

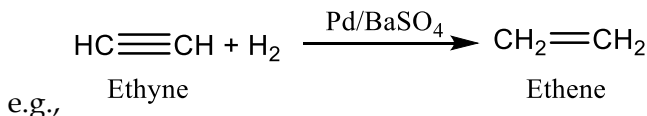
14.2 Alkenes

- Which of the following is an unsaturated hydrocarbon?
 - Alkane
 - Alkene
 - Cycloalkane
 - All of the above
- Alkenes are also called
 - Paraffins
 - Olefins
 - Acetylenes
 - Arenes

14.2.1 General Methods of Preparation of Alkenes

1. From alkynes (Catalytic hydrogenation)

Alkynes can be hydrogenated to Alkenes with hydrogen gas in the presence of Pd/BaSO₄, which can be considered the catalyst.

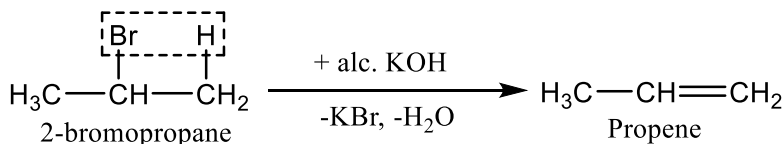


- Alkynes can be reduced to Alkenes by hydrogenation in the presence of
 - Raney Ni
 - Anhydrous AlCl₃
 - Pd
 - Lindlar's catalyst

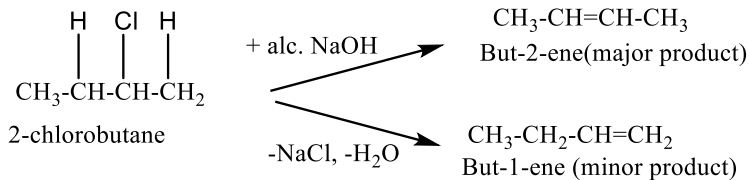
- How would you convert Ethyne into Ethene?** 1
- What happens when Ethyne reacts with hydrogen in the presence of Pd/BaSO₄? 2

2. From Haloalkanes (dehydrohalogenation)

Haloalkanes undergo elimination with alcoholic KOH or alc. NaOH gives alkenes. e.g.,



Saytzeff's rule- when two different **alkenes** are possible, the one **with the highest number of alkyl groups on the two sides of the double bond** is the **main** product.



3. What product do you expect when 2-bromopropane is heated with alc. KOH? 2
4. Give a suitable reaction for Dehydrohalogenation 1
5. Write down the chemical reaction to prepare Ethene from Chloroethane. 1
6. What happens when Chloroethane is heated with alcoholic KOH? 1
7. What happens when Iodoethane is heated with alc. NaOH? 1

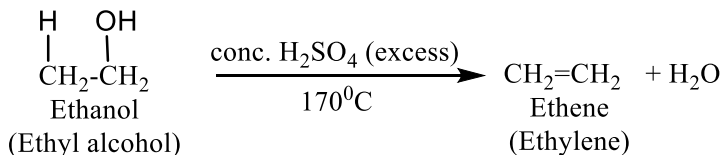
4. 2-bromopropane reacts with hot ethanolic sodium hydroxide.
Which substance is the major product of this reaction?
A propan-1-ol **B** propan-2-ol
C 2-hydroxypropene **D** propene
5. Which row describes the solvent used and the type of reaction occurring when bromoethane reacts with NaOH to form ethene?

	solvent	type of reaction
A	ethanol	elimination
B	ethanol	substitution
C	water	elimination
D	water	substitution

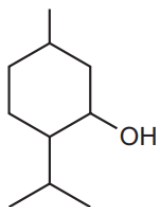
6. Alcoholic KOH is used for
 - a. Dehydration
 - b. Hydrogenation
 - c. Dehydrogenation
 - d. Dehalogenation

