Hydrocarbons

Question1

The empirical formula weight of ' Z ' in the given reaction sequence is

$$n\text{-propyl bromide} \xrightarrow[\text{Dry ether}]{\text{Na}} X \xrightarrow[\substack{773\ \text{K} \\ 20\ \text{atm}}]{\text{v}_2\text{O}_5} Y \xrightarrow[\text{UV}\quad 500\ \text{K}]{\text{Cl}_2} Z$$

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Options:

A.

47.5

B.

54.5

C.

84.5

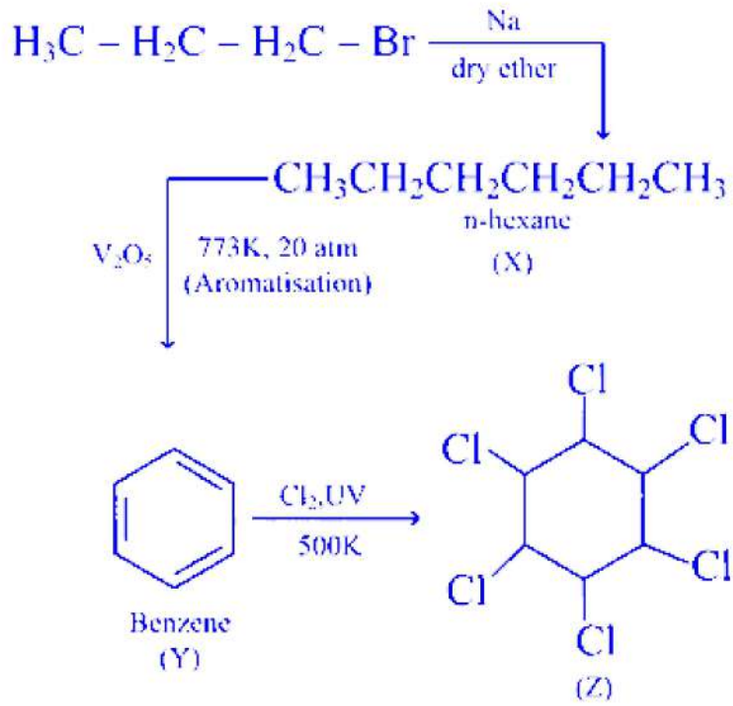
D.

48.5

Answer: D

Solution:

The complete reaction sequence is as follows



So, the molecular formula is C_6H_6Cl and its empirical formula is CHCl . Thus, the empirical formula weight of *Z* is 48.5

Question2

Which one of the following compounds does not give benzoic acid when treated with alkaline $KMnO_4$?

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Options:

A. Acetophenone

B.

n-propyl benzene

C.

Styrene

D.

t-butyl benzene

Answer: D

Solution:

t-butyl benzene does not give benzoic acid when treated with alkaline $KMnO_4$ because it lack the necessary benzylic hydrogen required for oxidation to form benzoic acid, since the tertiary carbon in *t*-butylbenzene has no hydrogen attached directly to it, the oxidation cannot proceeds to form carboxylic acid.

Question3

Consider the following

Statement I Kolbe's electrolysis of sodium propionate gives n-hexane as product.

Statement II In Kolbe's process CO_2 is liberated at anode and H_2 is liberated at cathode.

Correct answer is

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Options:

A.

Both statement-I and statement-II are correct

B.

Both statement-I and statement-II are not correct

C.

Statement-I is correct, but statement-II is not correct

D.

Statement-I is not correct, but statement-II is correct

Answer: D

Solution:

Statement I is wrong, but Statement II is right.

Statement I should say: In Kolbe's electrolysis of sodium propionate, the product is butane, not n-hexane.

The chemical reaction is:

$$2CH_3CH_2COONa + 2H_2O \longrightarrow CH_3CH_2CH_2CH_3 + 2CO_2 + 2NaOH + H_2 \uparrow$$

Butane

In Statement II, it is correct that in Kolbe's process, carbon dioxide (CO_2) is released at the anode and hydrogen gas (H_2) is released at the cathode.

Question4

The catalyst used for the isomerisation of n-alkanes to branched chain alkanes is

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Options:

A.

anhy. $AlCl_3/HCl$

B.

Mo_2O_3

C.

$FeCl_3$

D.

$TiCl_4 + R_3Al$

Answer: A

Solution:

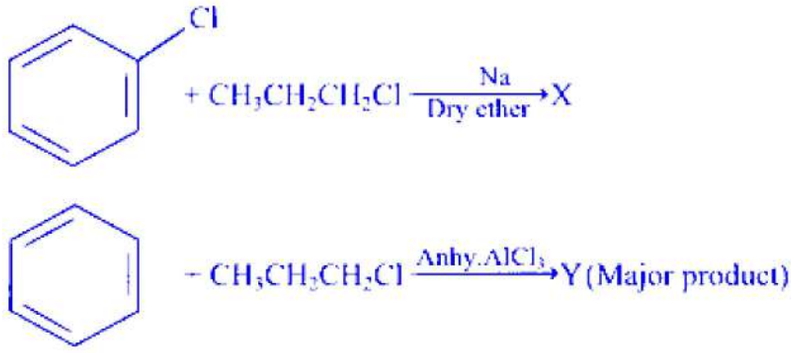
The primary catalyst used for the isomerisation of n-alkanes to branch

chain alkanes are acid catalyst, particularly zeolites and sulphated zirconia.

Anhydrous $AlCl_3$ or HCl can be also used.

Question5

What are X and Y respectively, in the following set of reactions?



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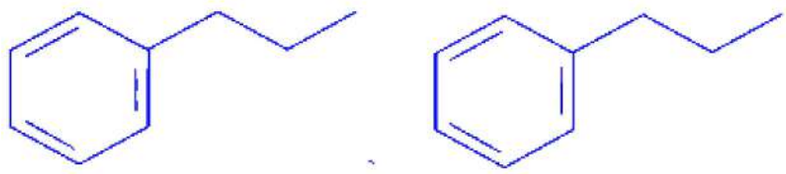
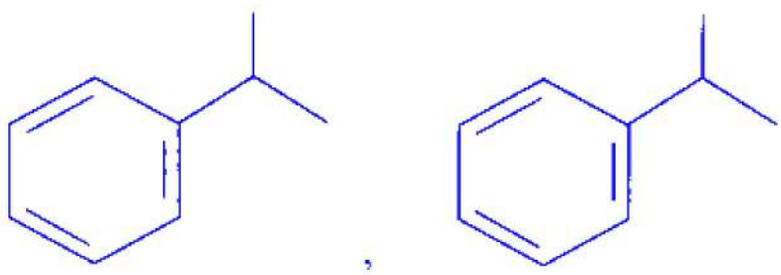
Options:

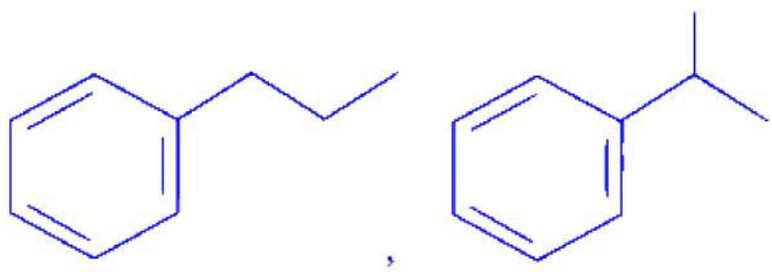
A.



