

CLASS-XI

for

BRUSH UP NEET/JEE

Brush up your concepts to get high rank in NEET/JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

2020

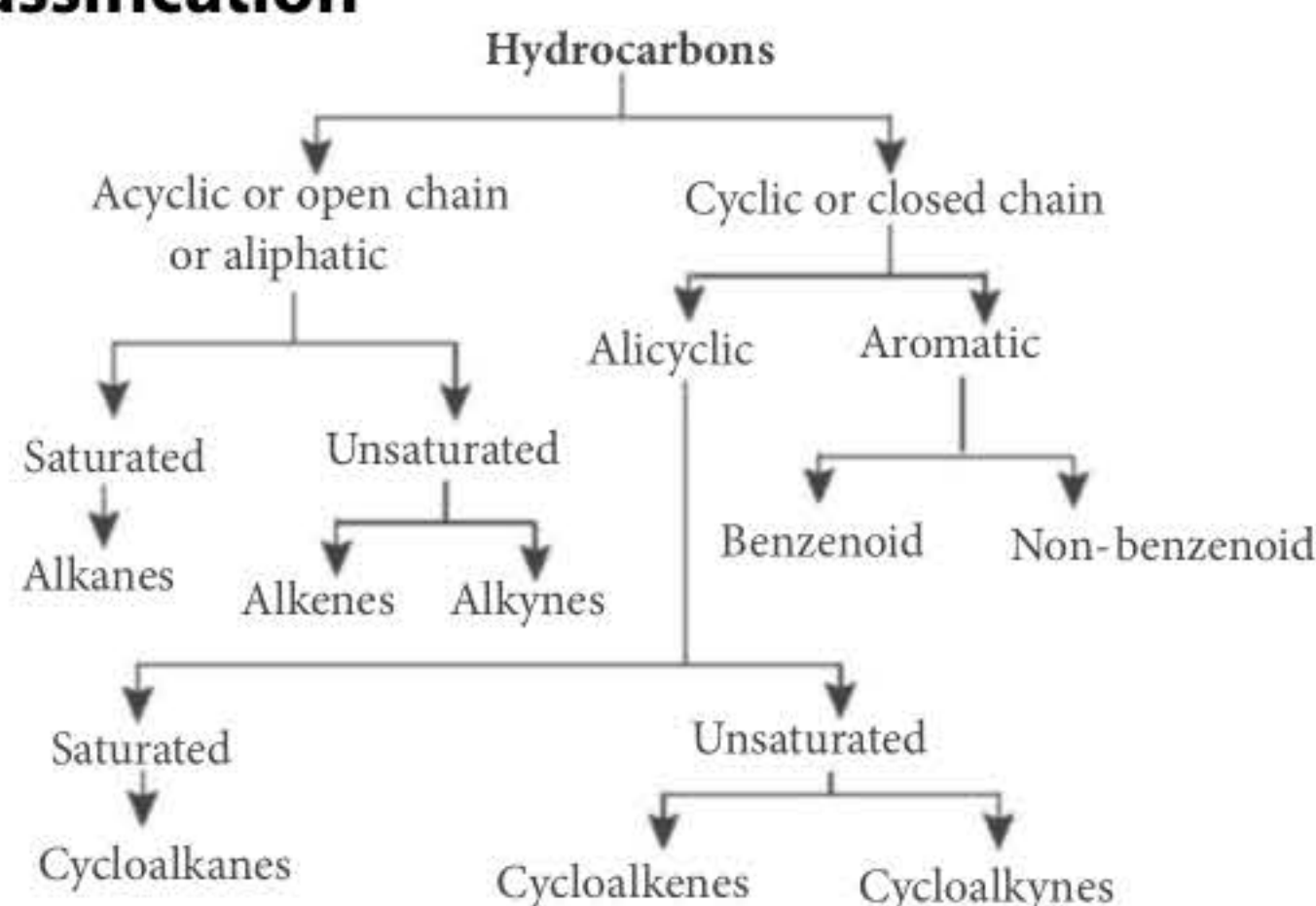
**Unit
8**

Hydrocarbons / Environmental Chemistry

Hydrocarbons

- Organic compounds composed of only C and H are called hydrocarbons.