3. From alcohols (dehydration)

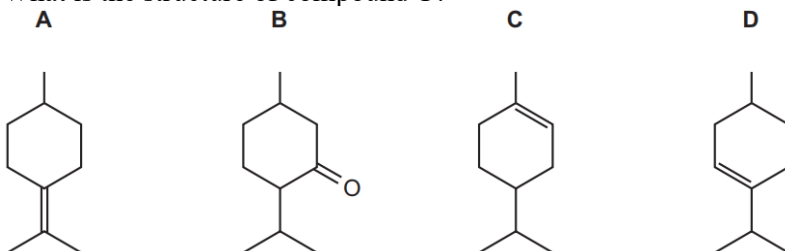
When the calculated amount of ethyl alcohol is heated with an excess of conc. H_2SO_4 at about 170°C , intramolecular dehydration results in Ethene.



7. Menthol is a naturally occurring alcohol.
menthol



When menthol is heated with concentrated sulfuric acid it reacts. The products formed include compound T. What is the structure of compound T?

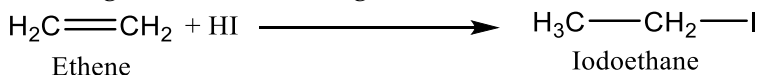


Chemical properties

1. Addition reactions

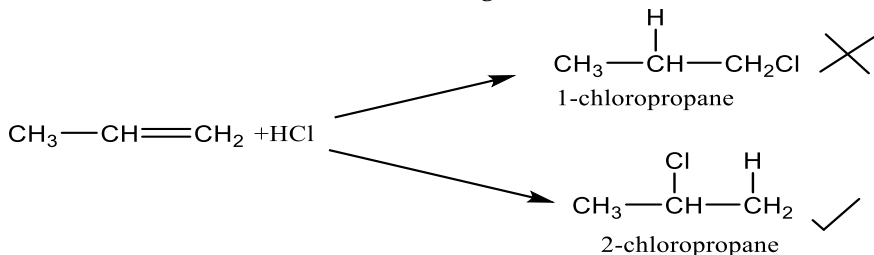
a. Addition of Hydrohalic acids (HCl, HBr, HI)

Alkenes undergo addition with hydrohalic acids (HCl, HBr and HI), resulting in haloalkanes. E.g.,



Markovnikov's rule:

When an unsymmetrical reagent is added to an unsymmetrical alkene, the positive part of the reagent is attached to the carbon atom with more hydrogen atoms the negative part gets bonded with the carbon atom with a smaller number of hydrogen atoms. e.g.,

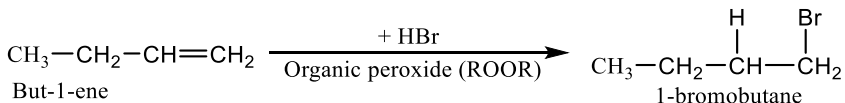


8. Markovnikov's rule is applicable in the addition reaction of which of the following compound?
- 2,3-dimethylbut-2-ene
 - Propane
 - Ethene
 - But-2-ene

8. State Markovnikov's rule. Give an example. 2
9. Write short notes on Markovnikov's rule and peroxide effect. 2
10. Write a short note on Markovnikov's rule. 1
11. Write a short note on Markovnikov's rule. 3

Peroxide effect (Anti-Markovnikov's rule)

When **HBr** is added to unsymmetrical Alkenes in the presence of **organic peroxide**, the positive part (H) gets bonded with the carbon having fewer hydrogens and the negative part gets bonded with the carbon having a higher number of hydrogens.



