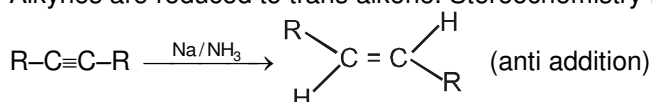
Step-2 : Proton is abstracted from the acidic source.



(i) **Birch reduction [Na or Li/NH₃(liq.) or (ethyl alcohol)] :**

Alkyne and Aromatic Compounds are reduced by Na or Li/NH₃.

Alkynes are reduced to trans alkene. Stereochemistry : anti addition.



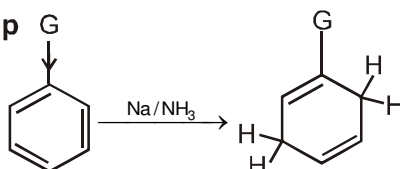
Benzene ring is reduced at 1, 4-position.

Typical example of reduction for aromatic system :

Presence of alkyl, alkoxy, amines reduces the benzene ring at ortho position.

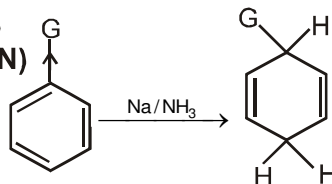


(**electron releasing group**
– R, – OR, – NH₂)



Presence of nitro, cyano, carboxylic, keto or aldehydic group reduces the benzene ring at ipso position.

(**electron withdrawing group**
– NO₂, – COOH, – CHO, – CN)

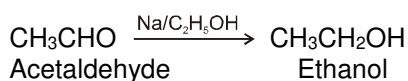


(ii) Bouveault-Blanc reduction [Na/C₂H₅OH] :

Reduction of aldehydes, ketones, acidhalides, esters or cyanide by means of excess of Na/C₂H₅OH is called Bouveault-Blanc reduction.

Na + C₂H₅OH is mild reducing agent.

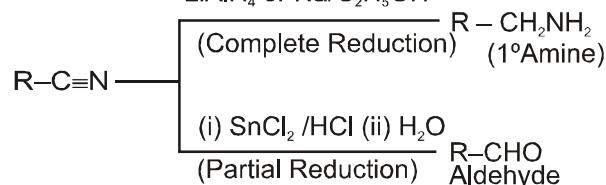
Reagent	Na/C ₂ H ₅ OH	Na/C ₂ H ₅ OH	Na/C ₂ H ₅ OH	Na/C ₂ H ₅ OH	Na/C ₂ H ₅ OH
Reactant	Aldehyde	Ketone	Cyanide	Ester	acid halide
Product	1° alcohol	2° alcohol	1° amine	1° alcohol	1° alcohol



(iii) Stephen's Reductions : [SnCl₂/HCl]

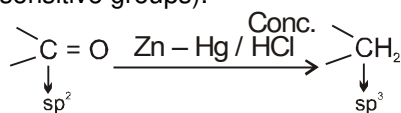
When reduction of cyanide is carried out with acidified stannous chloride (SnCl₂/HCl) at room temperature, imine hydrochloride is obtained. Which on subsequent hydrolysis with boiling water gives aldehyde. This specific type of reduction of nitrile is called stephen's reduction.

LiAlH₄ or Na/C₂H₅OH

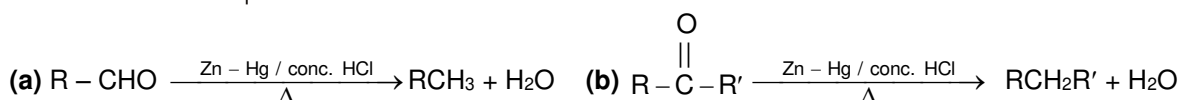
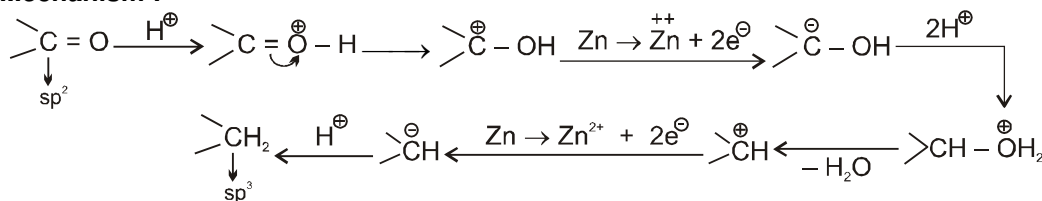


(iv) Clemmensen's Reduction : [Zn-Hg/Conc. HCl]

It is used to prepare alkanes from carbonyl compounds (Aldehyde and ketones in absence of acid sensitive groups).



Mechanism :



Note : Clemmensen reduction is avoid to use for compounds which have **acid sensitive** group.
[Like: Alcohol, Alkene, Alkyne, Ether].



Section (B) : Reduction-2

1.3 Metal hydrides reduction

Certain complex metal and boron hydrides, are important reagents for reduction.

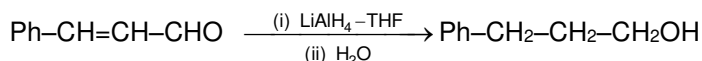
(i) LiAlH_4 (LAH) Lithium aluminium hydride [LiAlH_4 / Ether or THF] :

LAH is most common and versatile reagent. It is sensitive to protic solvent and therefore used in ether.

Reagent	LiAlH_4	LiAlH_4	LiAlH_4 /Excess	LiAlH_4 /Excess	LiAlH_4	LiAlH_4	LiAlH_4	LiAlH_4	LiAlH_4	LiAlH_4
Reactant	Aldehyde	Ketone	Acid	Acid anhydride	Acid chloride	Ester	Cyanide	Amide	Isocyanide	Nitro
Product	1° alcohol	2° alcohol	1° alcohol	1° alcohol	1° alcohol	1° alcohol	1° amine	1° amine	2° amine	1° amine

Note : Alkene, alkyne, benzene rings are not reduced by LiAlH_4 in ether but it is reported that

(*) double bond can be reduced by LiAlH_4 / THF in few cases like :

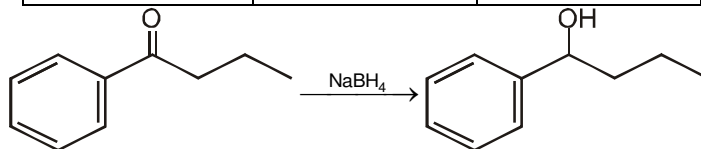


[Cinnamaldehyde]

(ii) Sodium borohydride [NaBH_4 / $\text{C}_2\text{H}_5\text{OH}$ or Ether] :

It is more specific than LAH as a reducing agent. It reduces ketones and aldehydes to the corresponding alcohols without affecting other functional groups, reduces acid chlorides to 1° alcohols. It does not reduce any other derivative of acid. It is effective even in protic solvent like alcohol.

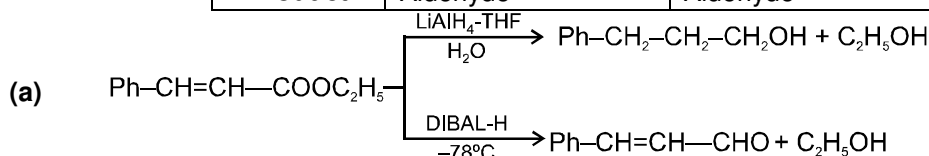
Reagent	NaBH_4	NaBH_4	NaBH_4
Reactant	Aldehyde	Ketone	Acid chloride
Product	1° alcohol	2° alcohol	1° alcohol



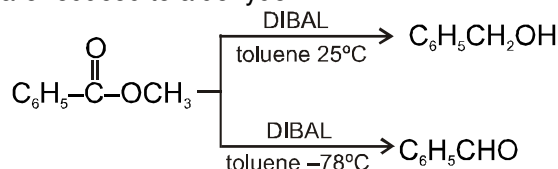
(iii) Diisobutyl Aluminium Hydride [DIBAL-H / Inert solvent] :

Diisobutyl aluminium hydride is parallel to LAH (Lithium aluminium hydride) as a reducing agent but it is more selective.

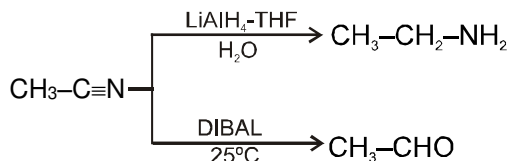
Reagent	DIBAL-H/(-78°C)	DIBAL-H
Reactant	Ester	Cyanide
Product	Aldehyde	Aldehyde



(b) By DIBAL at ordinary temperature esters are reduced to alcohols but at low temperature esters are reduced to aldehyde.



(c) LAH reduce RCN to amine but DIBAL is found to be reduce it to aldehyde.

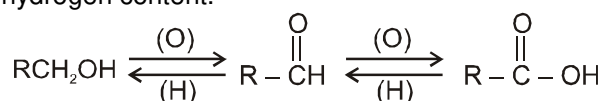




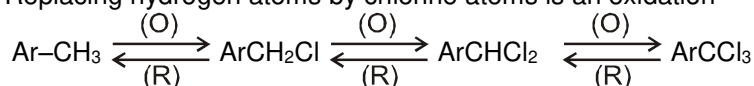
Section (C) : Oxidation-1

Introduction

- oxidation is defined as the addition of oxygen (electronegative) element to a substance or removal of hydrogen (electropositive) element from a substance.
- Oxidation of an organic molecule usually corresponds to increasing its oxygen content or decreasing its hydrogen content.



- Oxidation of an organic compound may be more broadly defined as a reaction that increases its content of any element more electronegative than carbon.
Replacing hydrogen atoms by chlorine atoms is an oxidation

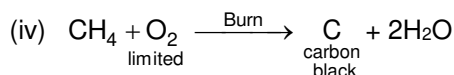
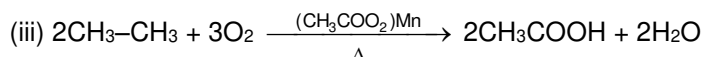
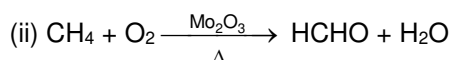
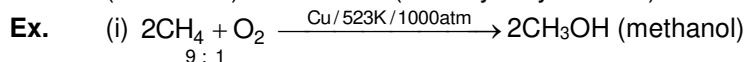
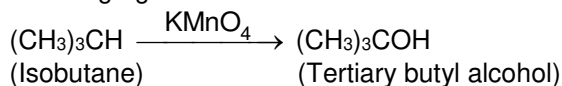


When organic compound is oxidised, **oxidising agent** used is reduced. When an organic compound is reduced, the **reducing agent** used must be oxidized.

2.1 Oxidation of alkanes

Different products are formed by the use of different oxidising agents or different reaction conditions.

- (i) **Chemical oxidation with KMnO_4 or $\text{K}_2\text{Cr}_2\text{O}_7$** : Alkanes are usually not affected by oxidising agents like KMnO_4 or $\text{K}_2\text{Cr}_2\text{O}_7$. However, alkanes having tertiary hydrogen are oxidised by these oxidising agents to an alcohol.



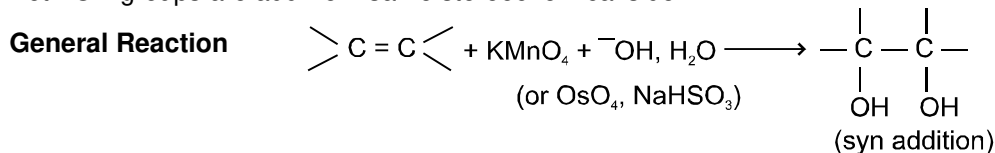
2.2 Oxidation of alkenes and alkynes

- (i) **Baeyer reagent [cold diluted to 1% alkaline KMnO_4 solution] :**

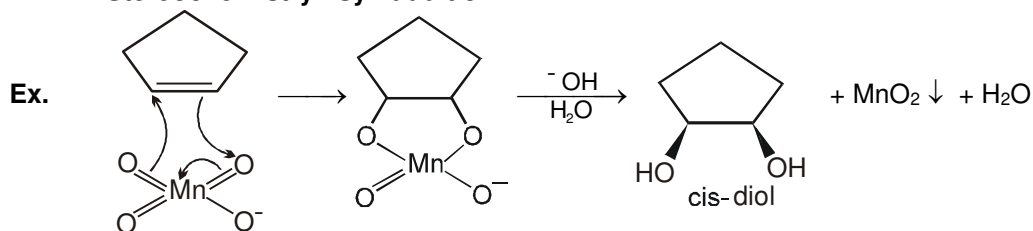
Baeyer Reagent	Baeyer Reagent	Baeyer Reagent
Reactant	Alkene	Alkyne
Product	Vicinal diol	Diketone

Stereochemistry : syn addition.

Both -OH groups are add from same stereochemical side.



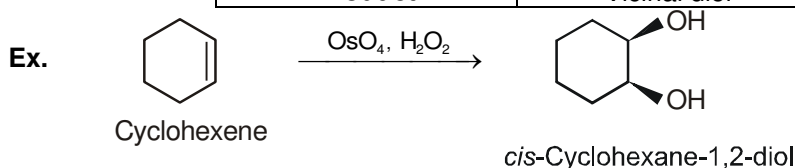
Stereochemistry : syn addition.



**(ii) Osmium tetroxide in alkaline medium [OsO₄ / NaHSO₃] :**

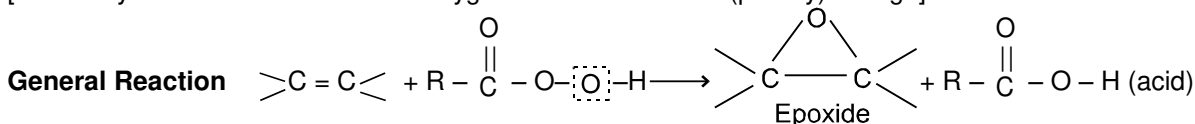
Similar to Baeyer's reagent.

OsO ₄ / NaHSO ₃	OsO ₄ / NaHSO ₃	OsO ₄ / NaHSO ₃
Reactant	Alkene	Alkyne
Product	Vicinal diol	Diketone

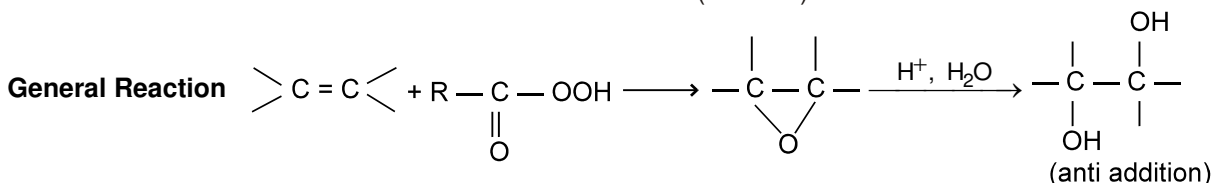
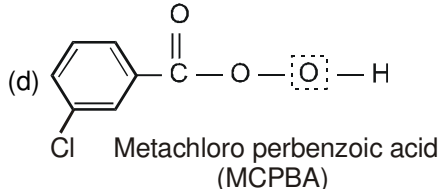
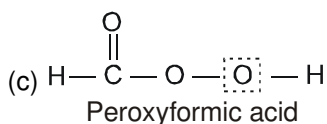
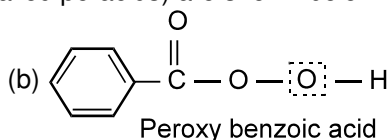
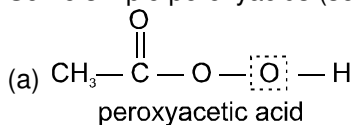
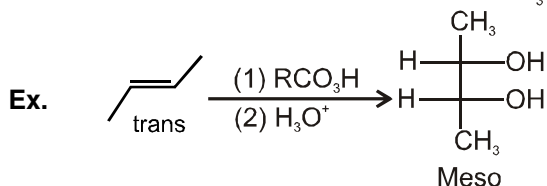
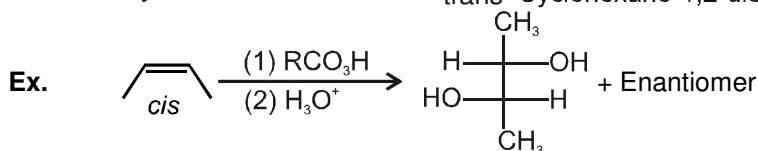
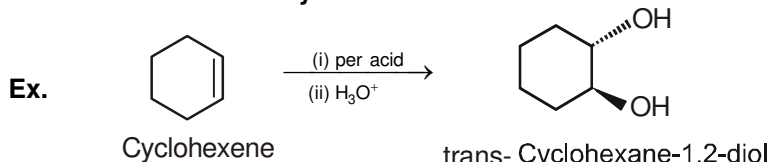
**(iii) Oxidation with peroxyacids**

An alkene is converted to an epoxide by a peroxyacid.

[a carboxylic acid that has an extra oxygen atom in a –O–O– (peroxy) linkage].

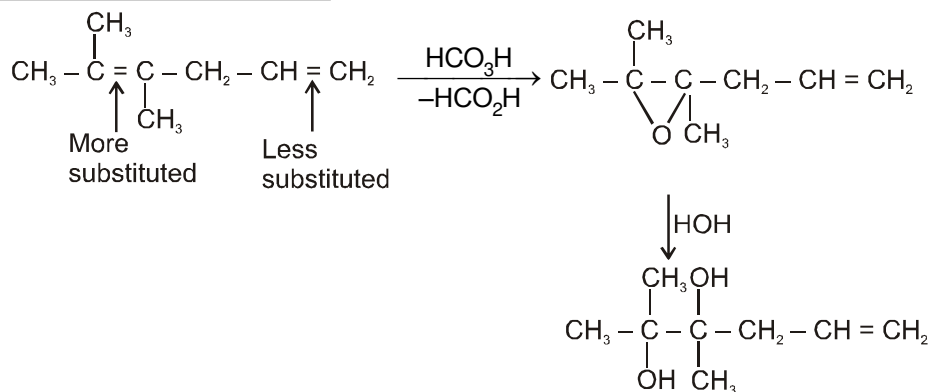


Some simple peroxyacids (sometimes called peracids) are shown below :

**Stereochemistry : anti addition in diol formation.**

Note : The more highly substituted olefinic bond is more nucleophilic and therefore reacts faster with the peroxyacid than the less substituted double bond.

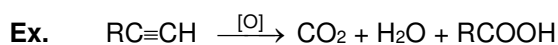
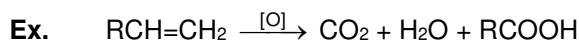




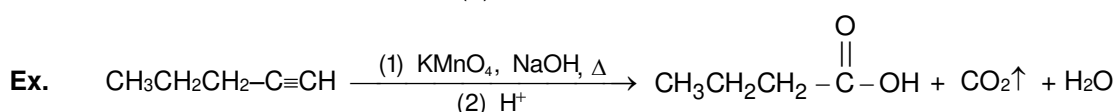
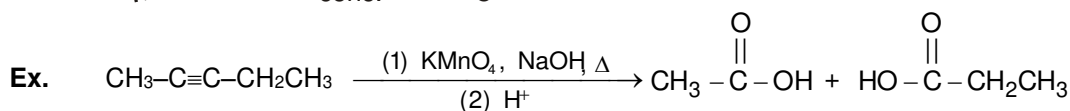
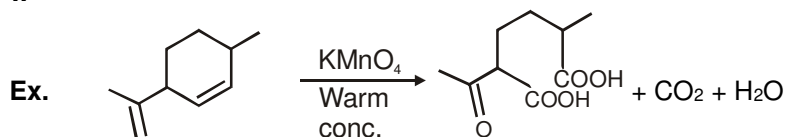
(iv) **Oxidation with acidic KMnO_4 [KMnO_4/H^+] : Stereochemistry : syn addition.**

When alkene & alkyne heated with KMnO_4 in acidic or in alkaline medium; following changes takes place.

KMnO_4/H^+	KMnO_4/H^+	KMnO_4/H^+	KMnO_4/H^+	KMnO_4/H^+	KMnO_4/H^+
Reactant	=CH_2 group	=CHR group	$\text{=CR}_1\text{R}_2$ group	$\equiv\text{CH}$ group	$\equiv\text{CR}$ group
Product	CO_2	RCOOH	$\text{O=CR}_1\text{R}_2$ group	CO_2	RCOOH
	Carbon dioxide	Carboxylic acid	Ketone	Carbon dioxide	Carboxylic acid



w



(v). **Oxidation with ozone (ozonolysis) : Alkene & Alkyne**

Like permanganate ozone cleaves double at very low temperature ($\approx -78^\circ\text{C}$) bonds to give Ketones and aldehydes. However, ozonolysis is milder, and both Ketones and aldehydes can be recovered without further oxidation.

Reductive Ozonolysis Products ($\text{O}_3/\text{Zn}, \text{H}_2\text{O}$)					
$\text{O}_3/\text{Zn}, \text{H}_2\text{O}$	$\text{O}_3/\text{Zn}, \text{H}_2\text{O}$	$\text{O}_3/\text{Zn}, \text{H}_2\text{O}$	$\text{O}_3/\text{Zn}, \text{H}_2\text{O}$	$\text{O}_3/\text{Zn}, \text{H}_2\text{O}$	$\text{O}_3/\text{Zn}, \text{H}_2\text{O}$
Reactant	=CH_2 group	=CHR group	$\text{=CR}_1\text{R}_2$ group	$\equiv\text{CH}$ group	$\equiv\text{CR}$ group
Product	HCHO	O=CHR group	$\text{O=CR}_1\text{R}_2$ group	$\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{CHO} \end{array}$	diketone
	Formaldehyde	Aldehyde	Ketone	Keto aldehyde	diketone

Oxidative Ozonolysis Products					
$\text{O}_3/\text{H}_2\text{O}_2$	$\text{O}_3/\text{H}_2\text{O}_2$	$\text{O}_3/\text{H}_2\text{O}_2$	$\text{O}_3/\text{H}_2\text{O}_2$	$\text{O}_3/\text{H}_2\text{O}_2$	$\text{O}_3/\text{H}_2\text{O}_2$
Reactant	=CH_2 group	=CHR group	$\text{=CR}_1\text{R}_2$ group	$\equiv\text{CH}$ group	$\equiv\text{CR}$ group
Product	CO_2	RCOOH	$\text{O=CR}_1\text{R}_2$ group	CO_2	RCOOH
	Carbon dioxide	Carboxylic acid	Ketone	Carbon dioxide	Carboxylic acid



Ex. C_8H_{10} (A) $\xrightarrow{O_3, H_2O}$ $C_4H_6O_2$ Acid (B). Identify (A) and (B) in the above reaction

Sol. (A)  (B) 

Ex. A certain hydrocarbon has the formula $C_{16}H_{26}$. Ozonolysis followed by hydrolysis gives $CH_3(CH_2)_4CO_2H$ and succinic acid as the only product. What is hydrocarbon

Sol. $DU = 4$

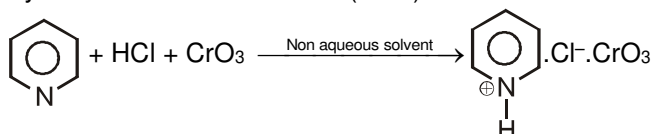
\therefore Molecular structure must be: $CH_3(CH_2)_4C \equiv C - CH_2 - CH_2 - C \equiv C(CH_2)_4 - CH_3$

Section (D) : Oxidation-2

2.3 Oxidation reaction of alcohols :

Oxidation Product of Alcohol-1						
	Weak oxidising agent			Strong oxidising agent		
	PCC*	PDC**	CrO_3 /Inert medium	CrO_3 in water or H_2CrO_4	$KMnO_4/H^+$	$K_2Cr_2O_7/H^+$
1° alcohol or primary alcohol	Aldehyde			Carboxylic acid		
2° alcohol or secondary alcohol	Ketone			Ketone		
3° alcohol or tertiary alcohol	Not oxidised			Not oxidised		

(a) Pyridinium Chloro Chromate (PCC)



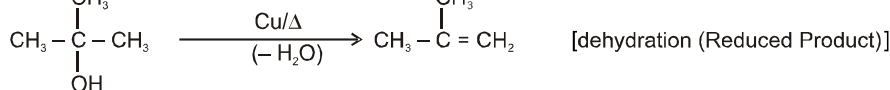
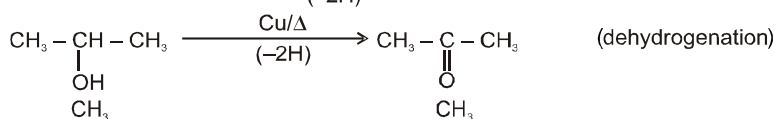
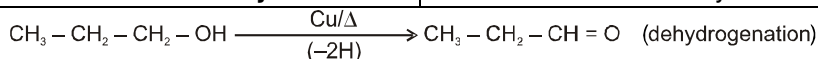
(b) Pyridinium dichromate (PDC) = $(2C_5H_5N \cdot CrO_3)$

(c) Jones reagent = dilute chromic acid + acetone

(d) Collin's Reagent = CrO_3 + pyridine, CH_2Cl_2

(e) MnO_2 = It is selectively oxidised reagent & oxidised allylic and benzylic alcohol into aldehyde and ketone.