Classification

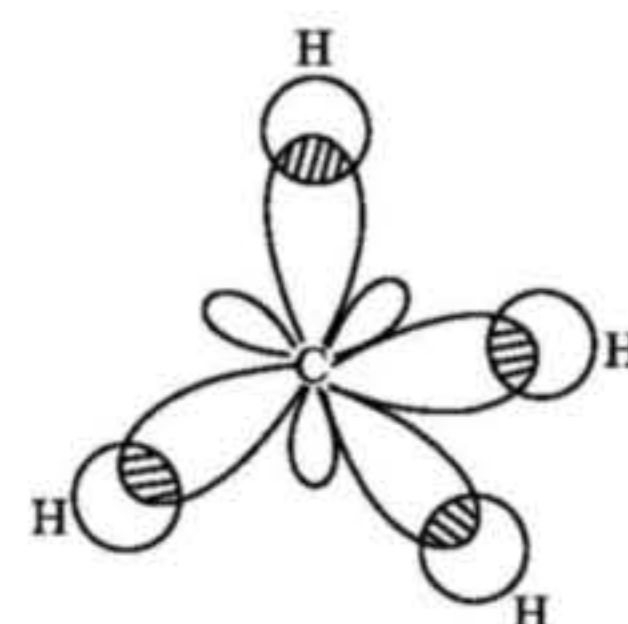


ALKANES

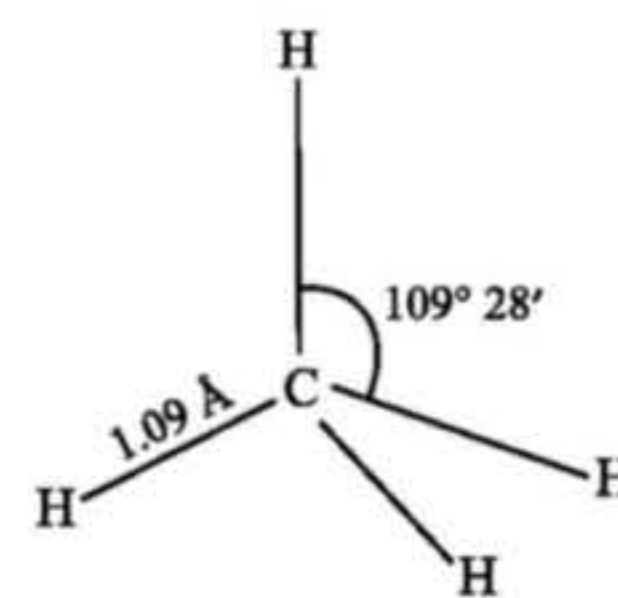
- Alkanes also called paraffins are saturated hydrocarbons with general formula C_nH_{2n+2} , where, n is equal to 1, 2, 3.... e.g., CH_4 (methane), C_2H_6 (ethane), C_3H_8 (propane), etc.

Structure

- Each carbon atom of alkanes is in sp^3 state of hybridization with its four bonding orbitals directed towards the four corners of a regular tetrahedron.



Overlap of four sp^3 orbitals of carbon with the $1s$ orbital of four hydrogen atoms



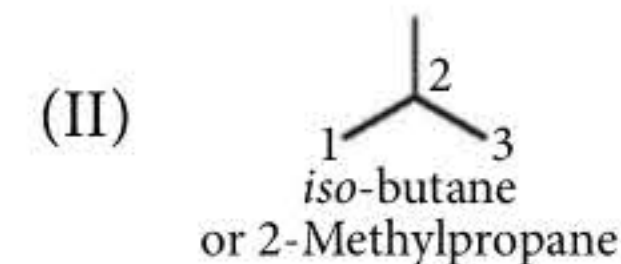
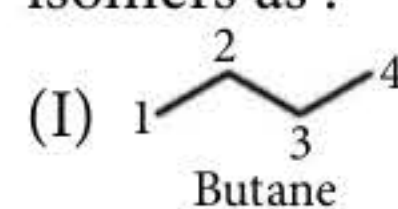
Bond length and bond angle in methane

