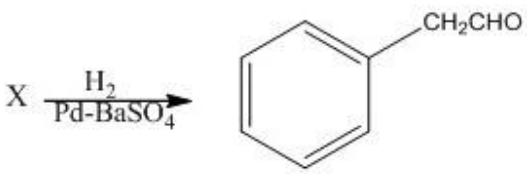
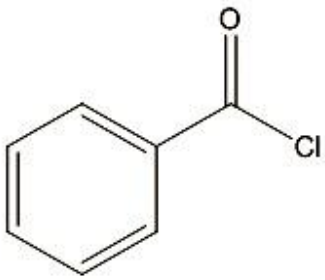
Chapter – Aldehydes Ketones and Carboxylic Acids

Very Short Answer Type Questions: **1 Mark**

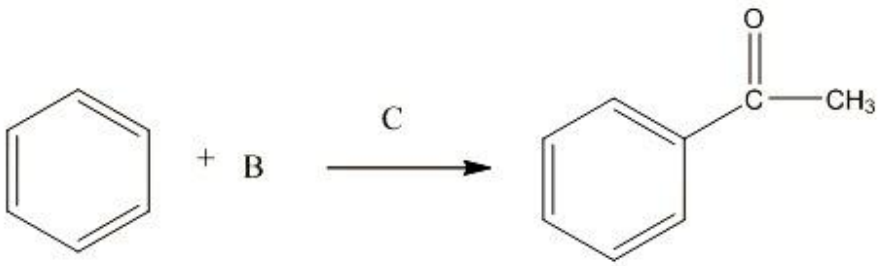
1. Identify X:



Ans: The compound named 'X' is benzoyl chloride.



2. Identify 'B' and 'C' in the following reaction.



Ans: The following reaction shows the conversion of benzene to acetophenone. The compound 'B' is acetyl chloride (CH_3COCl) and the compound 'C' is anhydrous aluminium chloride ($AlCl_3$).

3. Arrange the following compounds in the increasing order of their boiling points:

$CH_3CH_2CH_2CH_3$, $CH_3OCH_2CH_3$, CH_3CH_2CHO, CH_3COCH_3, $CH_3CH_2CH_2OH$

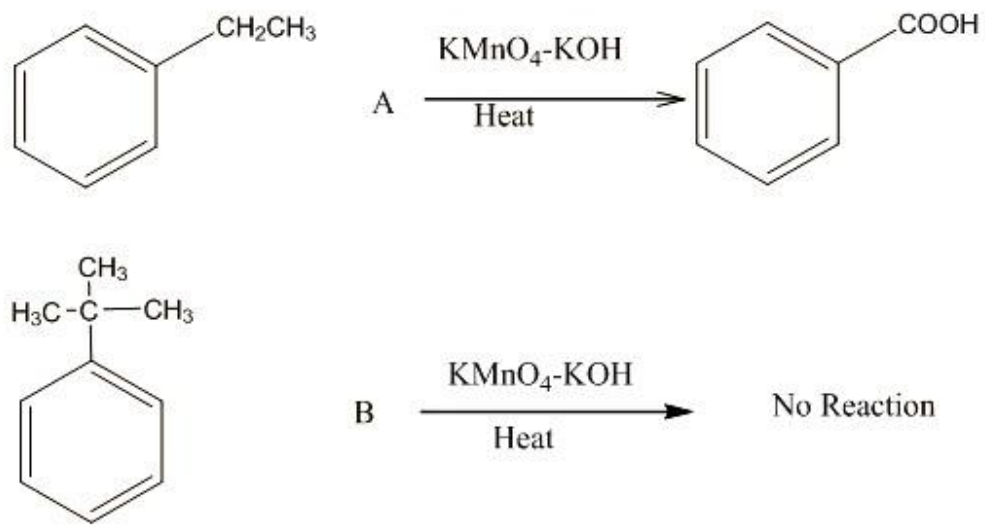
Ans: The increasing order of boiling points in the compounds is:

$CH_3CH_2CH_2CH_3 < CH_3OCH_2CH_3 < CH_3COCH_3 < CH_3CH_2CHO < CH_3CH_2CH_2OH$

4. Propanal is more reactive than propanone. Give reason.

Ans: Due to the presence of alkyl groups on both sides of the carbonyl carbon, propanone is sterically more hindered than propanal, making it less reactive to nucleophilic attack. Both methyl groups have an electron-releasing tendency due to the -I effect. This is the reason why propanal is more reactive than propanone.

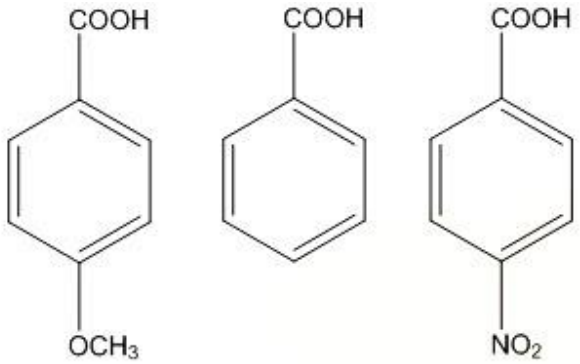
5. According to the reactions:



Observe the reactions and state why the compound A is oxidized whereas compound B is not oxidized by $KMnO_4$?

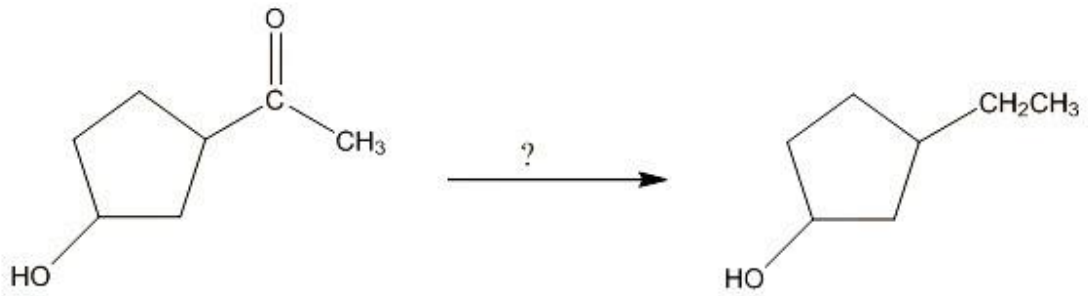
Ans: In the first reaction the side chain oxidation takes place due to the presence of an alpha hydrogen on the ethyl side chain, that it why it gets converted to an acid. In the second reaction, there is not alpha hydrogen present in the aryl alkane side chain, so no reaction will take place.