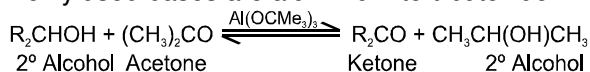
Oxidation Product of Alcohol-2		
	Very-Very Strong oxidising agent $KMnO_4/H^+/Heat$	Copper & heat as oxidising agent
1° alcohol or Primary alcohol	Carboxylic acid	Aldehyde
2° alcohol or Secondary alcohol	Mixture of Carboxylic acid	Ketone
3° alcohol or tertiary alcohol	Mixture of Carboxylic acid	Dehydrate to alkene

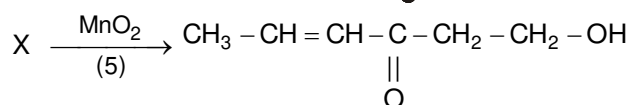
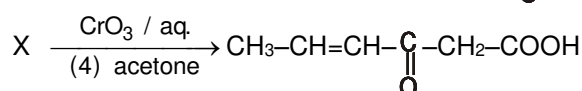
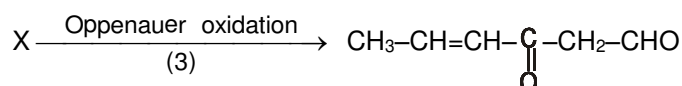
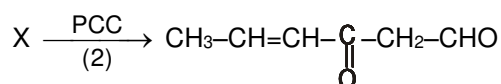
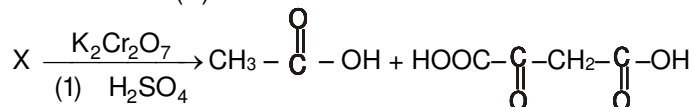
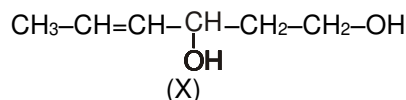


Oppenauer's oxidation

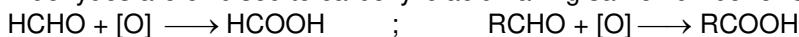
(i) This reaction involves the oxidation of a secondary alcohol with a ketone and base to the corresponding ketone.

(ii) Commonly used bases are aluminium tert-butoxide.

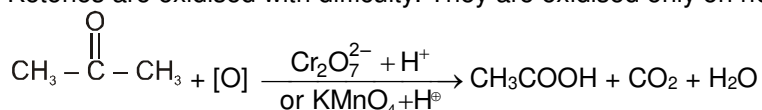
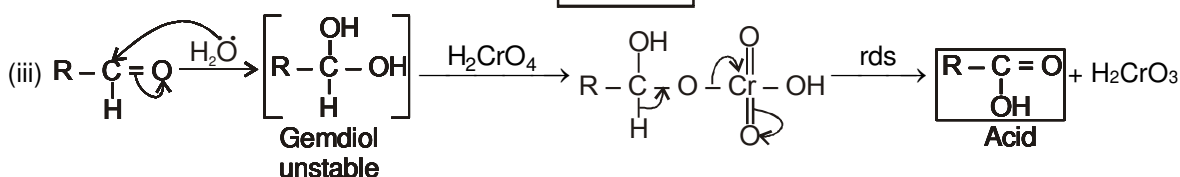
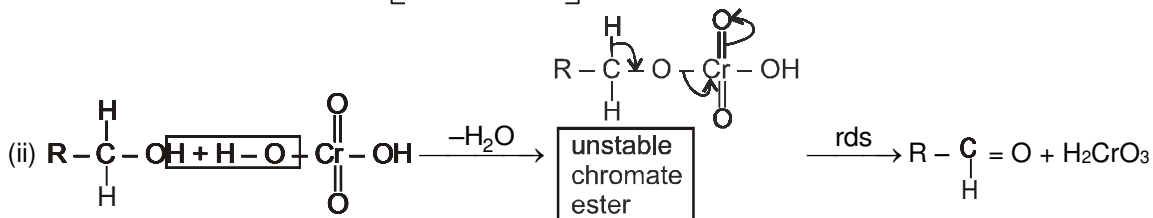
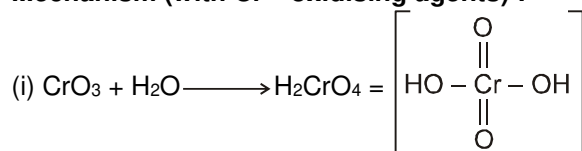


**Rate of Oxidation :**(a) $\text{RCH}_2\text{OH} > \text{R}_2\text{CHOH} > \text{R}_3\text{C}-\text{OH}$ (inert)(b) $\text{RCHO} > \text{RCH}_2\text{OH}$ **Ex.** Write the product of following reactions.**2.4 Oxidation reaction of carbonyl compound****(i) Acidic KMnO_4 & $\text{K}_2\text{Cr}_2\text{O}_7$ as oxidising agent :**

Aldehydes are oxidised to carboxylic acid having same number of C atoms as aldehyde.



Ketones are oxidised with difficulty. They are oxidised only on heating with a strong oxidising agent.

In case of mixed or unsymmetrical ketones the $>\text{C}=\text{O}$ group remains with the smaller alkyl group. (**Popoff's rule**)**Mechanism (with Cr^{+6} oxidising agents) :**

**Remarks :**

- (1) Primary alcohol forms a chromate ester with chromic acid.
- (2) The chromate ester decomposes in 2nd slow step with the elimination of α -hydrogen. So the first oxidation product, an aldehyde is obtained.
- (3) In **aqueous medium**, aldehyde forms a gemdiol (hydrated aldehyde). It is further oxidised to an acid by similar mechanism.
- (4) The following reactivity orders can be explained by this mechanism :

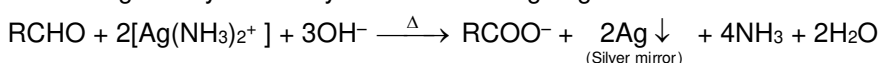
Rate of Oxidation

- (a) $R-CH_2OH > R-CD_2OH$ (Bond Energy : $C-H < C-D$) (b) $RCHO > RCDO$

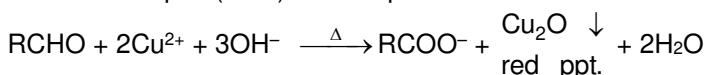
(ii) With Tollen's reagent :

$RCHO$ (aldehydes) can be easily oxidised to $RCOOH$ (except $HCHO$ that can be oxidised to CO_2) by weak oxidising agents like ammonical $AgNO_3$ (**Tollen's reagent**) hence they are better reducing agents.

Aldehydes reduce Tollen's reagent to Ag and appears in the form of silver mirror is called **silver-mirror test**. It is given by all aldehydes and reducing sugars.

**(iii) With Fehling solution :**

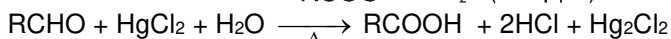
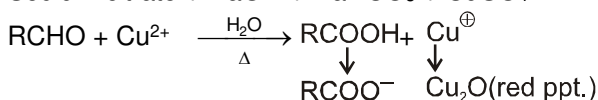
Aldehydes (except benzaldehyde) reduce **Fehling's solution** (Cu^{2+} reduced to Cu^+) which is an alkaline solution of cupric (Cu^{2+}) ion complexed with tartrate ion.



Aldehydes also reduce Benedict's solution (Cu^{2+} complexed with citrate ion) to Cu^+

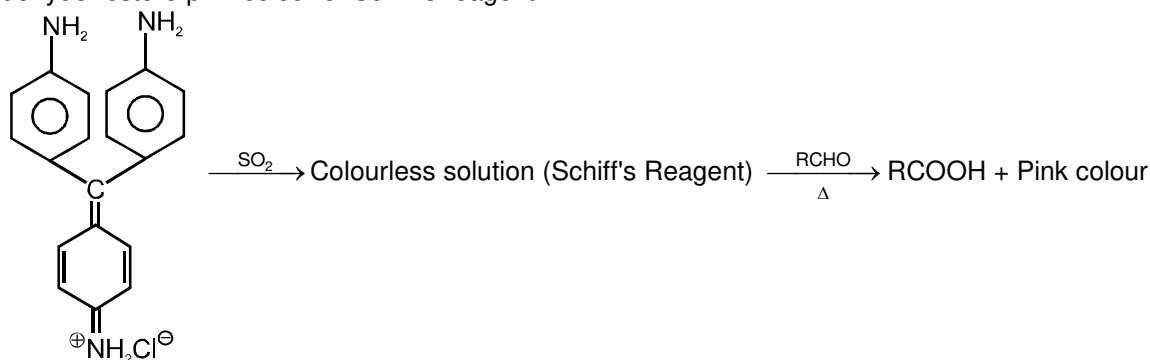
(iv) With Benedict's solution

Sodium citrate + $NaOH$ + $NaHCO_3$ + $CuSO_4$

**(v) With Schiff's reagent**

Schiff's Reagent is aq. solution of following base decolourised by passing SO_2 .

Aldehyde restore pink colour of Schiff's reagent.



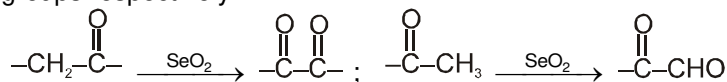
p-Rosaniline Hydrochloride

Magenta colour (Fuschin)

Ketons are not easy to oxidize so they do not give these 5 tests. These five tests can be used to distinguish aldehyde and ketones. Both give 2, 4 DNP test.

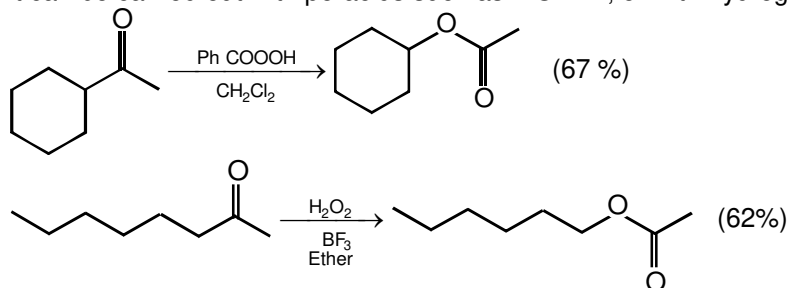
**(vi) Oxidation by using SeO_2**

SeO_2 is a selective oxidizing agent which converts $-\text{CH}_2-$ group adjacent to carbonyl group into carbonyl group. The reagent, in general, oxidises active methylene and methyl groups to ketonic and aldehydic groups respectively.

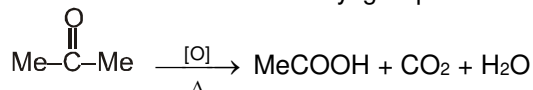
**(vii) Baeyer-villiger oxidation**

Baeyer-villiger oxidation is the oxidative cleavage of a carbon-carbon bond adjacent to a carbonyl which converts ketones to esters and cyclic ketones to lactones.

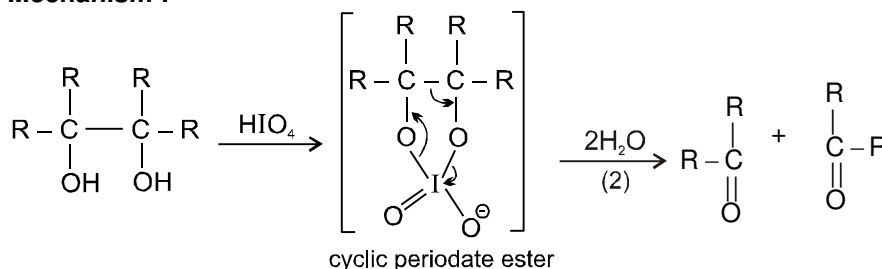
It can be carried out with peracids such as MCBPA, or with hydrogen peroxide and a Lewis acid.

**KETONES ARE DIFFICULT TO OXIDIZE :**

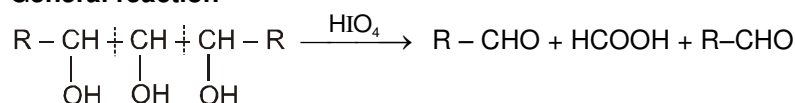
Ketones can be oxidized from their enolic form at high temperature with very strong oxidizing agent. Oxidation of ketones is sometimes governed by Popoff's rule. According to this rule carbonyl group remains with the smaller alkyl group. More electron rich alkene will be easy to oxidized.

**2.5 Oxidation reaction of diols****(i) HIO_4 oxidation : (Oxidation by lead acetate is similar to HIO_4 oxidation)**

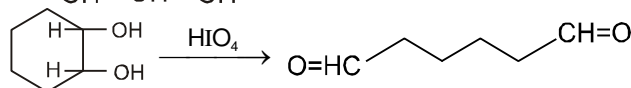
Mechanism :

**Remarks**

- (1) HIO_4 (periodic acid) oxidises vicinal diols (1, 2-diols).
- (2) It brings about oxidative cleavage of vicinal diol.
- (3) It can also oxidise α -hydroxy carbonyl compound and α -dicarbonyl compound.
- (4) HIO_4 forms a cyclic periodate ester as an intermediate. So the two $-\text{OH}$ groups should have syn-conformation.
- (5) In cyclic diols only cis-vicinal diols are oxidised. Trans isomers are not oxidised.

Ex. General reaction

Ex.





Section (E) : Hydrolysis

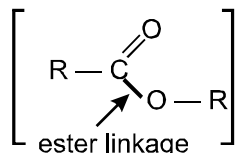
Introduction :

Hydrolysis is a chemical reaction or process in which a **molecule splits into two parts** by reacting with a molecule of water, (H_2O). One of the parts gets OH^- from the water molecule and the other part gets H^+ from the water. Such reactions are endothermic.

This is distinct from a hydration reaction, in which water molecules are added to a substance, but no fragmentation of molecule/species occurs. Such a process is exothermic.

(i) Hydrolysis of an ester :

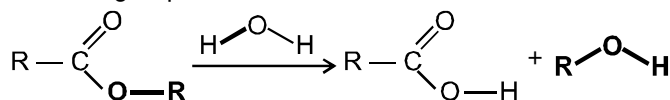
Hydrolysis of an ester involves breaking off an ester link. It can take place in



(a) **Mild acidic medium** : Dilute H_2SO_4 , dilute HCl .

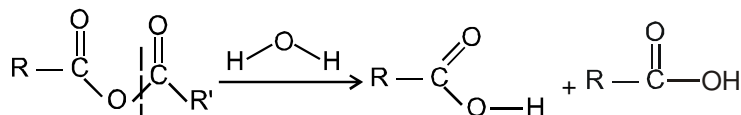
(b) **Strong alkaline medium** : Aqueous NaOH or KOH and heat.

One hydrolysis product contains a hydroxyl functional group, while the other contains a carboxylic acid functional group.



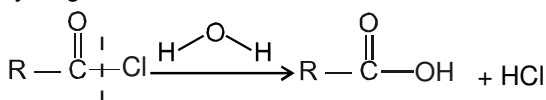
(ii) Hydrolysis of an anhydride :

The hydrolysis of acid anhydride produces two carboxylic acids.



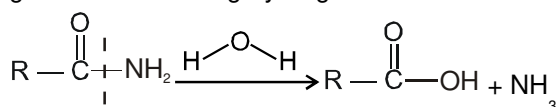
(iii) Hydrolysis of acid halide :

Hydrolysis of an acid halide results into a carboxylic acid and hydrogen halide. Only the carboxylic acid product has a hydroxyl group derived from the water. Hydrohalic acid product gains the remaining hydrogen ion.



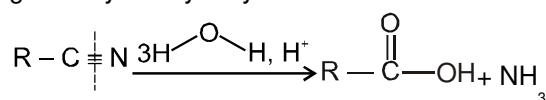
(iv) Hydrolysis of acid amide :

Hydrolysis of an amide results into a carboxylic acid and an amine product or ammonia, only the carboxylic acid product has a hydroxyl group derived from the water. The amine product (or ammonia) gains the remaining hydrogen ion.



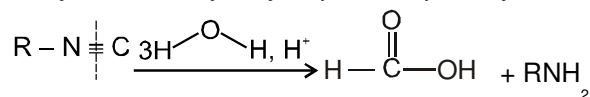
(v) Hydrolysis of cyanides :

Cyanide on hydrolysis produce ammonia and carboxylic acids. It is carried out in acidic medium generally but hydrolyse in basic medium also.

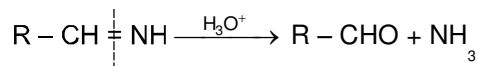


**(vi) Hydrolysis of isocyanides :**

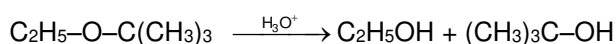
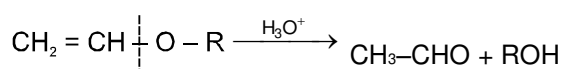
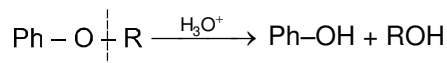
Isocyanides on hydrolysis produce primary amines and formic acids. It is carried out in acidic medium.



Note : Alkylisocyanide does not hydrolyse in basic medium.

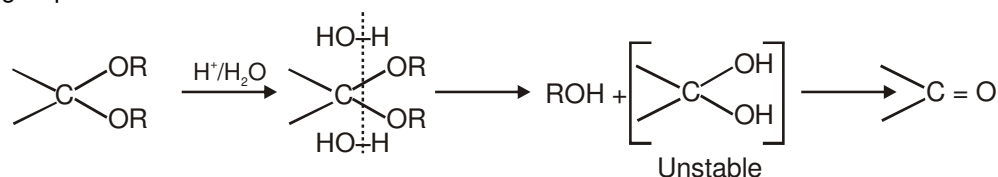
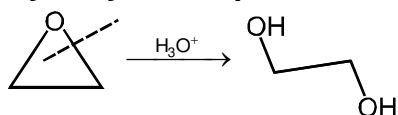
(vii) Hydrolysis of imine :**(viii) Hydrolysis of ethers :**

Ethers has R-O-R group. In strong acidic medium (HI or HBr) in hydrolysis to produce 2 equivalent of alcohols.

**(ix) Hydrolysis of Vinyl ether :****(x) Hydrolysis of phenyl ether :****(xi) Hydrolysis of hemiacetals and acetals :**

Hemiacetals and Acetals has R-O-R group.

Hemiacetals are unstable and get hydrolysed to aldehyde/ketones even in aq medium. However acetals/Ketals are stable and hydrolyse only in strong acidic medium (HI or HBr) to produce 2 equivalent of alcohols and one equivalent of aldehyde/ketone. Acetals are often used as protecting groups.

**(xii) Hydrolysis of epoxide :**

Note : Three and four membered epoxides can also be hydrolysed in basic medium.



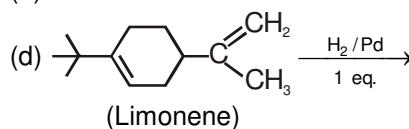
Exercise-1

Marked questions are recommended for Revision.

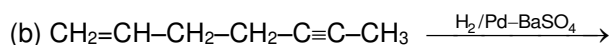
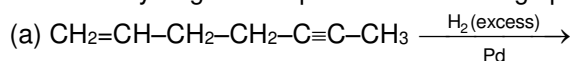
PART - I : SUBJECTIVE QUESTIONS

Section (A) : Reduction-1

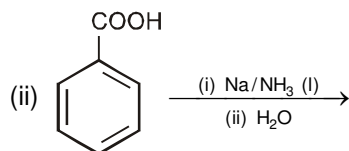
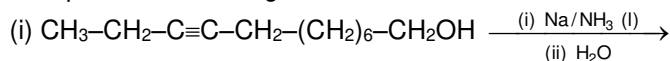
A-1. Write the hydrogenation product of following species with H_2/Pd .



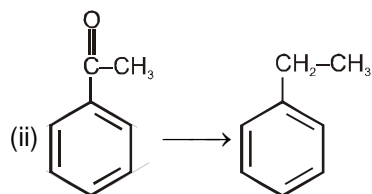
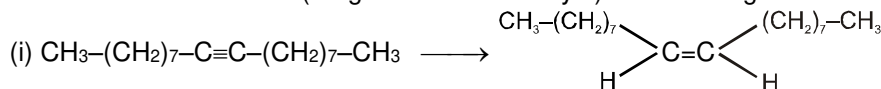
A-2. Write the hydrogenation product of following species



A-3. Complete the following reactions :

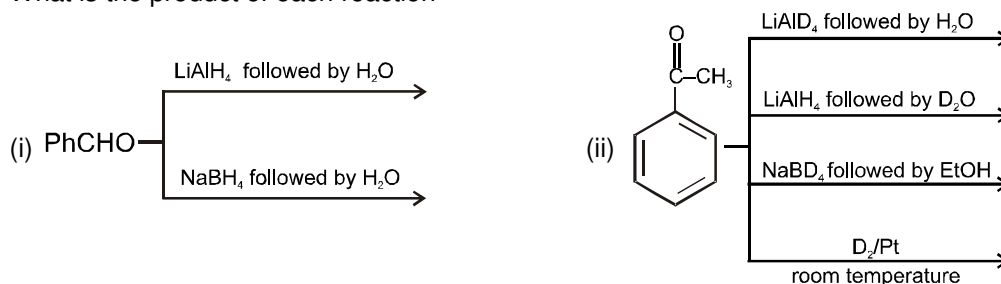


A-4. Give reaction conditions (reagents and/or catalyst) for effecting the following conversions :



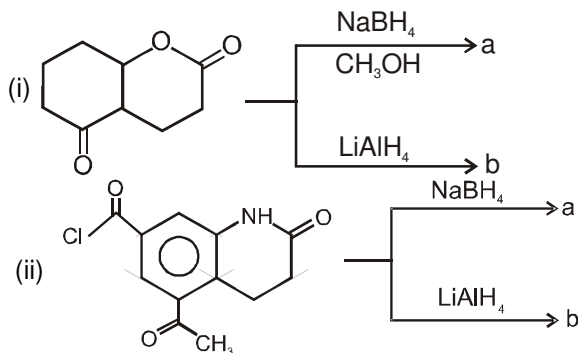
Section (B) : Reduction-2

B-1. What is the product of each reaction

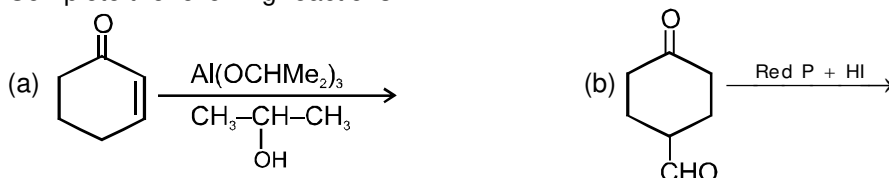




B-2. Identify a and b, in the following reactions :



B-3. Complete the following reactions :

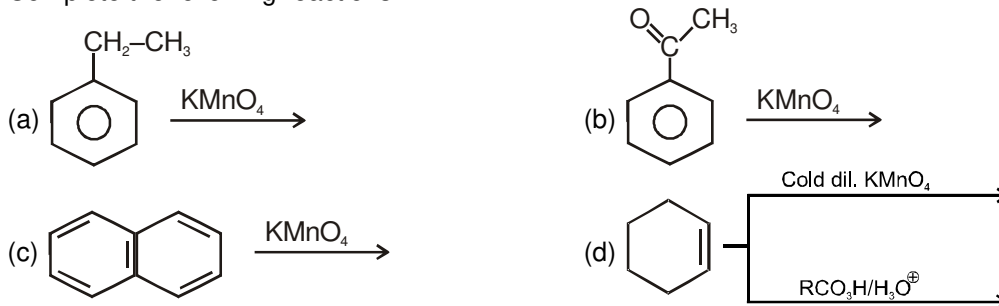


Section (C) : Oxidation-1

C-1. Write the structural formulas for the products formed when 3-heptyne reacts with KMnO_4 under ?

- neutral condition at room temp.
- alkaline or acidic condition at higher temp.