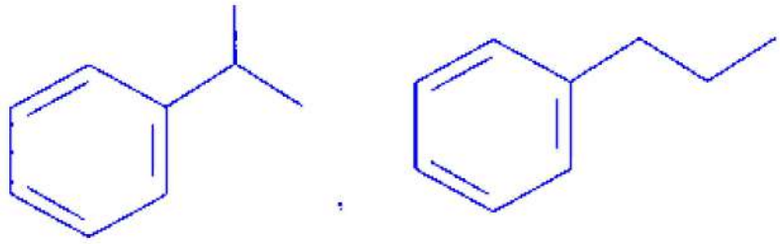
B.



C.



D.

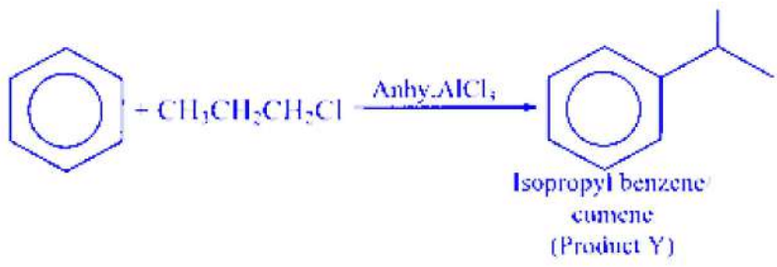


Answer: C

Solution:

The complete reaction is as follows

This is Wurtz-fittig reaction



This is Friedel-Craft alkylation.

Question6

Consider the following reaction sequence

$$\text{Vinyl benzene} \xrightarrow[\Delta]{KMnO_4+KOH} X \xrightarrow[\Delta]{NaOH+CaO} Y$$

$'Y'$ can also be formed from

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Options:

A.

polymerisation of ethylene

B.

polymerisation of propyne

C.

aromatisation of n-hexane

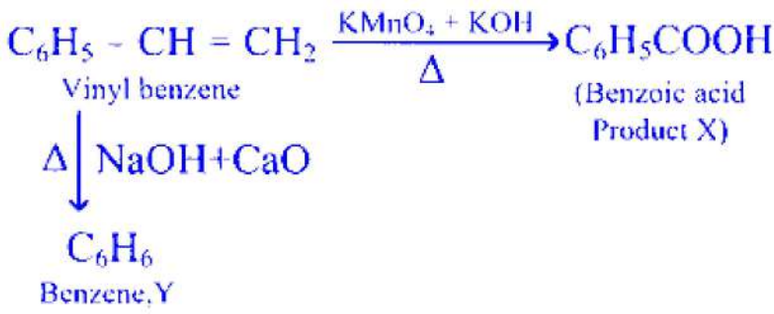
D.

aromatisation of n-heptane

Answer: C

Solution:

The complete reaction is as follows,



The final product is benzene, which is also formed by aromatisation of n-hexane.

Question7

When ethyl bromide and n-propyl bromide are allowed to react with Na metal in dry ether, the number of different alkanes formed is

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Options:

A.

1

B.

2

C.

3

D.

4

Answer: C

Solution:

The reaction is a Wurtz reaction, In the given case, three alkanes are formed

$$2C_2H_5Br + 2Na \xrightarrow[\text{Ether}]{\text{Dry}} \underset{\text{Butane}}{C_4H_{10}} + 2NaBr$$

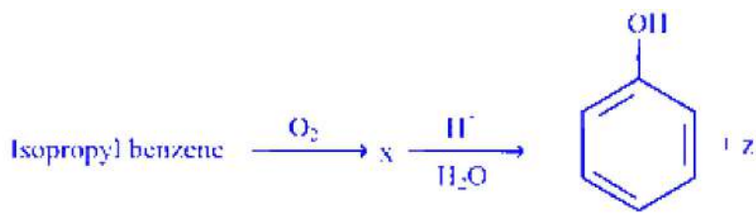
$$2C_3H_7Br + 2Na \xrightarrow[\text{Ether}]{\text{Dry}} \underset{\text{Hexane}}{C_6H_{14}} + 2NaBr$$

$$C_2H_5Br + C_3H_7Br + 2Na \longrightarrow \underset{\text{Pentene}}{C_5H_{12}} + 2NaBr$$

$\therefore$ Butane, hexane, pentane are formed.

Question8

Consider the following sequence of reactions



The incorrect statement about z is

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Options:

A.

z gives yellow precipitate of CHI_3 with $NaOH + I_2$, solution.

B.

z gives isopropyl alcohol on reduction with H_2 in the presence of Pd catalyst.

C.

z on reaction with CH_3MgBr followed by hydrolysis gives 2° alcohols.

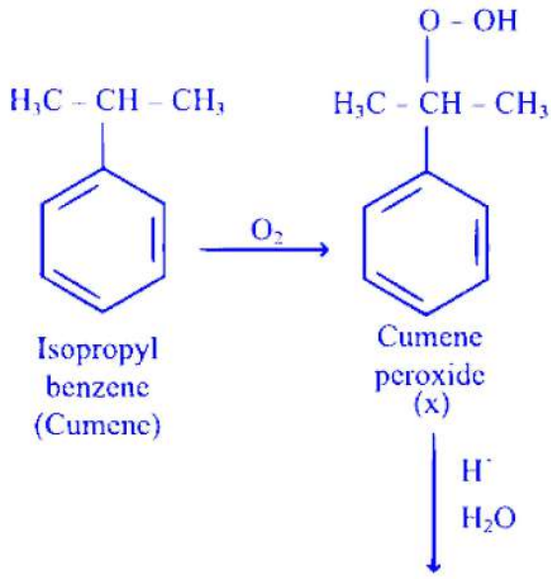
D.

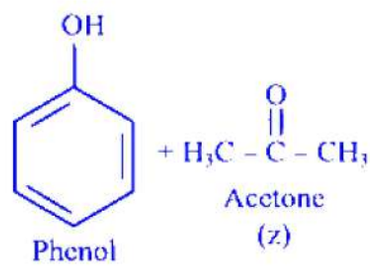
z does not give positive test with Fehling's reagent.