6. Which among the following is the strongest acid?



Ans: Benzoic acid (C_6H_5COOH) is the strongest acid amongst the given acids. As $-OCH_3$ is an electron donating ring and $-NO_2$ is an electron withdrawing group which can disrupt the resonance on the benzene ring causing it to be less acidic.

7. Identify the reagent used in the following conversion.

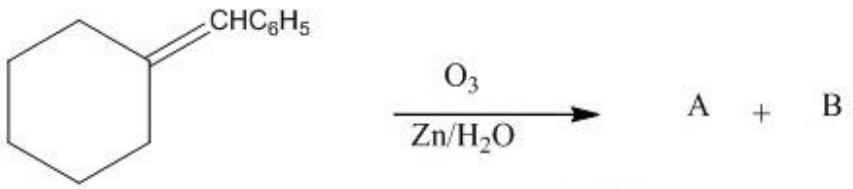


Ans: The reagent used in the given conversion is hydrazine (H_2NNH_2).

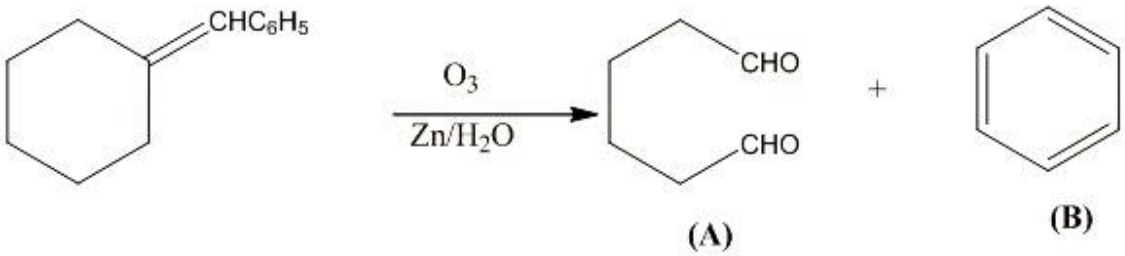
8. Fluorine is more electronegative than Chlorine even then P-Fluorobenzoic acid is weaker acid than P-Chlorobenzoic acid. State the plausible reason for this.

Ans: Both fluorine and chlorine are implicated in the $-I$ and $+M$ effects with the benzene ring (owing to the presence of lone electron pairs). While the $-I$ effect tends to increase acidic strength, the $+M$ effect tends to decrease it. Because fluorine is more electronegative than chlorine, it has a higher $-I$ effect. However, as compared to chlorine, it has a larger $+M$ effect (opposing factor). This could be due to the fact that the $2p$ orbitals of carbon and fluorine are similar in size, whereas the carbon and chlorine atoms' orbitals are not. As a result, $p-$ fluorobenzoic acid is less potent than $p-$ chlorobenzoic acid.

9. Identify A and B in the following reaction.

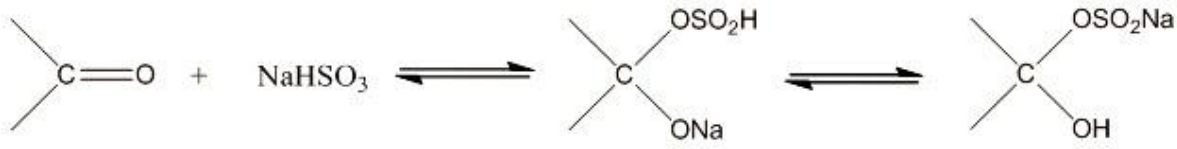


Ans: The reaction will be:



Short Answer Type Questions: **2 Mark**

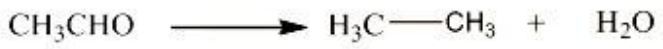
10. For the reaction:



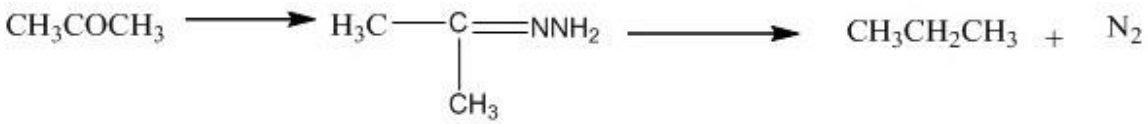
The position of equilibrium lies largely on the right hand side for most aldehydes and to the left hand side for most ketones. Find out the reason.

Ans: For most crystalline aldehyde compounds, the position of –SOH proton transfer –SO , –Na the equilibrium is predominantly to –ONa –OH the right hand busulphite addition side, and to the left for most ketones due to steric considerations. The hydrogensulphite addition product being water soluble it is changed back to its original state when a dilute mineral acid or alkali is added to it.

11. Identify the following naming reactions and write the reagents used:



Ans: In the above given reaction, acetaldehyde is converted to ethane. It is a Wolff – Kishner reduction and the reagents used are hydrazine (NH_2NH_2) and potassium hydroxide (KOH).



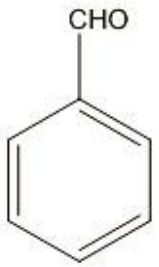
The above reaction is a conversion of acetone to propane and this reaction is called as Clemmensen's reduction using the reagent as Zn/Hg/HCl.

12. Aldol condensation of a ketone in the presence of a dilute alkali gives 4-Hydroxy – 4 – methylpentan – 2 – one. Write the structure of the ketone and its IUPAC name.

Ans: The reaction is given as:

The ketone in the above reaction is acetone and its IUPAC name is propan-2-one.

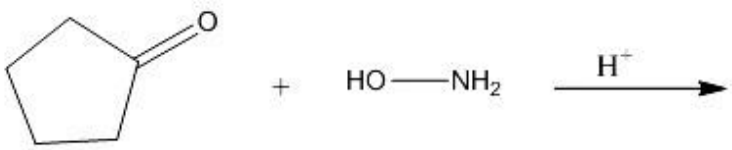
13. Which among the following compounds give Cannizzaro reaction and state the reason?



