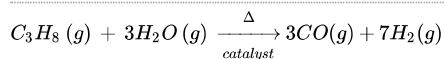


#423492

Topic: Characteristics of alkane

Complete the following reactions:  $C_3H_8(g) + 3H_2O(g) \xrightarrow[catalyst]{\Delta}$

Solution



#423611

Topic: Alkanes

Define hydrogenation.

Solution

Addition of hydrogen to another reactant is called hydrogenation. This reduces a compound in the presence of a suitable catalyst. For examples, vegetable oils are hydrogenated to fats using hydrogen in presence of Ni catalyst.

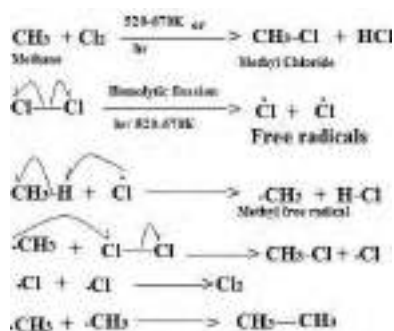
#423643

Topic: Alkanes

How do you account for the formation of ethane during chlorination of methane?

Solution

During chlorination of methane, ethane is formed due to side reaction in termination step by the combination of two methyl free radicals.



#423727

Topic: Alkanes

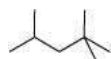
Passage

Give condensed and bond line structural formula and identify the functional group(s) present, if any, for :

2,2,4-Trimethyl pentane

Solution

The condensed formula for 2,2,4-Trimethylpentane is  $(CH_3)_2CHCH_2C(CH_3)_3$ . The bond line formula is as shown.

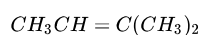


#423930

Topic: Alkenes

Passage

Write IUPAC names of the following compound:

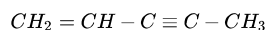


Solution

The correct IUPAC name of the compound  $CH_3CH = C(CH_3)_2$  is 2-methyl-but-2-ene. The parent hydrocarbon contains 4C atoms and a double bond. Hence, it is but-2-ene. A methyl group is present at a second carbon atom.

#423931

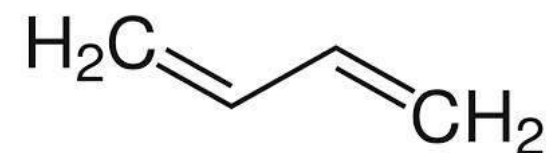
Topic: Alkynes

**Passage**Write *IUPAC* names of the following compound:**Solution**The correct IUPAC name of the compound  $CH_2 = CH - C \equiv C - CH_3$  is pent-1-ene-3-yne.

The parent hydrocarbon contains 5 carbon atoms and a double bond and a triple bond.

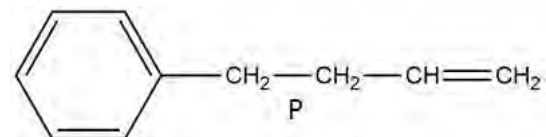
#423932

Topic: Alkenes

**Passage**Write *IUPAC* names of the following compound:**Solution**The correct IUPAC name is Buta-1,3-diene. The parent hydrocarbon contains 4 *C* atoms and 2 double bonds. It is a conjugated diene.

#423936

Topic: Arenes

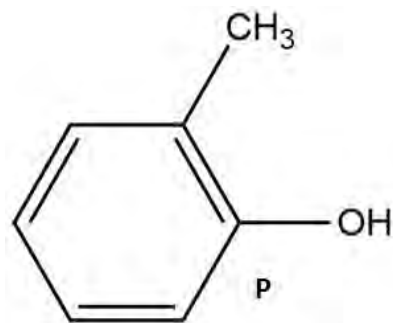
**Passage**Write *IUPAC* names of the following compound:Compound *P*.**Solution**

The correct IUPAC name of the compound is 4 - phenylbut - 1 - ene. It contains 4 carbon atoms and one double bond. Hence, it is butene. Phenyl group is present as substituent on fourth carbon atom.