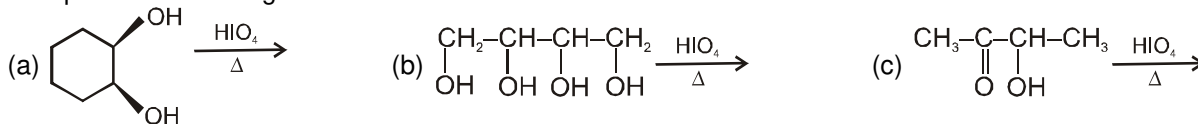
C-2. Complete the following reactions :



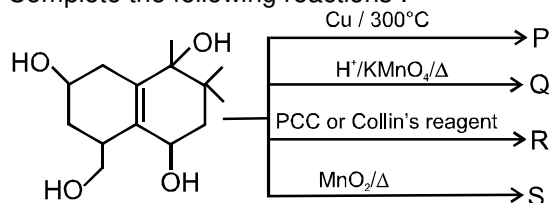
C-3. When t-Butanol and n-Butanol are separately treated with a few drops of dilute KMnO_4 in one case only, the purple colour disappears and a brown precipitate is formed. Which of the two alcohols gives the above reaction and which is the brown precipitate. **[IIT-JEE, 1994]**

Section (D) : Oxidation-2

D-1. Complete the following reactions :

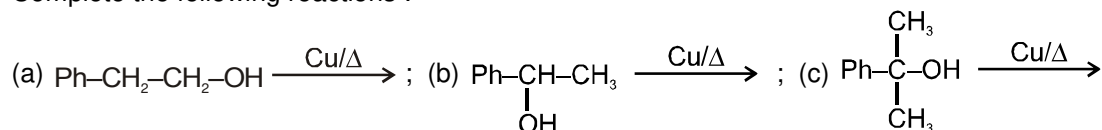


D-2. Complete the following reactions :



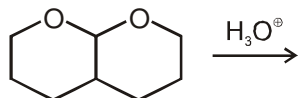


D-3 Complete the following reactions :

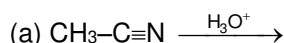


Section (E) : Hydrolysis

E-1. Write the products of following reaction



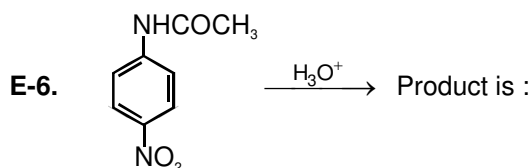
E-2. Write the products of following reaction



E-3. Reactant $\xrightarrow{\text{H}_3\text{O}^+}$ $\text{CH}_3\text{COOH} + \text{HCl}$

E-4. $\text{CH}_3\text{CONH}_2 \xrightarrow{\text{H}_3\text{O}^+}$ Product is :

E-5. The hydrolysis of acid anhydride produces



E-7. Reactant ($\text{C}_3\text{H}_6\text{O}$) $\xrightarrow{\text{H}_3\text{O}^+}$ $\text{CH}_3\text{CHO} + \text{CH}_3\text{OH}$

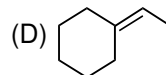
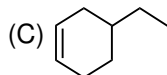
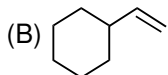
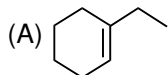
PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Reduction-1

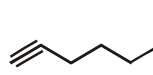
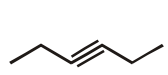
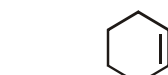
A-1. The relative rates of hydrogenation is in the order of :

- (A) $\text{CH}_2 = \text{CH}_2 > \text{RCH} = \text{CH}_2 > \text{RCH} = \text{CHR} > \text{R}_2\text{C} = \text{CHR}$
 (B) $\text{R}_2\text{C} = \text{CHR} > \text{RCH} = \text{CHR} > \text{RCH} = \text{CH}_2 > \text{CH}_2 = \text{CH}_2$
 (C) $\text{RCH} = \text{CHR} > \text{R}_2\text{C} = \text{CHR} > \text{RCH} = \text{CH}_2 > \text{CH}_2 = \text{CH}_2$
 (D) $\text{R}_2\text{C} = \text{CHR} > \text{CH}_2 = \text{CH}_2 > \text{RCH} = \text{CHR} > \text{RCH} = \text{CH}_2$

A-2. In which case the reaction is most exothermic with H_2 / Ni .



A-3. An organic compound with molecular formula C_6H_{10} is not reduced by $\text{H}_2 / \text{Pd} / \text{BaSO}_4$. From the given options, the compounds may be :

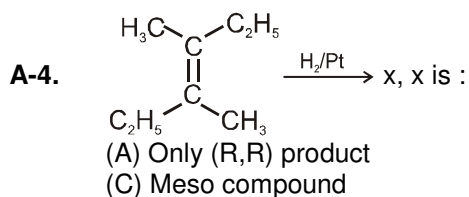


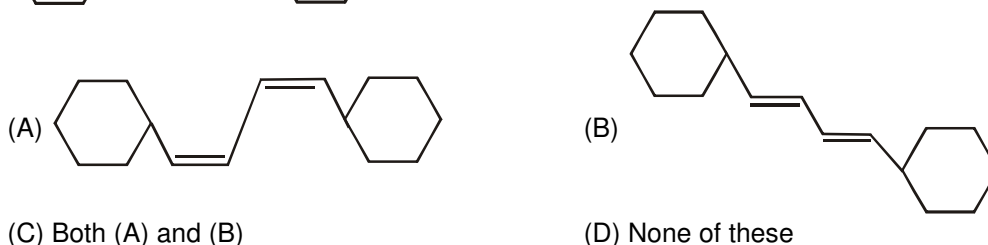
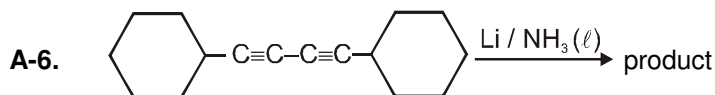
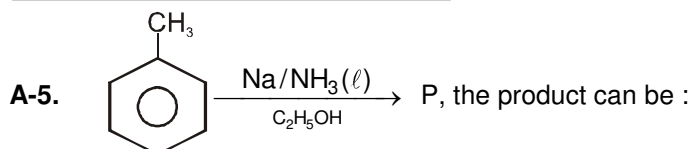
(A) I, II

(B) I, III

(C) II, IV

(D) II, II



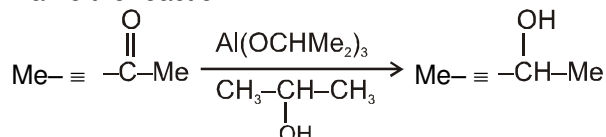


- A-7. Which of the following reagents converts both acetaldehyde and acetone to alkanes ?
 (A) Ni/H₂ (B) LiAlH₄ (C) I₂/NaOH (D) Zn-Hg/conc.HCl
- A-8. Stephen reduction (SnCl₂/HCl) converts cyanides to
 (A) Aldehydes (B) Ketones (C) Amines (D) Acids

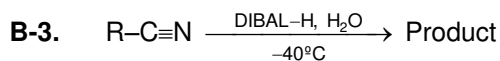
Section (B) : Reduction-2

- B-1. When benzoic acid is treated with LiAlH₄, it forms
 (A) Benzaldehyde (B) Benzyl alcohol (C) Benzene (D) Toluene

- B-2. Name the reaction

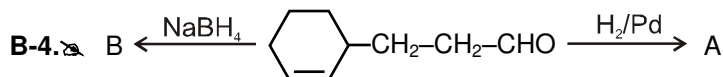


- (A) Meerwein-Ponndorf-Verley reduction (B) Wolff-Kishner reduction
 (C) Bouveault-Blanc reduction (D) Stephen's reduction



The product formed is :

- (A) R-CO-NH₂ (B) R-CH₂-NH₂ (C) R-CHO (D) R-CH₂-NO₂



A and B are respectively :

- (A) ,
 (B) ,
 (C) in both case
 (D) in both case



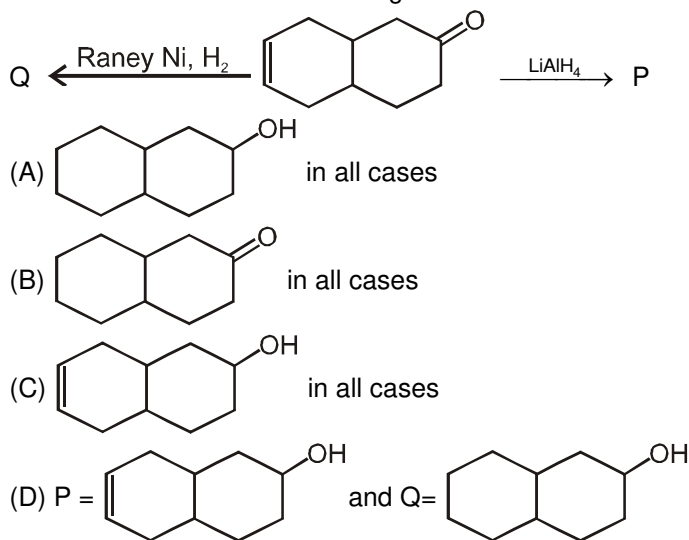
- B-5.** In the following reaction $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5 + 4\text{H} \xrightarrow{\text{Red P + HI}} 2\text{X} + \text{H}_2\text{O}$, X is
 (A) Ethane (B) Ethylene (C) Butane (D) Propane

- B-6.** $\text{R}-\text{CO}-\text{O}-\text{R}' \xrightarrow[\text{-78}^\circ\text{C}]{\text{diisobutyl aluminium hydride}} \text{Y} + \text{R}'-\text{OH}$

The product Y is

- (A) $\text{R}-\text{CH}_2-\text{OH}$ (B) $\text{R}-\text{CHO}$ (C) $\text{R}-\text{COOH}$ (D) $\text{R}-\text{CH}_3$

- B-7.** What are A and B in the following ?



Section (C) : Oxidation-1

- C-1.** Baeyer's reagent decolourises which of the following :

- (A) Alkane (B) Alkene only
 (C) Alkene and alkyne both (D) Benzene

- C-2.** Ethanol on reaction with alkaline KMnO_4 gives:

- (A) Ethanal (B) Glyoxal (C) Acetic acid (D) Acrolein.

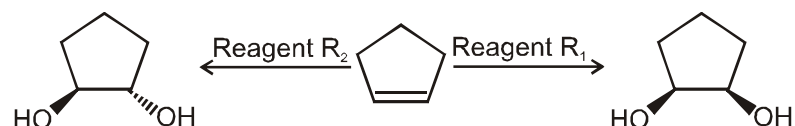
- C-3.** $1\text{-Butyne} \xrightarrow{\text{KMnO}_4 / \Delta} \text{X} + \text{Y}$

Identify X and Y ?

- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} + \text{O}_2$ (B) $\text{CH}_3\text{CH}_2\text{COOH}$
 (C) $\text{CH}_3\text{CH}_2\text{COOH} + \text{CO}_2 + \text{H}_2\text{O}$ (D) $\text{CH}_3\text{CH}_2\text{COCH}_3 + \text{HCOOH}$

- C-4.** An alkyne C_7H_{12} when reacted with alkaline KMnO_4 followed by acidification by HCl , yielded a mixture of $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{COOH}$ & $\text{CH}_3\text{CH}_2\text{COOH}$. The alkyne is -

- (A) 3-hexyne (B) 2-methyl-2-hexyne
 (C) 2-methyl-3-hexyne (D) 3-methyl-2-hexyne

- C-5.**  ; R_1 and R_2 are
- (A) Cold alkaline KMnO_4 , $\text{OsO}_4/\text{H}_2\text{O}_2$ (B) Cold alkaline KMnO_4 , HCO_3H & H_3O^+
 (C) Cold alkaline KMnO_4 , $\text{C}_6\text{H}_5\text{CO}_3\text{H}$ (D) $\text{C}_6\text{H}_5\text{CO}_3\text{H}$, HCO_3H



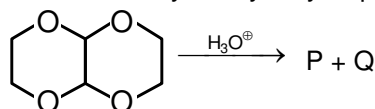
Section (D) : Oxidation-2

- D-1.** Glucose as well as fructose are oxidized by periodic acid. The number of moles of HCOOH formed from each mole of glucose and fructose are
 (A) 5 and 5 (B) 5 and 4 (C) 5 and 3 (D) 4 and 3
- D-2.** Secondary alcohols on heating with copper at 300°C give
 (A) Alkenes (B) Aldehydes (C) Ketones (D) tert-alcohols
- D-3.** The reagent, with which both acetaldehyde and acetone react easily is :
 (A) Tollens reagent (B) Schiff's reagent (C) H_2/Ni (D) Fehling's solution
- D-4.** Which of the following compounds is resistant to periodic acid oxidation ?
 (A) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CO} \\ | \\ \text{CH}_2\text{OH} \end{array}$ (B) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CH}_2 \\ | \\ \text{CH}_2\text{OH} \end{array}$ (C) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CHOH} \\ | \\ \text{CH}_2\text{OH} \end{array}$ (D) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$

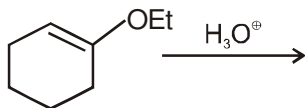
Section (E) : Hydrolysis

- E-1.** What product is obtained when Benzenecarbonitrile is hydrolysed.
 (A) Benzoylchloride (B) Benzenecarboxamide
 (C) Benzaldehyde (D) Benzoic acid

- E-2.** The acid catalysed hydrolysis products in the following reaction are -



- (A) $\begin{array}{c} \text{CHO} \\ | \\ \text{CHO} \end{array}$ & $\begin{array}{c} \text{CHO} \\ | \\ \text{CHO} \end{array}$ (B) $\begin{array}{c} \text{COOH} \\ | \\ \text{COOH} \end{array}$ & $\begin{array}{c} \text{CH}_2\text{-OH} \\ | \\ \text{CH}_2\text{-OH} \end{array}$ (C) $\begin{array}{c} \text{CHO} \\ | \\ \text{CHO} \end{array}$ & $\begin{array}{c} \text{CH}_2\text{-OH} \\ | \\ \text{CH}_2\text{-OH} \end{array}$ (D) $\begin{array}{c} \text{COOH} \\ | \\ \text{COOH} \end{array}$ & $\begin{array}{c} \text{CHO} \\ | \\ \text{CHO} \end{array}$



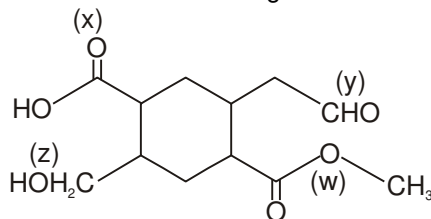
E-3.

Product obtained in above reaction are :

- (A) EtOH , (B) , $\text{CH}_3\text{-CHO}$ (C) CH_3COOH , (D) EtOH ,

PART - III : MATCH THE COLUMN

1. Observe the following compound and match the reagents of List-I and List-II



	Reagents-I		Functional group oxidised / reduced-II
(A)	$\text{CrO}_3 / \text{Pyridine} / \text{CH}_2\text{Cl}_2$	(p)	W
(B)	NaBH_4	(q)	Z
(C)	$\text{Na} / \text{C}_2\text{H}_5\text{OH}$	(r)	X
(D)	$\text{CrO}_3 / \text{H}^+$	(s)	Y



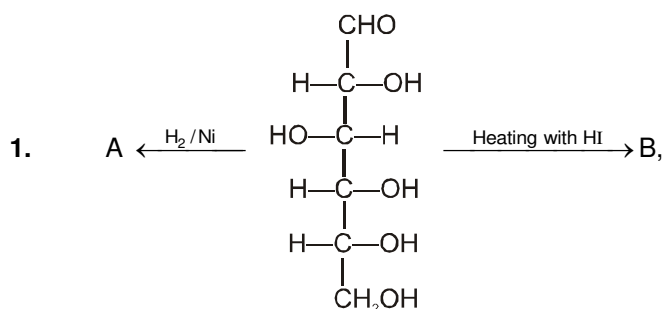
2. Match the following column:

	Column-I		Column-II
	Reactant and reagents		Products
(A)	$\text{Ph}-\text{CH}=\text{CH}-\text{COOMe} \xrightarrow{\text{LiAlH}_4 / \text{ether}}$	(p)	$\text{Ph}-\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} + \text{MeOH}$
(B)	$\text{Ph}-\text{CH}=\text{CH}-\text{COOMe} \xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) DIBAL-H } (-78^\circ\text{C})}$	(q)	$\text{Ph}-\text{CH}=\text{CH}-\text{CHO} + \text{MeOH}$
(C)	$\text{Ph}-\text{CH}=\text{CH}-\text{COOMe} \xrightarrow{\text{NaBH}_4}$	(r)	$\text{Me}-\text{CH}=\text{CH}-\text{CHO} + \text{MeOH}$
(D)	$\text{Me}-\text{CH}=\text{CH}-\text{COOMe} \xrightarrow{\text{H}_2 + \text{Pd/C}}$	(s)	$\text{Me}-\text{CH}_2\text{CH}_2\text{COOMe}$
		(t)	No reaction

Exercise-2

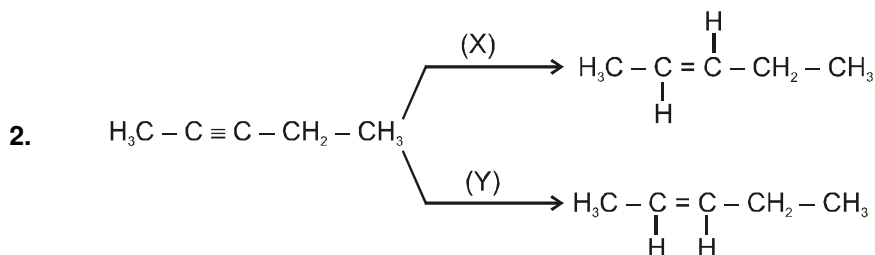
Marked questions are recommended for Revision.

PART - I : ONLY ONE OPTION CORRECT TYPE



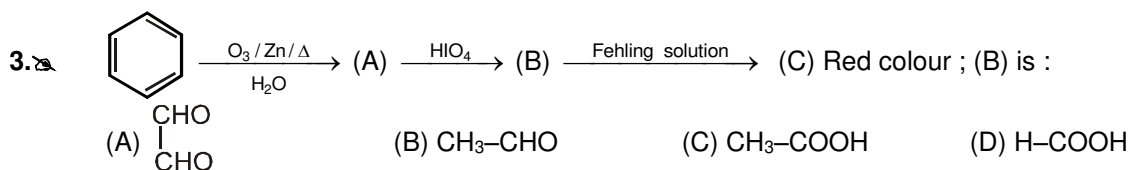
A and B can be :

- (A) Both are n-Hexane
 (B) Both are Hexan-1,2,3,4,5,6-hexaol
 (C) A is n-Hexane B is Hexan-1,2,3,4,5,6-hexaol
 (D) A is Hexan-1,2,3,4,5,6-hexaol and B is n-Hexane



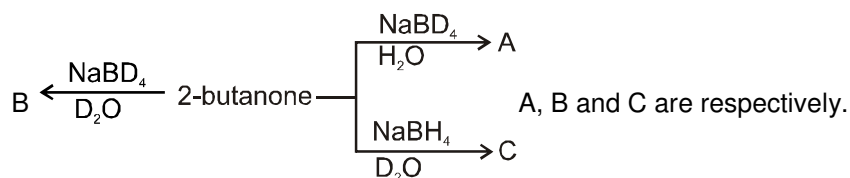
In the above reaction the using reagents X and Y are ;

- (A) Na/ liq. NH_3 for X
 (B) H_2 , Pd/ BaSO_4 for Y
 (C) $\text{BH}_3\text{-THF} + \text{CH}_3\text{COOH}$ for Y
 (D) All of these are correct.





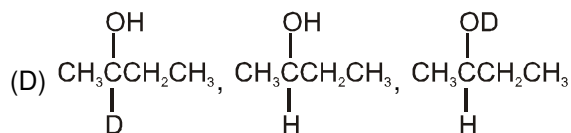
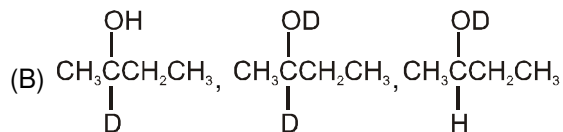
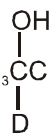
4. Consider reduction of 2-butanone.



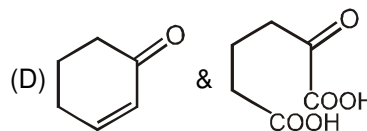
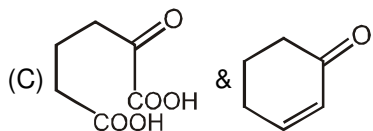
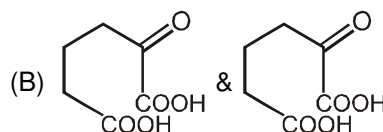
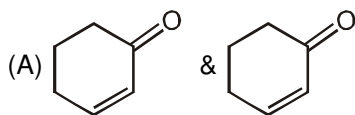
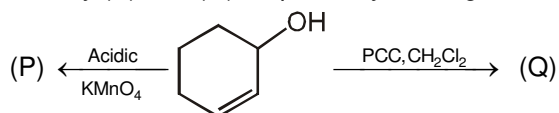
(A) $\text{CH}_3\text{CHCH}_2\text{CH}_3$ in all cases



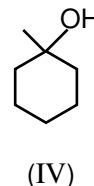
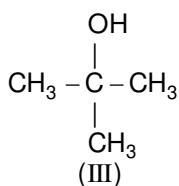
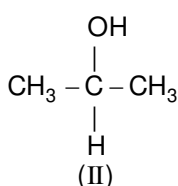
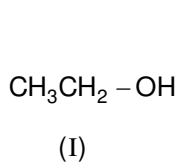
(C) $\text{CH}_3\text{CCH}_2\text{CH}_3$ in all case



5. Identify (P) and (Q) respectively in the given reaction :



6. Which of the following sets of compounds cannot turn clear orange solution of CrO_3 / aq. H_2SO_4 to greenish opaque solution



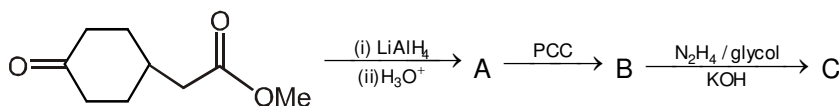
(A) I, IV

(B) II, III

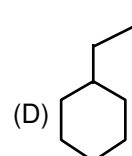
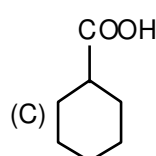
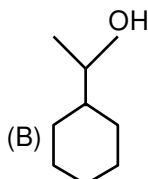
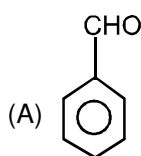
(C) I, II

(D) III, IV

7.

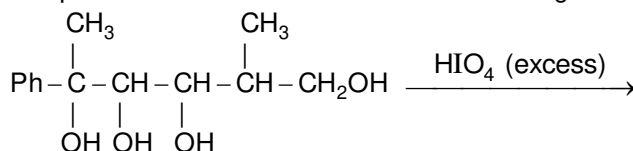


Product C is :





8. The product which is not formed in the following reaction :



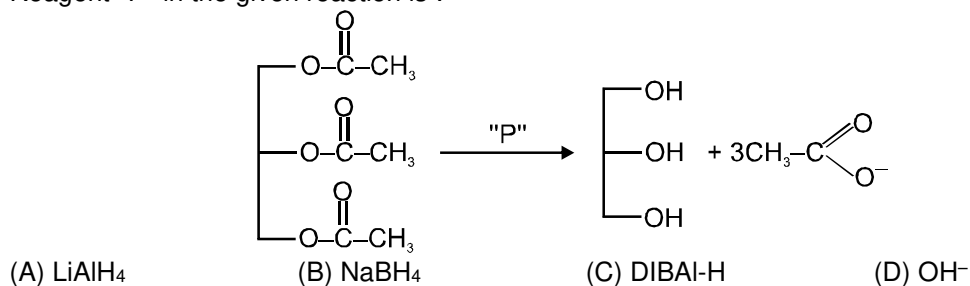
(A) HCOOH

(B) $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$

(C) $\text{OHC}-\overset{\text{CH}_3}{\text{CH}}-\text{CH}_2\text{OH}$

(D) $\text{OHC}-\overset{\text{CH}_3}{\text{CH}}-\text{CHO}$

9. Reagent "P" in the given reaction is :



10.  $\xrightarrow{\text{H}_3\text{O}^+} \text{P} + \text{Q}$

P and Q are respectively.

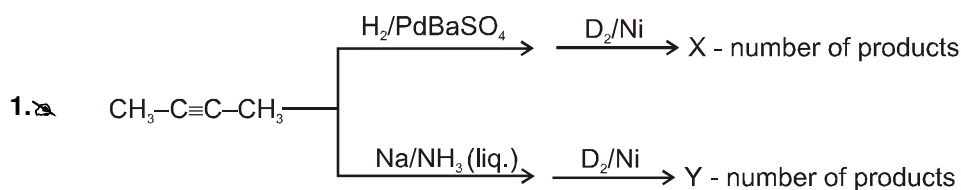
(A) Acetone and Hexane-1,2,5,6-tetraol.