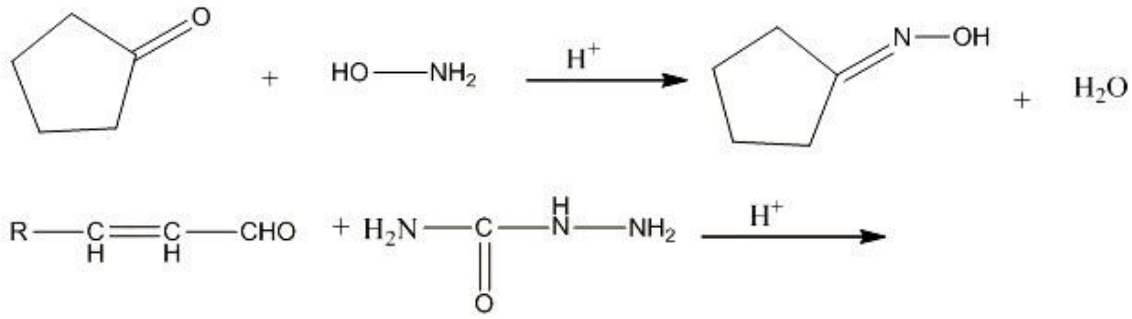
CH_3CHO CH_3COCH_3

Ans: Cannizaro reaction is given by aldehydes and not by ketones. It is given by the compounds having an alpha hydrogen bonded to the carbonyl carbon. So, amongst the above given compounds, acetaldehyde (CH_3CHO) undergoes cannizzaro reaction. Benzaldehyde and acetone does not undergo cannizzaro reaction.

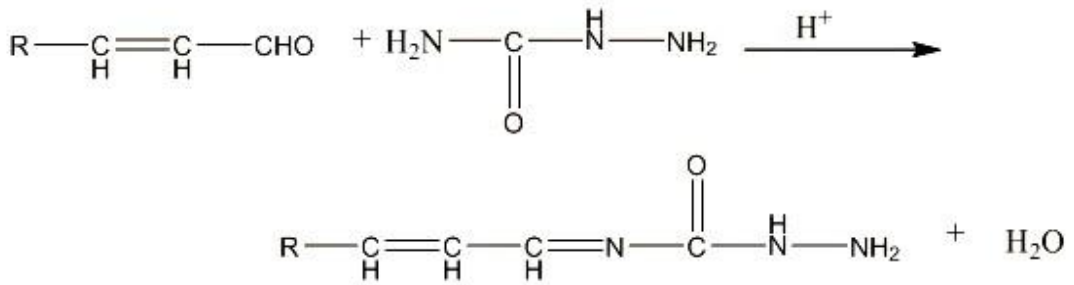
14. Predict the products of the following reactions:



Ans: The reaction of cyclopentanone with hydroxyl amine in acidic conditions forms cyclopentanone oxime.



Ans: When an α,β – unsaturated aldehyde reacts with semicarbazide, $(H_2NCONHNH_2)$, it forms semicarbazone as a product.



15. The decreasing order of acidity of a few carboxylic acids is given below:

$C_6H_5COOH > C_6H_5CH_2COOH > CH_3COOH > CH_3CH_2COOH$

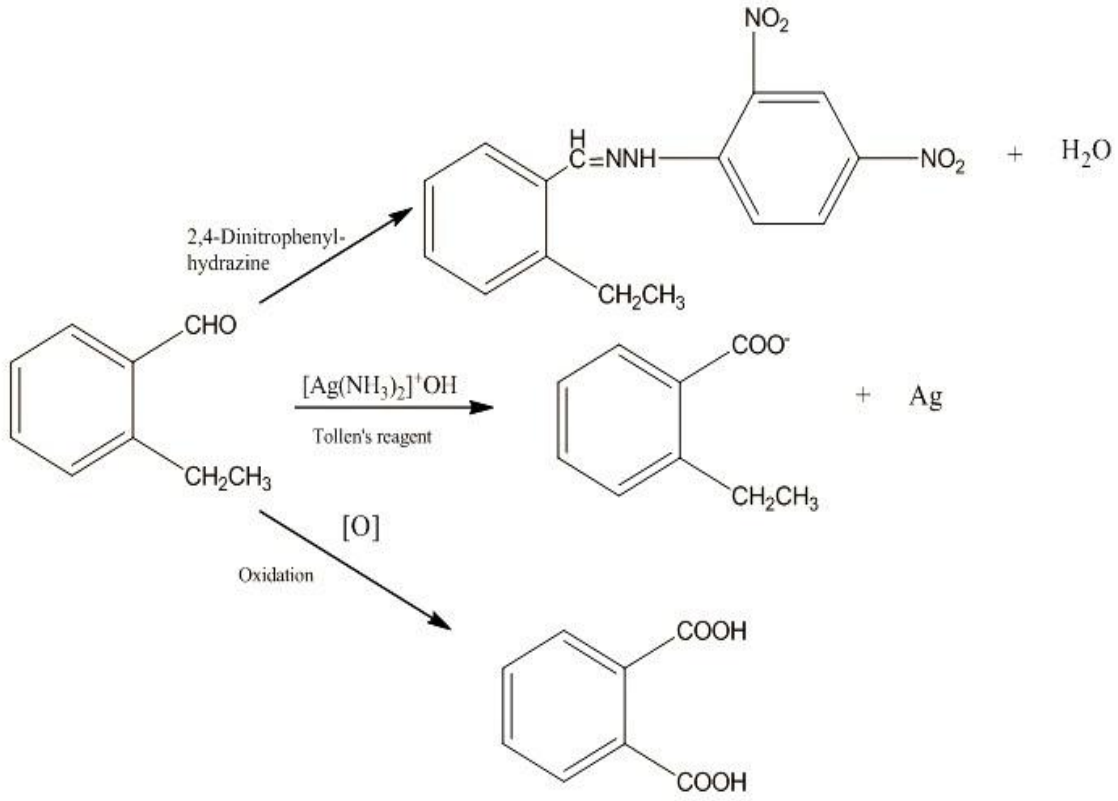
Explain the plausible reason for the order of acidity followed.