Answer: C

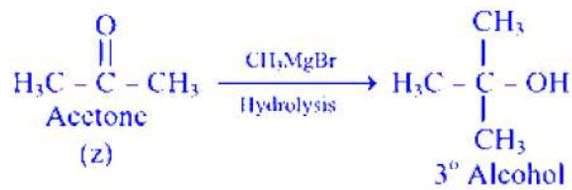
Solution:

The complete reaction sequence is as follows





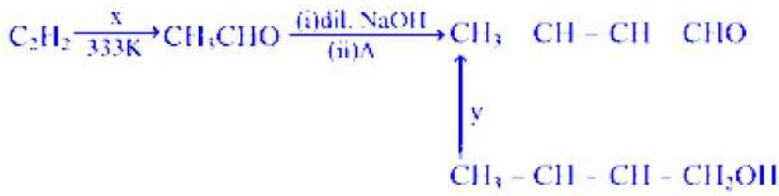
Now



Thus, statement given in option (C) is incorrect z on reaction with CH_3MgBr followed by hydrolysis will give 3° alcohol.

Question9

What are x and y in the following reaction sequence?



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Options:

A.

$H_2O/H_2SO_4; KMnO_4/H^+$

B.

$H_2O/H_2SO_4; PCC$

C.

$H_2O/H_2SO_4, Hg^{2+}; KMnO_4/H^+$

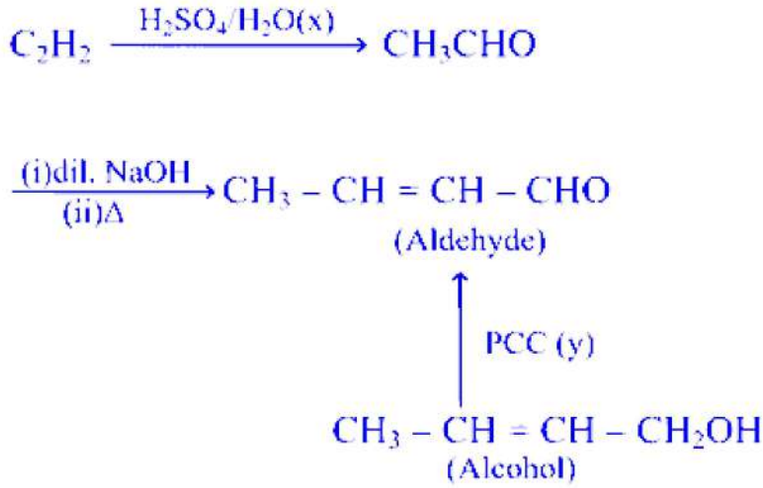
D.

$H_2O/H_2SO_4, Hg^{2+}; PCC$

Answer: D

Solution:

The complete reaction is as follows,



$x = H_2O/H_2SO_4, Hg^{2+}$
$y = PCC$

Question10

Which of the following sequence of reagents convert3- hexene to propane?

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Options:

A. $KMnO_4H^+, NaOH, CaO$

B. (i) O_3 (ii) $Zn, H_2O, NaBH_4$

C. (i) O_3 (ii) $Zn, H_2O, Zn - Hg, HCl$

D. $KMnO_4H^+, LiAlH_4, H_2O$

Answer: C

Solution:

$$\underset{\text{3-hexene}}{CH_3CH_2CH = CHCH_2CH_3} \xrightarrow[\text{(ii) } Zn,H_2O]{\text{(i) } O_3}$$

$$2CH_3CH_2CHO \xrightarrow{Zn-Hg,HCl} \underset{\text{Propane}}{CH_3CH_2CH_3}$$

So, the correct sequence of reagent is (i) O_3 (ii) $Zn, H_2O; Zn - Hg, HCl$.

Question11

Toluene on reaction with the reagent X gave Y, which dissolves in $NaHCO_3$ and when reacted with Br_2/Fe gave Z. What are X and Z ?

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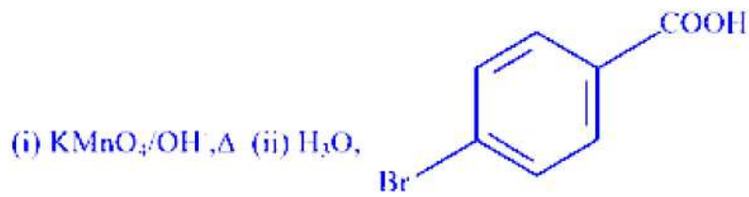
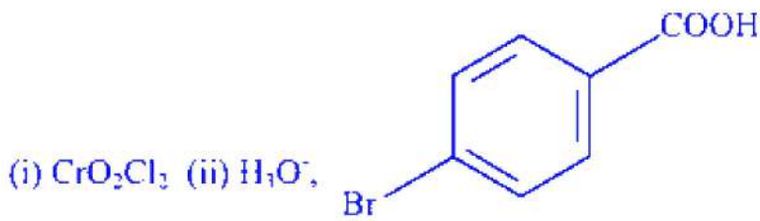
Options:

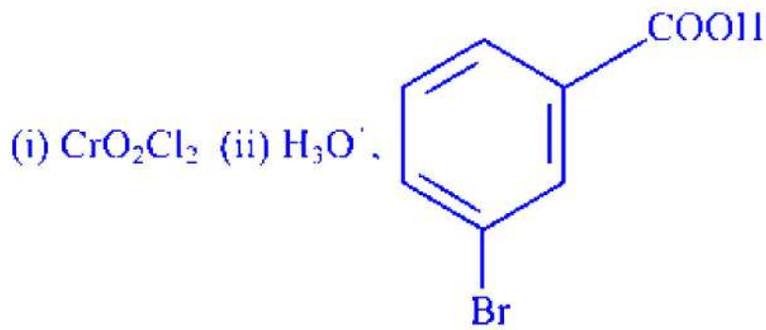
A.



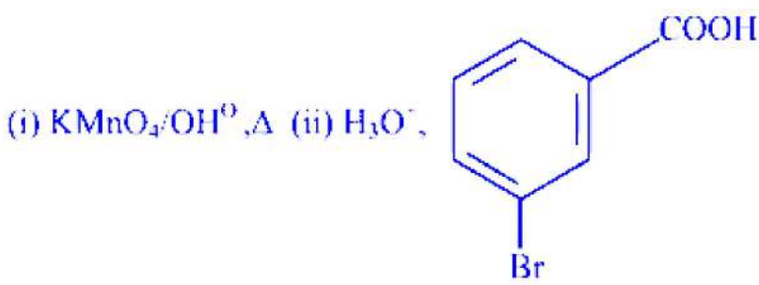
B.