(B) Acetaldehyde and Acetone.

(C) Acetaldehyde and Hexane-1,2,5,6-tetraol.

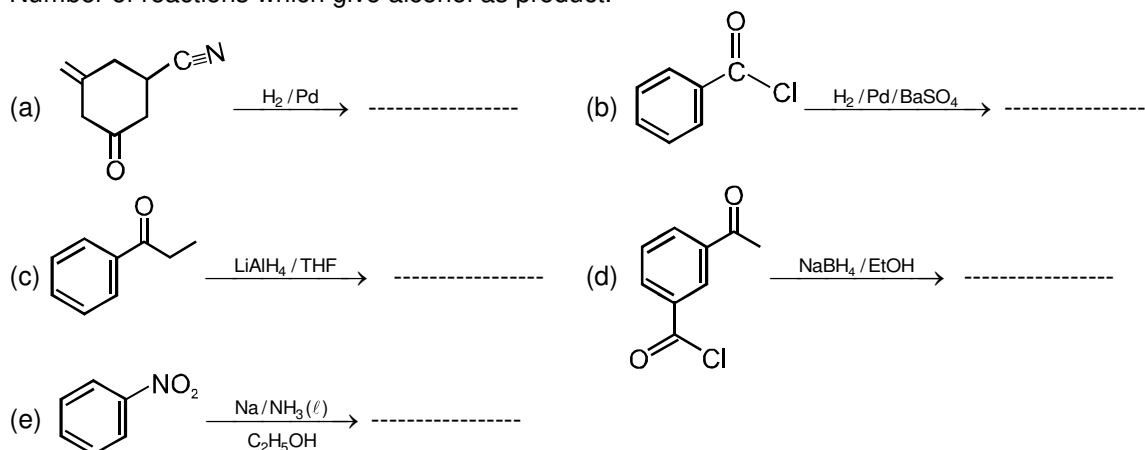
(D) Acetone and Formaldehyde.

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE



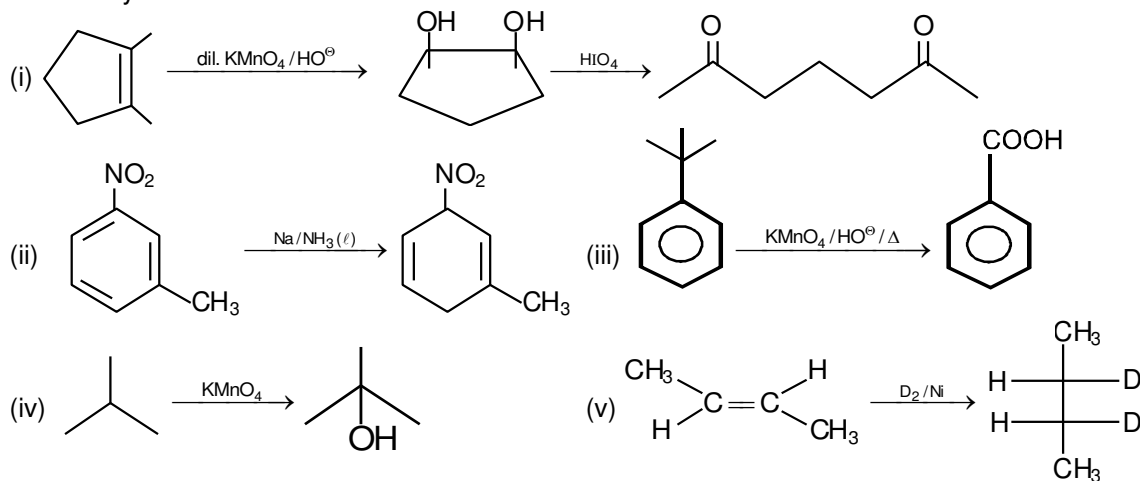
Find the value of $x + y$.

2. Number of reactions which give alcohol as product.

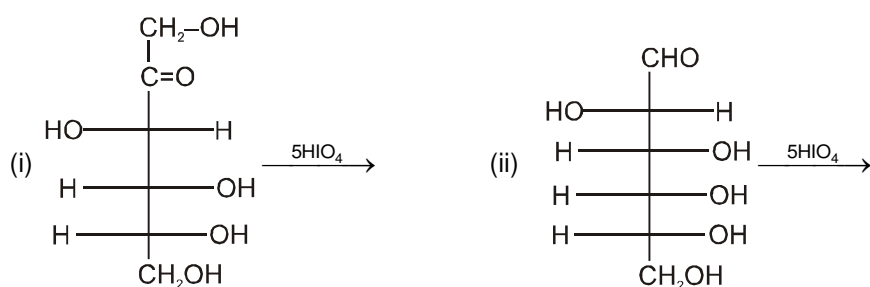




3. How many reactions are correct ?

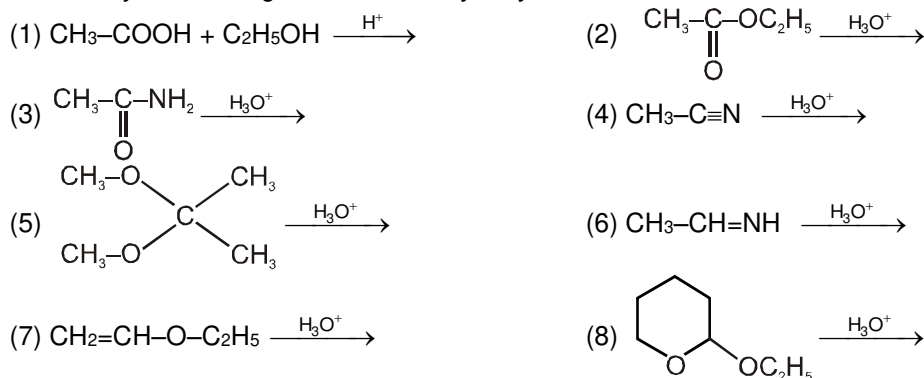


4.

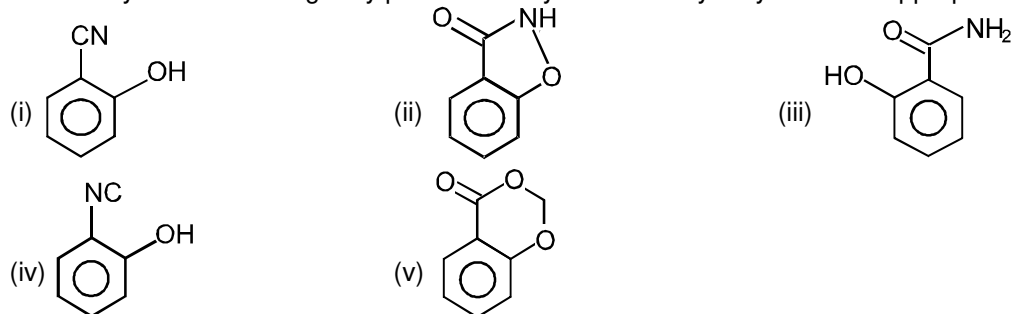


Sum of moles of formaldehyde obtained in the reaction (i) and reaction (ii) ?

5. How many of following reactions are hydrolysis reactions ?



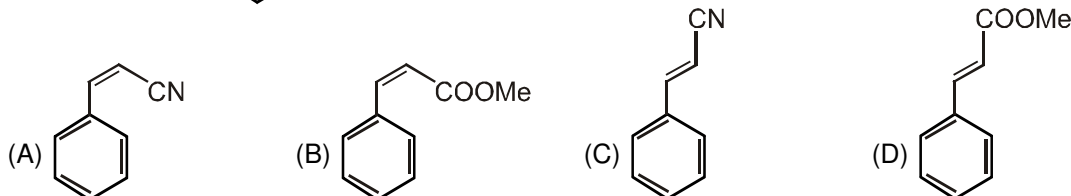
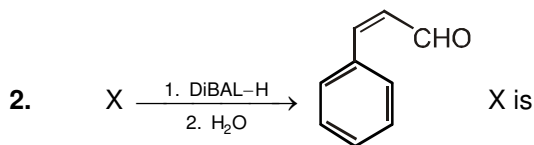
6. How many of the following may produce salicylic acid on hydrolysis under appropriate conditions ?



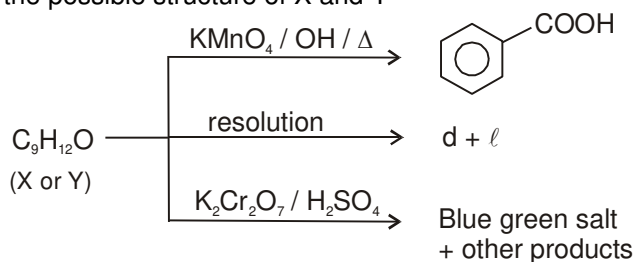


PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. Which of the following catalysts is/are used for partial reduction of alkyne ?
 (A) $\text{Na}/\text{NH}_3(\ell)$ (B) Ni_2B or P-2 catalyst
 (C) Lindlar catalyst (D) Rosenmund catalyst

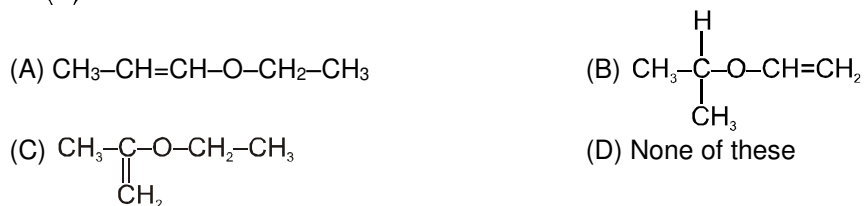


3. Identify the possible structure of X and Y



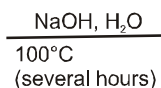
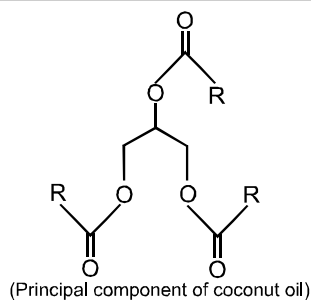
	X	Y
(A)	$\text{Ph}-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_3$	$\text{Ph}-\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{CH}_3$
(B)	$\text{Ph}-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{OH}$	$\text{Ph}-\underset{\text{OH}}{\overset{\text{CH}_3}{\text{C}}}-\text{CH}_3$
(C)		$\text{Ph}-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_3$
(D)	$\text{Ph}-\underset{\text{H}}{\overset{\text{CH}_3}{\text{C}}}-\text{CH}_2-\text{OH}$	$\text{Ph}-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_3$

4. $\text{C}_5\text{H}_{10}\text{O} \xrightarrow{\text{H}_3\text{O}^+} \text{B} + \text{C}$; (B) and (C) both give +ve iodoform test. Compound (A) is :

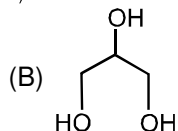




5.



Product is obtained in the above reaction is :

(A) $\text{R}-\text{CO}_2\text{Na}$ 

(B)

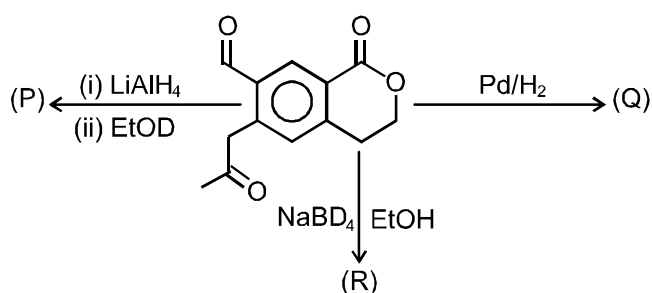
(C) RCHO

(D) None of these

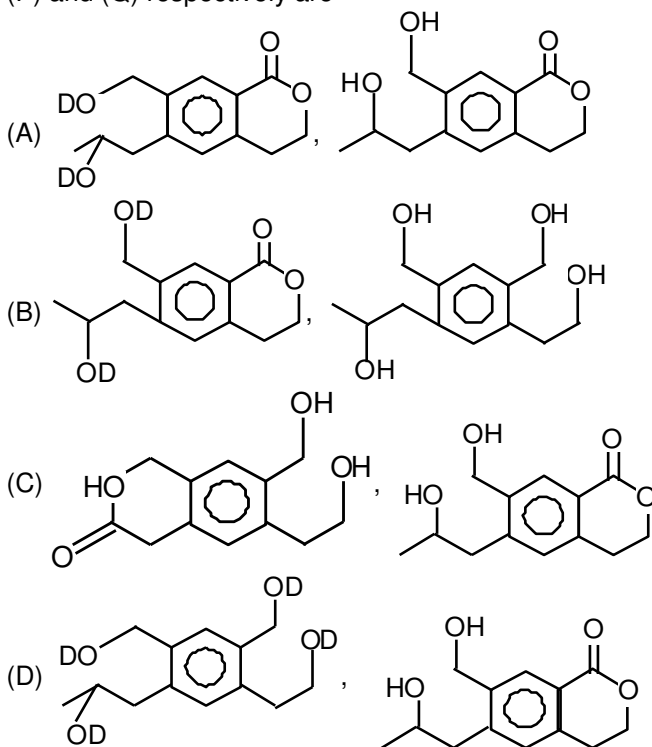
PART - IV : COMPREHENSION

Read the following passage carefully and answer the questions.

Comprehension # 1

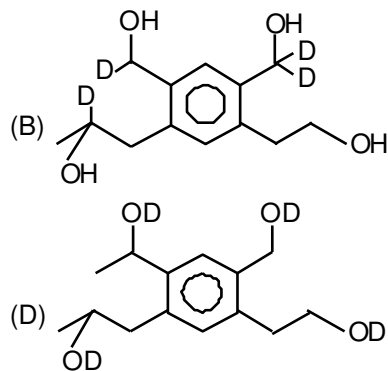
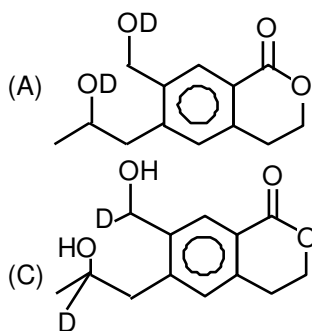


1. (P) and (Q) respectively are

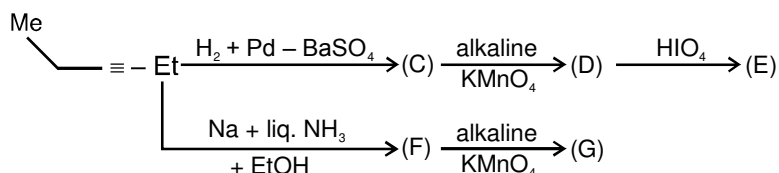




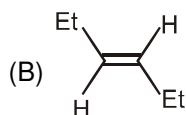
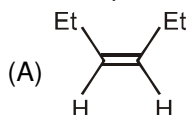
2. (R) is :



Comprehension # 2



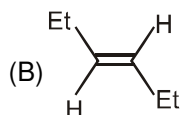
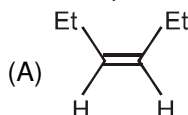
3. The compound (C) is :



(C) $\text{Et} \text{---} \text{Et}$

(D) Both (A) and (B)

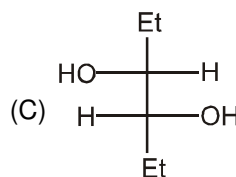
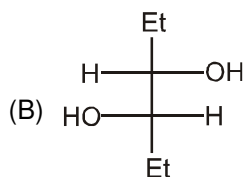
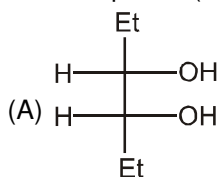
4. The compound (F) is :



(C) $\text{Et} \text{---} \text{Et}$

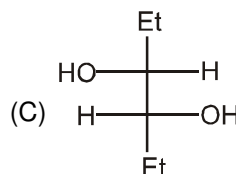
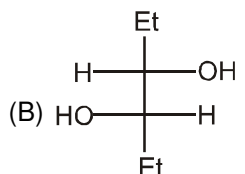
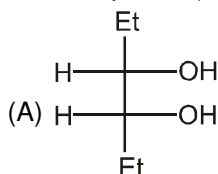
(D) Both (A) and (B)

5. The compound (D) is :



(D) Both (B) and (C)

6. The compound (G) is :



(D) Both (B) and (C)

7. The compound (E) is :

(A) Two moles of $\text{Me} \text{---} \text{CHO}$.

(B) Two moles of $\text{Me} \text{---} \text{COOH}$.

(C) One mole of (A) and one mole of (B)

(D) No reaction.



Comprehension # 3

Answer Q.8, Q.9 and Q.10 by appropriately matching the information given in the three columns of the following table.

Column-1, 2 and 3 contains starting material, reaction condition and type of reaction respectively.					
	Column-1		Column-2		Column-3
(I)	$\text{CH}_3\text{--}\overset{\text{O}}{\parallel}\text{C}\text{--}\text{O}\text{--}\overset{\text{O}}{\parallel}\text{C}\text{--}\text{CH}_3$	(i)	KMnO_4	(P)	Oxidation
(II)		(ii)	Cu/Δ	(Q)	Reduction
(III)	$\text{CH}_3\text{--}\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}\text{--}\text{OH}$	(iii)	H_3O^+	(R)	Hydrolysis
(IV)		(iv)	LiAlH_4	(S)	Dehydration

8. Which of the following combination of reaction result in formation of an alkene.
 (A) (I) (iv) Q (B) (III) (i) S (C) (III) (ii) S (D) (II), (iii) R
9. The only correct combination in which product gives position test with sodium bicarbonate is -
 (A) (III) (ii) P (B) (I) (iii) Q (C) (II) (iii) R (D) (IV) (i) P
10. The reaction and condition which obey bimolecular nucleophilic substitution reaction with respect to tetrahedral intermediate is -
 (A) (IV) (i) P (B) (I) (iv) Q (C) (II) (iii) R (D) (III) (ii) S

Exercise-3

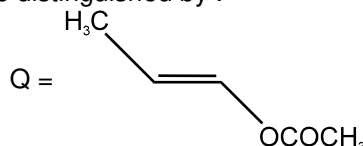
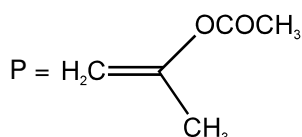
* Marked Questions may have more than one correct option.

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

1. What would be the major product in the following reaction ? [IIT-JEE 2000(M), 1/100]
-
2. Hydrogenation of the adjoining compound in the presence of poisoned palladium catalyst gives. [IIT-JEE 2001(S), 1/35]
-
- (A) an optically active compound (B) an optically inactive compound
 (C) a racemic mixture (D) a diastereomeric mixture
3. 1-Propanol and 2-Propanol can be best distinguished by : [IIT-JEE 2001(S), 1/35]
- (A) oxidation with alkaline KMnO_4 followed by reaction with Fehling solution
 (B) oxidation with acidic dichromate followed by reaction with Fehling solution
 (C) oxidation by heating with copper followed by reaction with Fehling solution
 (D) oxidation with concentrated H_2SO_4 followed by reaction with Fehling solution



4. **Assertion** : Dimethylsulphide is commonly used for the reduction of an ozonide of an alkene to get the carbonyl compounds [IIT-JEE-2001(S), 1/35]
Reason : It reduces the ozonide giving water soluble dimethyl sulfoxide and excess of it evaporates
 (A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
 (B) Assertion is True, Reason is True; Reason is NOT a correct explanation for Assertion.
 (C) Assertion is True, Reason is False.
 (D) Assertion is False, Reason is True.
5. Five isomeric para-disubstituted aromatic compounds A to E with molecular formula $C_8H_8O_2$ were given for identification. Based on the following observations, give structures of the compounds.
 (i) Both A and B form a silver mirror with Tollen's reagent; also B gives a positive test with $FeCl_3$ solution.
 (ii) C gives positive iodoform test.
 (iii) D is readily extracted in aqueous $NaHCO_3$ solution.
 (iv) E on acid hydrolysis gives 1, 4-dihydroxybenzene. [IIT-JEE-2002(M), 5/60]
6. The product of acid hydrolysis of P and Q can be distinguished by : [IIT-JEE 2003(S), 3/84]



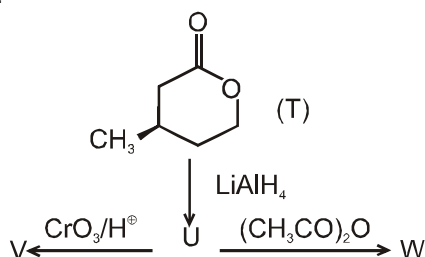
- (A) Lucas reagent
 (C) Fehling's solution

- (B) 2,4-DNP
 (D) $NaHSO_3$

7. Amongst the following the reagent that would convert 2-hexyne into trans-2-hexene is [IIT-JEE 2004(S), 3/84]
 (A) $H_2, Pt / O_2$ (B) $H_2, Pd / SO_4^{2-}$
 (C) $Li / NH_3 / C_2H_5OH$ (D) $NaBH_4$
8. A compound $P(C_5H_{10}O)$ reacts with dilute sulfuric acid to give Q and R as the final products. This reaction is about 10^{15} times faster than of ethylene. Both Q and R give positive iodoform test.
 (a) Identify the structures of P, Q and R.
 (b) Rationalize the extraordinary reactivity of P. [IIT-JEE-2004(M), 2/60]
9. Match each of the compounds in **Column I** with its characteristic reaction(s) in **Column II**. [IIT-JEE 2009, 8/160]

	Column I		Column II
(A)	$CH_3CH_2CH_2CN$	(p)	Reduction with $Pd-C/H_2$
(B)	$CH_3CH_2OCOCH_3$	(q)	Reduction with $SnCl_2/HCl$
(C)	$CH_3-CH=CH-CH_2OH$	(r)	Development of foul smell on treatment with chloroform and alcoholic KOH.
(D)	$CH_3CH_2CH_2CH_2NH_2$	(s)	Reduction with diisobutylaluminium hydride (DIBAL-H)
		(t)	Alkaline hydrolysis

- 10.* With reference to the scheme given, which of the given statements(s) about T, U, V and W is (are) correct?