Ans: The overall power to remove electrons from the atoms linked to the carboxyl group is known to change the strength of carboxylic acids. The acid will be stronger if the substituent group has greater electron-withdrawing capability. The electron-releasing group reduces the acidic intensity. The release of protons is hampered as a result. C_6H_5 is a powerful withdrawing , therefore C_6H_5COOH is a stronger acid than others. The CH_3 group has a lesser electron-withdrawing power than CH_2 group. So, CH_3COOH is a weaker acid as compared to $C_6H_5CH_2COOH$. Similarly, CH_3CH_2COOH is weaker than CH_3COOH and $C_6H_5CH_2COOH$.

16. An organic compound A, molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzene dicarboxylic acids. Identify A.

Ans: The compound A will be 2-Ethylbenzaldehyde.

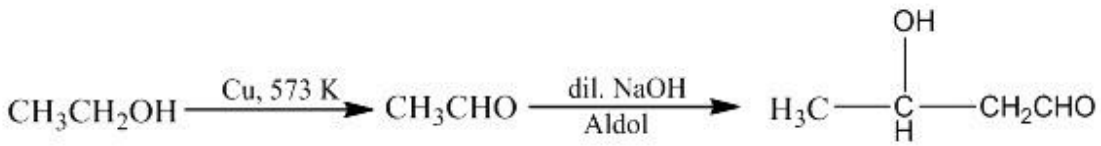
The reactions can explain the following:



17. Do the following conversion using suitable reagents in not more than two steps:

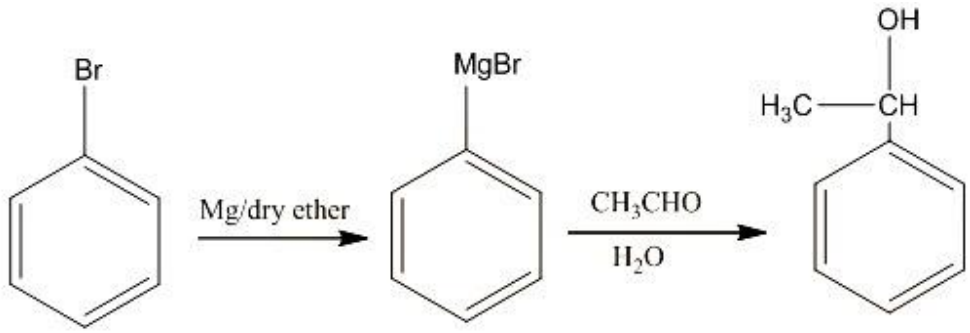
a. Ethanol to 3 – Hydroxy butanal.

Ans: The following conversion takes place as:



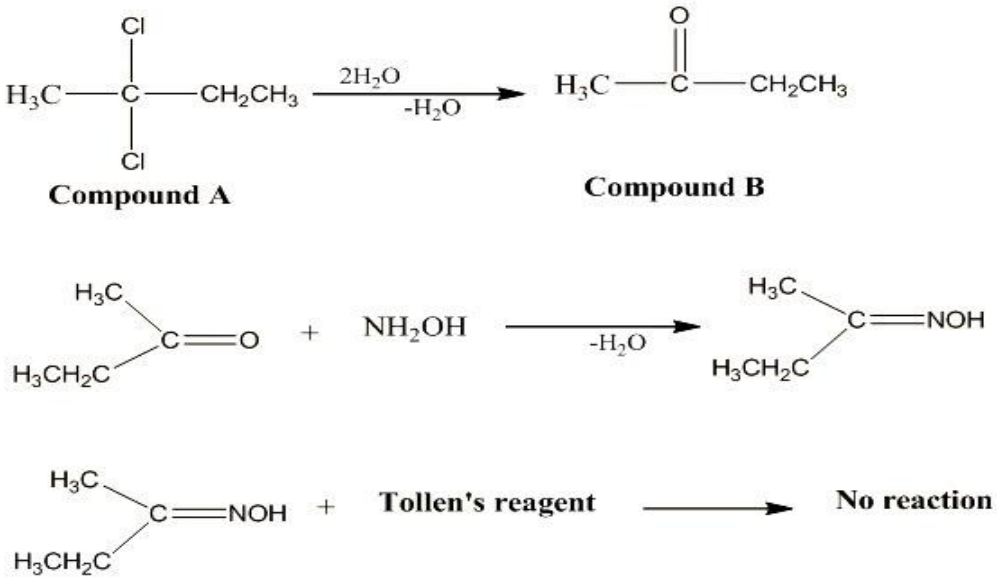
b. Bromobenzene to 1 – phenyl ethanol.

Ans: The following conversion takes place as:

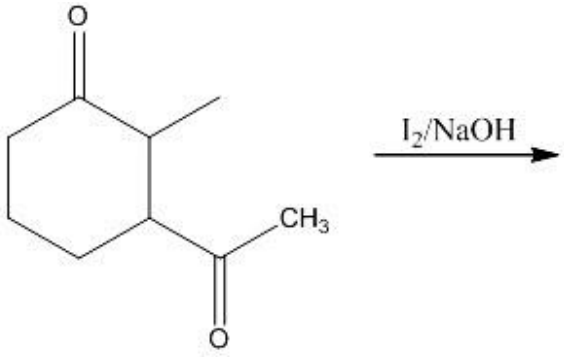


18. Compound A $C_4H_8Cl_2$ **is hydrolysed to a compound B** C_4H_8O **which forms an oxime with** NH_2OH **and gives negative Tollens test. What are the structures of A and B. Write balanced chemical equations for the reactions involved.**

Ans: The balanced chemical equations are:

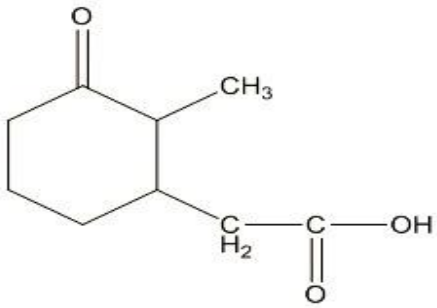


19. Write the structure of the product and name the reaction.



Ans: The above reaction is the Iodoform reaction

The structure of the product is:



20. Give reasons for the following:

i. Iodoform is obtained when methyl ketones react with hypoiodite but not with iodide.

Ans: During the production of iodoform, methyl ketones or acetone is oxidised to the acetate ion. Because Hypoiodite is a stronger oxidising agent, it can convert acetone to iodoform, whereas iodide ion is a reducing agent and so cannot operate as an oxidizer.

ii. Hydrazones of aldehydes and ketones are not prepared in highly acidic medium.