#423940

Topic: Arenes

**Passage**Write *IUPAC* names of the following compound:



Compound *P*.

#### Solution

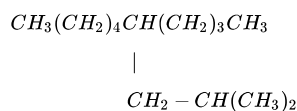
The correct IUPAC name is 2-Methylphenol. A methyl substituent is present at second carbon atom of phenol.

#423942

Topic: Alkanes

#### Passage

Write *IUPAC* names of the following compound:



#### Solution

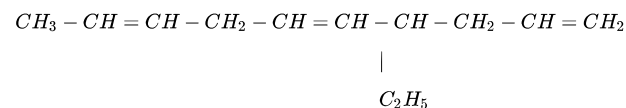
The correct IUPAC name of the compound is 5-(2-methylpropyl)-decane. The parent hydrocarbon contains 10 carbon atoms and is called decane. At fifth carbon atom, 2-methylpropyl group is present.

#423944

Topic: Alkenes

#### Passage

Write *IUPAC* names of the following compound:



#### Solution

The correct IUPAC name is 4-ethyldeca 1,5,8- triene. The parent hydrocarbon contains 10 carbon atoms and 3 double bonds. Hence, it is decatriene. An ethyl group is present at fourth carbon atom.

#423947

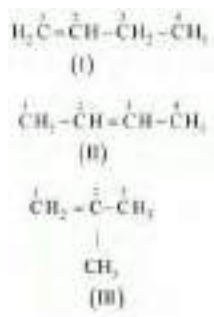
Topic: Alkenes

For  $C_4H_8$  (one double bond), write the structural formula and IUPAC name for all possible isomers.

#### Solution

Three isomers are possible. Their IUPAC names are (I) but-1-ene, (II) but-2-ene and (III) 2-methylprop-1-ene.

The structural formulas are as shown.



#423980

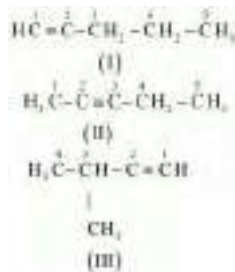
Topic: Alkynes

For the following compounds, write structural formulas and IUPAC names for all possible isomers having the number of double or triple bond as indicated :  $C_5H_8$  (one triple bond)

Solution

Three isomers are possible. Their IUPAC names are (I) pent-1-yne, (II) pent-2-yne and (III) 3-methylbut-1-yne.

The structural formulas are as shown.



#423986

Topic: Characteristics of alkenes

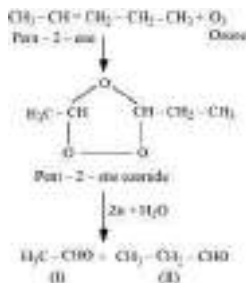
Passage

Write IUPAC names of the products obtained by the ozonolysis of the following compounds.

Pent - 2 - ene

Solution

IUPAC names of the products obtained by the ozonolysis of Pent - 2 - ene are (I) ethanal and (II) propanal.



#423987

Topic: Characteristics of alkenes

Passage

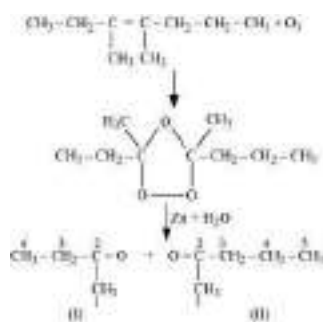
Write IUPAC names of the products obtained by the ozonolysis of the following compounds.

3, 4 - Dimethylhept - 3 - ene

**Solution**

IUPAC names of the products obtained by the ozonolysis of Pent - 2 - ene are ethanal and propanal.

The IUPAC names of the products obtained by the ozonolysis of 3, 4 - Dimethylhept - 3 - ene are (I) butan-2-one and (II) pentan-2-one.