C.

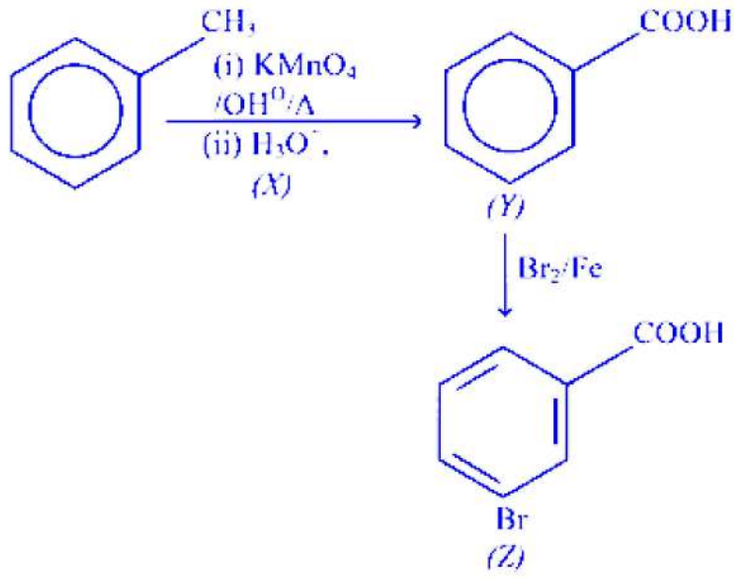


D.



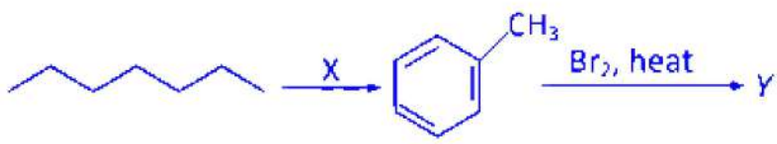
Answer: D

Solution:



Question12

What are X and Y respectively in the following reaction sequence?



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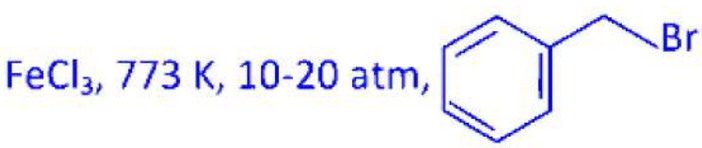
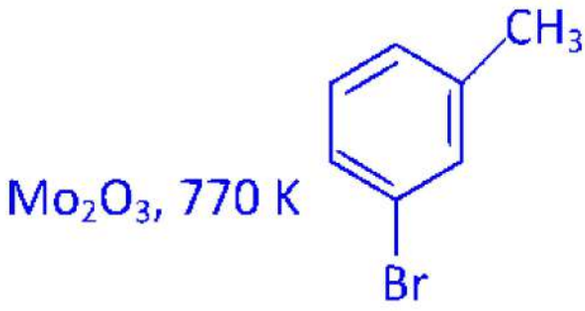
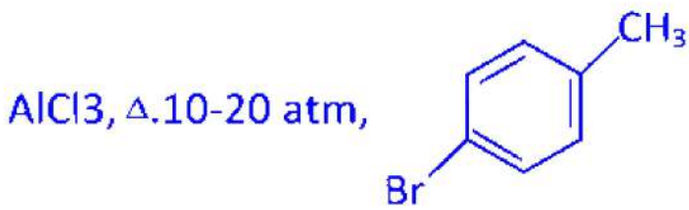
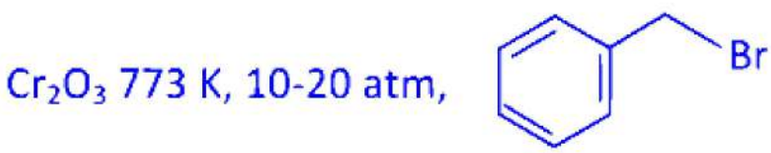
Options:

A.



B. 

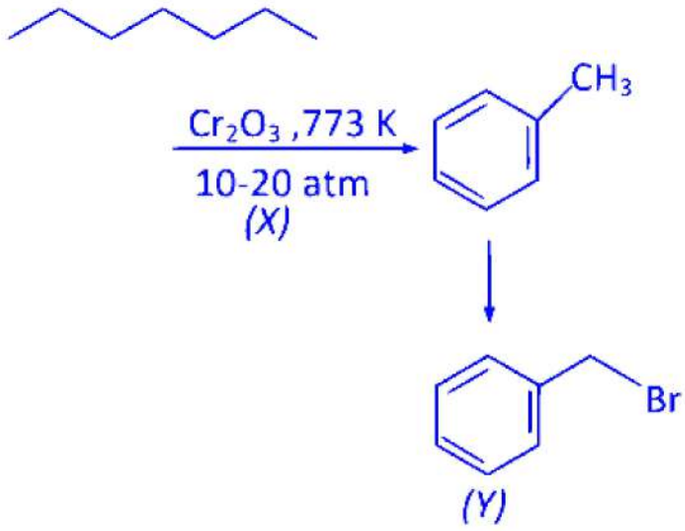
C. 

D. 

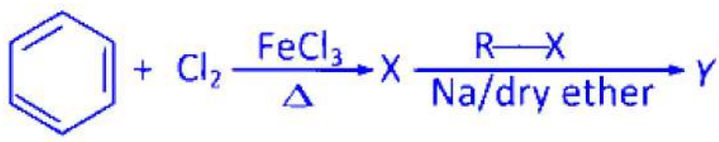
Answer: D

Solution:

The complete reaction is as follows



Question13



Conversion of X to Y is an example of

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Options:

A. Wurtz reaction

B. Fittig reaction

C. Wurtz-Fittig reaction

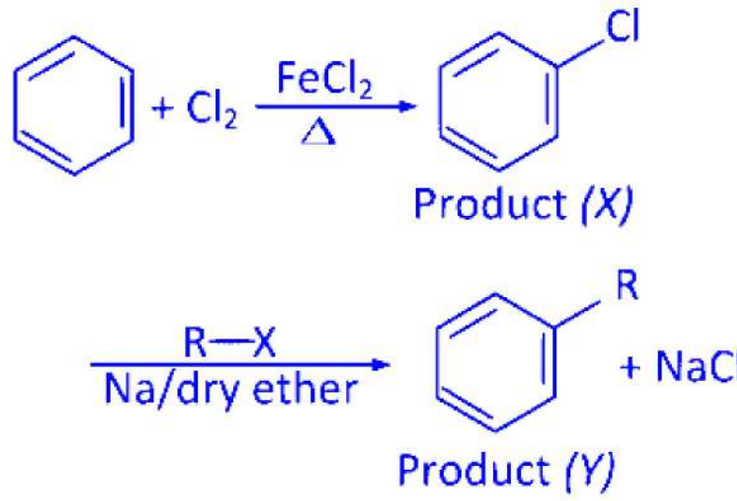
D. Friedel-Crafts reaction

Answer: C

Solution:

The given reaction is Wurtz Fifting reaction.