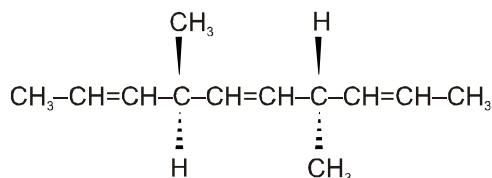


- (A) T is soluble in hot aqueous NaOH
 (B) U is optically active
 (C) Molecular formula of W is $C_{10}H_{18}O_4$
 (D) V gives effervescence on treatment with aqueous $NaHCO_3$

[IIT-JEE 2012, 4/136]



11. The number of optically active products obtained from the **complete** ozonolysis of the given compound is :



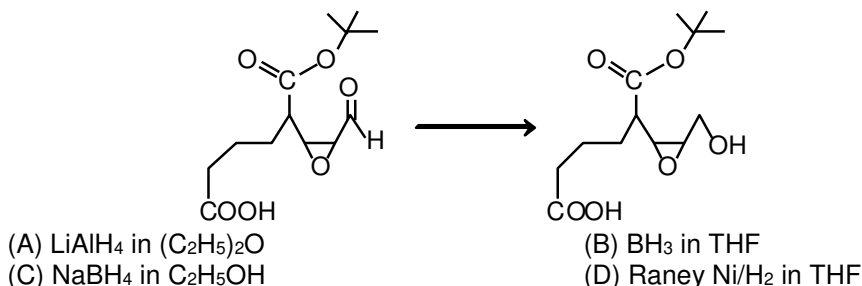
[JEE-2012, 3/70]

- (A) 0 (B) 1 (C) 2 (D) 4
12. Consider all possible isomeric ketones, including stereoisomers of MW = 100. All these isomers are independently reacted with NaBH_4 (**Note:** stereoisomers are also reacted separately). The total number of ketones that give a racemic product(s) is/are

[JEE(Advance)-2014, 3/120]

- 13.* Reagent(s) which can be used to bring about the following transformation is(are) :

[JEE(Advance)-2016, 3/124]

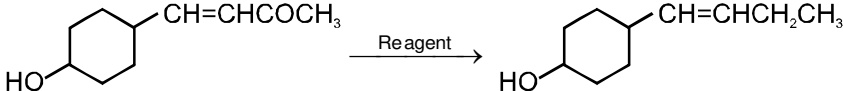
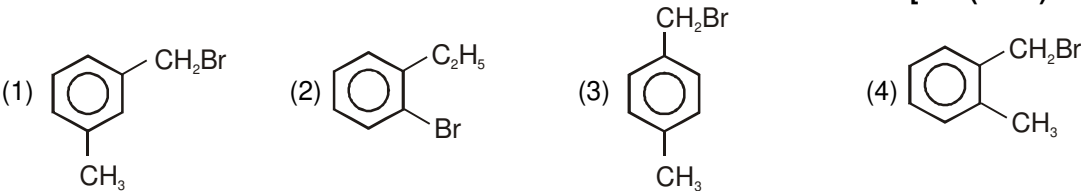
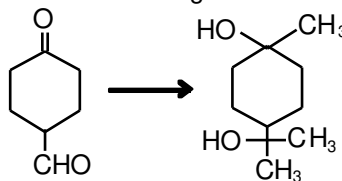
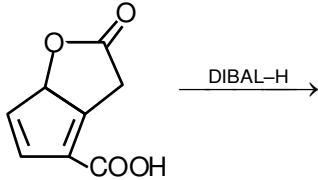
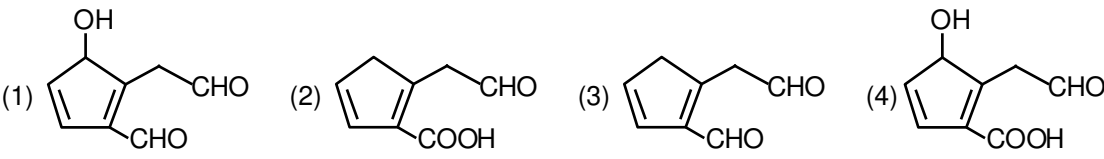


PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

JEE(MAIN) OFFLINE PROBLEMS

1. But-1-ene may be converted to butane by reaction with : [AIEEE-2003, 3/225]
(1) Zn-HCl (2) Sn-HCl (3) Zn-Hg (4) Pd/H_2
2. When $\text{CH}_2=\text{CH}-\text{COOH}$ is reduced with LiAlH_4 , the compound obtained will be: [AIEEE-2003, 3/225]
(1) $\text{CH}_3-\text{CH}_2-\text{COOH}$ (2) $\text{CH}_2=\text{CH}-\text{CH}_2\text{OH}$ (3) $\text{CH}_3-\text{CH}_2-\text{CH}_2\text{OH}$ (4) $\text{CH}_3-\text{CH}_2-\text{CHO}$.
3. Which one of the following is reduced with Zn , Hg and HCl acid to give the corresponding hydrocarbon? [AIEEE-2004, 3/225]
(1) Ethyl acetate (2) Butan-2-one (3) Acetamide (4) Acetic acid
4. The best reagent to convert pent-3-en-2-ol into pent-3-ene-2-one is [AIEEE-2005, 3/225]
(1) Pyridinium chloro-chromate (2) Chromic anhydride in glacial acetic acid
(3) Acidic dichromate (4) Acidic permanganate
5. The hydrocarbon which can react with sodium in liquid ammonia is: [AIEEE-2008, 3/105]
(1) $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$ (2) $\text{CH}_3\text{CH}=\text{CHCH}_3$
(3) $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CCH}_2\text{CH}_3$ (4) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}\equiv\text{CCH}_2\text{CH}_2\text{CH}_3$
6. In the following sequence of reactions, the alkene affords the compound 'B' [AIEEE-2008, 3/105]
 $\text{CH}_3\text{CH}=\text{CHCH}_3 \xrightarrow{\text{O}_3} \text{A} \xrightarrow[\text{Zn}]{\text{H}_2\text{O}} \text{B}$, The compound B is :
(1) CH_3COCH_3 (2) $\text{CH}_3\text{CH}_2\text{COCH}_3$ (3) CH_3CHO (4) $\text{CH}_3\text{CH}_2\text{CHO}$
7. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44 u. The alkene is : [AIEEE-2010, 4/144]
(1) propane (2) 1-butene (3) 2-butene (4) ethene
8. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of : [AIEEE-2011, 4/120]
(1) two ethylenic double bonds (2) a vinyl group
(3) an isopropyl group (4) an acetylenic triple bond



9. 2-Hexyne gives trans-2-Hexene on treatment with : **[AIEEE-2012, 4/120]**
 (1) Pt/H₂ (2) Li / NH₃ (3) Pd/BaSO₄ (4) Li AlH₄
10. In the given transformation, which the following is the most appropriate reagent ? **[AIEEE-2012, 4/120]**

 (1) NH₂NH₂, O^- (2) Zn-Hg/HCl (3) Na, Liq, NH₃ (4) NaBH₄
11. Compound (A), C₈H₉Br, gives a white precipitate when warmed with alcoholic AgNO₃. Oxidation of (A) gives an acid (B), C₈H₆O₄. (B) easily forms anhydride on heating. Identify the compound (A). **[JEE(Main)-2013, 4/120]**

12. The most suitable reagent for the conversion of R-CH₂-OH → R-CHO is : **[JEE(Main)-2014, 4/120]**
 (1) KMnO₄ (2) K₂Cr₂O₇
 (3) CrO₃ (4) PCC (Pyridinium Chlorochromate)
13. In the following sequence of reactions :
 Toluene $\xrightarrow{\text{KMnO}_4}$ A $\xrightarrow{\text{SOCl}_2}$ B $\xrightarrow[\text{BaSO}_4]{\text{H}_2/\text{Pd}}$ C
 the product C is : **[JEE(Main)-2015, 4/120]**
 (1) C₆H₅COOH (2) C₆H₅CH₃ (3) C₆H₅CH₂OH (4) C₆H₅CHO
14. The correct sequence of reagents for the following conversion will be : **[JEE(Main)-2017, 4/120]**

 (1) CH₃MgBr, H⁺/CH₃OH, [Ag(NH₃)₂]⁺OH⁻
 (2) CH₃MgBr, [Ag(NH₃)₂]⁺OH⁻, H⁺/CH₃OH
 (3) [Ag(NH₃)₂]⁺OH⁻, CH₃MgBr, H⁺/CH₃OH
 (4) [Ag(NH₃)₂]⁺OH⁻, H⁺/CH₃OH, CH₃MgBr
15. The major product obtained in the following reaction is : **[JEE(Main)-2017, 4/120]**


16. The trans-alkenes are formed by the reduction of alkynes with : **[JEE(Main)-2018, 4/120]**
 (1) Na/liq. NH₃ (2) Sn - HCl
 (3) H₂-Pd/C, BaSO₄ (4) NaBH₄



JEE(MAIN) ONLINE PROBLEMS

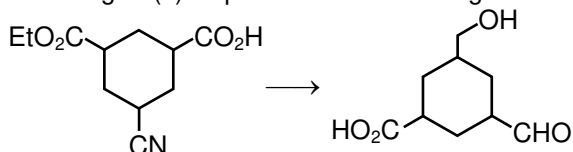
1. The reagent needed for converting $\text{Ph}-\text{C}\equiv\text{C}-\text{Ph} \longrightarrow \begin{array}{c} \text{Ph} \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{Ph} \end{array}$ is : [JEE(Main) 2014 Online (11-04-14), 4/120]

- (1) Cat. Hydrogenation (2) $\text{H}_2/\text{Lindlar Cat.}$
(3) Li/NH_3 (4) LiAlH_4

2. The gas liberated by the electrolysis of Dipotassium succinate solution is : [JEE(Main) 2014 Online (11-04-14), 4/120]
(1) Ethane (2) Ethyne (3) Ethene (4) Propene

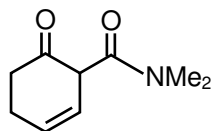
3. Bouveault-Blanc reduction reaction involves: [JEE(Main) 2016 Online (09-04-16), 4/120]
(1) Reduction of an anhydride with LiAlH_4 .
(2) Reduction of an ester with $\text{Na}/\text{C}_2\text{H}_5\text{OH}$.
(3) Reduction of a carbonyl compound with Na/Hg and HCl .
(4) Reduction of an acyl halide with H_2/Pd .

4. The reagent(s) required for the following conversion are: [JEE(Main) 2018 Online (15-04-18), 4/120]



- (1) (i) NaBH_4 (ii) Raney Ni/H_2 (iii) H_3O^+ (2) (i) LiAlH_4 (ii) H_3O^+
(3) (i) B_2H_6 (ii) DIBAL-H (iii) H_3O^+ (4) (i) B_2H_6 (ii) SnCl_2/HCl (iii) H_3O^+

5. The main reduction product of the following compound with NaBH_4 in methanol is : [JEE(Main) 2018 Online (15-04-18), 4/120]

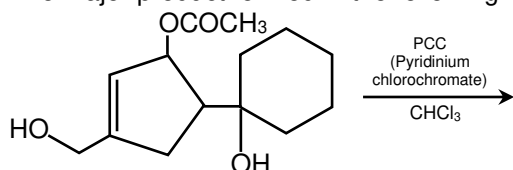


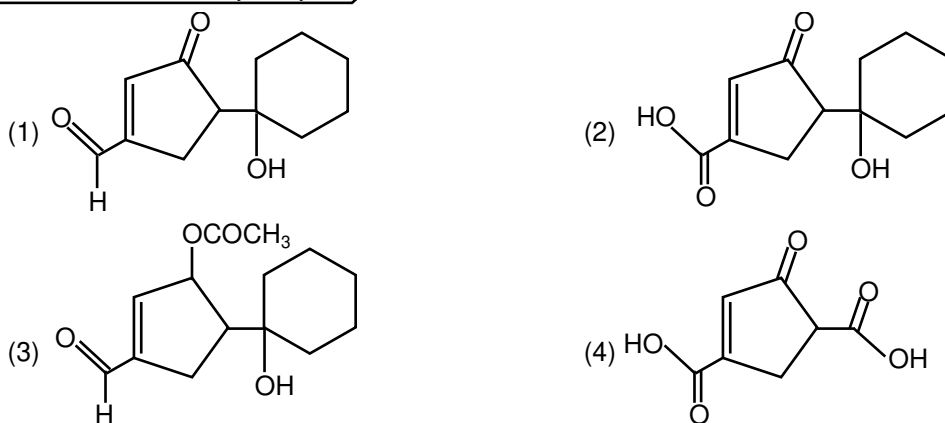
- (1)
- (2)
- (3)

- (4)

6. When 2-butyne is treated with $\text{H}_2/\text{Lindlar's catalyst}$, compound X is produced as the major product and when treated with $\text{Na}/\text{liq. NH}_3$ it produces Y as the major product. Which of the following statements is correct? [JEE(Main) 2018 Online (15-04-18), 4/120]
(1) X will have higher dipole moment and higher boiling point than Y.
(2) Y will have higher dipole moment and higher boiling point than X.
(3) X will have lower dipole moment and lower boiling point than Y.
(4) Y will have higher dipole moment and lower boiling point than X.

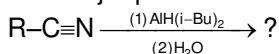
7. The major product formed in the following reaction is : [JEE(Main) 2018 Online (15-04-18), 4/120]





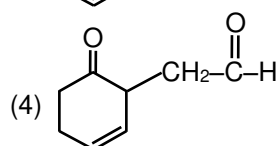
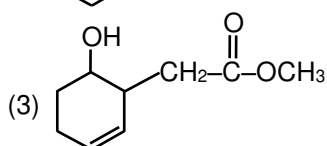
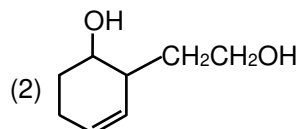
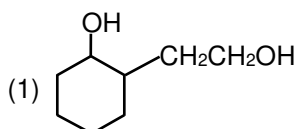
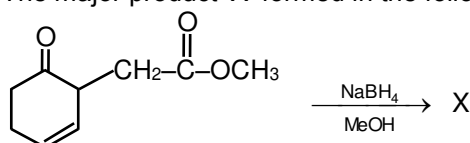
8. The major product of following reaction is :

[JEE(Main) 2019 Online (09-01-19), 4/120]



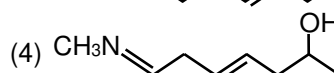
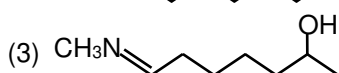
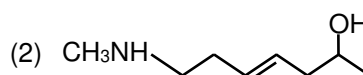
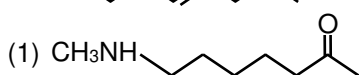
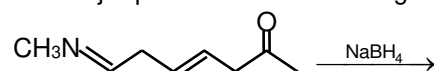
- (1) $RCONH_2$ (2) RCH_2NH_2 (3) $RCHO$ (4) $RCOOH$

9. The major product 'X' formed in the following reaction is: [JEE(Main) 2019 Online (10-01-19), 4/120]



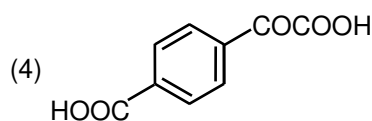
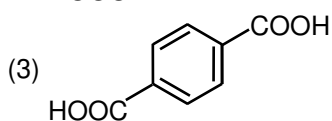
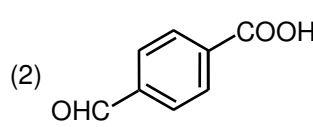
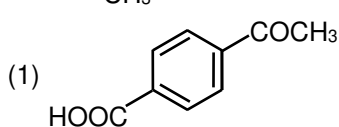
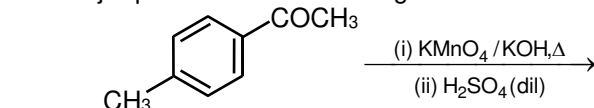
10. The major product of the following reaction is:

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



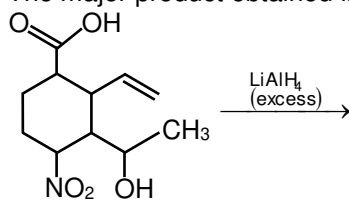
11. The major product of the following reaction is:

[JEE(Main) 2019 Online (11-01-19), 4/120]



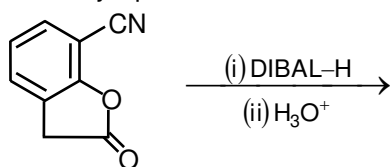


12. The major product obtained in the following reaction is : [JEE(Main) 2019 Online (11-01-19), 4/120]



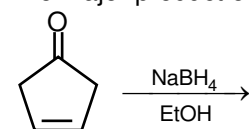
- (1) (2) (3) (4)

13. The major product of the following reaction is : [JEE(Main) 2019 Online (12-01-19), 4/120]



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

14. The major product of the following reaction is : [JEE(Main) 2019 Online (12-01-19), 4/120]



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



Answers

EXERCISE - 1

PART - I

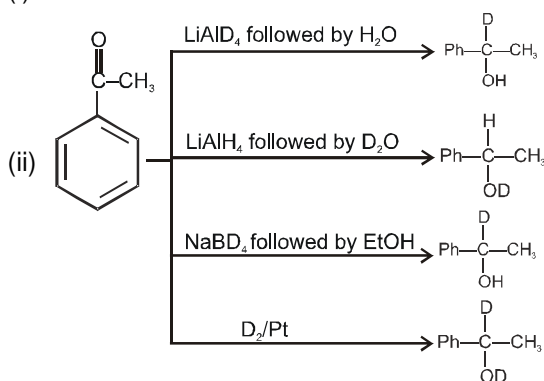
- A-1.** (a) Butane (b) Butane (c) $\text{Ph}-\text{CH}_2-\text{OH}$ (d)

- A-2.** (a) $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2-\text{C}\equiv\text{C}-\text{CH}_3 \xrightarrow[\text{Pd}]{\text{H}_2(\text{excess})} \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$
- (b) $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2-\text{C}\equiv\text{C}-\text{CH}_3 \xrightarrow{\text{H}_2/\text{Pd}-\text{BaSO}_4} \text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2-\text{C}(\text{H})=\text{C}(\text{H})-\text{CH}_3$
(cis isomer)
- (c) Benzaldehyde (Benzene carbaldehyde)

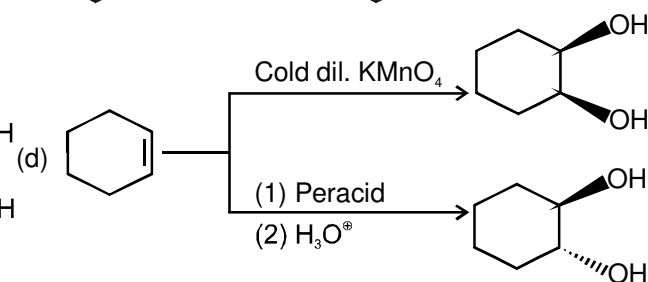
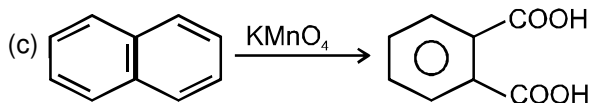
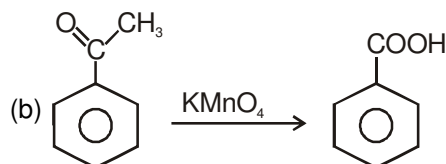
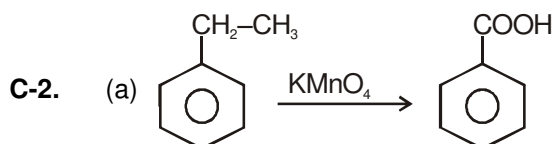
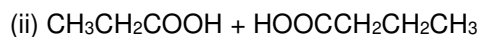
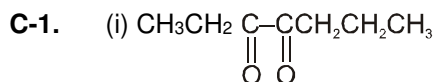
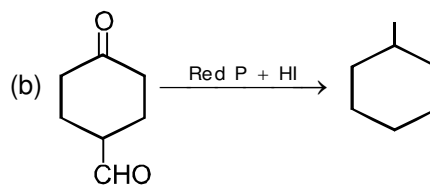
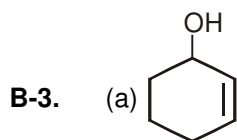
- A-3.** (i) $\text{CH}_3-\text{CH}_2-\underset{\text{trans}}{\text{CH}=\text{CH}}-(\text{CH}_2)_7-\text{CH}_2-\text{OH}$ (ii)

- A-4.** (i) $\text{H}_2/\text{Pd}-\text{BaSO}_4$
(ii) In this conversion $-\text{CO}-$ converts into $-\text{CH}_2-$ which can be achieved by any one of the following reagents :
(a) $\text{NH}_2-\text{NH}_2/\text{KOH}/\Delta$ (b) $\text{Zn}-\text{Hg}$, Conc HCl , Δ (c) Red P + HI

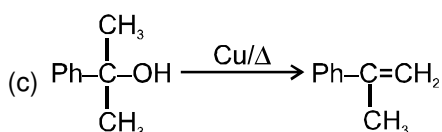
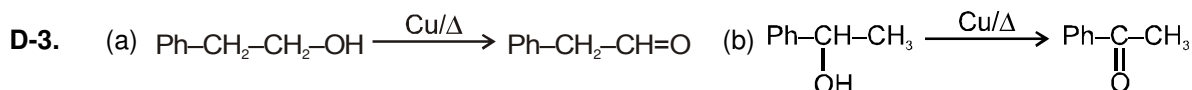
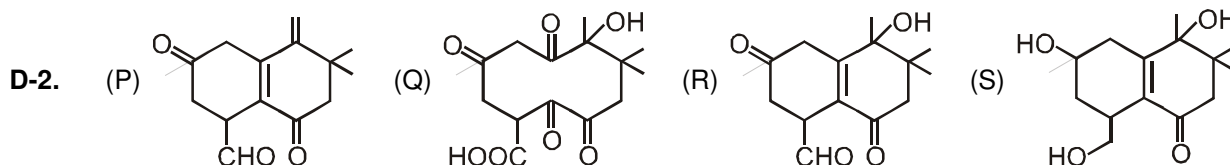
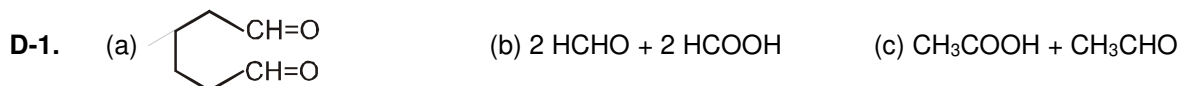
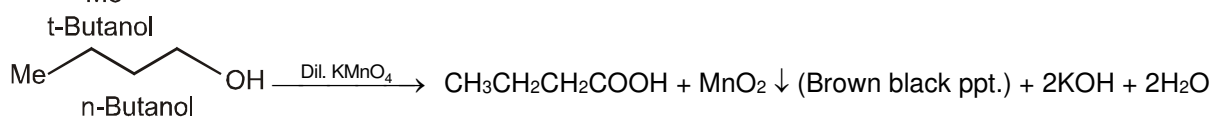
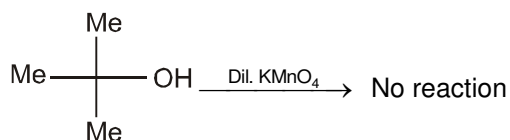
- B-1.** LiAlH_4 and NaBH_4 both gives same products with carbonyl compounds.
(i) $\text{Ph}-\text{CH}_2-\text{OH}$



- B-2.** (i) a :
b :
- (ii) a :
b :

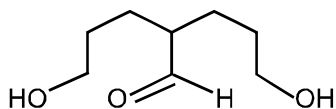


C-3. t-Butanol is not oxidised by dilute KMnO_4 , so it does not give brown-black precipitate of MnO_2 . n-Butanol is oxidised with dil KMnO_4 and MnO_4^- is converted to brown-black precipitate of MnO_2 .

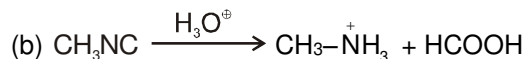
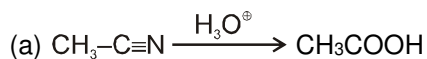




E-1.



E-2.



E-3.



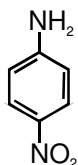
E-4.



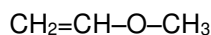
E-5.

Two carboxylic acids

E-6.



E-7.



PART - II

A-1.

(A)

A-2.

(B)

A-3.

(B)

A-4.

(D)

A-5.

(B)

A-6.

(B)

A-7.

(D)

A-8.

(A)

B-1.

(B)

B-2.

(A)

B-3.

(C)

B-4.

(B)

B-5.

(A)

B-6.

(B)

B-7.

(D)

C-1.

(C)

C-2.

(C)

C-3.

(C)

C-4.

(C)

C-5.

(B)

D-1.

(C)

D-2.

(C)

D-3.

(C)

D-4.

(B)

E-1.

(D)

E-2.

(C)

E-3.

(D)

PART - III

1.

(A) – (q) ; (B) – (s) ; (C) – (p, s) ; (D) – (q, s)

2.

(A) – (p) ; (B) – (q) ; (C) – (t) ; (D) – (s).

EXERCISE - 2

PART - I

1.

(D)

2.

(D)

3.

(D)

4.

(B)

5.

(C)

6.

(D)

7.

(D)

8.

(D)

9.

(D)

10.

(A)

PART - II

1.

3

2.

3

3.

3 (i, ii, iv)

4.

3

5.

7

6.

4 (i, ii, iii, v)

PART - III

1.

(ABCD)

2.

(AB)

3.

(AD)

4.

(BC)

5.

(AB)

PART - IV

1.

(D)

2.

(C)

3.

(A)

4.

(B)

5.

(A)

6.

(D)

7.

(A)

8.

(C)

9.

(D)

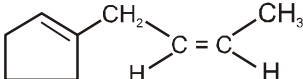
10.

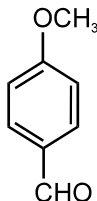
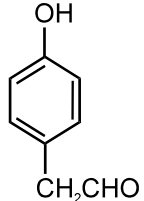
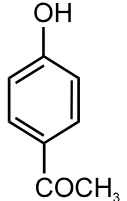
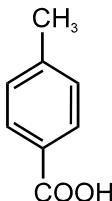
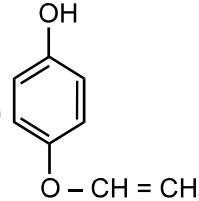
(B)



EXERCISE - 3

PART - I

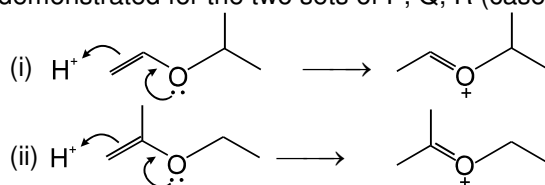
1.  2. (B) 3. (C) 4. (A)
- cis-isomer

5. (A)  (B)  (C)  (D)  (E) 

6. (C) 7. (C)

8. (a) $P = \text{H}_2\text{C}=\text{CH}-\text{O}-\text{CH}(\text{CH}_3)_2$; $Q = \text{H}_3\text{C}-\text{C}(=\text{O})-\text{H}$; $R = \text{HO}-\text{CH}(\text{CH}_3)_2$
or
 $P = \text{H}_2\text{C}=\text{CH}-\text{O}-\text{CH}(\text{CH}_3)_2$; $Q = \text{H}_3\text{C}-\text{C}(=\text{O})-\text{H}$; $R = \text{HO}-\text{CH}(\text{CH}_3)_2$

(b) The greater stability of the oxonium ion intermediate is responsible for the extraordinary reactivity. This is demonstrated for the two sets of P, Q, R (cases i and ii above) as follows.