#423988

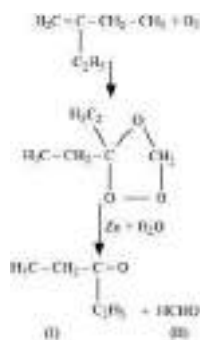
**Topic:** Characteristics of alkenes**Passage**

Write IUPAC names of the products obtained by the ozonolysis of the following compounds.

2 - Ethylbut - 1 - ene

**Solution**

The IUPAC names of the products obtained by the ozonolysis of 2 - Ethylbut - 1 - ene are (I) pentan-3-one and (II) methanal.



#423989

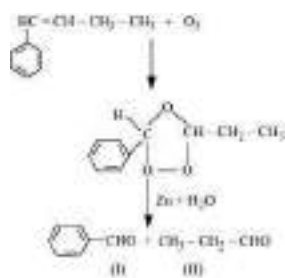
**Topic:** Characteristics of alkenes**Passage**

Write IUPAC names of the products obtained by the ozonolysis of the following compounds.

1-Phenylbut-1-ene

**Solution**

The IUPAC names of the products obtained by the ozonolysis of 1 - phenylbut-1-ene are (I) benzaldehyde and (II) propanal.



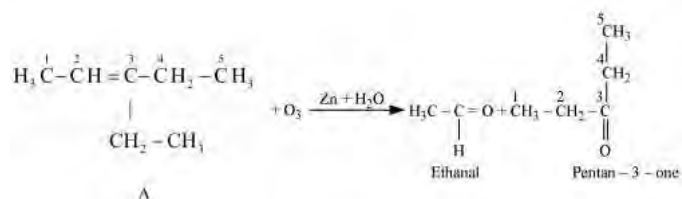
#423991

**Topic:** Characteristics of alkenes

An alkene A on ozonolysis gives a mixture of ethanal and pentan - 3 - one. Write structure and IUPAC name of A.

**Solution**

The alkene A is 3-Ethylpent-2-ene. On ozoloysis, it gives a mixture of ethanal and pentan-3-one.

**#423992**

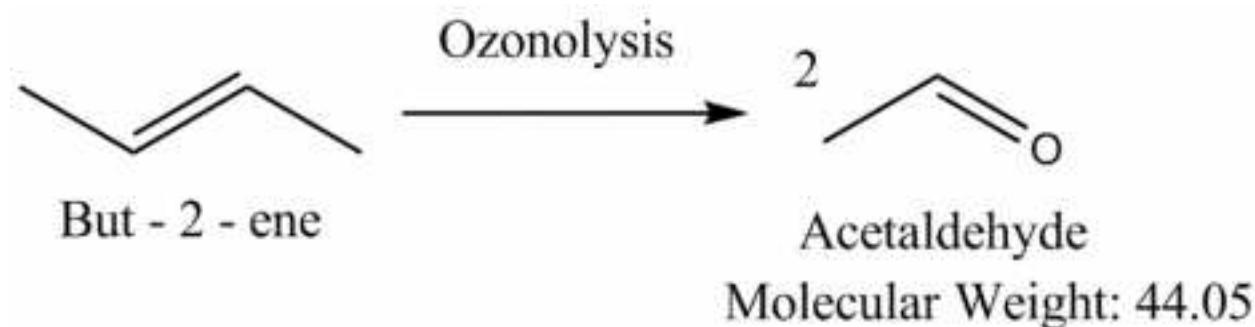
**Topic:** Characteristics of alkenes

An alkene A contains three  $C - C$ , eight  $C - H$   $\sigma$  bonds and one  $C - C$   $\pi$  bond. A on ozonolysis gives two moles of an aldehyde of molar mass 44 u. Write IUPAC name of A.

**Solution**

The aldehyde with molar mass of 44 u is acetaldehyde. 2 molecules of acetaldehyde are obtained on ozonolysis. Hence, the alkene A is But - 2 - ene.