Ans: Hydrazine becomes protonated in the very acidic media and hence is unable to serve as a nucleophile. As a result, extremely acidic media is not used to prepare aldehydes and ketones.

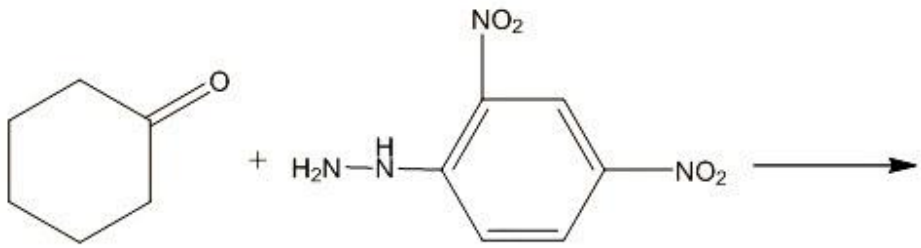
21. Both alkenes and carbonyl compounds give addition reactions. How do the addition reactions differ in both the cases and explain why?

Ans: Because the double bond in alkenes connects two carbon atoms and there is no resulting polarity, electrophilic addition occurs, whereas nucleophilic addition occurs in aldehydes and ketones. The polarity of the carbonyl bond renders them susceptible to a nucleophile, an atom that gives electrons, in carbonyl compound reactions.

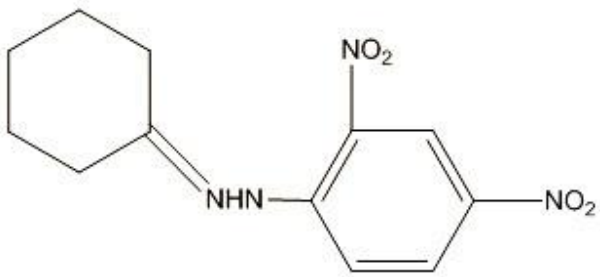
22. Benzaldehyde gives a positive test with Tollens reagent but not with Fehlings solution. State the reason.

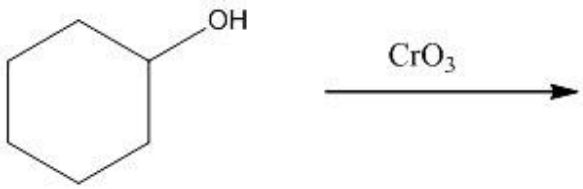
Ans. Under normal circumstances, aldehydes that lack alpha hydrogens and so cannot form an enolate do not produce a positive test using Fehling's solution, which is a weaker oxidising agent than Tollen's reagent.

23. Write the structures of the products in the following reactions:

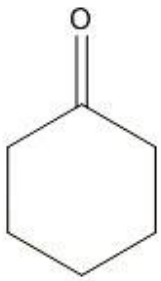


Ans: The structure of the product in the above given reaction is:





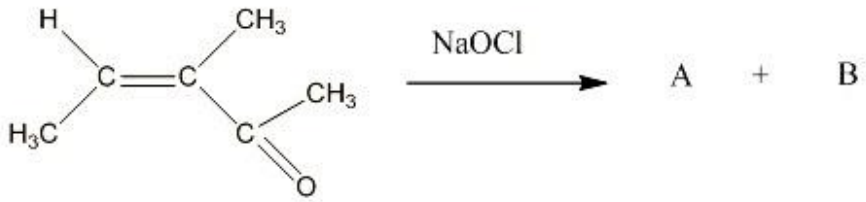
Ans: The structure of the product in the above given reaction is:



The name of the product is cyclohexanone.

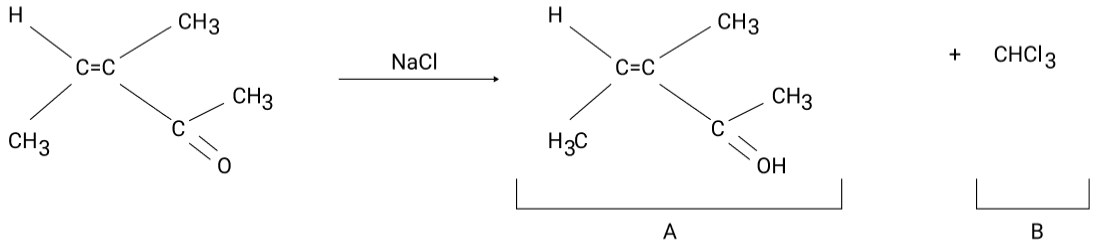
Short Answer Type Questions: **3 Mark**

24. According to the given reaction:



a. Write the structures of A and B.

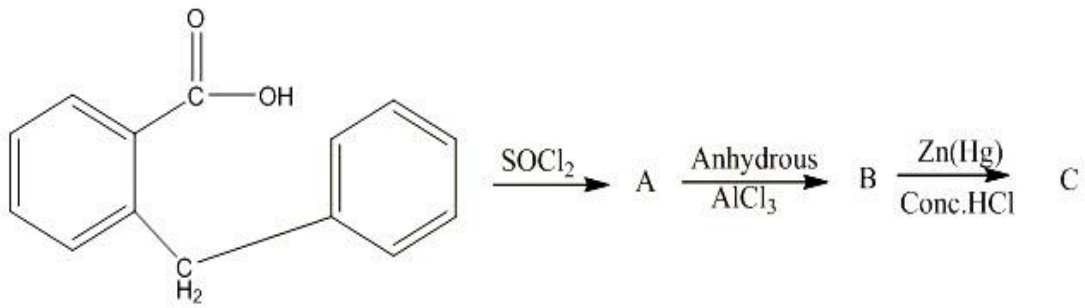
Ans: The structures of A and B are:



b. Identify any two important features of this reaction

Ans: The important feature of this haloform reaction is that they always give chloroform, bromoform and iodoform as products.