9. The peroxide effect is also known as
- Inductive effect
 - Markovnikov's rule
 - Resonance effect
 - Anti-markovnikov's rule

10. The addition of HBr on Propene in the presence of peroxide occurs according to

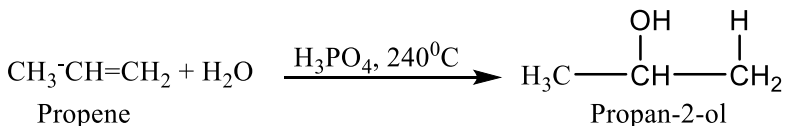
- | | |
|-----------------------|---------------------------|
| a. Markovnikov's rule | c. Antimarkovnikov's rule |
| b. Saytzeff's rule | d. Hoffmann's rule |

12. Write an example of the peroxide effect.

1

b. Addition of Water

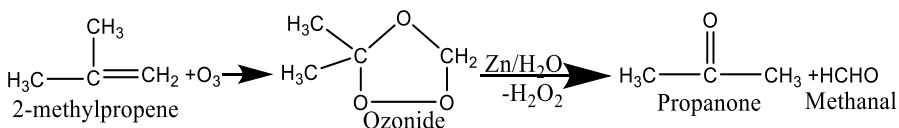
Alkenes react with water at high temperatures and pressures in the presence of phosphoric acid as a catalyst to form alcohols.



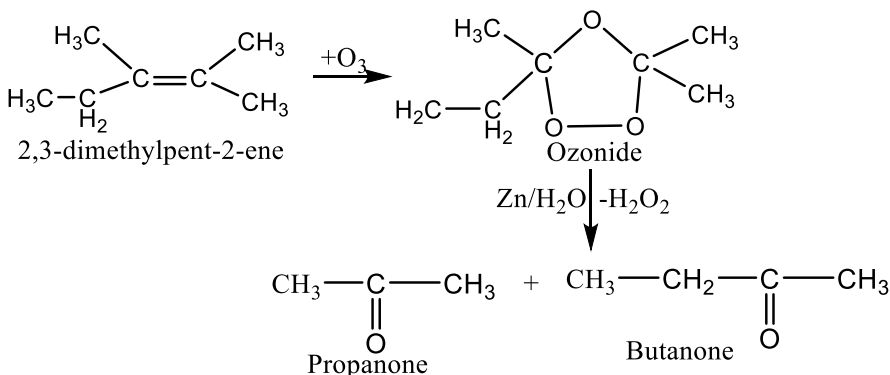
c. Addition of Ozone (Ozonolysis)

Alkenes, when treated with ozone, form unstable ozonides, which, upon hydrolysis with zinc and water, yield carbonyl compounds.

- Alkenes of the type $\text{RCH}=\text{CH}_2$ or $\text{RCH}=\text{CHR}$ give aldehydes.



- Alkenes of the type $\text{R}_2\text{C}=\text{CH}_2$, $\text{R}_2\text{C}=\text{CHR}$ or $\text{R}_2\text{C}=\text{CR}_2$ give at least one ketone.

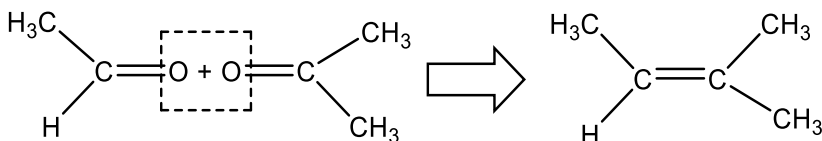


13. Identify A and B in the following reaction:

2



14. An alkene A undergoes ozonolysis to give Ethanal and Propanone as the major products. Identify the A and write its IUPAC name.2



15. An alkene A undergoes ozonolysis to give Ethanal and Methanal as major products. Identify A and give its IUPAC name. 2

16. How is Ethanal prepared from But-2-ene? 1

17. Write a short note on Ozonolysis. 2

18. Ozonolysis of a compound gave Acetone (Propanone) as the only product. Identify the compound. 2

19. An alkene A undergoes ozonolysis to give Ethanal and Methanal as major products, identify A and write its IUPAC name. 2

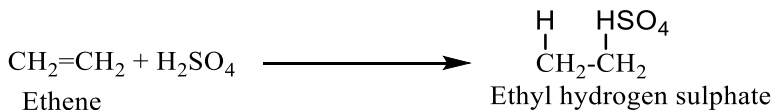
20. Give the complete chemical reactions for the following;

a) The reaction of 2-bromo-3-methylpentane with alc. KOH. Also, elaborate the rule which determines the distribution of products.

b) The major product formed in the above reaction is subjected to ozonolysis. 3+1

d. Addition of Sulphuric acid

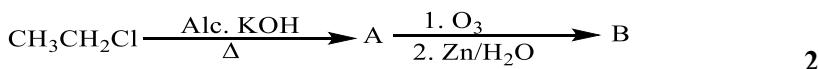
Concentrated sulphuric acid adds to alkene producing alkyl hydrogen sulphate.