It contains three C-C  $\sigma$  bonds, eight C-H  $\sigma$  bonds and one C=C  $\pi$  bond.

**#423993**

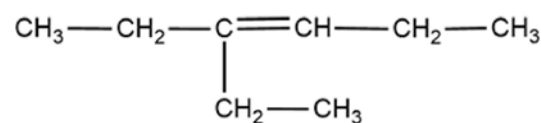
**Topic:** Characteristics of alkenes

Propanal and pentan - 3 - one are the ozonolysis products of an alkene. What is the structural formula of the alkene?

**Solution**

The ozonolysis of 4-Ethylhex-3-ene gives propanal and pentan-3-one.

The structural formula of the alkene is as shown.

**#423996**

**Topic:** Characteristics of alkane

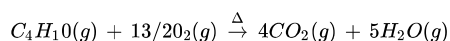
**Passage**

Write chemical equations for combustion reaction of the following hydrocarbons.

Butane

**Solution**

The chemical equation for combustion reaction of butane is as given below.

**#423999**

**Topic:** Characteristics of alkane

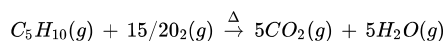
**Passage**

Write chemical equations for combustion reaction of the following hydrocarbons.

Pentene

#### Solution

The chemical equation for combustion reaction of pentane is as given below.



#### #424000

**Topic:** Characteristics of alkenes

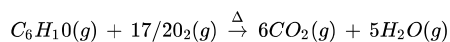
#### Passage

Write chemical equations for combustion reaction of the following hydrocarbons.

Hexyne

#### Solution

The chemical equation for combustion reaction of hexyne is as given below.



#### #424002

**Topic:** Characteristics of arenes

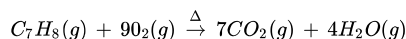
#### Passage

Write chemical equations for combustion reaction of the following hydrocarbons.

Toluene

#### Solution

The chemical equation for combustion reaction of toluene is as given below.



#### #424003

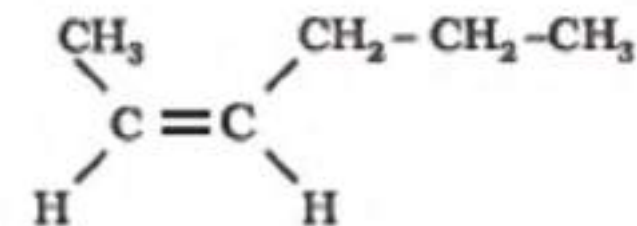
**Topic:** Characteristics of alkenes

Draw the cis and trans structures of hex-2-ene. Which isomer will have higher b.p. and why?

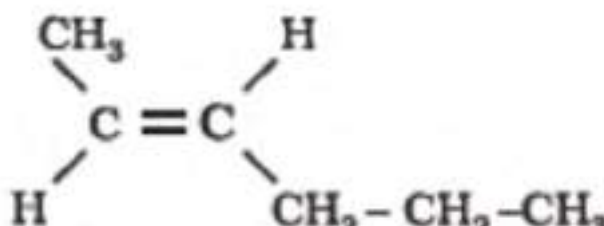
#### Solution

The cis and trans structures of hex-2-ene are as shown.

The cis form will have higher boiling point due to more polar nature leading to stronger intermolecular dipole-dipole interaction, thus requiring more heat energy to separate them.



*cis-Hex-2-ene*



*trans-Hex-2-ene*

#### #424004

**Topic:** Arenes

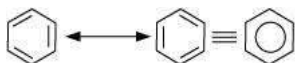
Why is benzene extra ordinarily stable though it contains three double bonds?

#### Solution

Benzene extra ordinarily stable though it contains three double bonds.

This is due to following reasons. Benzene is a resonance hybrid of two canonical forms.

In the resonance hybrid, all the six pi electrons are completely delocalized. This results in resonance stabilization.



#424005

Topic: Arenes

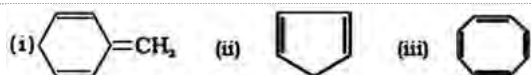
What are the necessary conditions for any system to be aromatic?