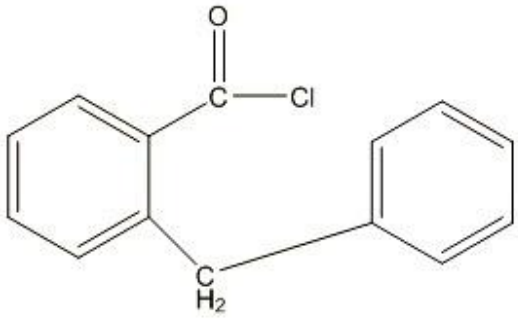
25. According to the following reaction:



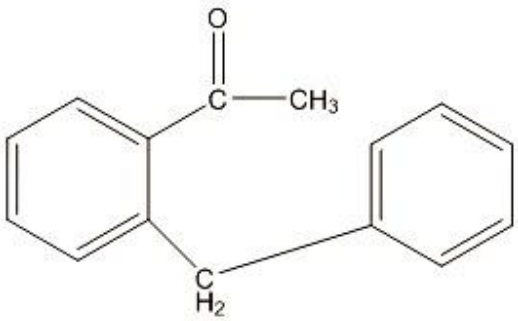
Write the structures of A, B and C.

Ans: The structures of A, B and C are:

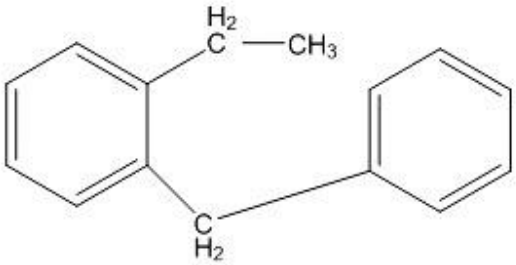
Compound A:



Compound B:



Compound C:



26. Compound X, containing chlorine on treatment with strong ammonia gives a solid Y which is free from chlorine. Y on analysis gives C = 49.31%, H = 9.59% and N = 19.18% and reacts with Br_2 and caustic soda to give a basic compound Z. Z reacts with HNO_2 to give ethanol. Suggest structures of X, Y and Z.

Ans: The empirical formula of compound Y is C_3H_7NO

. Hence the molecular formula will be $CH_3CH_2CONH_2$

. It gives Hofmann's bromamide reaction with bromine and caustic soda:

$$CH_3CH_2CONH_2 + Br_2 + 4KOH \rightarrow CH_3CH_2NH_2 + 2KBr + K_2CO_3 + 2H_2O$$

The compound Z is $CH_3CH_2NH_2$ it when reacts with HNO_2 gives ethanol:

$$CH_3CH_2NH_2 + HNO_2 \rightarrow CH_3CH_2OH + N_2 + H_2O$$

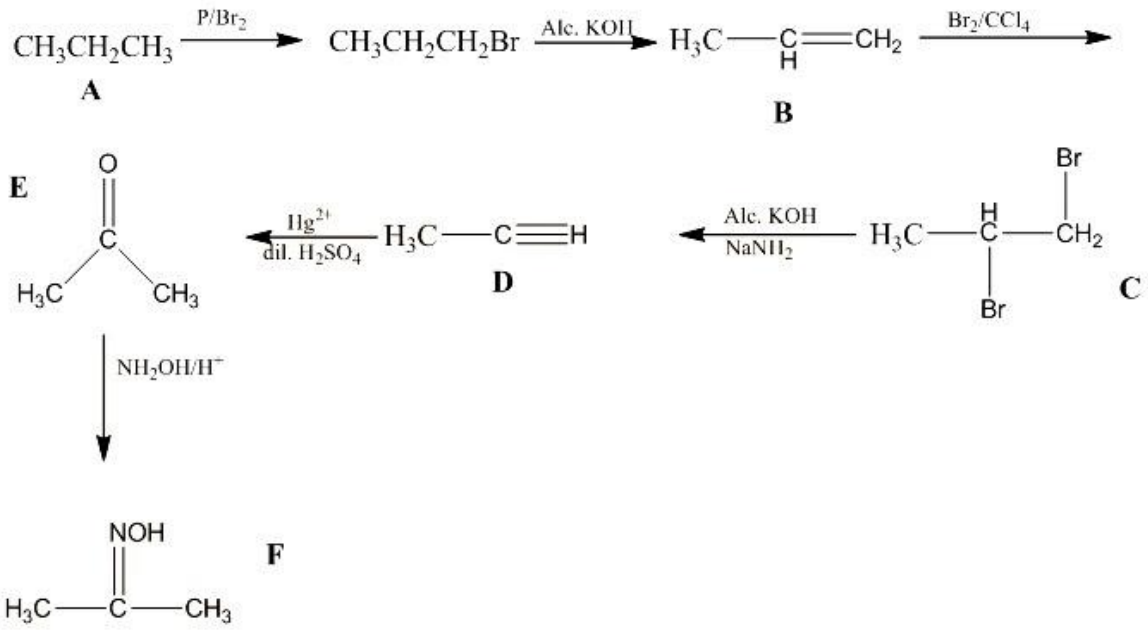
Compound X is a chlorine containing compound which in treatment with strong ammonia gives compound Y, therefore compound X is CH_3CH_2COCl.

$$CH_3CH_2COCl + NH_3 \rightarrow CH_3CH_2CONH_2 + HCl$$

27. Complete the following equation and write the structures of A, B, C, D, E, and F.

$$A \xrightarrow{P/Br_2} CH_3CH_2CH_2Br \xrightarrow{\text{Alc. KOH}} B \xrightarrow{Br_2/CCl_4} C \xrightarrow[NaNH_2]{\text{Alc. KOH}} D \xrightarrow[\text{dil. } H_2SO_4]{Hg^{2+}} E \xrightarrow{NH_4OH/H^+F}$$

Ans: The complete equation involving the structures of the missing compounds are:

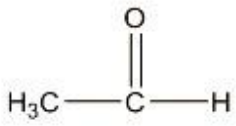


28. A compound X (C_2H_4O) **on oxidation gives Y** $(C_2H_4O_2)$**. X undergoes haloform reaction. On treatment with** HCN**, X forms a product Z which on hydrolysis gives 2-hydroxypropanoic acid.**

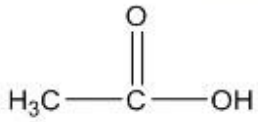
a. Write down the structures of X and Y.

Ans. The compound X is acetaldehyde and the compound Y is acetic acid and their structures are:

Acetaldehyde:



Acetic Acid:



b. Name the product when X reacts with dilute NaOH**.**

Ans: When compound X, acetaldehyde reacts with dilute sodium hydroxide then the product obtained is an aldol named 3 – hydroxy butanal.