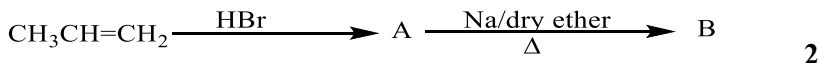
Alkyl hydrogen sulphate gives back alkene on heating and alcohol on boiling with water.

Conversions

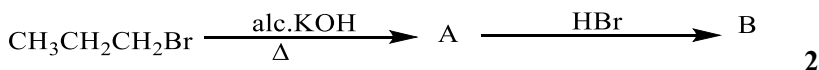
21. Identify the unknown organic compounds A and B in the following reaction:



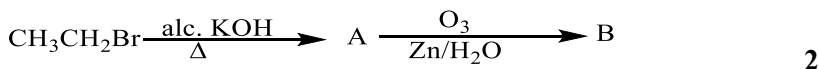
22. Identify the main products A and B and give their IUPAC name.



23. Identify the major product A and B of the following and write their IUPAC names.



24. Identify the major products A and B giving their IUPAC names.



Alkynes

11. The general molecular formula of an alkyne is

- a. $\text{C}_n\text{H}_{2n+2}$ b. $\text{C}_n\text{H}_{2n+1}$ c. $\text{C}_n\text{H}_{2n+0}$ d. $\text{C}_n\text{H}_{2n-1}$

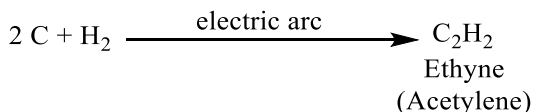
12. The minimum number of carbon atoms in Alkyne to show isomerism is

- a. 3 b. 4 c. 5 d. 6

Preparations

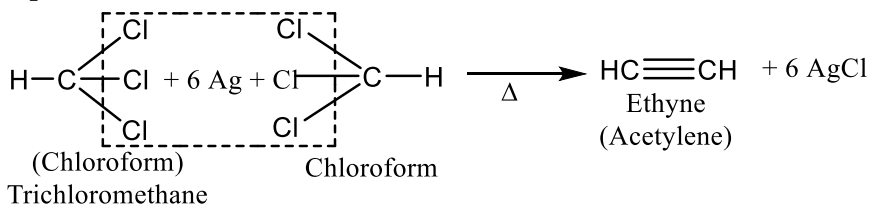
1. From carbon and hydrogen (total synthesis)

Ethyne is prepared by passing an electric arc between two carbon electrodes in an atmosphere of hydrogen.



2. From haloforms (chloroform and iodoform)

When chloroform or iodoform is heated with silver powder Ethyne is produced.



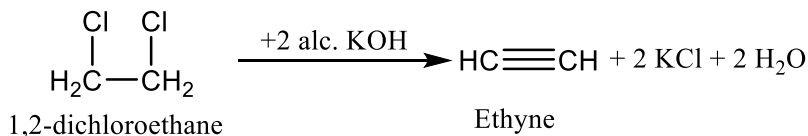
25. What happens when Iodoform is heated with silver powder? 1

26. An alkyne is produced when trihaloalkanes are heated with Ag powder.

Write such a reaction where ethyne is produced 1

3. From 1,2-dibromoethane (By dehydrohalogenation)

Ethyne can be prepared by dehydrohalogenation (elimination) of 1,2-dibromoethane with alcoholic KOH or NaOH.