**Solution**

The necessary conditions for any system to be aromatic are planar, conjugated ring system with delocalisation of  $(4n+2)\pi$  electrons, where, n is an integer.

#424006

Topic: Arenes



Explain why the following systems are not aromatic?

**Solution**

The given systems are not aromatic due to lack of localisation of  $(4n + 2)\pi$  electrons in the cyclic system.

For a molecule to be aromatic,  $4n + 2\pi$  electrons should be completely delocalized in the planar ring system.

For compounds (i) and (ii) only  $4\pi$  electrons are present in the ring. For compound (iii),  $8\pi$  electrons are present in the ring.

#424008

Topic: Characteristics of arenes

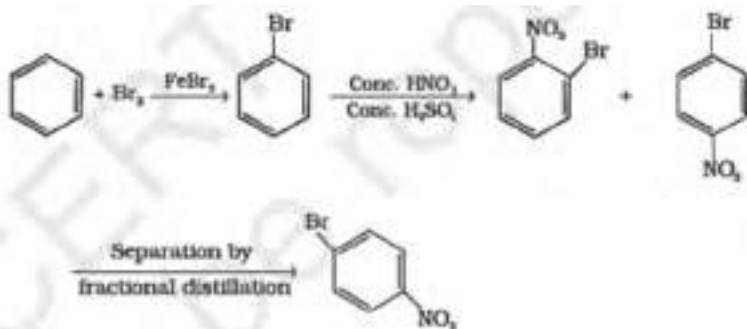
**Passage**

How will you convert benzene into:

p - nitrobromobenzene

**Solution**

Electrophilic aromatic substitution of benzene with bromine in presence of ferric bromide gives bromobenzene. Nitration with conc nitric acid and concentric sulphuric acid give a mixture of ortho bromo nitrobenzene and para bromo nitrobenzene which are separated by fractional distillation.



#424009

Topic: Characteristics of arenes

**Passage**

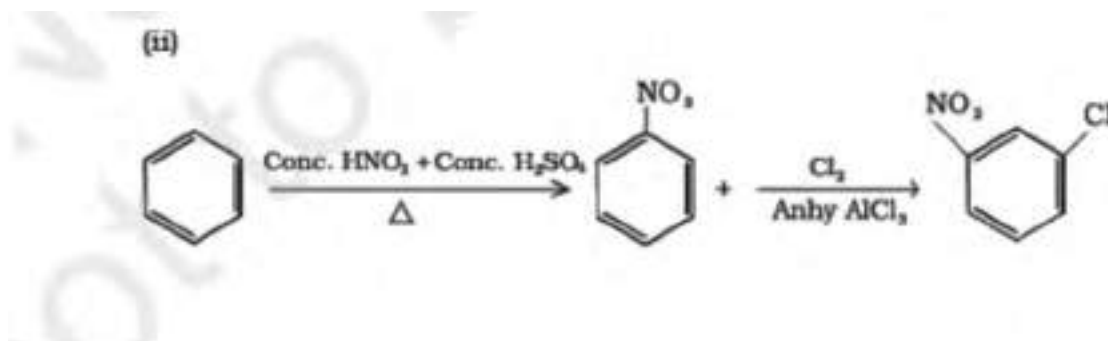
How will you convert benzene into:

m - nitrochlorobenzene

**Solution**



Nitration of benzene with conc nitric acid and conc sulphuric acid gives nitrobenzene. Chlorination with chlorine in presence of anhydrous aluminum chloride gives meta nitro chlorobenzene.