9. (A) – p, q, s, t ; (B) – s, t ; (C) – p ; (D) – r
10. (ACD) 11. (A) 12. 5 13. (CD)

PART - II

JEE(MAIN) OFFLINE PROBLEMS

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (4) | 2. (2) | 3. (2) | 4. (1) | 5. (1) |
| 6. (3) | 7. (3) | 8. (2) | 9. (2) | 10. (1) |
| 11. (4) | 12. (4) | 13. (4) | 14. (4) | 15. (4) |
| 16. (1) | | | | |

JEE(MAIN) ONLINE PROBLEMS

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



Additional Problems for Self Practice (APSP)

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

PART - I : PRACTICE TEST-1 (IIT-JEE (MAIN Pattern))

Max. Time : 1 Hr.

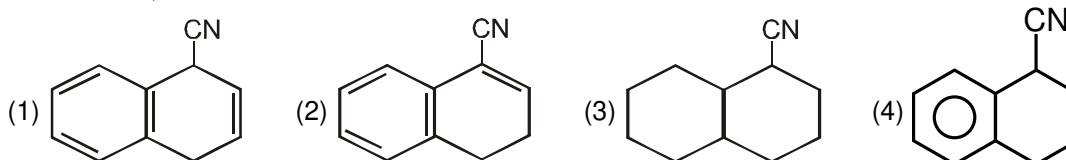
Max. Marks : 120

Important Instructions

- The test is of **1 hour** duration.
- The Test Booklet consists of **30** questions. The maximum marks are **120**.
- Each question is allotted **4 (four)** marks for correct response.
- Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question.
 $\frac{1}{4}$ (**one fourth**) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
- There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 4 above.

- Propyne and propene can be distinguished by :
 (1) Conc. H_2SO_4 (2) Br_2 in CCl_4
 (3) Dil. KMnO_4 (4) AgNO_3 in ammonia
- The reactivity order towards hydrogenation of the following compounds is
 (I) $\text{CH}_3\text{—C}\equiv\text{C—CH}_3$ (II) $\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{H} \end{array}$
 (III) $\begin{array}{c} \text{CH}_3 \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{CH}_3 \end{array}$ (IV) $\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
 (1) $\text{I} > \text{II} > \text{III} > \text{IV}$ (2) $\text{II} > \text{III} > \text{IV} > \text{I}$ (3) $\text{III} > \text{IV} > \text{II} > \text{I}$ (4) $\text{IV} > \text{III} > \text{II} > \text{I}$

- P, the product can be :



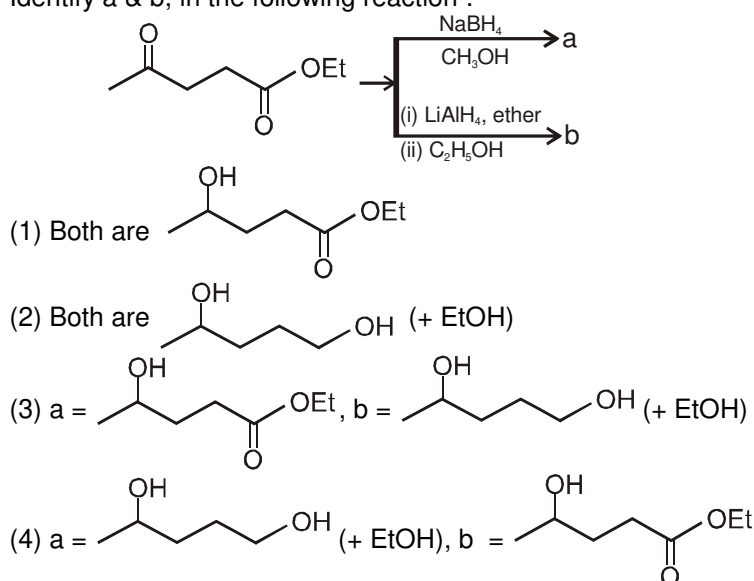
- The product of following reaction is

$$\text{PhCH=CHCH=O} \xrightarrow[\text{(ii) } \text{H}_3\text{O}^+]{\text{(i) } \text{LiAlH}_4}$$
 (1) $\text{PhCH}_2\text{CH=CHCH}_2\text{OH}$ (2) Ph(OH)C=CHCH_3
 (3) $\text{PhCH=CHCH}_2\text{OH}$ (4) $\text{PhCH}_2\text{CH}_2\text{CH}_2\text{OH}$
- The product of the reaction $\text{Ph}_2\text{C=O} \xrightarrow[\text{H}_3\text{O}^+]{\text{LiAlD}_4}$ is
 (1) $\text{Ph}_2\text{CD(OH)}$ (2) $\text{Ph}_2\text{CH(OD)}$ (3) $\text{Ph}_2\text{CD(OD)}$ (4) None



6. X can be
 (1) $\text{NaBH}_4/\text{EtOH}$ (2) $\text{LiAlH}_4/\text{THF}$ (3) Na/EtOH (4) $\text{H}_2/\text{Pd}-\text{BaSO}_4$
7. Hydrogenation of benzoyl chloride in the presence of $\text{Pd} / \text{BaSO}_4$ gives
 (1) benzyl alcohol (2) benzaldehyde (3) benzoic acid (4) phenol
8. Which of the following reagent not convert carbonyl compound into alcohol ?
 (1) DIBAL-H (2) $\text{NH}_2-\text{NH}_2/\text{KOH}$ (3) $\text{Na}-\text{Hg}/\text{HCl}$ (4) LiAlH_4

9. , X can be
 (1) $\text{NH}_2-\text{NH}_2 / \text{KOH}$ (2) $\text{Zn}-\text{Hg} / \text{HCl}$ (3) $\text{Red P} + \text{HI}$ (4) All
10. Identify a & b, in the following reaction :

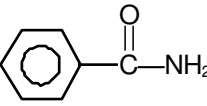
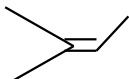
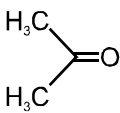
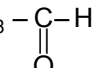
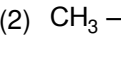
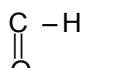
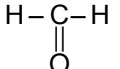
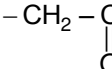
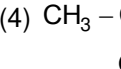
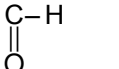
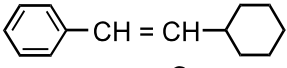
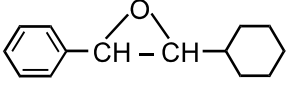
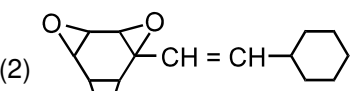
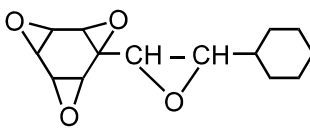
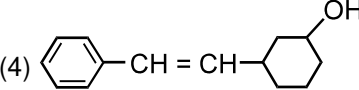
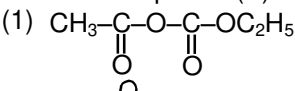
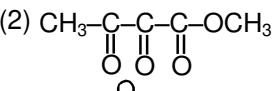
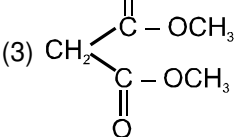
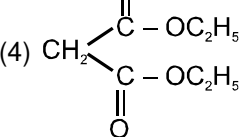


11. Alkene (X) $\xrightarrow[\Delta]{\text{KMnO}_4}$ + ; X is :
 (1)
 (2)
 (3)
 (4)

12. An alkene on ozonolysis yields only ethanal. There is an isomer of this, which on ozonolysis yields :
 (1) Propanone and methanal (2) Propanone and ethanal
 (3) Ethanal and methanal (4) Only propanone

13. $(\text{CH}_3)_3\text{CCl} \xrightarrow[\Delta]{\text{alc. KOH}} \text{X} \xrightarrow{\text{CF}_3\text{CO}_3\text{H}} \text{Y}$; The product 'Y' is
 (1) $\text{CH}_2=\text{CH}-\text{CH}_2\text{OH}$ (2)
 (3) $\text{CH}_3\text{COCH}_2\text{CH}_3$ (4) $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$



14. Which of the following will decolorise alkaline KMnO_4 solution ?
 (1) C_3H_8 (2) CH_4 (3) CCl_4 (4) C_2H_4
15. Bayer's reagent is :
 (1) alkaline permanganate solution
 (2) acidified permanganate solution
 (3) neutral permanganate solution
 (4) aqueous bromine solution
16. (P)  $\xrightarrow{\text{H}_3\text{O}^+}$ (A) + E(gas) $\xrightarrow[2. \text{H}_2\text{O}]{1. \text{LiAlH}_4}$ (B) $\xrightarrow{\text{KMnO}_4 / \text{H}^+}$ (C)
 Select correct options, for identical pairs
 (1) P, A (2) A, C (3) B, C (4) P, C
17.  $\xrightarrow[\text{H}_2\text{O}_2]{\text{OSO}_4}$ A $\xrightarrow{\text{HIO}_4}$ B + C ;
 Product B and C are respectively :
 (1)  and 
 (2)  and 
 (3)  and 
 (4)  and 
18.  $\xrightarrow{\text{RCOOH}}$
 (1) 
 (2) 
 (3) 
 (4) 
19. Fenton's reagent is :
 (1) $\text{FeSO}_4 + \text{H}_2\text{O}_2$ (2) $\text{HgSO}_4 + \text{H}_2\text{O}_2$ (3) $\text{FeSO}_4 + \text{H}_2\text{O}$ (4) None of these
20. The reagent with which both acetaldehyde and acetone react easily is
 (1) Tollen's reagent (2) Schiff's reagent
 (3) Grignard reagent (4) Fehling reagent
21. An organic compound (P) with molecular formula $\text{C}_5\text{H}_8\text{O}_4$ is stable to heat but hydrolyse to (Q) and MeOH by NaOH followed by acidification. (Q) on strong heating gives (R) which with Red P/HI gives ethane. Compound (P) is :
 (1) 
 (2) 
 (3) 
 (4) 
22. When acetaldehyde is treated with Fehling's solution, it gives a precipitate of
 (1) Cu (2) CuO (3) Cu_2O (4) $\text{Cu} + \text{Cu}_2\text{O} + \text{CuO}$

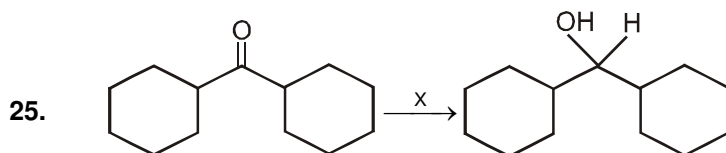


23. Identify the correct statement about MnO_2/Δ

- (1) $\text{C}_6\text{H}_5\text{-CHOH-CH}_3$ as well as $\text{CH}_3\text{-CH=CH-CH}_2\text{OH}$ are oxidised
- (2) $\text{C}_6\text{H}_5\text{-CH}_2\text{-CH}_2\text{-OH}$ as well as $\text{CH}_2\text{=CH-CH}_2\text{-CH}_2\text{-OH}$ are oxidised
- (3) $\text{C}_6\text{H}_5\text{-CHOH-CH}_3$ is not oxidised but $\text{CH}_3\text{-CH=CH-CH}_2\text{-OH}$ is oxidised.
- (4) $\text{C}_6\text{H}_5\text{-CHOH-CH}_3$ is oxidised but $\text{CH}_3\text{-CH=CH-CH}_2\text{OH}$ is not oxidised.

24. Which of the following reaction involves homogeneous reduction?

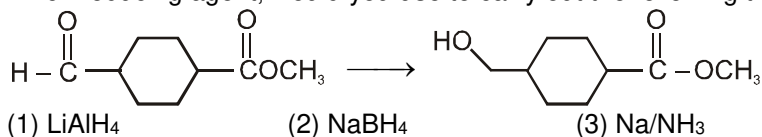
- (A) $\text{CH}_2\text{=CH}_2 \xrightarrow{\text{H}_2/\text{Ni}} \text{CH}_3\text{-CH}_3$
- (B) $\text{CH}_3\text{-C}\equiv\text{C-CH}_3 \xrightarrow{\text{Wilkinson's catalyst}} \text{CH}_3\text{-CH=CH-CH}_3$
- (C) $\text{CH}_3\text{COCl} \xrightarrow{\text{H}_2/\text{Pd/CaCO}_3/\text{quinoline}} \text{CH}_3\text{CHO}$
- (D) $\text{CH}_3\text{C}\equiv\text{CH} \xrightarrow{\text{H}_2/\text{Pd/CaCO}_3/\text{quinoline}} \text{CH}_3\text{CH=CH}_2$



X is :

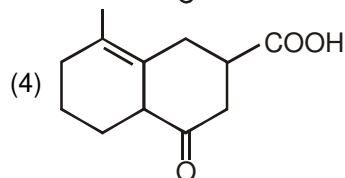
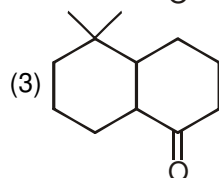
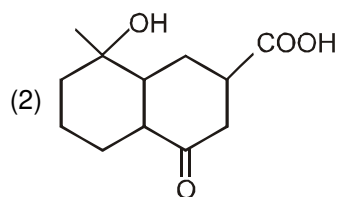
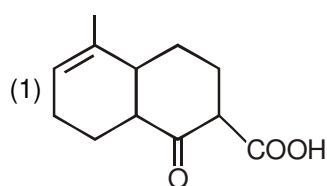
- (1) $\text{NaBH}_4/\text{EtOH}$
- (2) $\text{LiAlH}_4/\text{THF}$
- (3) $\text{Al(OiPr)}_3/\text{CH}_3\text{-CH(OH)-CH}_3$
- (4) All of these

26. Which reducing agent, would you use to carry out the following transformation.

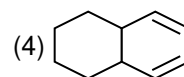
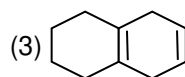
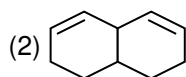
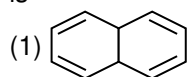


- (1) LiAlH_4
- (2) NaBH_4
- (3) Na/NH_3
- (4) DIBAL-H

27.



28. An unknown compound decolorizes bromine in carbon tetrachloride, and it undergoes catalytic reduction to give decalin. When treated with warm, conc. potassium permanganate, this compound give cis-cyclohexane-1,2-dicarboxylic acid and oxalic acid. Possible a structure for the unknown compound is -





29. The reaction, $\text{Ph}-\text{CH}_2-\text{CH}=\text{CH}-\underset{\text{OH}}{\text{CH}}-\text{CH}_3 \xrightarrow[\text{ketone(excess)/}\Delta]{\text{Al(tBuO)}_3} \text{PhCH}_2\text{CH}=\text{CH}-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{CH}_3$ is known as :
- (1) Wolff-kishner reduction (2) Oppenauer oxidation
(3) Meerwein -Ponndorf reaction (4) Clemmensen reduction
30. The reagent used to convert $\text{RCOOH} \rightarrow \text{RCH}_2\text{OH}$ is
- (1) NaBH_4 (2) Na/Alcohol (3) Zn/Hg-HCl (4) LiAlH_4

Practice Test-1 (IIT-JEE (Main Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

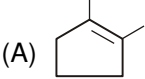
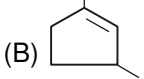
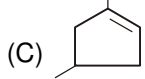
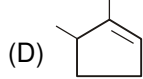
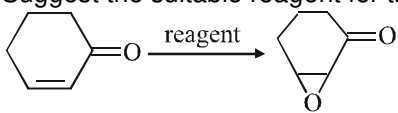
Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) STAGE-I

1. If 2-pentanone is reacted with NaBH_4 followed by hydrolysis with D_2O the product will be [NSEC-2000]
(A) $\text{CH}_3\text{CH}(\text{OD})\text{CH}_2\text{CH}_2\text{CH}_3$ (B) $\text{CH}_3\text{CD}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_3$
(C) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_3$ (D) $\text{CH}_3\text{CD}(\text{OD})\text{CH}_2\text{CH}_2\text{CH}_3$
2. If 1 mole H_2 is reacted with 1 mole of the following compound. [NSEC-2000]
-
- Which double bond will be hydrogenated ?
(A) c (B) b (C) a (D) d
3. Which of the following can not be obtained when alkenes are oxidised with KMnO_4 and then followed by acid hydrolysis ? [NSEC-2000]
(A) alkanic acids (B) alkanals (C) alkanones (D) carbon dioxide
4. In the reaction

$$\text{CH}_3\text{CN} + 2\text{H} \xrightarrow[\text{ether}]{\text{HCl}} \text{X} \xrightarrow[\Delta]{\text{H}_2\text{O}} \text{Y}, \text{Y is}$$
 (A) acetaldehyde (B) ethanamine (C) dimethylamine (D) acetone [NSEC-2001]
5. A compound is soluble in conc. H_2SO_4 . It does not decolorise bromine in carbon tetrachloride but oxidised by chromic anhydride in aqueous sulphuric acid within two seconds, turning orange solution to blue, green and then opaque. The original compound is : [NSEC-2001]
(A) an alkane (B) a tertiary alcohol (C) a primary alcohol (D) an ether
6. If 3-hexanone is reacted with NaBH_4 followed by hydrolysis with D_2O , the product will be : [NSEC-2001]
(A) $\text{CH}_3\text{CH}_2\text{CH}(\text{OD})\text{CH}_2\text{CH}_2\text{CH}_3$ (B) $\text{CH}_3\text{CH}_2\text{CD}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_3$
(C) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_3$ (D) $\text{CH}_3\text{CH}_2\text{CD}(\text{OD})\text{CH}_2\text{CH}_2\text{CH}_3$

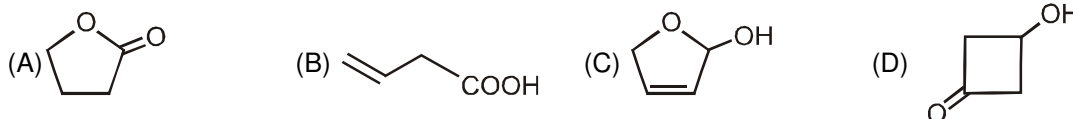


7. Hydrogenation of benzoyl chloride in the presence of Pd and BaSO₄ gives : [NSEC-2001]
(A) benzyl alcohol (B) benzoic acid (C) benzaldehyde (D) toluene
8. The reaction, $R_2CO + 4[H] \xrightarrow[\text{Conc. HCl}]{Zn-Hg} R_2CH_2 + H_2O$ is well known as : [NSEC-2001]
(A) Wurtz reaction (B) Rosenmund reduction
(C) Kolbe reaction (D) Clemmensen reduction
9. Acetone will be obtained on ozonolysis of [NSEC-2002]
(A) 1-pentene (B) 2-pentene (C) isopentene (D) 2-pentyne
10. The reducing agent for conversion of $O_2NCH_2CH_2CH=CH_2$ to $H_2NCH_2CH_2CH=CH_2$ is : [NSEC-2002]
(A) LiAlH₄ (B) H₂/Pd (C) B₂H₆ (D) NaBH₄
11. Reduction of an isonitrile gives a [NSEC-2002]
(A) primary amine (B) secondary amine
(C) tertiary amine (D) quaternary ammonium salt.
12. Methane may be obtained from monochloromethane by [NSEC-2002]
(A) reduction with nascent hydrogen (Zn + HCl) (B) reduction with hydrogen (H₂)
(C) heating with sodium metal in dry ether (D) hydrolysis with aqueous NaOH.
13. The compound which does not react with lithium aluminium hydride is [NSEC-2003]
(A) 3-penten-2-one (B) methyl benzoate (C) 2-pentanol (D) propanenitrile
14. The compound that would yield a 5-oxo-2-methylhexanal on ozonolysis is [NSEC-2004]
(A)  (B)  (C)  (D) 
15. Reduction of methylbenzoate (C₆H₅COOCH₃) to benzyl alcohol (C₆H₅CH₂OH) can be accomplished using [NSEC-2005]
(A) H₂/Pd (B) LiAlH₄ (C) NaBH₄ (D) Zn-Hg/HCl
16. Oxidation of cyclopentanol to cyclopentanone can be accomplished by using [NSEC-2005]
(A) Tollen's reagent (B) chromic acid (C) bromine water (D) Fehling's solution.
17. Carbonyl compounds can generally be converted to hydrocarbons by [NSEC-2006]
(A) H₂/Pt (B) LiAlH₄ (C) N₂H₄-KOH (D) K₂Cr₂O₇-H₂SO₄
18. To reduce a nitroaldehyde to a nitroalcohol the reducing agent of choice is [NSEC-2008]
(A) LiAlH₄ (B) NaBH₄ (C) Molecular H₂ (D) SnCl₂
19. Suggest the suitable reagent for the following transformation. [NSEC-2008]


(A) meta-chloroperoxybenzoic acid (B) ozone
(C) potassium dichromate (D) alkaline hydrogen peroxide
20. An isocyanide on reduction with hydrogen in the presence of platinum gives : [NSEC-2009]
(A) amide (B) primary amine
(C) secondary amine (D) alcohol
21. Compound X (C₅H₁₀O) is a chiral alcohol. It is catalytically hydrogenated to an achiral alcohol Y (C₅H₁₂O) and oxidized by activated MnO₂ to an achiral carbonyl compound Z (C₅H₈O). Compound X is [NSEC-2009]
(A) 1-penten-3-ol (B) 4-penten-2-ol
(C) 3-methyl-2-buten-1-ol (D) 2-methyl-2-buten-1-ol

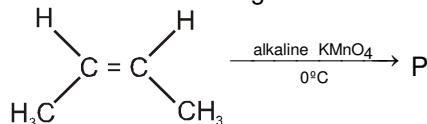


22. 4-Oxobutanoic acid is reduced with Na-borohydride and the product is treated with aqueous acid. The final product is : [NSEC-2009]

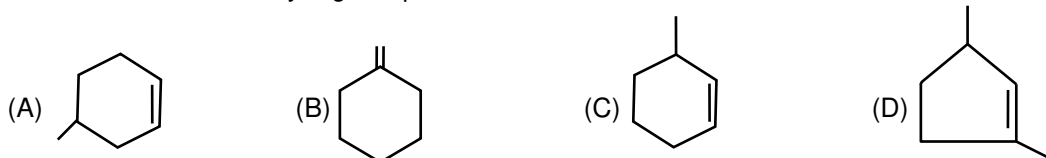


23. A solution of sodium metal in liquid ammonia is strongly reducing due to the presence of [NSEC-2013]
(A) sodium atoms (B) sodium hydride (C) sodium amide (D) solvated electrons

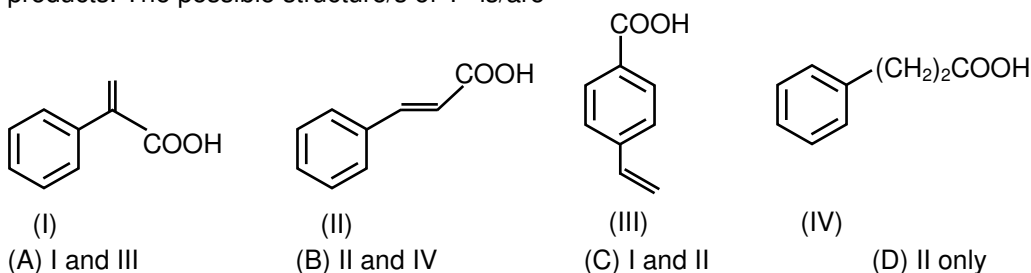
24. Which of the following statements is true for the reaction given below ? [NSEC-2013]



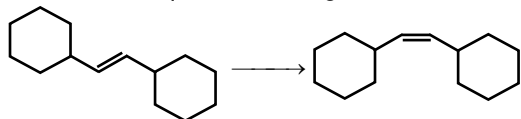
- (A) P is a meso compound of 2,3-butanediol formed by syn addition.
(B) P is a meso compound of 2,3-butanediol formed by anti addition.
(C) P is a racemic mixture of d- and l-2,3-butanediol formed by anti addition.
(D) P is a racemic mixture of d- and l-2,3-butanediol formed by syn addition.
25. Complete catalytic hydrogenation of naphthalene gives decalin ($C_{10}H_{18}$). The number of isomers of decalin formed and the total number of isomers of decalin possible are respectively. [NSEC-2016]
(A) 1, 2 (B) 2, 2 (C) 2, 4 (D) 3, 4
26. Which of the following on treatment with hot concentrated acidified $KMnO_4$ will give 2-methylhexane-1,6-dioic acid as the only organic product? [NSEC-2017]



27. An organic compound 'P' with molecular formula $C_9H_8O_2$ on oxidation gives benzoic acid as one of the products. The possible structure/s of 'P' is/are [NSEC-2017]



28. The correct sequence of reagents from those listed below for the following conversion is [NSEC-2018]



- I. $NaNH_2$ II. Br_2
III. $H_2/Pd-C$, quinolone IV. H_3O^+
(A) IV – I – III (B) III – IV – I (C) II – I – III (D) I – II – III

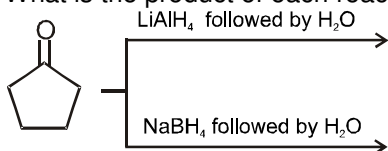


PART - III : HIGH LEVEL PROBLEMS (HLP)

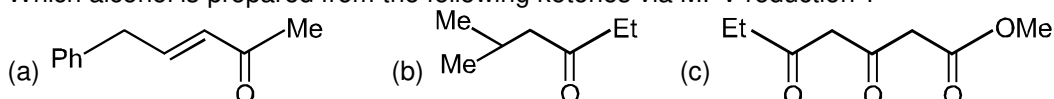
SUBJECTIVE QUESTIONS

1. An alkene (A) $C_{16}H_{16}$ on ozonolysis gives only one product (B) C_8H_8O . Compound (B) 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 two 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. [JEE-2001, 5/100]

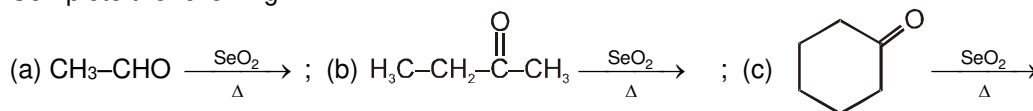
2. What is the product of each reaction



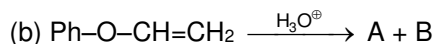
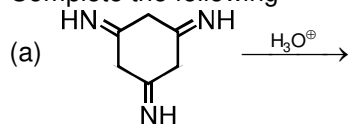
3. Which alcohol is prepared from the following ketones via MPV reduction ?