27. Write any two methods of preparation of Ethyne. 2

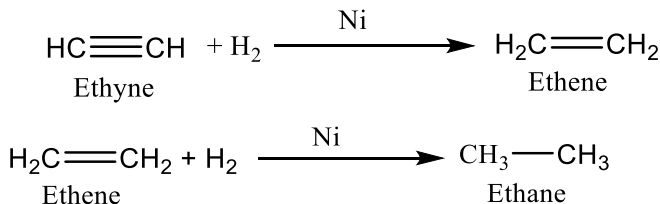
28. Give a suitable reaction for the preparation of Ethyne. 1

Chemical properties

1. Addition reactions

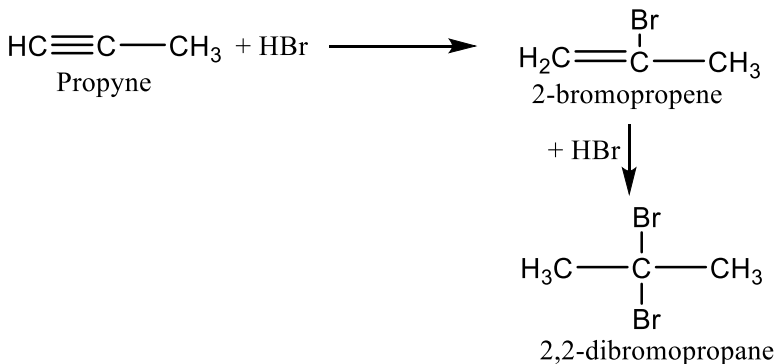
a. Addition of Hydrogen (catalytic hydrogenation)

Alkynes undergo addition with hydrogen in the presence of finely divided Nickel (Ni), Platinum (Pt) or Palladium (Pd) as a catalyst at a temperature of about 200-300°C producing alkenes and finally alkanes.



b. Addition of Hydrohalic acid (HX)

Alkynes undergo an addition reaction with hydrohalic acids in two steps giving dihaloalkanes. The addition occurs according to Markovnikov's rule.

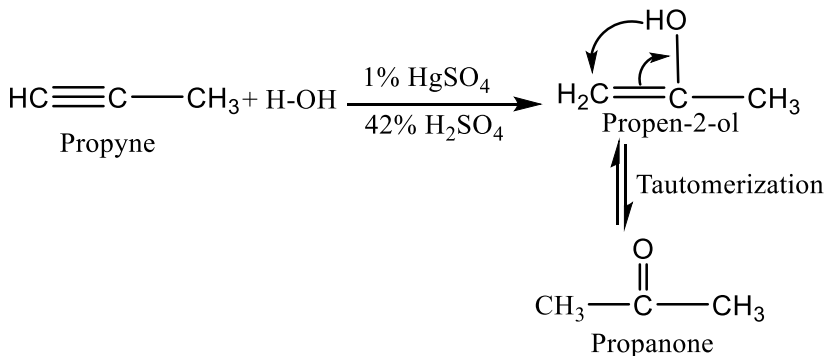


29. What action takes place when the Ethyne gas is allowed to react with HBr? 1

c. Addition of Water

Water can be added to alkynes in the presence of 1% HgSO₄ and 42% H₂SO₄ to give vinyl alcohols, which tautomerize to form carbonyl compounds (aldehydes and ketones). This addition also

occurs according to Markovnikov's rule. Ethyne gives Ethanal; other alkynes give ketones.

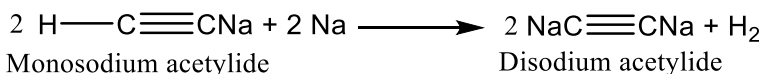


30. What happens when Ethyne is hydrated catalytically? 1
31. How is Ethyne converted into Ethanal? 1

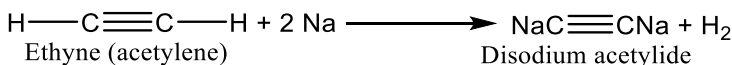
2. Acidic nature

a. Reaction with Sodium

When Ethyne (Acetylene) gas is passed over molten sodium, monosodium acetylide and disodium acetylide are produced.