#424010

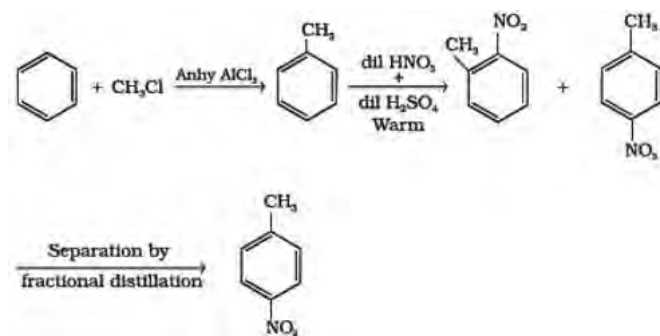
Topic: Characteristics of arenes

How will you convert benzene into p - nitrotoluene?

Solution

Friedel crafts alkylation of benzene with methyl chloride in presence of anhydrous aluminium chloride gives toluene.

nitration of toluene with a mixture of dil nitric acid and dil sulphuric acid gives a mixture of ortho and para nitro toluene which are separated by fractional distillation.



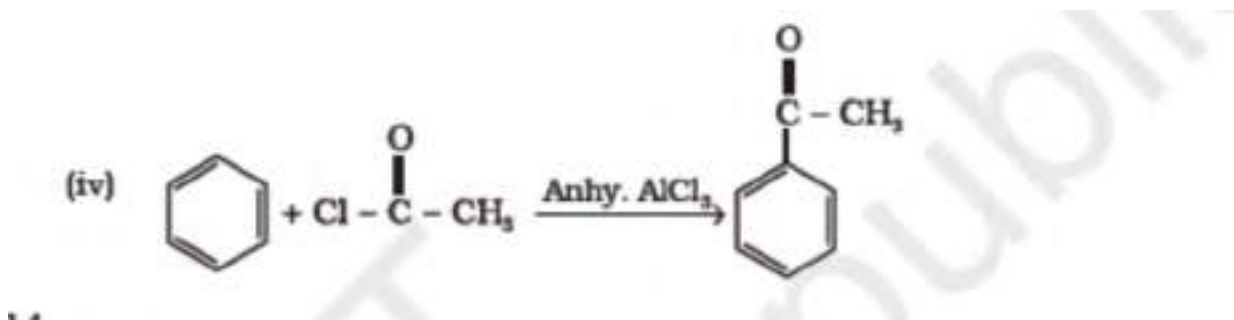
#424011

Topic: Characteristics of arenes

How will you convert benzene into acetophenone?

Solution

Acetylation of benzene with acetyl chloride in presence of anhydrous aluminum chloride gives acetophenone.



#424013

Topic: Alkanes

In the alkane  $\text{H}_3\text{C}-\text{CH}_2-\text{C}(\text{CH}_3)_2-\text{CH}_2-\text{CH}(\text{CH}_3)_2$ , identify  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  carbon atoms and give the number of H atoms bonded to each one of these.

Solution

There are 5 methyl groups which contain primary carbon atoms. Thus 15 H atoms are attached to primary carbon atoms.

There are 2 methylene groups which contain secondary carbon atoms. Thus, 4 H atoms are attached to secondary carbon atoms.

There is one tertiary carbon atom to which 1 hydrogen atom is attached.

There is one quaternary carbon atom.

#424014

Topic: Characteristics of alkane

What effect does branching of an alkane chain has on its boiling point?

**Solution**

Alkanes with stronger intermolecular van der Waals forces have higher boiling point. With increase in the branching, the surface area of the molecule decreases and van der Waals forces of attraction decreases which can be overcome at a relatively lower temperature. Hence, the boiling point of an alkane chain decreased with an increase in branching.

#424015

Topic: Characteristics of alkenes

Addition of  $\text{HBr}$  to propene yields 2-bromopropane, while in the presence of benzoyl peroxide, the same reaction yields 1-bromopropane. Explain and give mechanism.**Solution**

Addition of  $\text{HBr}$  to propene yields 2-bromopropane. This is accordance with Markovnikov's rule. The reaction proceeds through ionic mechanism and involves formation of carbocation intermediate. Secondary carbocation is more stable than primary carbocation and is preferentially formed.

