SHORT QUESTIONS

Q.1 Boiling point of straight chain alkane is greater than the boiling point of branched chain hydrocarbons why?

Ans. Boiling point of straight chain hydrocarbon is greater than branched chain hydrocarbon due to greater polarizability and greater intermolecular forces in it. For example, boiling point of n-butane is –0.5°C while isobutane is –11.7°C.

Q.2 Alkanes are less reactive than alkenes. Explain it.

Ans. In alkane, all sigma bonds are present between C – H and C – C atoms. In case of alkenes, Pi bonds are also present. Sigma bond is stronger bond than Pi bond and more energy is required to break this bond. So all alkanes are less reactive than alkenes.

Q.3 Alkenes usually undergo addition reactions while alkanes do not, why?

Ans. Alkenes usually undergo addition reaction due to presence of double bond one sigma and one Pi bond in them. Pi bond is weak and easily break to give electrons to electrophile and acts as nucleophile. Alkanes do not undergo such additions reactions due to lack of Pi bond.

Q.4 What is propagation step in any mechanism?

Ans. Step of mechanism in which same radical is consumed and evolved in the next step is called propagation. For example, in the halogenation of alkane step-II is propagation and step-I is initiation.

Step-I: $Cl - Cl \longrightarrow Cl^{\circ} + Cl^{\circ}$

Step-II: $CH_4 + Cl^{\circ} \longrightarrow HCl + CH_3^{\circ}$

$CH_3^{\circ} + Cl - Cl \longrightarrow CH_3Cl + Cl^{\circ}$

Q.5 Why alkenes are more reactive than alkynes?

Ans. Alkynes are less reactive than alkenes. The electron density between triple bond carbon atoms is high due to the presence of one sigma and two pi-bonds between C-C atoms. Due to high density of electrons in alkynes they are drawn closer to each other and less exposed than alkenes. Therefore, alkynes are less reactive toward electrophilic reagents.

Q.6 Ethyne have acidic hydrogen while ethene does not. Why?

Ans. In alkyne triple bond is present between C-C atoms. Carbon in alkyne is sp-hybridized and have one sigma and two Pi bonds. Due to greater overlapping, distance between C-C is reduced. Due to greater attraction carbon has partial negative charge and hydrogen attached to sp-hybridized carbon is slightly positive.

$$R - C \equiv \overset{-\delta}{C}\,\overset{+\delta}{H} \qquad\qquad \overset{+\delta}{H} - \overset{\delta-}{C} \equiv \overset{-\delta}{C} - \overset{+\delta}{H}$$

Q.7 How will you distinguish between ethene and ethane?

Ans. Ethane does not react with Br_2 or aqueous alkaline $KMnO_4$ solution. Ethene reacts with Br_2 or $KMnO_4$ and their colour is discharged.

$$CH_2 = CH_2 + Br_2 \longrightarrow CH_2Br - CH_2Br$$

$$3CH_2 = CH_2 + 4H_2O + 2KMnO_4 \longrightarrow 3CH_2 - CH_2 + 2MnO_2 + 2KOH$$

$$\begin{array}{cc} | & | \\ OH & OH \end{array}$$

Q.8 How will you distinguish between ethene and ethyne?

Ans. Ethene does not react with ammonical silver nitrate or ammonical cuprous chloride. Ethyne reacts with ammonical silver nitrate to form white precipitate of silver acetylide.

$$HC \equiv CH + 2AgNO_3 + 2NH_4OH \longrightarrow AgC \equiv CAg + 2NH_4NO_3 + 2H_2O$$

Ethyne also reacts with ammonical cuprous chloride to form red precipitate of copper acetylide.

$$HC \equiv CH + Cu_2Cl_2 + 2NH_4OH \longrightarrow CuC \equiv CCu + 2NH_4Cl + 2H_2O$$

Q.9 How will you distinguish between 1-butyne or 2-butyne, both have triple bond in them?

Ans. In 2-butyne no acidic hydrogen is present and does not react with ammonical silver acetylide.

$$CH_3 - C \equiv C - CH_3 + AgNO_3 + NH_4OH \longrightarrow \text{No reaction}$$

1-butyne reacts with ammonical silver nitrate to form white precipitate of silver acetylide.

$$HC \equiv C - CH_2 - CH_3 + AgNO_3 + NH_4OH \longrightarrow AgC \equiv C - CH_2CH_3 +$$

$$NH_4NO_3 + H_2O$$

Q.10 If HBr is added to propene, Markonikov's rule is obeyed why?