Nomenclature

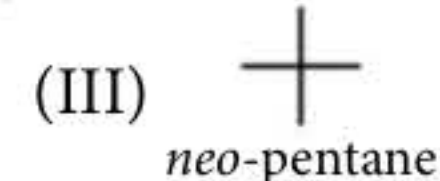
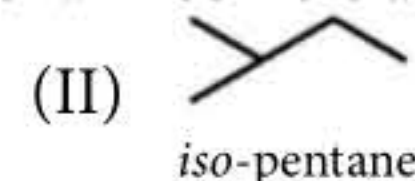
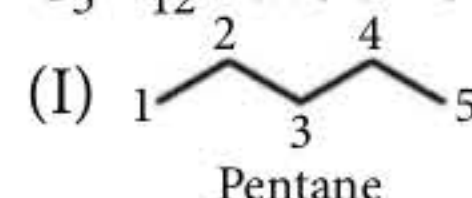
- Root word + ane = alkane
e.g., $CH_3CH_2CH_2CH_3$, $CH_3CH_2CH_2CH_2CH_2CH_3$
n-butane *n*-hexane

Isomerism

- Alkanes exhibit mainly structural (chain) and conformational isomerism.
- Structural isomerism** : Methane, ethane, propane do not exhibit isomerism. C_4H_{10} have two chain isomers as :

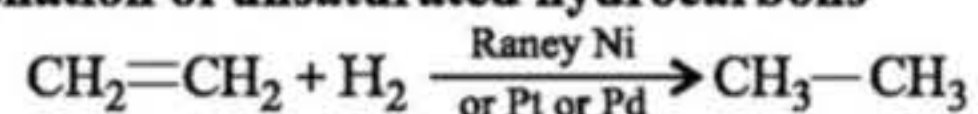


C_5H_{12} have three chain isomers as :

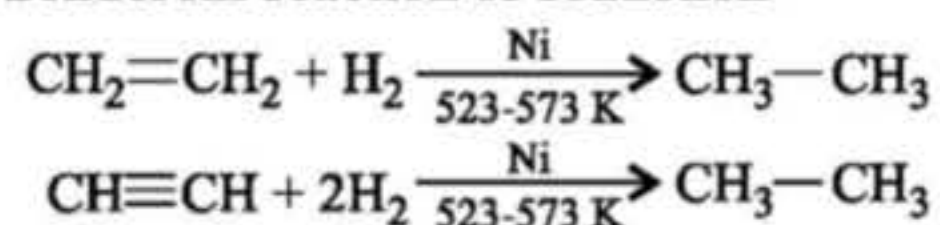


Methods of Preparation

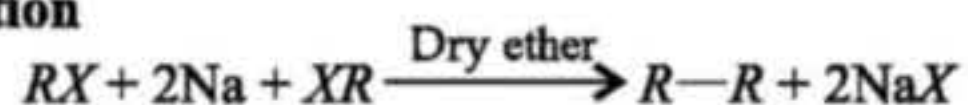
By hydrogenation of unsaturated hydrocarbons



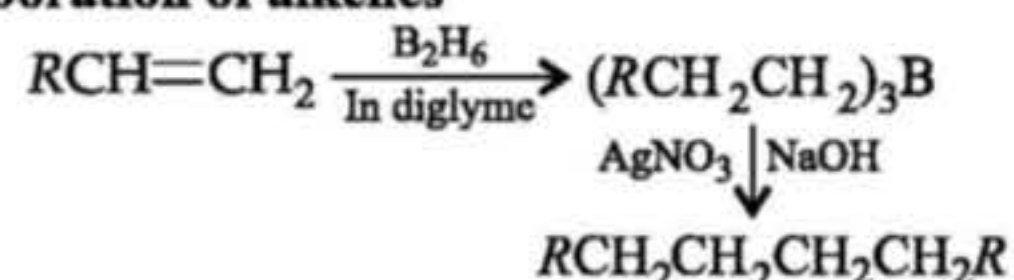
Sabatier and Senderens reaction or reduction