While in the presence of benzoyl peroxide, the same reaction yields 1-bromopropane. This is in accordance with anti Markovnikov's rule. This happens in presence of peroxide and with  $\text{HBr}$  only. The reaction proceeds through free radical mechanism. The reaction involves formation of primary and secondary free radicals. Secondary free radical is more stable and preferentially formed.



#424016

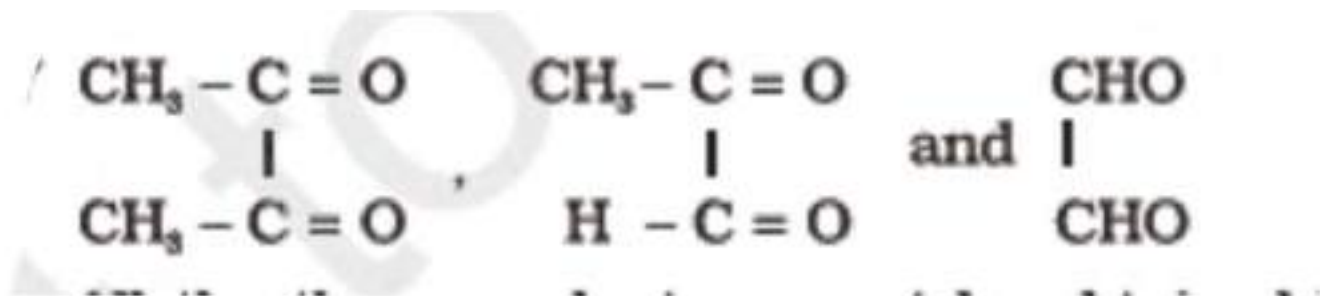
Topic: Characteristics of arenes

Write down the products of ozonolysis of 1, 2-dimethylbenzene (o-xylene). How does the result support Kekulé structure for benzene?

**Solution**

The products of ozonolysis of 1, 2-dimethylbenzene (o-xylene) are as shown.

All the three products cannot be obtained by any one of the Kekulé structures. This shows that benzene is a resonance hybrid of the two resonating structures.



#424020

Topic: Characteristics of alkynes

Arrange benzene, n-hexane and ethyne in decreasing order of acidic behaviour. Also give reason for this behaviour.

**Solution**

The decreasing order of acidic behavior is  $\text{HC} \equiv \text{CH} > \text{C}_6\text{H}_6 > \text{C}_6\text{H}_{14}$

Due to maximum  $s$  orbital character in ethyne (50 %) as compared to 33% in benzene and 25% in n-hexane.

#424023

Topic: Characteristics of arenes

Why does benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions difficulty?

#### Solution

Due to the presence of  $6\pi$  electrons, benzene behaves as a rich source of electrons, thus, being easily attacked by reagents deficient in electrons.

Hence, benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions with difficulty

#424025

Topic: Characteristics of alkynes

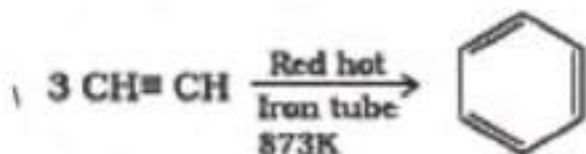
#### Passage

How would you convert the following compound into benzene?

Ethyne

#### Solution

When acetylene is heated in red hot iron tube at 873 K, benzene is obtained.



#424029

Topic: Characteristics of alkane

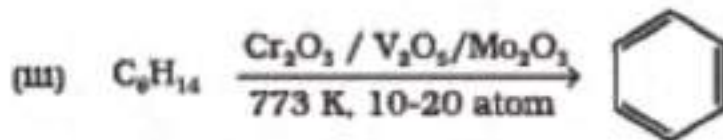
#### Passage

How would you convert the following compound into benzene?

Hexane

#### Solution

Oxidation of hexane with catalyst  $\text{Cr}_2\text{O}_3/\text{V}_2\text{O}_5/\text{Mo}_2\text{O}_3$  at 773 K, 10 -20 atm gives benzene.