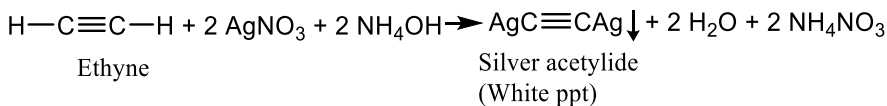


Or, the reaction may be written in a single step as;



b. Action with ammonical AgNO₃

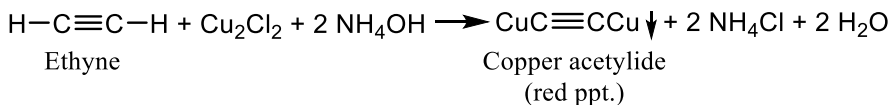
Ammonical silver nitrate solution is commonly called **Tollen's reagent**. When acetylene is passed through Tollen's reagent, a white precipitate of silver acetylide is obtained. Hence this reaction is also used as a test to detect Ethyne.



Alkynes, having no acidic hydrogen, do not react in such a way.

c. Action with ammonical Cu_2Cl_2 (CuCl)

When acetylene is passed through an ammonical solution of cuprous chloride, a red precipitate of copper acetylide is obtained.



32. Give a chemical reaction to show the acidic nature of Ethyne. 2

33. What happens when acetylene (Ethyne) gas is passed through an ammonical solution of silver nitrate? 1

34. How does Ethyne react with cuprous chloride? 1

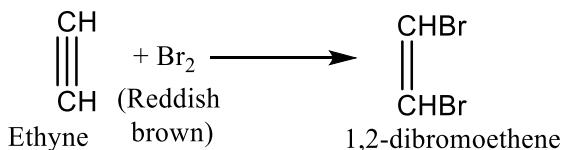
13. What happens when Ethyne is passed through an ammonical solution of cuprous chloride? Ethylene and acetylene can be separated by
- | | |
|-------------------------------|-----------------------------|
| a. Ammoniacal AgNO_3 | c. Alkaline KMnO_4 |
| b. Fehling's solution | d. Tollen's reagent |

1

3. Test of unsaturation for (Ethene and Ethyne)

a. Bromine water test

The presence of unsaturation (double or triple bond) can be tested by using bromine water.



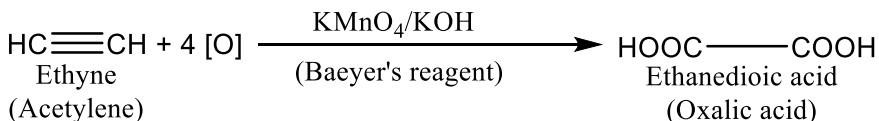
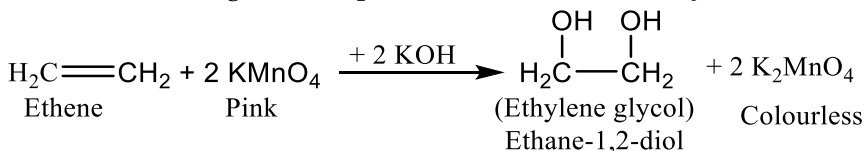
14. Addition of Br_2 to but-2-ene gives

- | | |
|----------------------|----------------------|
| A. 1,4-dibromobutane | c. 1,3-dibromobutane |
| B. 2,3-dibromobutane | d. 1,2-dibromobutane |

b. Oxidation with alkaline KMnO_4 (Bayer's test)

(hydroxylation)

When Ethene is treated with an alkaline solution of dilute KMnO_4 , the pink colour of KMnO_4 is discharged and Ethylene glycol is obtained. Such a reaction is also shown by other alkenes and alkynes. A dilute alkaline solution of KMnO_4 is called **Bayer's reagent** and this reaction is used as a test for *the detection of unsaturation* in organic compounds in the name of **Bayer's test**.