It is a chemical process that produces substituted aromatic compounds from aryl halides and alkyl halides in presence of sodium and dry ether. The complete reactions are as follow,



Question14

In Kolbe's electrolysis of sodium propanoate, products formed at anode and cathode are respectively

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Options:

A. C_2H_6, H_2

B. C_3H_8, H_2

C. C_1H_4, H_2

D. H_2, C_4H_{10}

Answer: C

Solution:

In Kolbe's electrolysis, the sodium or potassium salt of a carboxylic acid undergoes decarboxylation to form the corresponding alkanes. The overall reaction is outlined below:

$$2\,CH_3CH_2COONa + 2\,H_2O \xrightarrow[\text{electrolysis}]{\text{Kolbe's}} \underset{\text{(At anode)}}{C_4H_{10}} + 2\,CO_2 + 2\,NaOH + \underset{\text{(At cathode)}}{H_2}$$

Thus, the products at the anode and cathode are:

Anode: C_4H_{10} (butane)

Cathode: H_2 (hydrogen gas)

Question15

In Wurtz-Fittig reaction a compound X reacts with alkyl halide. What is X ?

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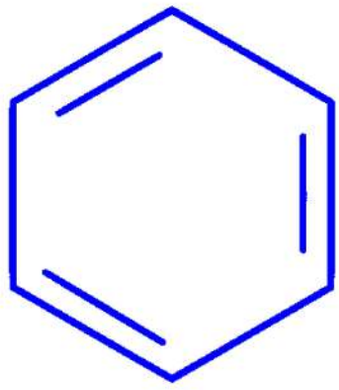
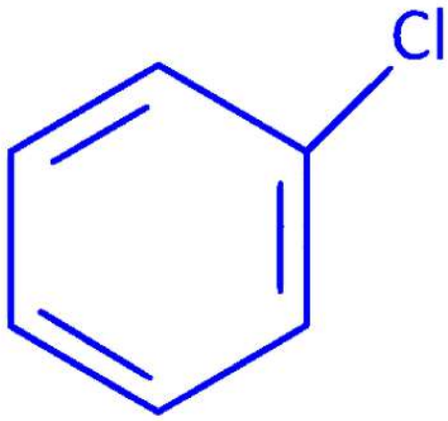
Options:

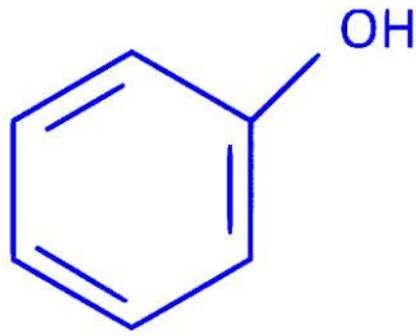
A.



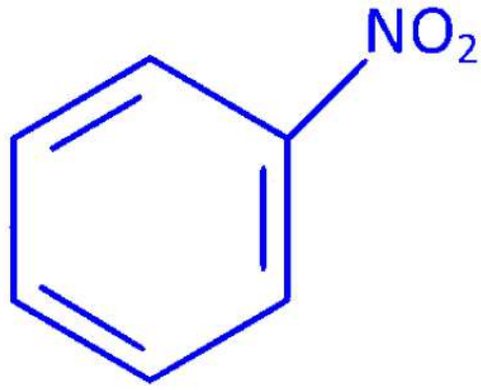
B.



C.



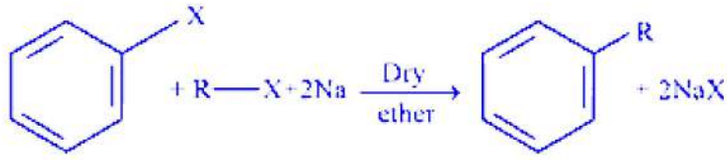
D.



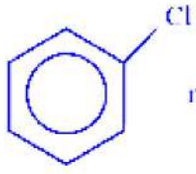
Answer: B

Solution:

Wurtz-Fittig reaction Aryl halide and alkyl halide react in presence of sodium metal/dry ether to form alkyl benzene.



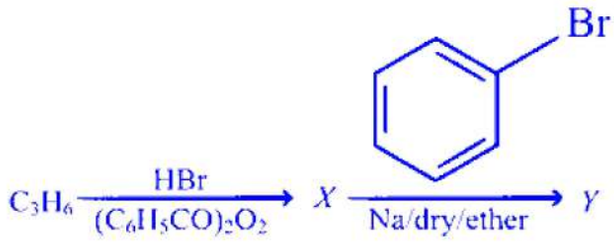
In given option,



match correctly as aryl halides.

Question16

What are X and Y respectively in the following reaction sequence?



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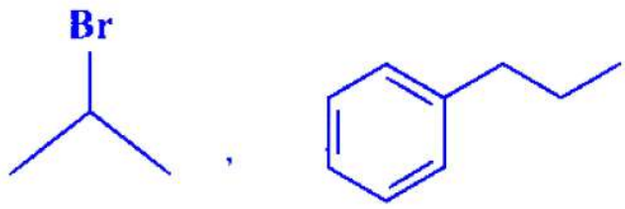
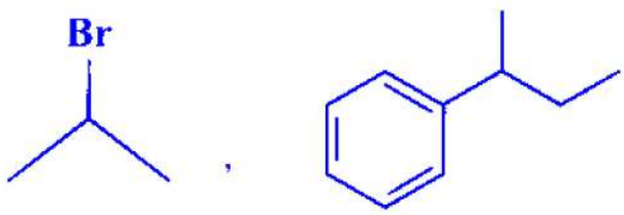
Options:

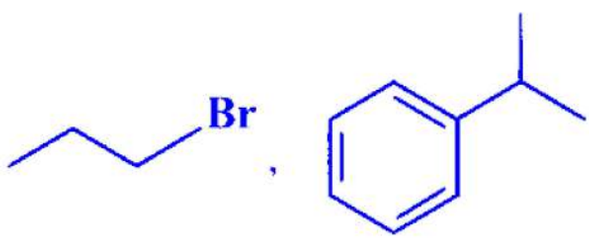
A.