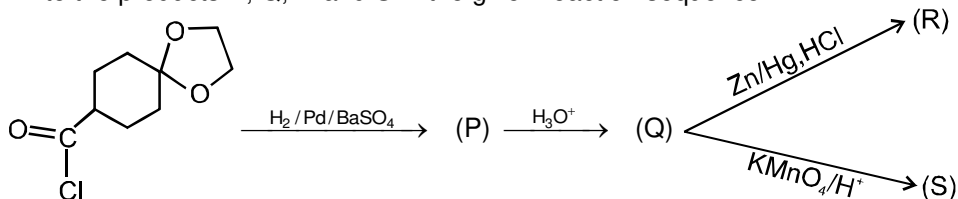
4. Complete the following



5. Complete the following

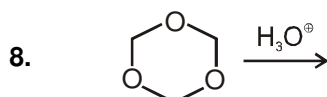


6. Write the products P, Q, R and S in the given reaction sequence.



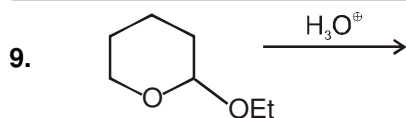
ONLY ONE OPTION CORRECT TYPE

7. Identify a reagent from the following list which can easily distinguish between 1-butyne and 2-butyne.
 (A) bromine, CCl_4 (B) H_2 , Lindlar catalyst
 (C) dilute H_2SO_4 , $HgSO_4$ (D) ammonical Cu_2Cl_2 solution [JEE-2002, 3/90]

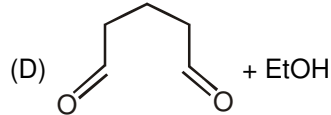
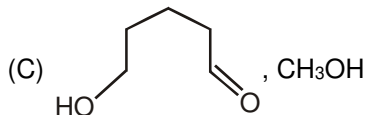
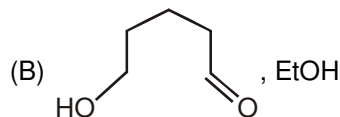
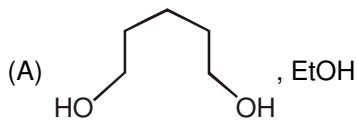


Product obtained in above reaction is :

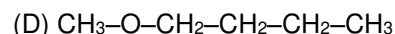
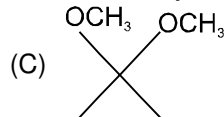
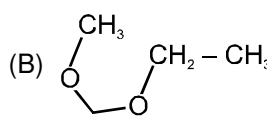
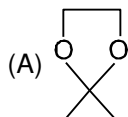
- (A) $3CH_3CHO$ (B) $3HCHO$ (C) $3HCOOH$ (D) $3CH_3OH$



Product of above reaction is :

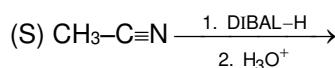
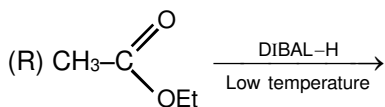
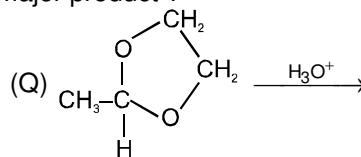
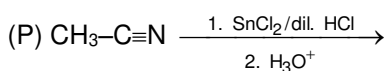


10. Which of the following gives CH₃-OH and CH₃-C(=O)-CH₃ on hydrolysis with H₃O⁺.

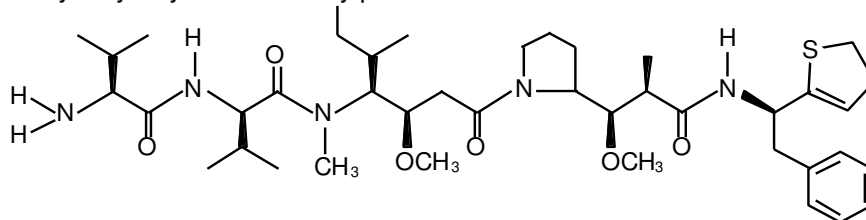


SINGLE AND DOUBLE VALUE INTEGER TYPE

11. In how many reaction CH₃-CHO is obtained as major product ?



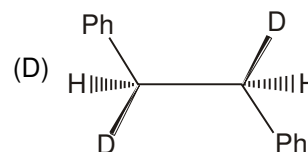
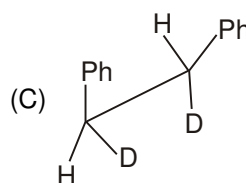
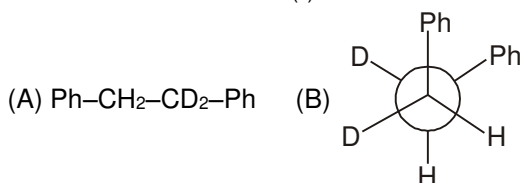
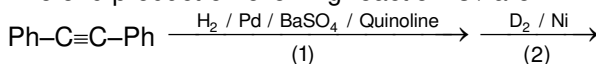
12. Dolastatin is an anti cancer compound isolated from Indian sea have *Dobabella ausiculasia*. One mole of it on acidic hydrolysis yield how many products are formed.



13. How many para substituted benzenoid isomers of C₈H₈O₂ gives 1, 4-dihydroxy benzene on hydrolysis ?

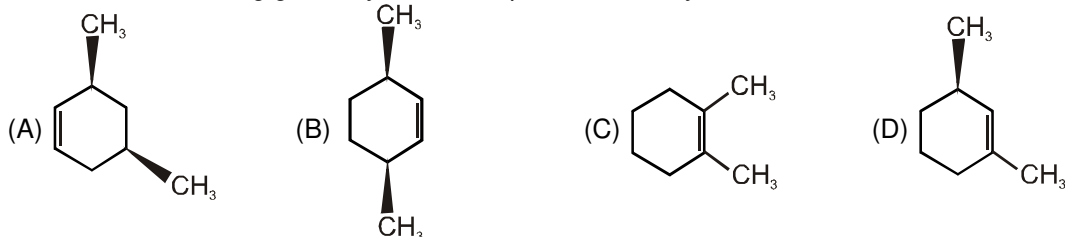
ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

14. The end product of following reaction is / are :

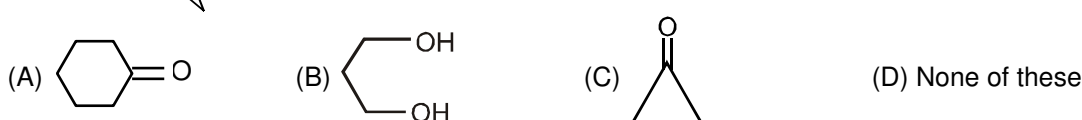




15. Which of the following give only meso compound on catalytic reduction ?



16. $\xrightarrow{\text{dil. H}_2\text{SO}_4}$ A + B



PART - IV : PRACTICE TEST-2 (IIT-JEE (ADVANCED Pattern))

Max. Time : 1 Hr.

Max. Marks : 66

Important Instructions

A. General :

- The test is of 1 hour duration.
- The Test Booklet consists of 22 questions. The maximum marks are 66.

B. Question Paper Format

- Each part consists of five sections.
- Section-1 contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE is correct.
- Section-2 contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE THAN ONE are correct.
- Section-3 contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9 (both inclusive).
- Section-4 contains 1 paragraph each describing theory, experiment and data etc. 2 questions relate to paragraph. Each question pertaining to a particular passage should have only one correct answer among the four given choices (A), (B), (C) and (D).
- Section-5 contains 1 multiple choice questions. Question has two lists (list-1 : P, Q, R and S; List-2 : 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE is correct.

C. Marking Scheme :

- For each question in Section 1, 4 and 5 you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (-1) mark will be awarded.
- For each question in Section 2, you will be awarded 3 marks. If you darken all the bubble(s) corresponding to the correct answer(s) and zero mark. If no bubbles are darkened. No negative marks will be answered for incorrect answer in this section.
- For each question in Section 3, you will be awarded 3 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marks will be awarded for incorrect answer in this section.



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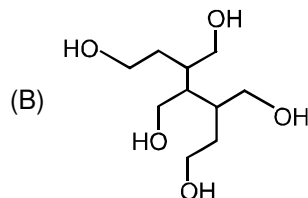
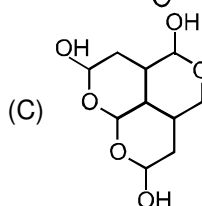
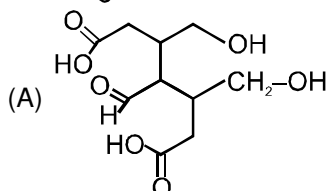
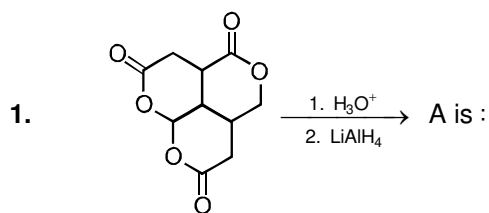
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ADVROHO - 48

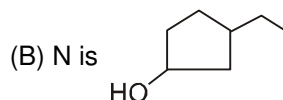
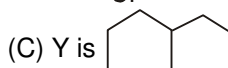
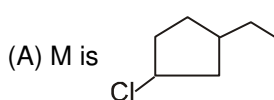
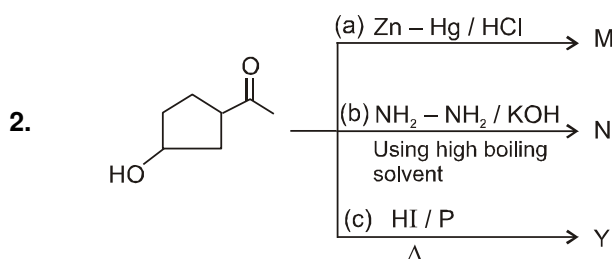


SECTION-1 : (Only One option correct Type)

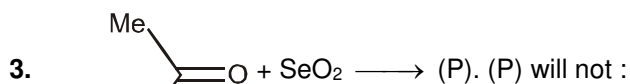
This section contains 8 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which Only ONE option is correct.



(D) None



(D) All of these are correct

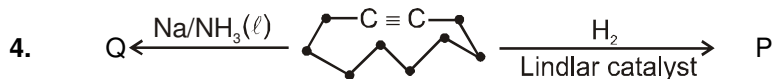


(A) reduce Tollens reagent.

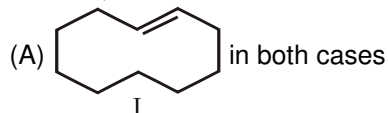
(C) form dioxime

(B) give Iodoform test.

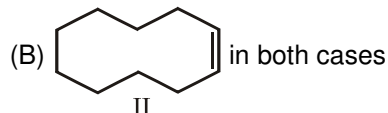
(D) give ceric ammonium nitrate test.



P and Q are :



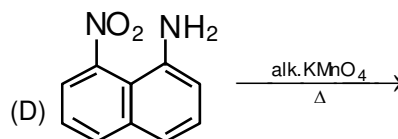
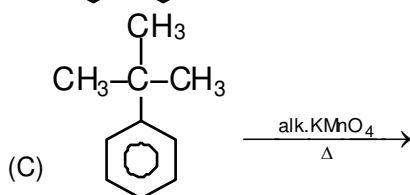
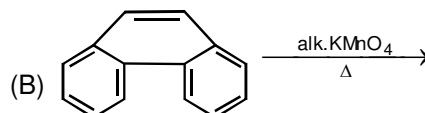
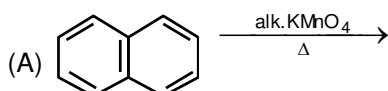
(C) P is I, Q is II



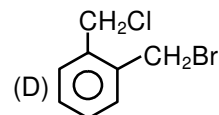
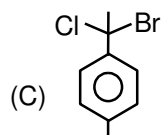
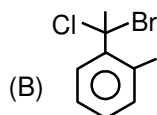
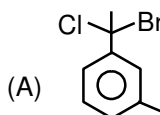
(D) P is II, Q is I



5. Which of the following Reaction is not possible ?



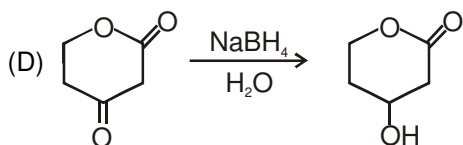
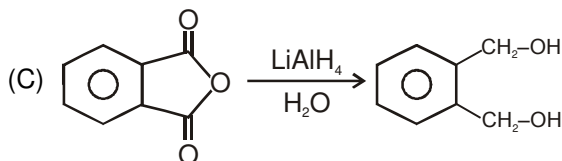
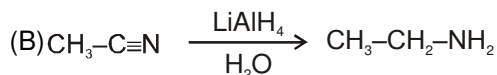
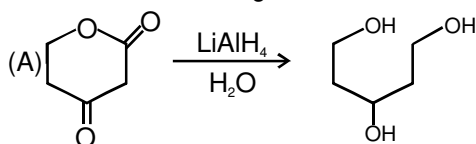
6. Hydrolysis of a compound $C_9H_{10}ClBr$ (P) yields $C_9H_{10}O$ (Q)
(Q) gives positive haloform test ?
Strong oxidation of (Q) yields a dibasic acid which gives only two mono-nitro derivative.
What is the structure of (P) ?



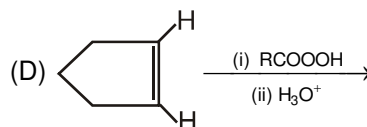
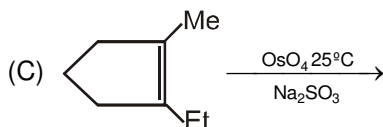
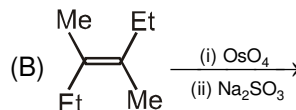
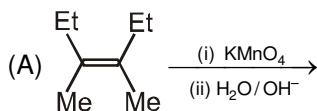
Section-2 : (One or More than one options correct Type)

This section contains 5 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

7. Which of the following reaction is/are correct ?

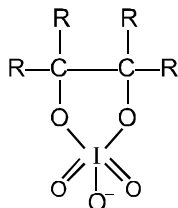


8. Which of the following will give syn addition ?

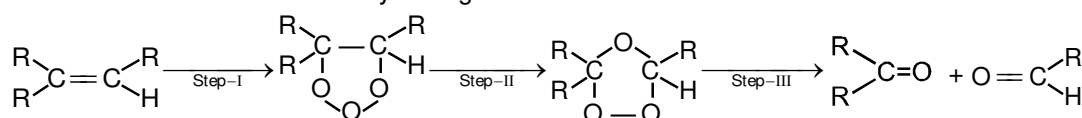




9. Periodic acid is generally used for the oxidation of vicinal diols or α -hydroxycarboxyl compounds. Which of the following statements are correct for this reaction
- (A) oxidative cleavage takes place in the above reactions.
 (B) final products are generally carbonyl compounds or carboxylic acids.
 (C) HIO_4 reduced into HIO_3
 (D) Intermediate of this reaction for a vicinal diol is



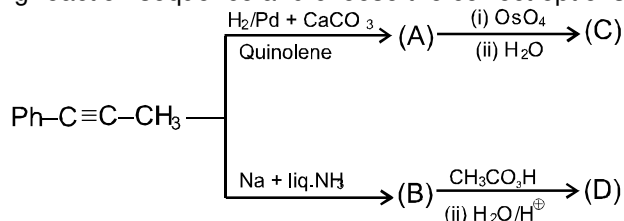
10. Mechanism of reductive ozonolysis is given below for an alkene.



Which is correct for the above mechanism

- (A) Ozone act as electrophile and as well as nucleophile in this reaction
 (B) First step of this reaction is an electrophilic addition
 (C) ozonide is formed in the step-II
 (D) When ozonide is cleaved in the presence of reducing agent such as Zn or Me_2S the products will be aldehydes and/or ketones.

11. Observed the following reaction sequence and choose the correct options.

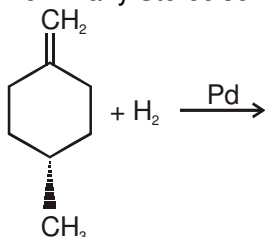


- (A) (A) and (B) are diastereomer's of each other.
 (B) upon catalytic hydrogenation (A) and (B) gives same product
 (C) Product (C) and (D) are Identical
 (D) Product (C) and (D) are separated by fractional distillation.

Section-3 : (Single/ Double Integer Value Correct Type.)

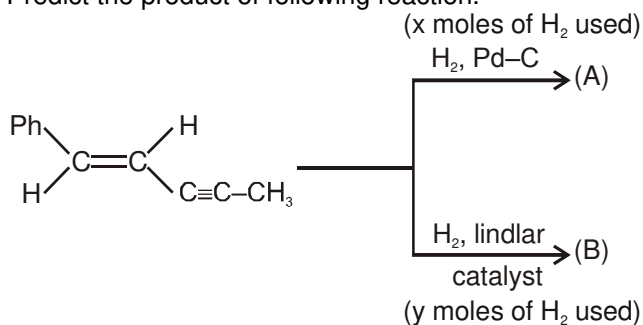
This section contains 6 questions. Each question, when worked out will result in one integer from 0 to 9 (both inclusive)

12. How many Stereoisomers are formed in following reaction ?

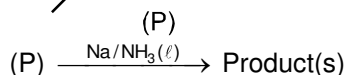
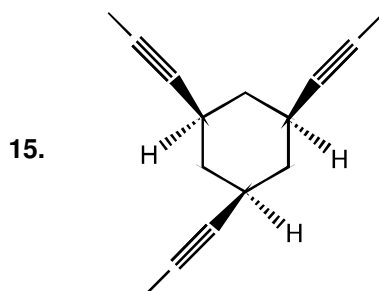




13. Predict the product of following reaction.



14. Compound X gives smallest acid & smallest 2° amine on hydrolysis. What is the molecular weight of compound X ?



The product(s) has/have **X** = degree of unsaturation and **Y** = number of isomeric product(s) formed. Then $X + Y = ?$

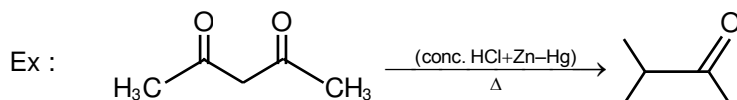
SECTION-4 : Comprehension Type (Only One options correct)

This section contains 1 paragraphs, each describing theory, experiments, data etc. 3 questions relate to the paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D)

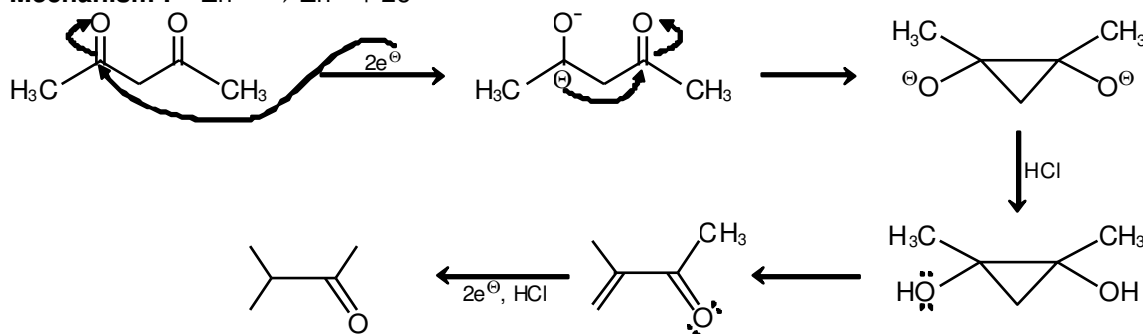
Paragraph for Questions 16 to 17

(Read the paragraph carefully and give the answer of following questions.)

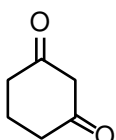

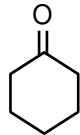
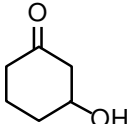
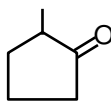
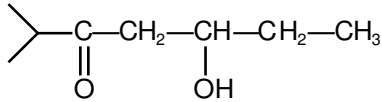
Generally, during the clemmenson reduction $>C=O$ group converts into $>CH_2$ after reacting with (conc. $HCl + Zn-Hg$). But in case of β -diketo compounds, its give unexpected products.



Mechanism : $Zn \longrightarrow Zn^{2+} + 2e^-$



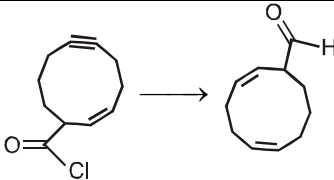
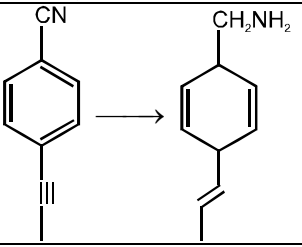
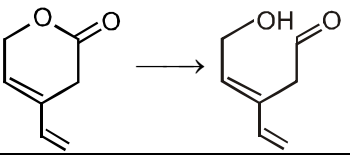
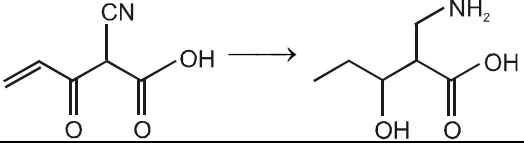


16.  $\xrightarrow[\Delta]{\text{conc. HCl} + \text{Zn-Hg}}$ Product (X), (X) will be :
- (A)  (B)  (C)  (D) 
17. $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\underset{\text{O}}{\text{C}}-\text{CH}_2-\underset{\text{O}}{\text{C}}-\text{CH}_2-\text{CH}_3 \xrightarrow[\Delta]{\text{Zn-Hg} + \text{conc. HCl}}$ Product (X), (X) will be :
- (A)  (B) $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$
 (C) $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\underset{\text{Cl}}{\text{CH}}-\text{CH}_2-\underset{\text{Cl}}{\text{CH}}-\text{CH}_2-\text{CH}_3$ (D) $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\underset{\text{O}}{\text{C}}-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_3$

SECTION-5 : Matching List Type (Only One options correct)

This section contains 1 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D) out of which one is correct

18. Match the reducing agents of **List-II** with the reaction of **List-I** and select the correct answer using the code given below the lists.

	List-I		List-II
P.		1.	DIBAL-H
Q.		2.	H_2/Ni , (25°C)
R.		3.	$\text{Na} / \text{NH}_3 (\ell) / \text{C}_2\text{H}_5\text{OH}$
S.		4.	$\text{H}_2/\text{Pd}/\text{BaSO}_4 / \text{quinoline}$

Code :

	P	Q	R	S		P	Q	R	S
(A)	4	3	1	2	(B)	1	2	4	3
(C)	3	1	2	4	(D)	2	3	1	4



Practice Test-2 ((IIT-JEE (ADVANCED Pattern))
OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18		
Ans.										