15. Baeyer's reagent is
- Aqueous permanganate solution
 - Acidified permanganate solution
 - Alkaline permanganate solution
 - Neutral permanganate solution
16. Which of the following compounds can decolourize alkaline KMnO_4 solution?
- C_2H_4
 - C_3H_8
 - CHCl_3
 - CH_4
17. KMnO_4 will oxidise acetylene to
- Ethylene glycol
 - Ethyl alcohol
 - Oxalic acid
 - Acetic acid
18. In reaction with Baeyer's reagent, Ethylene and Acetylene respectively form:
- Formic acid and acetic acid
 - Acetic acid and formic acid
 - Oxalic acid and ethylene glycol
 - Ethylene glycol and oxalic acid
19. Propyne and Propene can be distinguished by:

- a. CuSO_4 b. Br_2/CCl_4 c. KMnO_4 d. $\text{AgNO}_3/\text{Ammonia}$

20. Propyne and Propene can be distinguished by

- a. Conc. H_2SO_4 b. Br_2 in CCl_4 c. Dil KMnO_4 d. AgNO_3 in NH_3

35. Describe Baeyer's test. What is observed, and what does it identify?

36. Give a suitable reaction for each: Baeyer's test **1**

37. You are supplied with two similar gas jars. One of the jars is filled with ethane while the other is with Ethyne. Suggest one suitable chemical test to identify them. **2**

38. Write a chemical test to distinguish Ethyne from Ethene. 2

39. Give a reaction to detect unsaturation in acetylene. 1

Comparative studies of the physical properties of alkanes, alkenes and alkynes

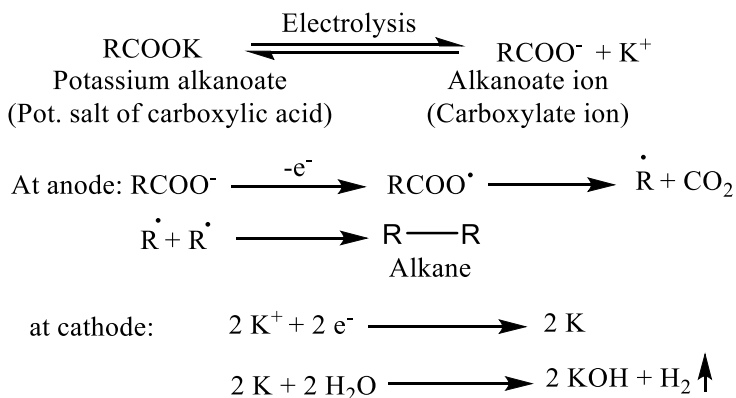
Alkanes, Alkenes and Alkynes are hydrocarbons; basically, their physical properties are similar. These can be studied comparatively as:

Physical properties	Alkanes	Alkenes	Alkynes
State	$\text{C}_1\text{-C}_4$ - colourless gases $\text{C}_5\text{-C}_{15}$ - liquids Higher members-waxy solids	$\text{C}_2\text{-C}_4$ -colourless gases $\text{C}_5\text{-C}_{12}$ - liquids Higher members-waxy solids	$\text{C}_2\text{-C}_4$ - colourless gases $\text{C}_5\text{-C}_{15}$ - liquids Higher members-waxy solids
Solubility	Insoluble in water(polar solvent); soluble in organic solvents (non-polar)	Insoluble in water(polar solvent); soluble in organic solvents (non-polar)	Insoluble in water(polar solvent); soluble in organic solvents (non-polar)
Density	Lighter than water; increases	Lighter than water; increases	Lighter than water; increases

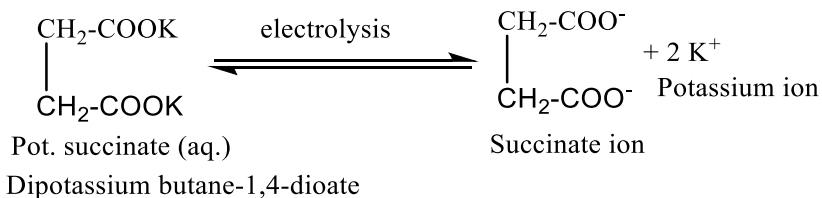
	with molecular weight	with molecular weight	with molecular weight
Melting and boiling points	Increases with increasing molecular mass	Higher compared to the corresponding alkanes.	Higher compared to the corresponding alkanes and alkenes.
Polarity	Non-Polar	Non-Polar	Non-Polar