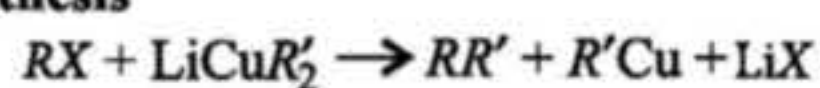
Wurtz reaction



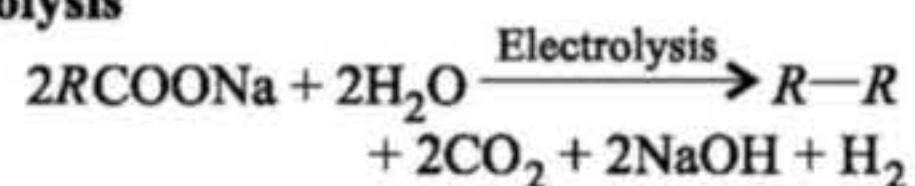
By hydroboration of alkenes



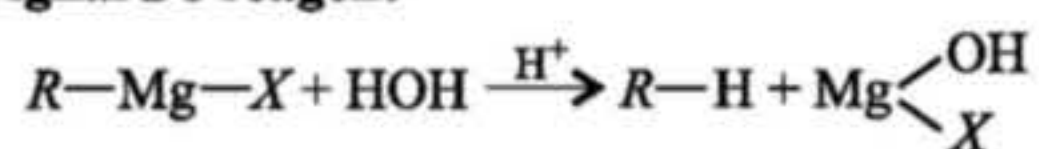
Corey-House synthesis



Kolbe's electrolysis



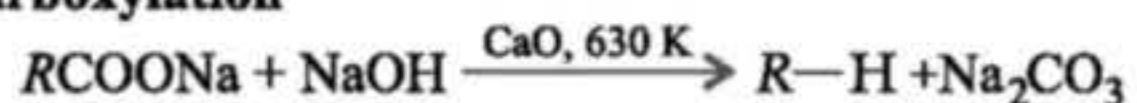
From Grignard's reagent



Reduction of alkyl halides

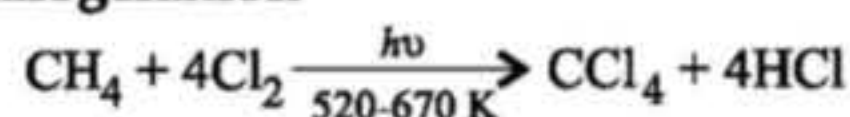


Decarboxylation

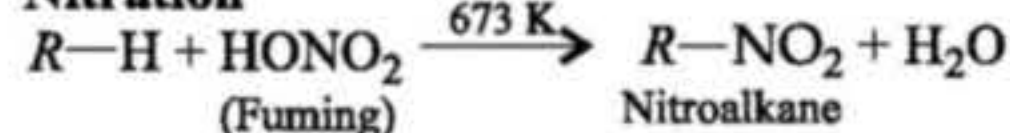