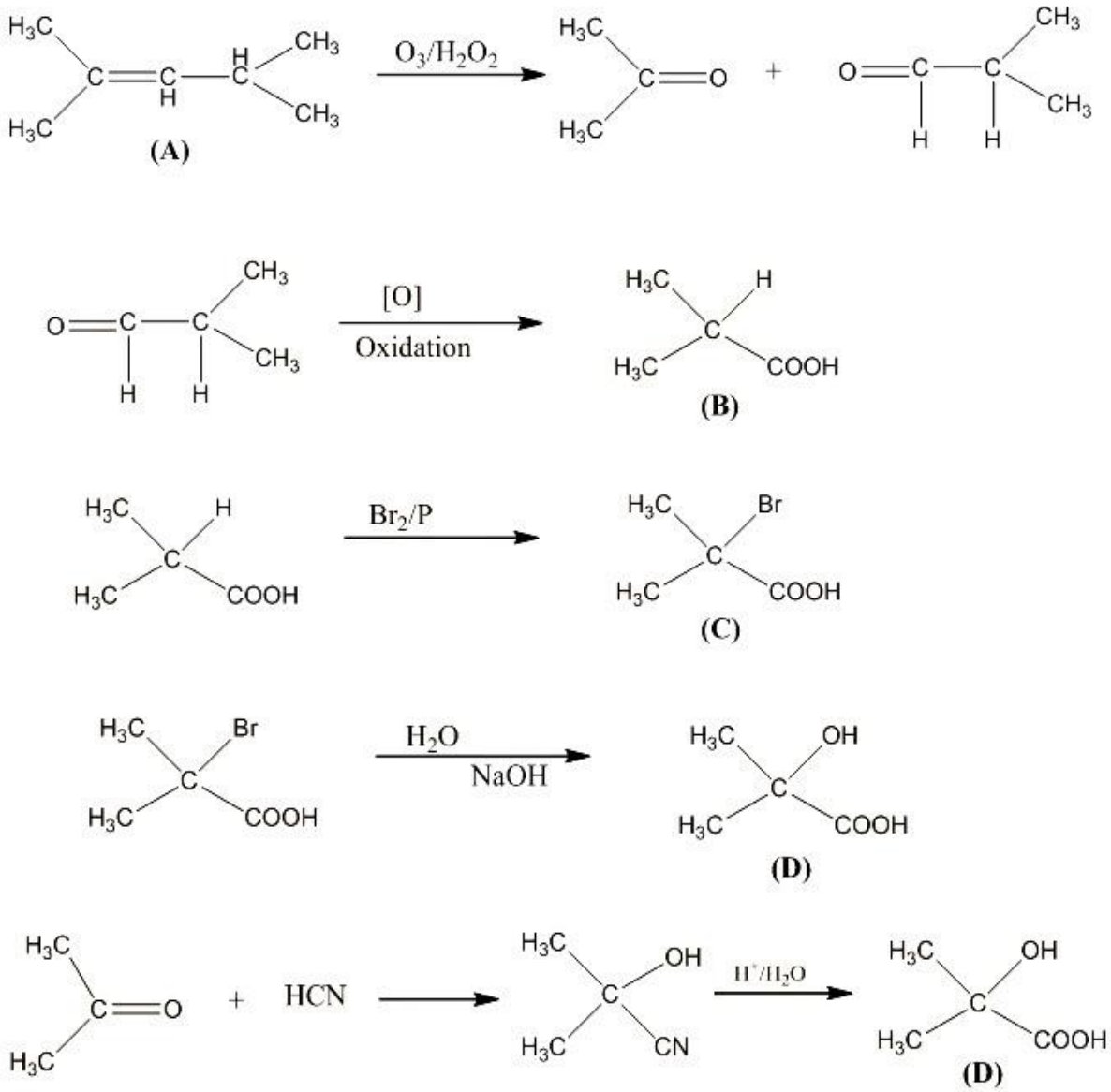
c. Write down the equations for the reactions involved.

Ans: The equations involved are:

Long Answer Type Questions: **5 Mark**

29. An alkene (A with molecular formula C_7H_{14}) on ozonolysis yields an aldehyde. The aldehyde is easily oxidized to an acid (B). When B is treated with bromine in presence of phosphorous it yields a compound (C) which on hydrolysis gives a hydroxyl acid (D). This acid can also be obtained from acetone by the reaction with hydrogen cyanide followed by hydrolysis. Identify A, B, C and D and write the chemical equations for the reactions involved.

Ans: The chemical equations for the reactions involved are:

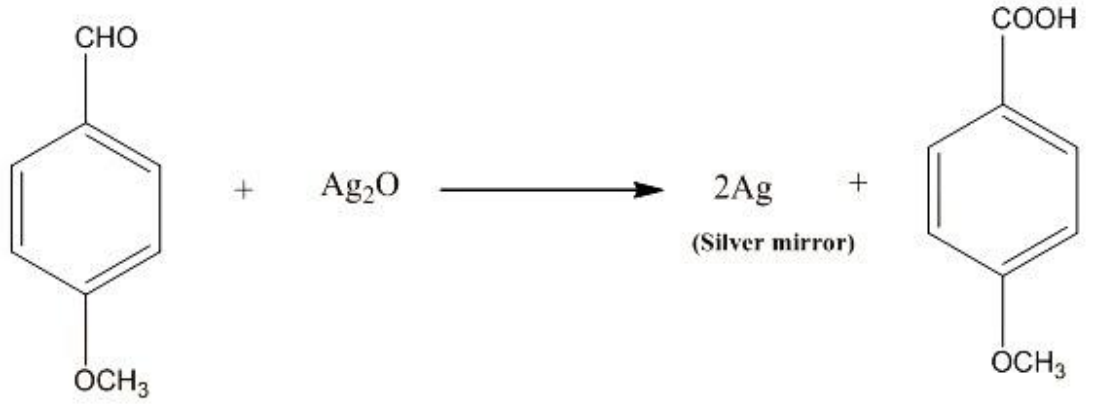


30. Five isomeric para-di- substituted aromatic compounds, A to E with molecular formula $C_8H_8O_2$ were given for identification. Based on the following observations give the structures of the compounds.