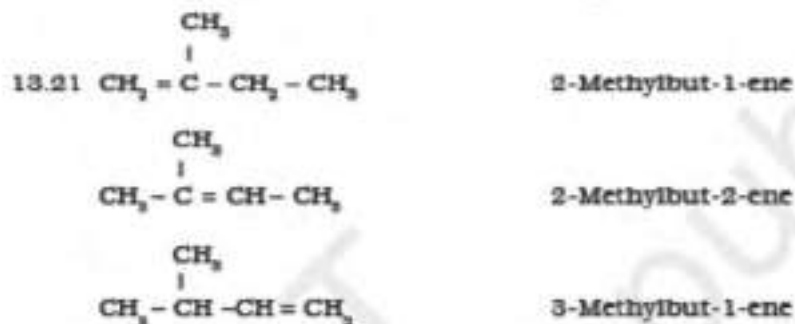
#424032

Topic: Characteristics of alkenes

Write structures of all the alkenes which on hydrogenation give 2 - methylbutane.

#### Solution

The structures of all the alkenes which on hydrogenation give 2 - methylbutane are as shown.



#424036

Topic: Characteristics of arenes

**Passage**

Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile,  $E^+$ .

Chlorobenzene, 2, 4- dinitrochlorobenzene, p-nitrochlorobenzene

**Solution**

The decreasing order of relative reactivity with an electrophile is:

Chlorobenzene  $>$  *p*- nitrochlorobenzene  $>$  2, 4 dinitrochlorobenzene

As the number of electron withdrawing nitro groups on the benzene nucleus increases, the electron density of benzene ring decreases and the reactivity with an electrophile decreases.

**#424038**

**Topic:** Characteristics of arenes

**Passage**

Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile,  $E^+$ .

Toluene, *p* -  $H_3C$   $C_6H_4$   $NO_2$ , *p* -  $O_2N$   $C_6H_4$   $NO_2$

**Solution**

The decreasing relative reactivity with an electrophile is

*Toluene*  $>$  *p* -  $CH_3$  -  $C_6H_4$  -  $NO_2$   $>$  *p* -  $O_2N$   $C_6H_4$   $NO_2$

As the number of electron withdrawing nitro groups on the benzene nucleus increases, the electron density of benzene ring decreases and the reactivity with an electrophile decreases.

**#424040**

**Topic:** Characteristics of arenes

Out of benzene, m dinitrobenzene and toluene which will undergo nitration most easily and why ?

**Solution**

The decreasing relative reactivity with an electrophile is:

*Toluene*  $>$  *p* -  $CH_3$  -  $C_6H_4$  -  $NO_2$   $>$  *p* -  $O_2N$   $C_6H_4$   $NO_2$

When electron withdrawing nitro group is present on the benzene nucleus, the electron density of benzene ring decreases and the reactivity with an electrophile decreases.

When electron releasing methyl group is present on the benzene nucleus, the electron density of benzene ring increases and the reactivity with an electrophile increases.

**#424042**

**Topic:** Characteristics of arenes

Lewis acid other than anhydrous aluminium chloride which can be used during ethylation of benzene is:

- ☐ **A**  $FeCl_3$
- ☐ **B**  $KOH$
- ☐ **C**  $LiAlH_4$
- ☐ **D** none of these

**Solution**

Lewis acid other than anhydrous aluminium chloride which can be used during ethylation of benzene is ferric chloride  $FeCl_3$ .

**#424043**

**Topic:** Alkanes

Why is Wurtz reaction not preferred for the preparation of alkanes containing odd number of carbon atoms? Illustrate your answer by taking one example.

**Solution**

Wurtz reaction is not preferred for the preparation of alkanes containing odd number of carbon atoms due to the formation of side products. For example, by starting with 1 - bromopropane and 1 - bromobutane, hexane and octane are the side products besides heptane.