Ans. When HBr is added to propene, 2 bromo propane is formed and 1-bromo-propane is not formed.

$$CH_3 - CH = CH_2 + HBr \longrightarrow \begin{array}{c} Br \\ | \\ CH_3 - CH - CH_3 \end{array} \quad \text{(actual product)}$$

$$CH_3 - CH = CH_2 + HBr \longrightarrow CH_3 - CH_2 - CH_2 - Br \quad \text{(not formed)}$$

When HBr is added to propene, H^+ is an electrophile and attack at double bond.

$$CH_3 - CH = CH_2 + \overset{+}{H}\overset{-}{Br} \begin{array}{l} \nearrow CH_3 - \overset{+}{C}H - CH_3 + Br^- \\ \searrow CH_3 - CH_2 - \overset{+}{C}H_2 + Br^- \end{array}$$

Secondary carbocation is more stable than primary carbocation and the following reaction takes place.

$$CH_3 - \overset{+}{C}H - CH_3 + Br^- \longrightarrow CH_3 - \underset{|}{\overset{Br}{CH}} - CH_3$$

Q.11 What happens when alkanes are burnt in limited supply of oxygen?

Ans. When methane burns in excess oxygen CO_2 is produced.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{Heat}$$

In limited supply of oxygen, CO is formed. Sometime carbon soot is also formed.

$$3CH_4 + 4O_2 \longrightarrow 2CO + 6H_2O + C$$

Q.12 How Raney nickel is prepared?

Ans. Raney nickel is prepared by the reaction of dilute caustic soda with Ni – Al alloy.

$$Ni - Al + NaOH + H_2O \longrightarrow Ni + NaAlO_2 + \tfrac{1}{2} H_2$$

Q.13 Raney nickel is more effective than ordinary nickel. Why?

Ans. Raney nickel is more effective due to its greater surface area. It is porous and its surface area is greater.

Q.14 How will you bring about the following conversion?

Ans. See Solved Exercise Q.9.

Q.15 How may ethene be converted into following:

Ans

(i) Ethene to ethylene dibromide:

$$CH_2 = CH_2 + Br_2 \longrightarrow \underset{|\quad\quad|}{\overset{Br\quad\quad Br}{CH_2 - CH_2}}$$

(ii) Ethene to ethyne:

$$CH_2 = CH_2 + Br_2 \longrightarrow \underset{|\quad\quad|}{\overset{Br\quad\quad Br}{CH_2 - CH_2}}$$

$$\underset{|\quad\quad|}{\overset{Br\quad\quad Br}{CH_2 - CH_2}} + 2KOH_{(alc)} \longrightarrow CH \equiv CH + 2KBr + 2H_2O$$

(iii) Ethene to ethane:

$$CH_2 = CH_2 + H_2 \xrightarrow[250^\circ C]{\text{Ni/heat}} CH_3 - CH_3$$

(iv) Ethene to ethylene glycol:

$$3CH_2 = CH_2 + 2KMnO_4 + 4H_2O \longrightarrow 3CH_2 - CH_2 + 2KOH + 2MnO_2$$

$$\begin{array}{cc} | & | \\ OH & OH \end{array}$$

Q.16 Complete the following reactions.

Ans.

(i) $CH_3 - CH_2 - OH \xrightarrow[180°C]{\text{Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$

$$CH_2 = CH_2 + Br_2 \longrightarrow CH_2Br - CH_2Br$$

$$\begin{array}{ll} Br & Br \\ | & | \\ CH_2 - & CH_2 \end{array} + 2KOH_{(alc)} \longrightarrow CH \equiv CH + 2H_2O + 2KBr$$

(ii) $CH_3 - CH = CH_2 + Br_2 \longrightarrow \begin{array}{l} Br \\ | \\ CH_3 - CH - \\ \end{array} \begin{array}{l} Br \\ | \\ CH_3 \end{array}$