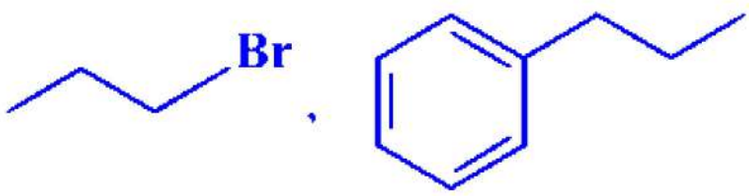
B.



C.



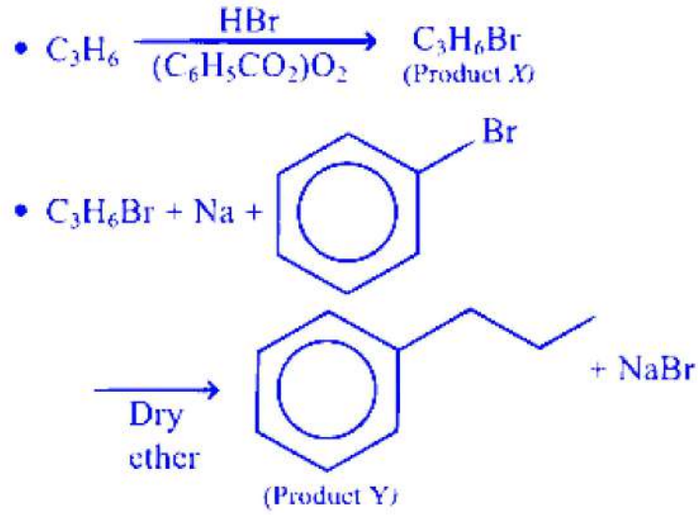
D.



Answer: D

Solution:

The complete reaciton is as follows,



This reaction is called as Wurtz reaction.

Question17

Hydrolysis of an alkyl bromide $(C_5H_{11}Br)$ follows first order kinetics. Reaction of X with Mg in dry ether followed by treatment of D_2O gave Y, What is Y ?

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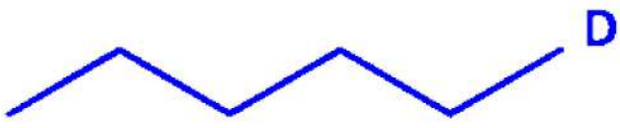
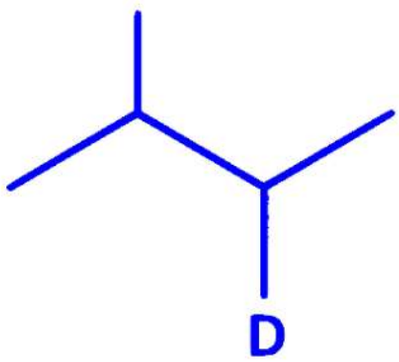
Options:

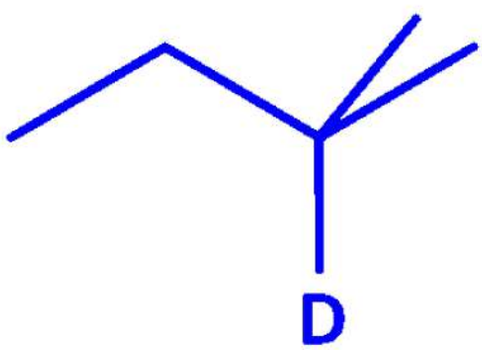
A. 

B.

C.

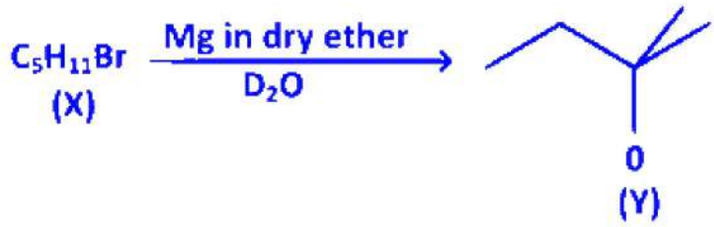


D.



Answer: D

Solution:



Question18

A mixture of ethyl iodide and n-propyl iodide is subjected to Wurtz reaction. The hydrocarbon which will not be formed is

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Options:

A. butane

B. propane

C. pentane

D. hexane

Answer: B

Solution:

In the Wurtz reaction, alkanes are synthesized by reducing alkyl halides using sodium in dry ether. This process combines two alkyl groups to form higher alkanes.

$$R - X + 2\text{Na} + X - R_1 \xrightarrow{\text{Dry ether}} R - R_1 + 2\text{NaI}$$

When a mixture of ethyl iodide and n-propyl iodide undergoes the reaction, the following higher alkanes are formed:

(i) **Butane**:

$$\text{CH}_3\text{CH}_2 - \text{I} + 2\text{Na} + \text{I} - \text{CH}_2\text{CH}_3 \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 + 2\text{NaI}$$

(ii) **Hexane**:

$$\text{CH}_3\text{CH}_2\text{CH}_2 - \text{I} + 2\text{Na} + \text{I} - \text{CH}_2\text{CH}_2\text{CH}_3 \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 + 2\text{NaI}$$

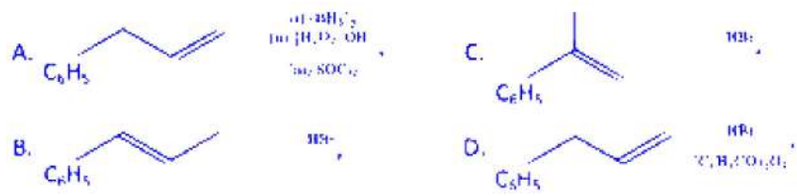
(iii) **Pentane**:

$$\text{CH}_3\text{CH}_2\text{I} + 2\text{Na} + \text{I} - \text{CH}_2\text{CH}_2\text{CH}_3 \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 + 2\text{NaI}$$

Thus, propane is the only hydrocarbon not formed in this reaction.

Question19

The product of which of the following reactions undergo hydrolysis by S_N1 mechanism?



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Options:

A. C, D only

B. A, B, C only

C. B, C only

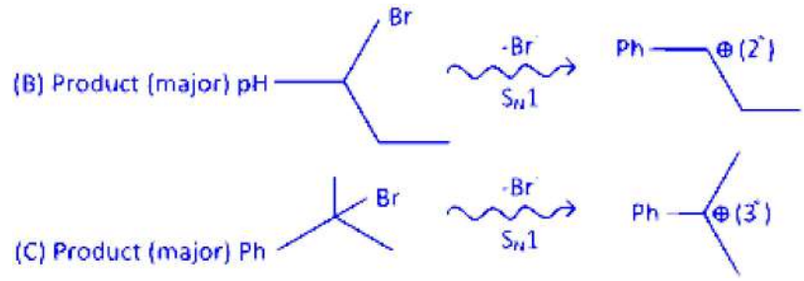
D. A, D only

Answer: C

Solution:

S_N1 mechanism are generally carried out in polar protic solvents and generally occurs in two steps.