APSP Answers

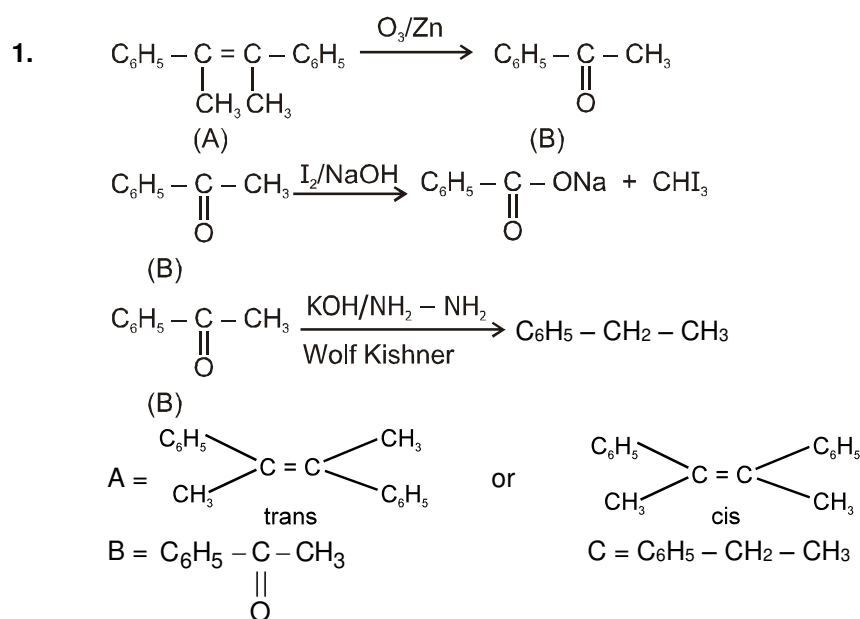
PART - I

1.	(4)	2.	(1)	3.	(1)	4.	(4)	5.	(1)
6.	(4)	7.	(2)	8.	(2)	9.	(4)	10.	(3)
11.	(1)	12.	(1)	13.	(2)	14.	(4)	15.	(1)
16.	(2)	17.	(1)	18.	(1)	19.	(1)	20.	(3)
21.	(3)	22.	(3)	23.	(1)	24.	(2)	25.	(4)
26.	(2)	27.	(2)	28.	(4)	29.	(2)	30.	(4)

PART - II

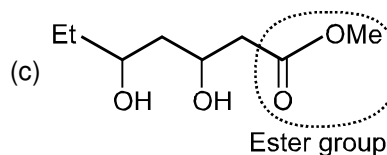
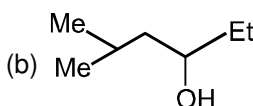
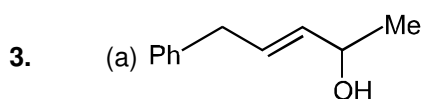
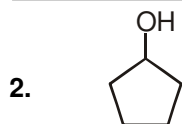
1.	(A)	2.	(D)	3.	(B)	4.	(A)	5.	(C)
6.	(A)	7.	(C)	8.	(D)	9.	(C)	10.	(A)
11.	(B)	12.	(A)	13.	(C)	14.	(B)	15.	(B)
16.	(B)	17.	(C)	18.	(B)	19.	(D)	20.	(C)
21.	(A)	22.	(A)	23.	(D)	24.	(A)	25.	(A)
26.	(C)	27.	(C)	28.	(C)				

PART - III

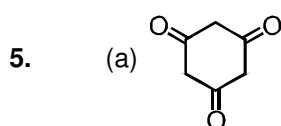
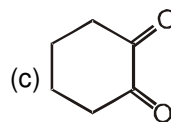
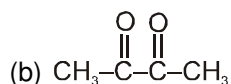
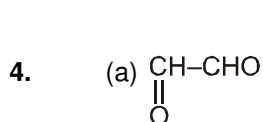


Trans isomer give racemic mixture.

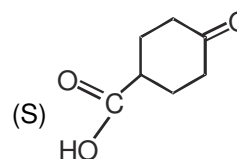
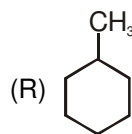
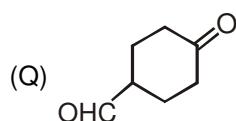
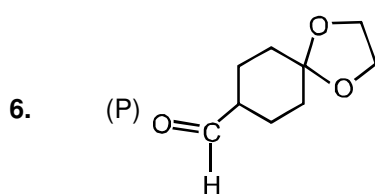




In (a), the (C=C) bond is not reduced and in (c), the ester (–COOMe) is not reduced in MPV reduction.



(b) A = PhOH, B = MeCHO



7. (D)

8. (B)

9. (B)

10. (C)

11. 4

12. 6

13. 1

14. (BC)

15. (AC)

16. (AB)

PART - IV

1. (B)

2. (D)

3. (D)

4. (D)

5. (C)

6. (B)

7. (ABCD)

8. (ABC)

9. (ABCD)

10. (ABCD)

11. (ABC)

12. 2

13. 4

14. 73

15. 5

16. (D)

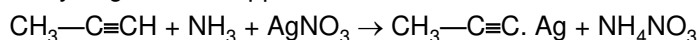
17. (D)

18. (A)

APSP Solutions

PART - I

1. Terminal alkyne gives white ppt with ammonical silver nitrate.

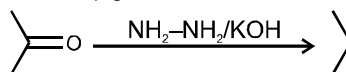


white ppt.

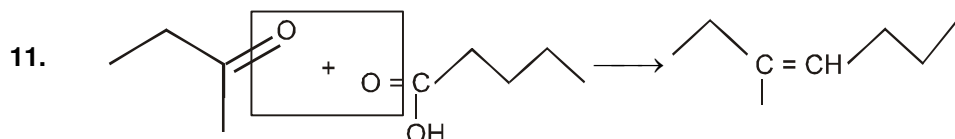
while propene does not give any reaction with ammonical AgNO_3 due to absence of acidic hydrogen.



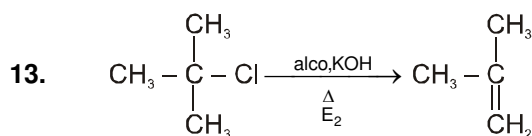
2. Rate of hydrogenation will decrease on increasing steric hinderance at π -bond.
3. It is birch reduction
6. $-\text{COCl}$ converts in $-\text{CHO}$ by $\text{H}_2/\text{Pd}-\text{BaSO}_4$ (Rosenmund reduction)
8. Wolf-kishner reduction ($\text{NH}_2-\text{NH}_2/\text{KOH}$) give alkane after reduction of carbonyl compound.



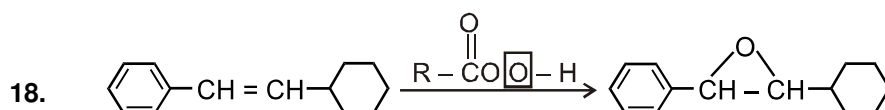
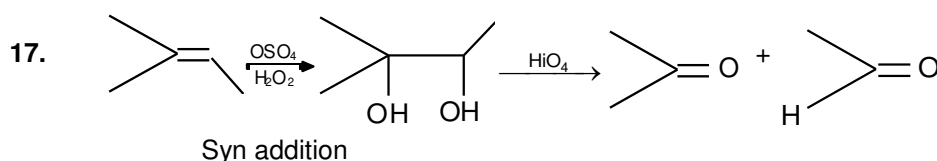
9. All reagents are used to convert $>\text{C}=\text{O}$ to $>\text{CH}_2$
10. Esters are not reduced by NaBH_4 , $>\text{C}=\text{O}$ (carbonyl) change to $-\text{CH}(\text{OH})$ by use of NaBH_4



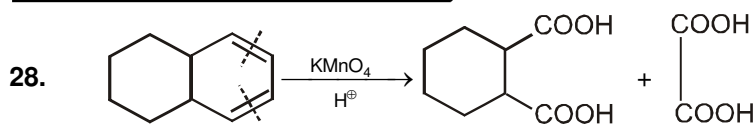
12. Alkene $\xrightarrow[(2) \text{Zn}+\text{H}_2\text{O}]{(1) \text{O}_3}$ CH_3CHO only



16. $\text{Ph}-\text{C}(=\text{O})-\text{NH}_2 \xrightarrow{\text{H}_3\text{O}^+} \text{Ph}-\text{COOH} \xrightarrow{\text{LiAlH}_4} \text{Ph}-\text{CH}_2\text{OH} \xrightarrow{\text{KMnO}_4} \text{Ph}-\text{COOH}$
(A) (B) (C)



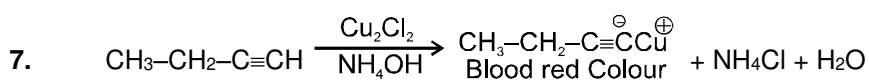
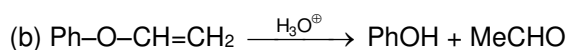
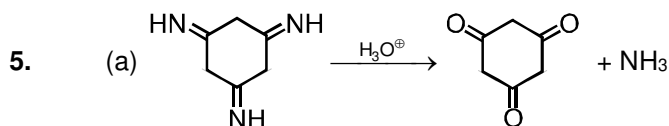
19. It is fact.
21. (P) on hydrolysis gives propanedioic acid and methanol. Propanedioic acid on strong heating gives acetic acid which when reduced with Red P/HI gives ethane.
24. Reduction with Wilkinson's catalyst is homogeneous
25. X can be $\text{NaBH}_4/\text{EtOH}$ or $\text{LiAlH}_4/\text{THF}$ or $\text{Al}(\text{O}i\text{Pr})_3/\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_3$
26. NaBH_4 can not reduce ester.



29. Oppenauer's oxidation, oxidised secondary alcohol into ketone and there is no effect on double bond.

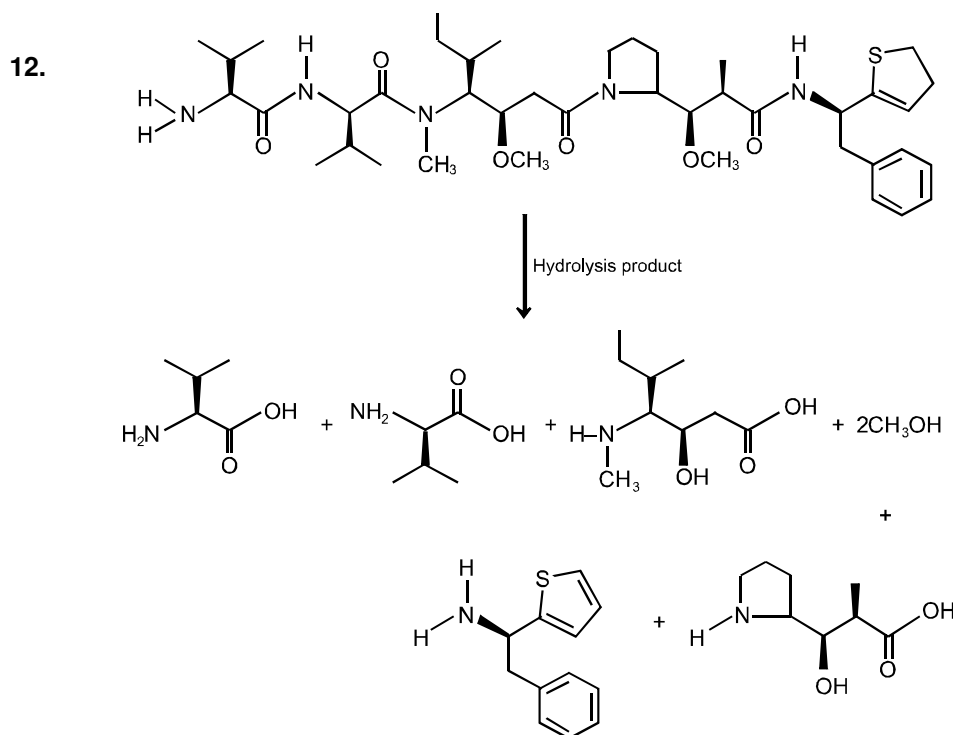
30. It is fact.

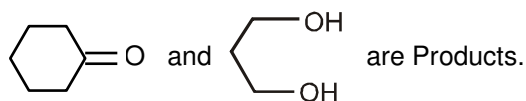
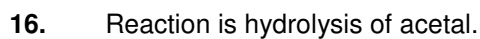
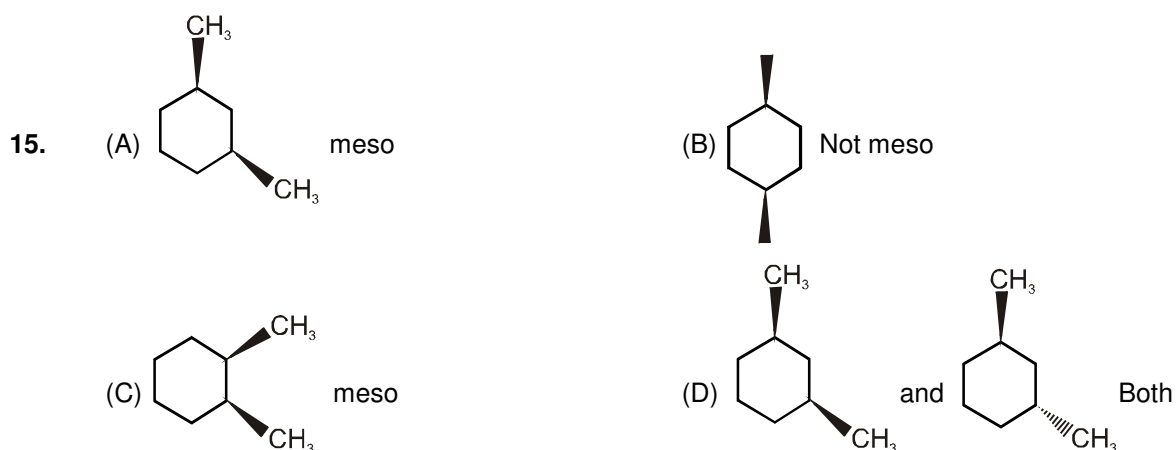
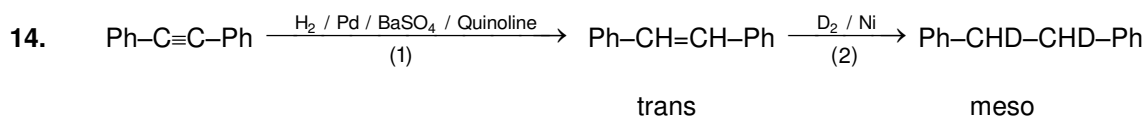
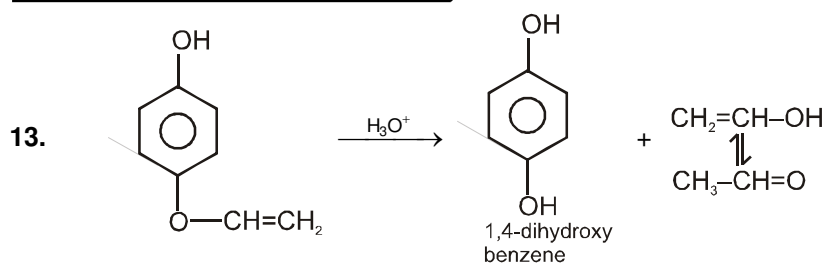
PART - III



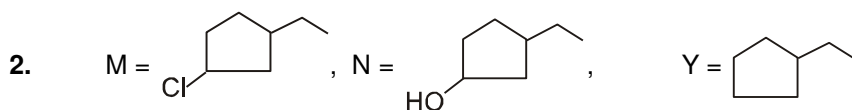
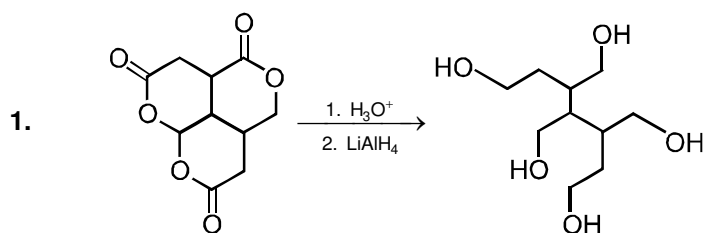
10. Only C on hydrolysis gives $\text{CH}_3\text{-OH}$ and $\text{CH}_3\text{-C(=O)-CH}_3$.

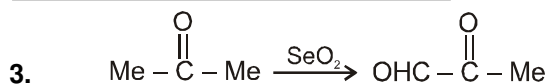
11. All four reactions gives $\text{CH}_3\text{-CHO}$ as major product.





PART - IV

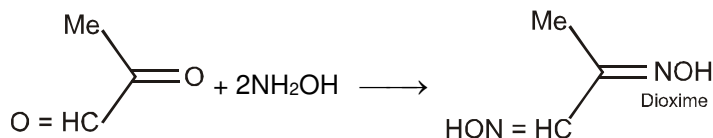




In (a), (P) reduces Tollens reagent, since it contains ($-\text{CHO}$) group.

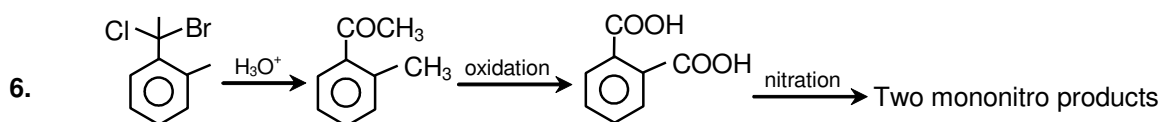
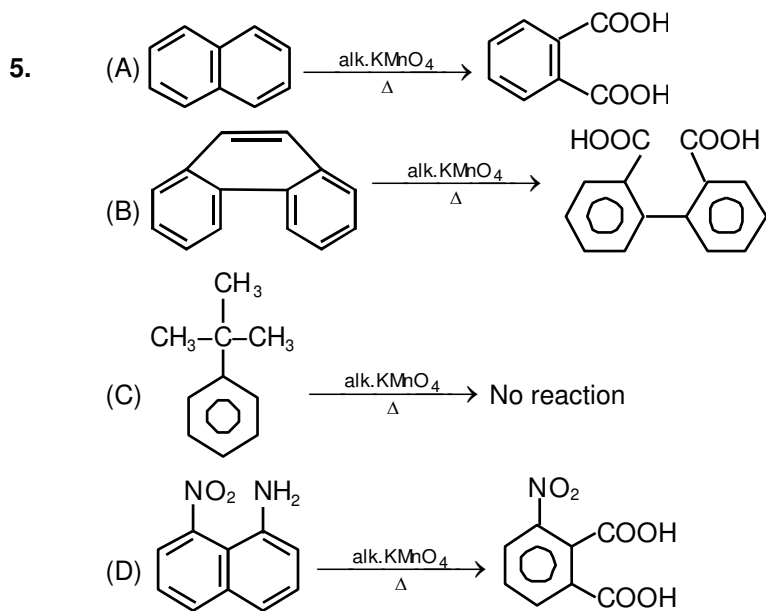
In (b), (P) gives iodoform test, since it contains ($\text{MeCO}-$) group.

In (c), (P) forms dioxime, since it contains ($-\text{CHO}$) and $\left(\overset{\text{O}}{\parallel} \text{C} \right)$ groups.



In (d), (P) does not give ceric ammonium nitrate test, since this test is given by alcohols and (P) does not contain an alcoholic group. So the answer is (D).

4. cis-alkene formed by Lindlar catalyst and trans-alkene formed by Na/NH_3 .

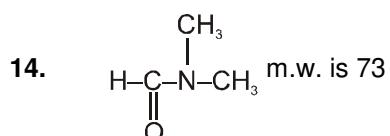
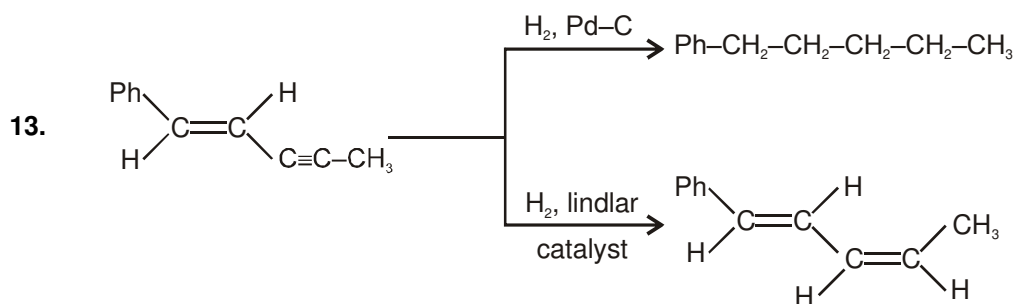
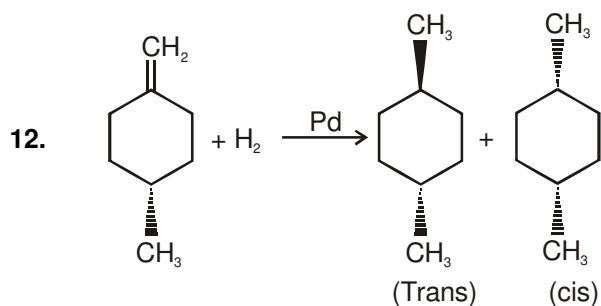
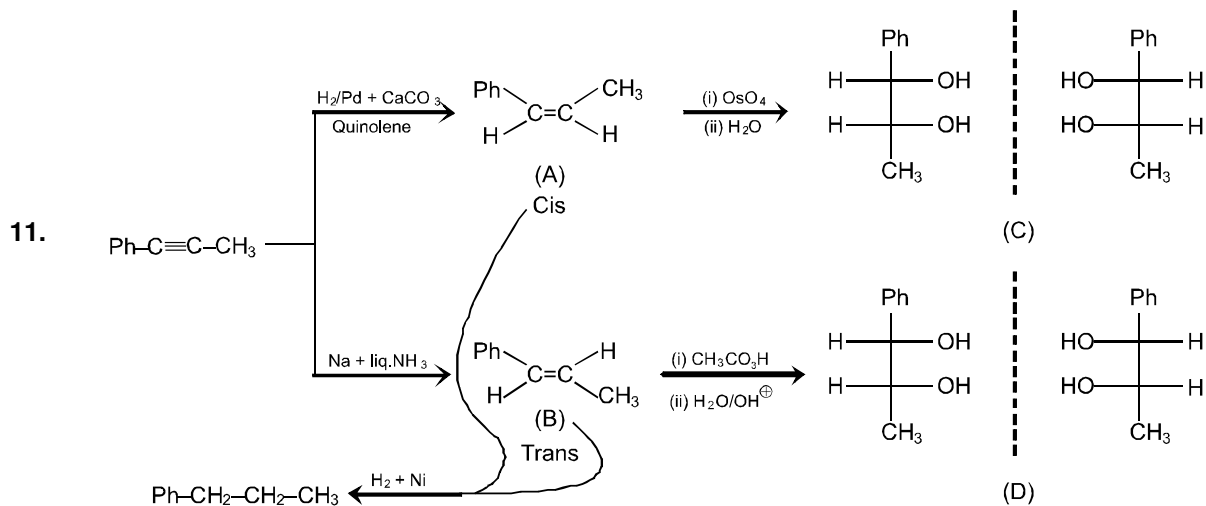


8. Self explanatory.



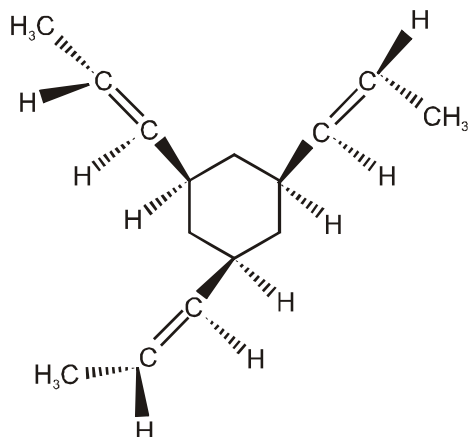
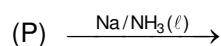
9. HIO_4 is a mild oxidising agent.

Cyclic intermediate is formed with vicinal diols.



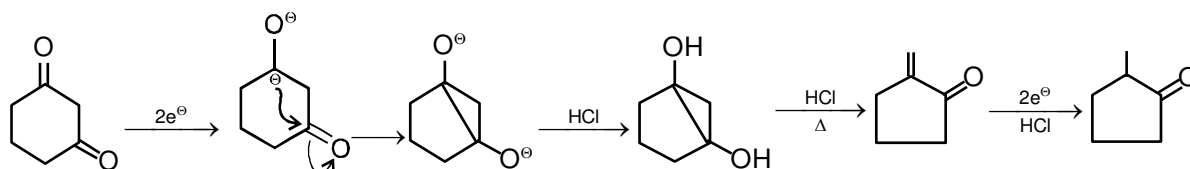


15.



D.u. = X = 4 ; Y = 1

16.



17.