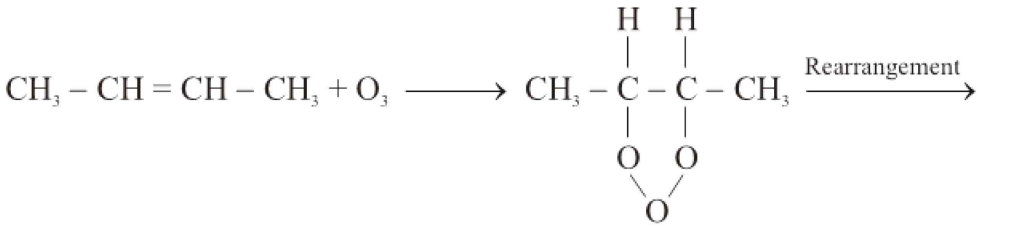
$$\begin{array}{ll} & Br \\ & | \\ CH_3 - & CH \end{array} \begin{array}{l} Br \\ | \\ - CH_3 \end{array} + 2KOH_{(alc)} \longrightarrow CH_3 - C \equiv CH + 2KBr + 2H_2O$$

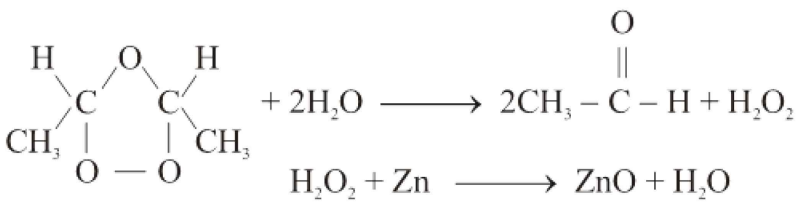
$$CH_3 - C \equiv CH + HCN \longrightarrow \begin{array}{l} CN \\ | \\ CH_3 - C = CH_2 \end{array}$$

Q.17 After an ozonlysis experiment, the only product obtained was acetaldehyde. The chemist who did the experiment correctly claimed that two possible standing materials could give this product. Can you guess the structural formulas of the compounds?

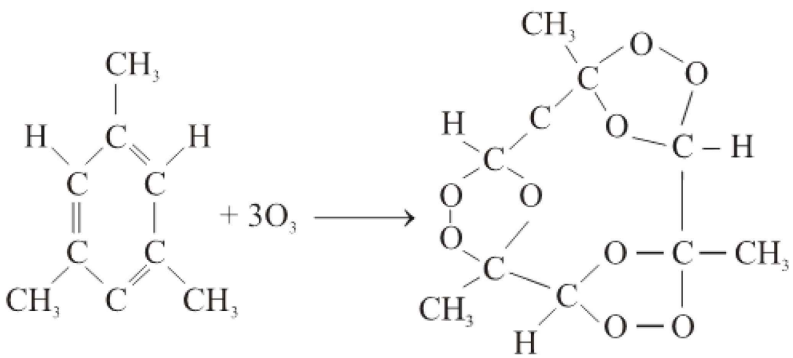
Ans.

(i) When cis 2-butene or trans 2-butene reacts separately with O_3 the final product will be acetaldehyde.

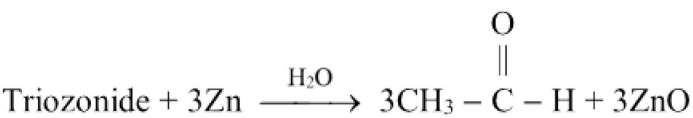




(ii) When 1, 3, 5 trimethyl benzene reacts with O_3, the final product is acetaldehyde.



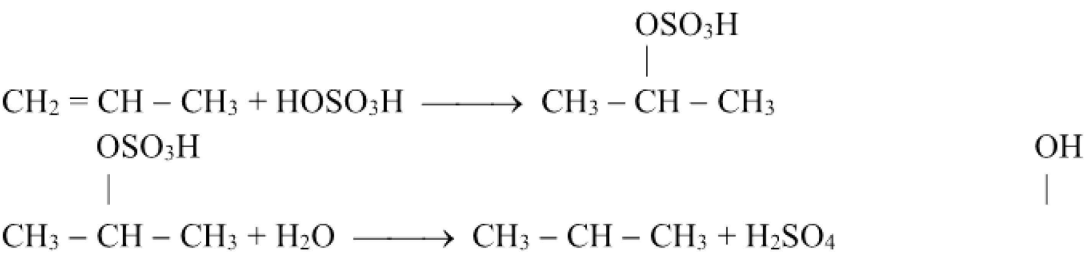
Triozonide



Q.18 The addition of sulphuric acid to an alkene obeys Markownikov's rule. Predict the structures of the alcohols obtained by the addition of the acid to the following compounds.