Among the given reactions products of B and C will undergo hydrolysis by S_N1 mechanism, as the products are $2^\circ/3^\circ$. benzy bromides which will furnish very stable carbocations.



Question20

Styrene on reaction with reagent X gave Y which on hydrolysis followed by oxidation gave Z. Z gives positive 2, 4-DNP test but does not give iodoform test. What are X and Z respectively ?

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Options:

A. $HBr : C_6H_5COCH_3$

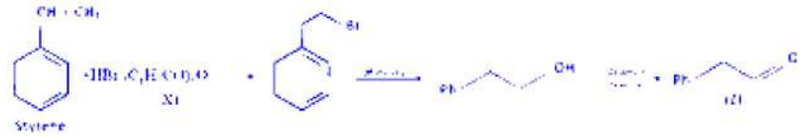
B. $HBr : C_6H_5CH_2CHO$

C. $HBr/(C_6H_5CO)_2O_2 : C_6H_5CH_2CHO$

D. $HBr/(C_6H_5CO)_2O_2 : C_6H_5COCH_3$

Answer: C

Solution:



Thus, the compound X and Z are $HBr/(C_6H_5CO)_2O_2$ and $C_6H_5CH_2CHO$.

Question21

An alkene $X\,(C_4H_8)$ on reaction with HBr gave $Y\,(C_4H_9Br)$. Reaction of Y with benzene in the presence of anhydrous $AlCl_3$ gave Z which is resistant to oxidation with $KMnO_4 - KOH$. What are X, Y, Z respectively?

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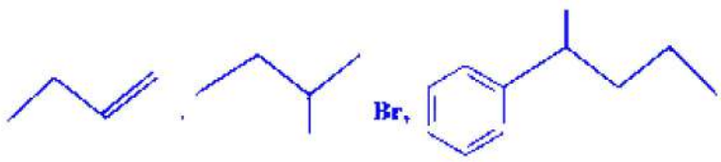
Options:

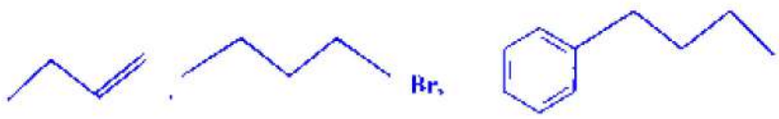
A.

B.

C.



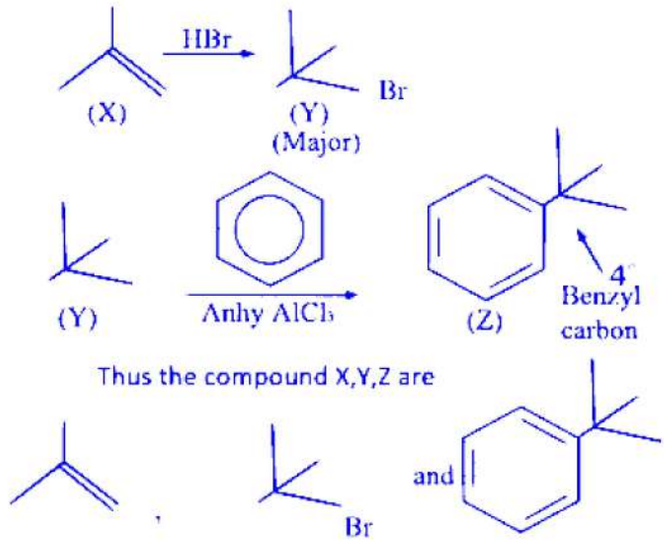
D.



Answer: A

Solution:

The complete reaction is as follows



Question22

An alkene $X\,(C_4H_8)$ does not exhibit cis-trans is memerisn Reaction of X with Br_2 in the presence of UV light gane Y. What is Y ?

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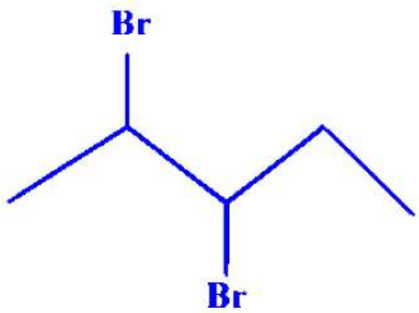
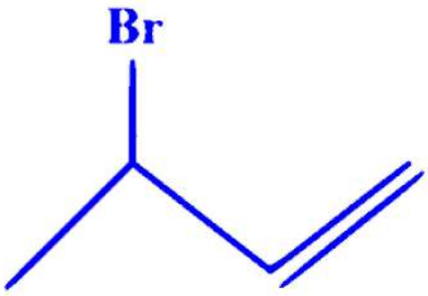
Options:

A.

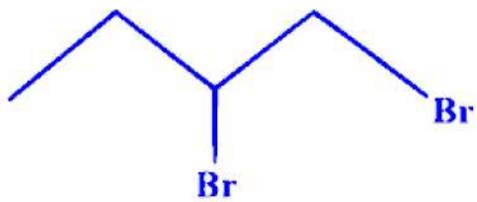


B.

C.



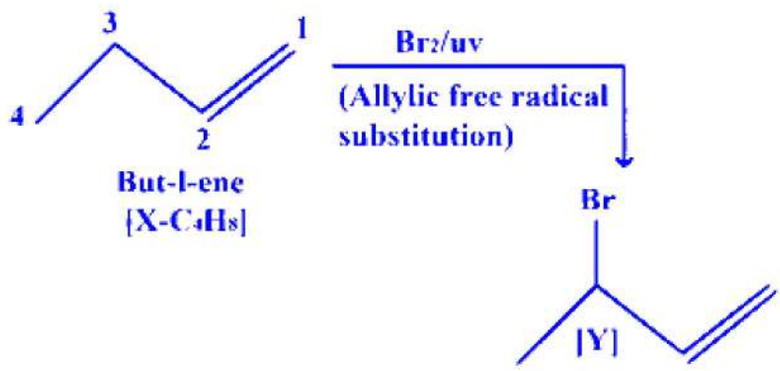
D.



Answer: C

Solution:

But-1-ene does not show cis-frans isomerism (geometrical).



Here, c-3 of X is the allyl carbon (2°).