Chemical Properties

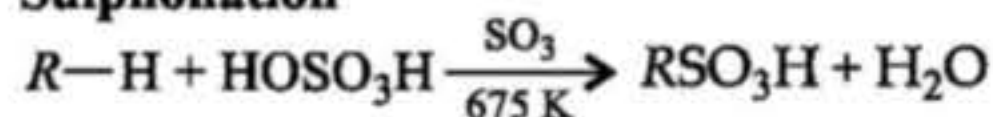
Halogenation



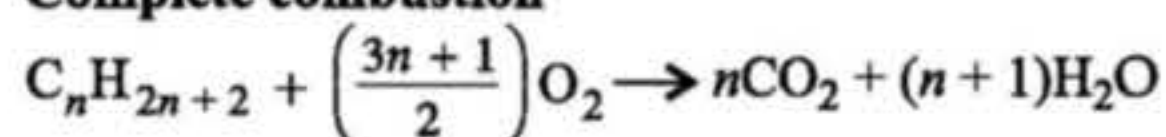
Nitration



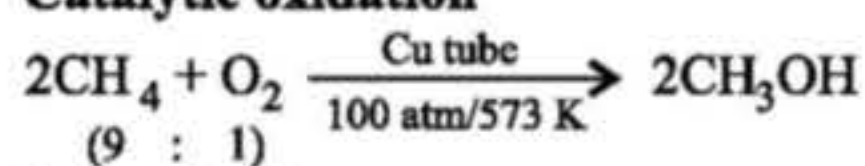
Sulphonation



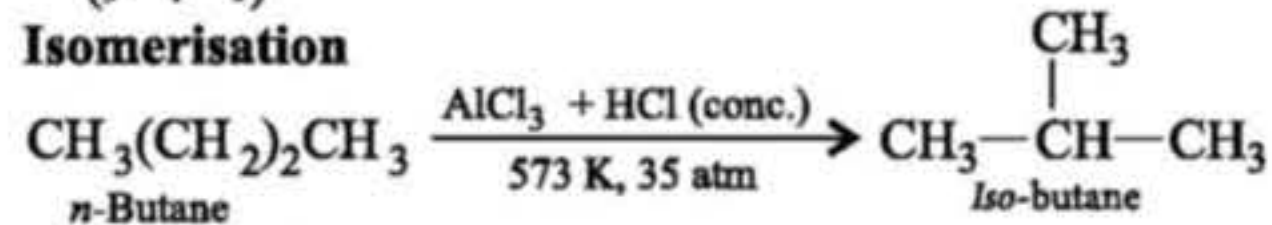
Complete combustion



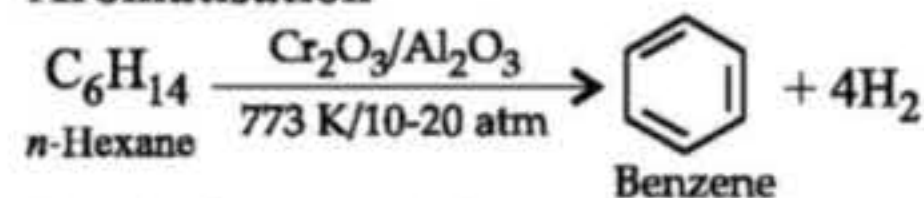
Catalytic oxidation



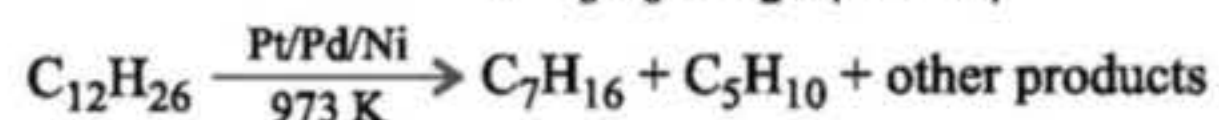
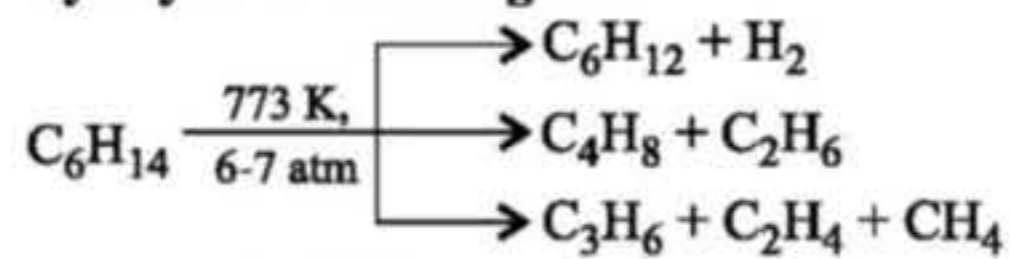
Isomerisation