Ans.

(i) Propene:



(ii) 1-butene:

$$CH_2 = \underset{\displaystyle OSO_3H}{\underset{|}{CH}} - CH_2 - CH_3 + HOSO_3H \longrightarrow CH_3 - \underset{\displaystyle OSO_3H}{\underset{|}{CH}} - CH_2 - CH_3$$

$$CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH_3 + H_2O \longrightarrow CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH_3 + H_2SO_4$$

(iii) 2-butene:

$$CH_3 - CH = CH - CH_3 + H_2SO_4 \longrightarrow CH_3 - \underset{\displaystyle OSO_3H}{\underset{|}{CH}} - CH_2 - CH_3$$

$$CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH_3 + H_2O \longrightarrow CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - CH_3 + H_2SO_4$$

Q.19 Predict the most likely product of addition of HCl to 2 methyl 2-butene.

Ans.

$$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH - CH_3 + HCl \longrightarrow CH_3 - \underset{\displaystyle Cl}{\underset{|}{C}} - CH_2 - CH_3$$

Q.20 How does ethyne react with?

Ans.

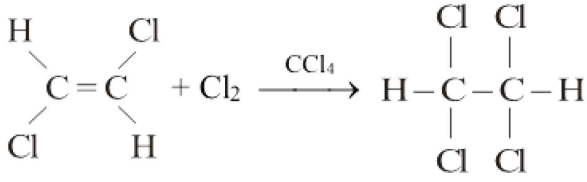
(i) Hydrogen:

$$CH \equiv CH + H_2 \xrightarrow[250°C]{Ni} CH_2 = CH_2$$

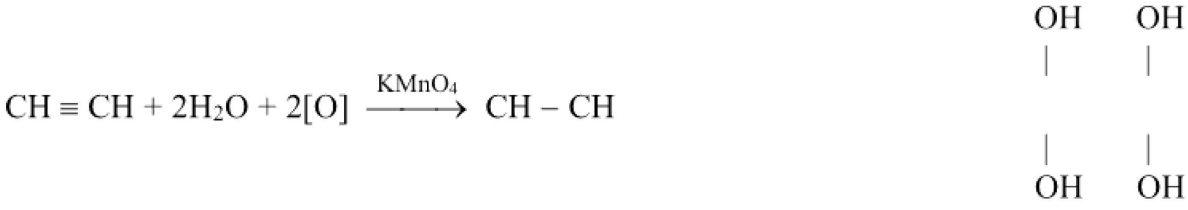
$$CH_2 = CH_2 + H_2 \xrightarrow[250°C]{Ni} CH_3 - CH_3$$

(ii) Halogen:

$$CH \equiv CH + Cl_2 \xrightarrow{CCl_4} \begin{matrix} H & & Cl \\ & \diagdown\ \diagup & \\ & C = C & \\ & \diagup\ \diagdown & \\ Cl & & H \end{matrix}$$

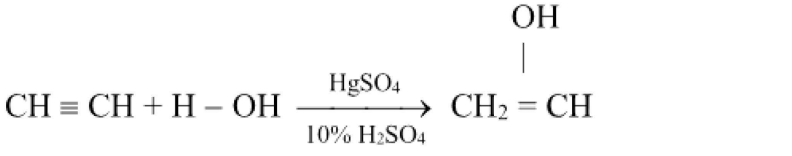


(iii) Alkaline $KMnO_4$:



(oxalic acid)

(iv) 10% H_2SO_4 in the presence of $HgSO_4$:



(acetaldehyde)

(v) Ammonical cuprous chloride:

$$HC \equiv CH + Cu_2Cl_2 + 2NH_4OH \longrightarrow Cu - C \equiv C - Cu + 2NH_4Cl + 2H_2O$$

(vi) Bromine water with:

$$CH \equiv CH + Br_2 \longrightarrow CHBr = CHBr$$

$$BrCH = CHBr + Br_2 \longrightarrow Br_2CH - CHBr_2$$