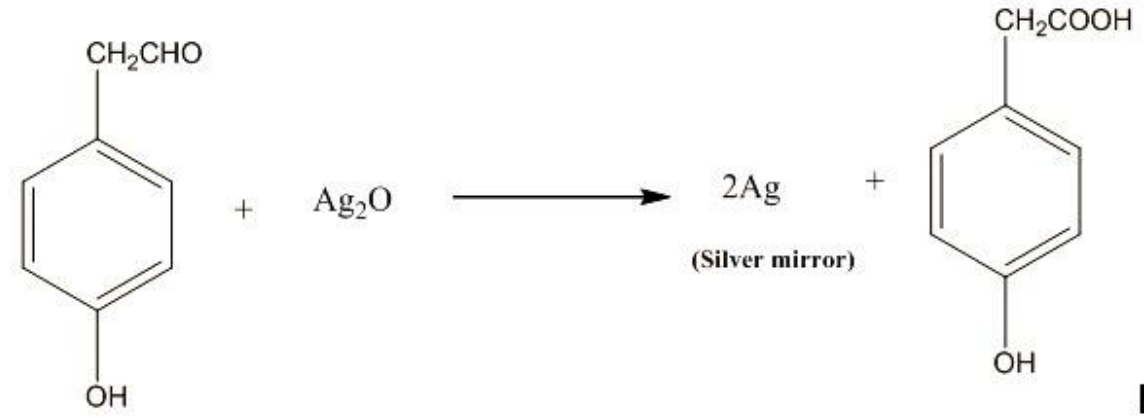
i. Both A and B form silver mirror with Tollens reagent, also B gives a positive test with $FeCl_3$.

Ans: If both the compounds A and B form silver mirror with Tollen's reagent then they have aldehydic group in their structures.

Compound A



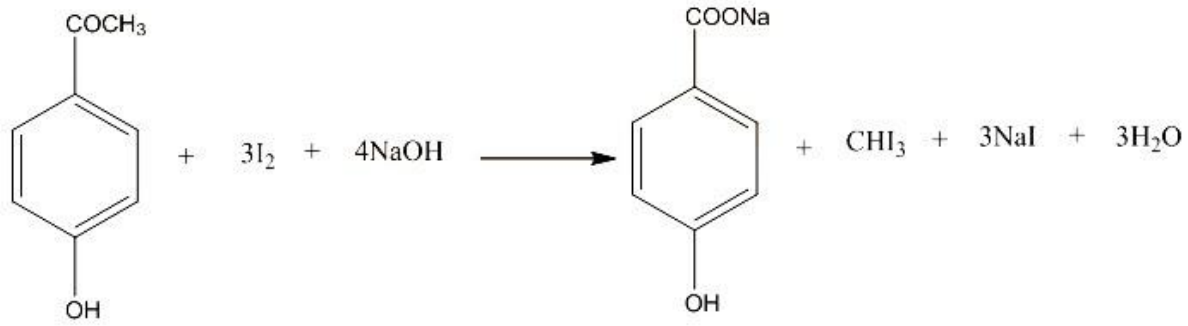
Compound B



Compound A is p-methoxybenzaldehyde and compound B is p-hydroxy phenyl acetaldehyde.

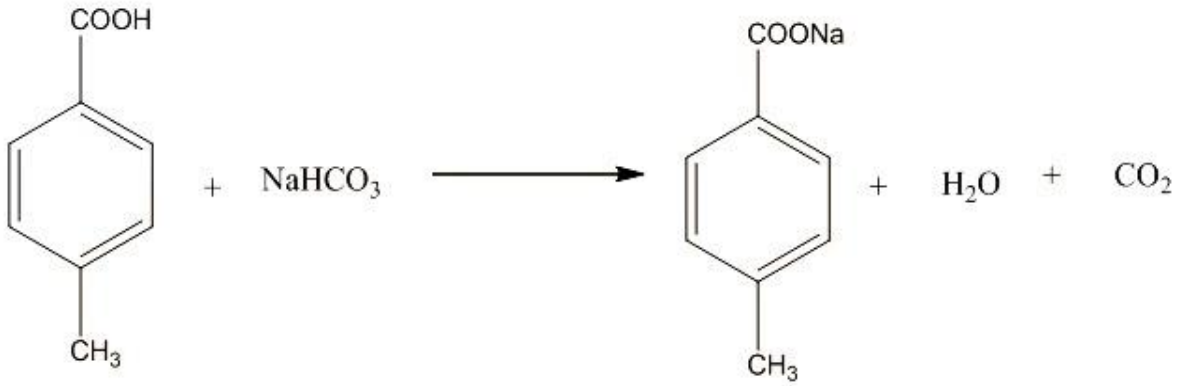
ii. C gives positive Iodoform test.

Ans: Compound C give positive Iodoform test so it will be, p-hydroxyphenyl methyl ketone.



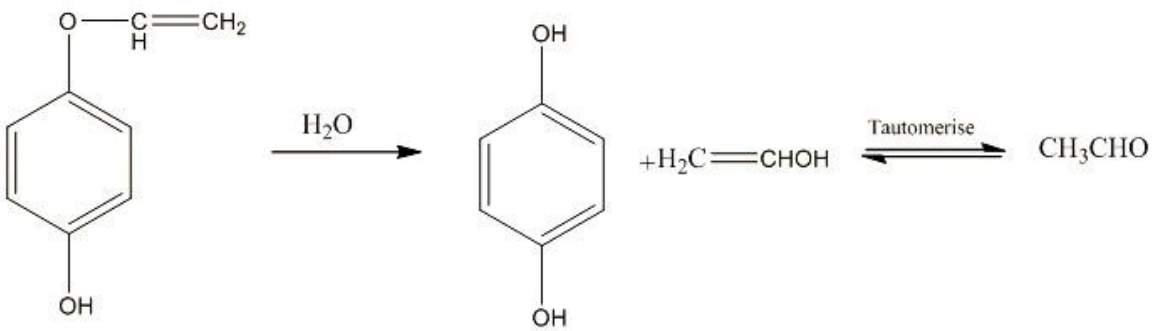
iii. D is readily extracted in aqueous $NaHCO_3$ solution.

Ans: Compound D must have an acid group in its structure as it is readily extracted in aqueous $NaHCO_3$. Therefore, compound D is p-methyl benzoic acid.



iv. E on acid hydrolysis gives 1,4 – dihydroxy benzene.

Ans: The chemical reaction is:



(Compound E)

Therefore compound E is p-hydroxyphenyl vinyl ether.