14.6 Kolbe's electrolysis methods for the preparation of alkane, alkene and alkynes

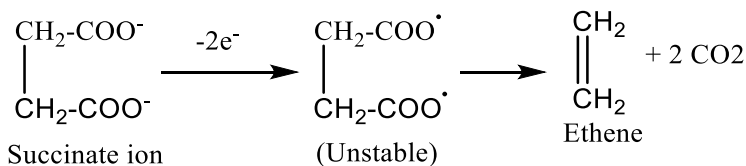
Alkanes: Electrolysis of a concentrated aqueous sodium or potassium salt of carboxylic acid (fatty acid) yields an alkane.



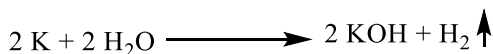
Alkene: When an aqueous solution of sodium or potassium succinate is electrolyzed, Ethene liberates at the anode.



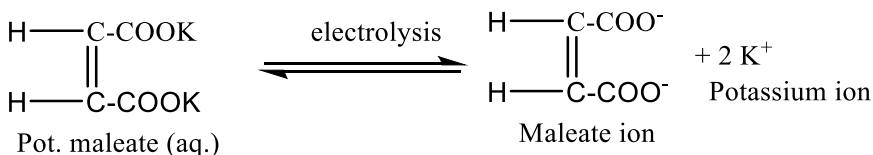
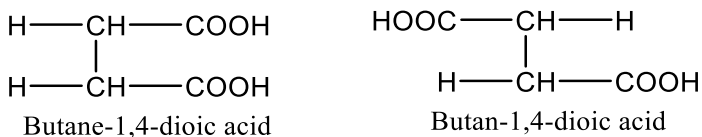
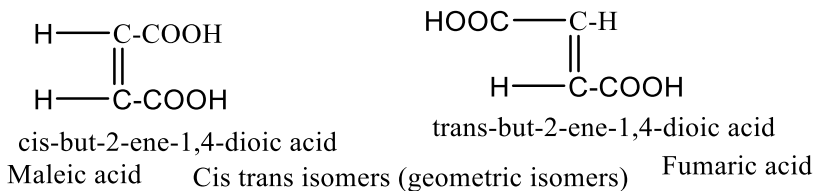
At anode:



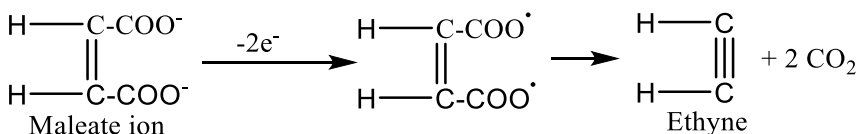
At cathode:



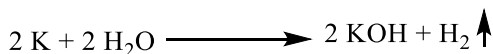
Alkyne: When an aqueous solution of sodium or potassium salt of Maleic acid (or Fumaric acid) is electrolyzed, Ethyne liberates at the anode.



At anode:



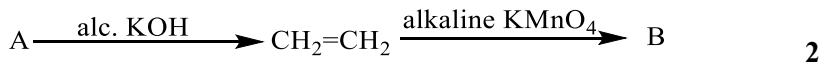
At cathode:



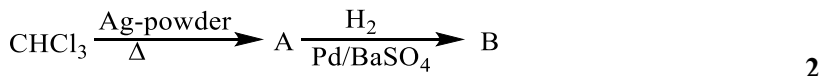
21. Alkenes are in water.

- a. Soluble b. Insoluble c. Mild soluble d. None

40. Identify A and B in the following reaction and give IUPAC name:



41. Identify the major products A and B in the following:



*****This is not a complete note. It is just to guide you. It is recommended to study prescribed textbooks along with this material.*****