Question23

What are X and Y respectively in the following reaction sequence?

$$\text{Isopentane} \xrightarrow{KMnO_4} X \xrightarrow{\text{Dehydration}} Y \text{ Major}$$

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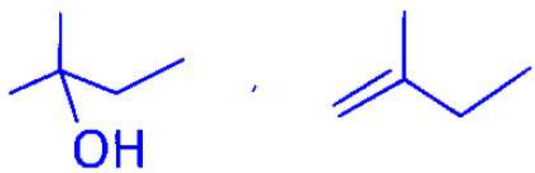
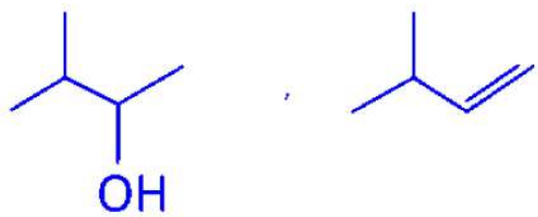
Options:

A. 

B. 

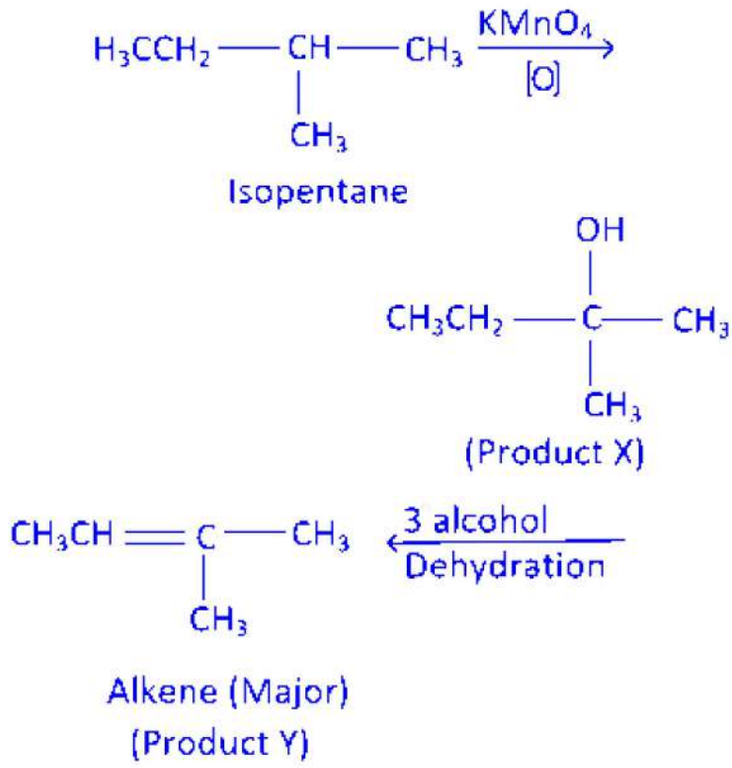
C. 

D. 

Answer: A

Solution:

The complete reaction is as follows,



Question24

The product formed when a hydrocarbon X of molecular formula C_6H_{10} is reacted with sodamide is subjected to ozonolysis, followed by hydrolysis with Zn/H_2O_2 and upon further oxidation gave two carboxylic acids, of which one is optically active. The hydrocarbon 'X' is

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Options:

A. hex-1-yne

B. hex-3-yne

C. 3-methyl pent-1-yne

D. 3,3-dimethyl but -1-yne

Answer: C

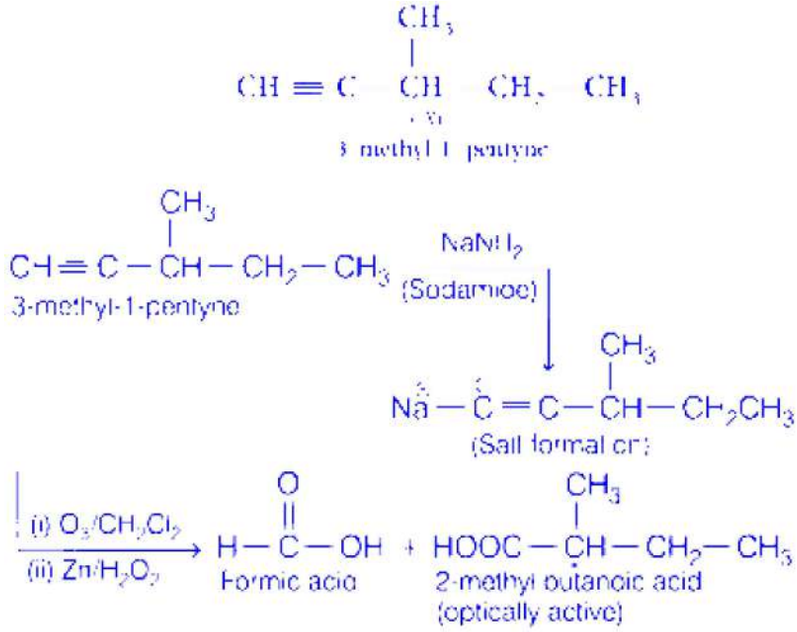
Solution:

Here for unknown formula given C_6H_{10}, we can predict molecular structure of given formula by using double bond equivalent.

$$\text{DBE} = \text{C} - \frac{\text{H}}{2} + \frac{\text{N}}{2} - \frac{X}{2} + 1$$

$$\Rightarrow \quad = 6 - \frac{10}{2} + 0 - 0 + 1$$

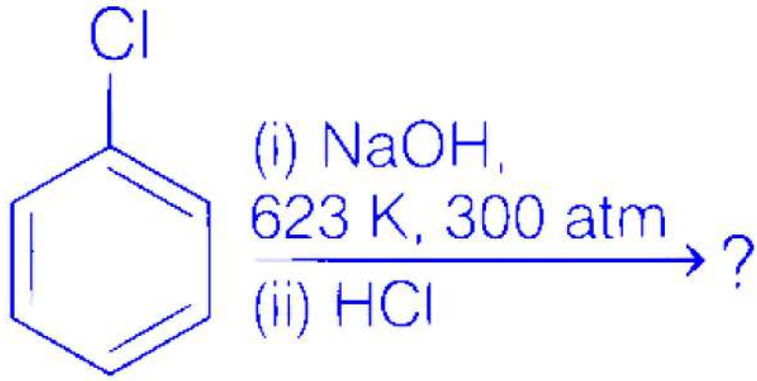
$$\Rightarrow \quad = 6 - 5 + 1 = 2$$



Hence, the hydrocarbon X is 3-methylpent-1-yne.

Question25

Identify the product of the following reaction.



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Options:

A. Benzene

B. Toluene

C. Aniline

D. Phenol

Answer: D

Solution:

When chlorobenzene is heated with 6%solution of NaOH at 623 K and under pressure300 atm to form sodium phenoxide.

Further on acidified with dilute HCl, it will formphenol.