Aromatisation



Pyrolysis or cracking



Conformations

- The different arrangements of atoms in space which result from the free rotation of groups about C—C single bond are called conformations or conformers or rotamers.
- Conformations of Ethane (Sawhorse and Newman Projections)**
 - Staggered conformation** : The hydrogen atoms attached to two carbons are far apart and experience minimum repulsion.
 - Eclipsed conformation** : The hydrogen atoms attached to two carbons are as close together as possible and experience maximum repulsion.
 - Gauche or Skew form** : A rotation of 60° converts a staggered conformation into an eclipsed conformation, or *vice-versa*. Rotation between 0° to 60° generates one of the many other arrangements in between staggered and eclipsed forms. These arrangements are called **gauche** or **skew form**.
 - Order of stability** : Staggered > Skew or Gauche > Eclipsed

ALKENES

- Alkenes also called olefins are unsaturated hydrocarbons which have general formula 'C_nH_{2n}'. They contain double bond (C = C) which is considered as a functional group. *e.g.*, C₂H₄ (ethene or ethylene), C₃H₆ (propene or propylene).

Structure

- In ethylene molecule, one of the sp²-hybridised orbitals of one carbon atom overlaps axially with one of the sp²-orbitals of another carbon atom. Two

GLIMPSE OF NEXT ISSUE...

Monthly Test

Drive (XI) :

Monthly Test

Drive (XII) :

Brush up for

NEET/JEE (XI) :

Brush up for

NEET/JEE (XII) :

Gear Up for JEE

Main 2020 :

NEET Practice Paper 2020

• Equilibrium

• Redox Reactions

• The d- and f-Block Elements

• Coordination Compounds

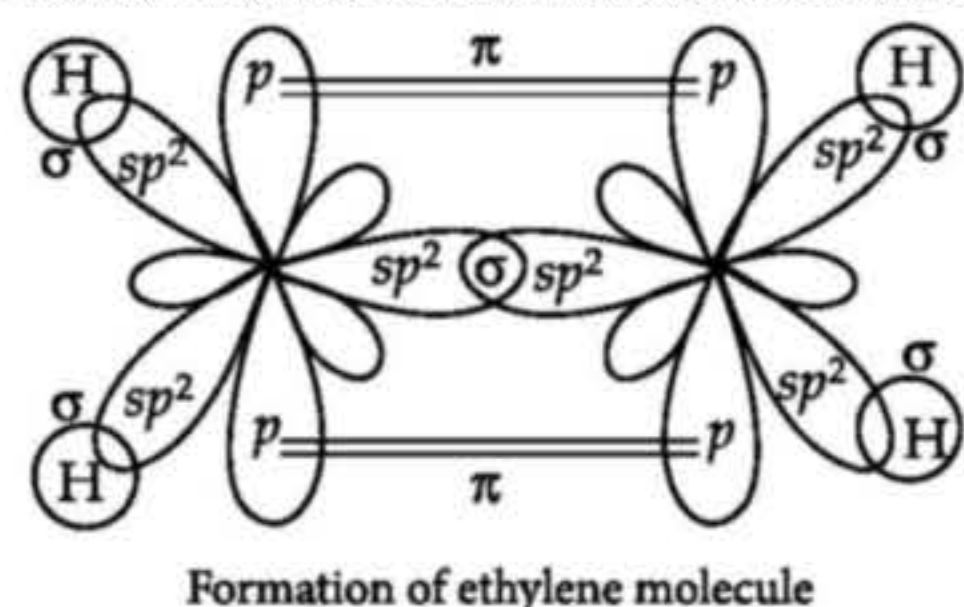
• Practical Chemistry

• Practical Chemistry

• Practical Chemistry

• Practice Paper

of the sp^2 -hybridised orbitals of each carbon atom overlap separately and along the axes with the $1s$ orbitals of the hydrogen atoms. The pure p -orbital on each of the two carbon atoms overlap each other laterally (sideways) and thus, a new type of bond (π) is formed between the two carbon atoms.



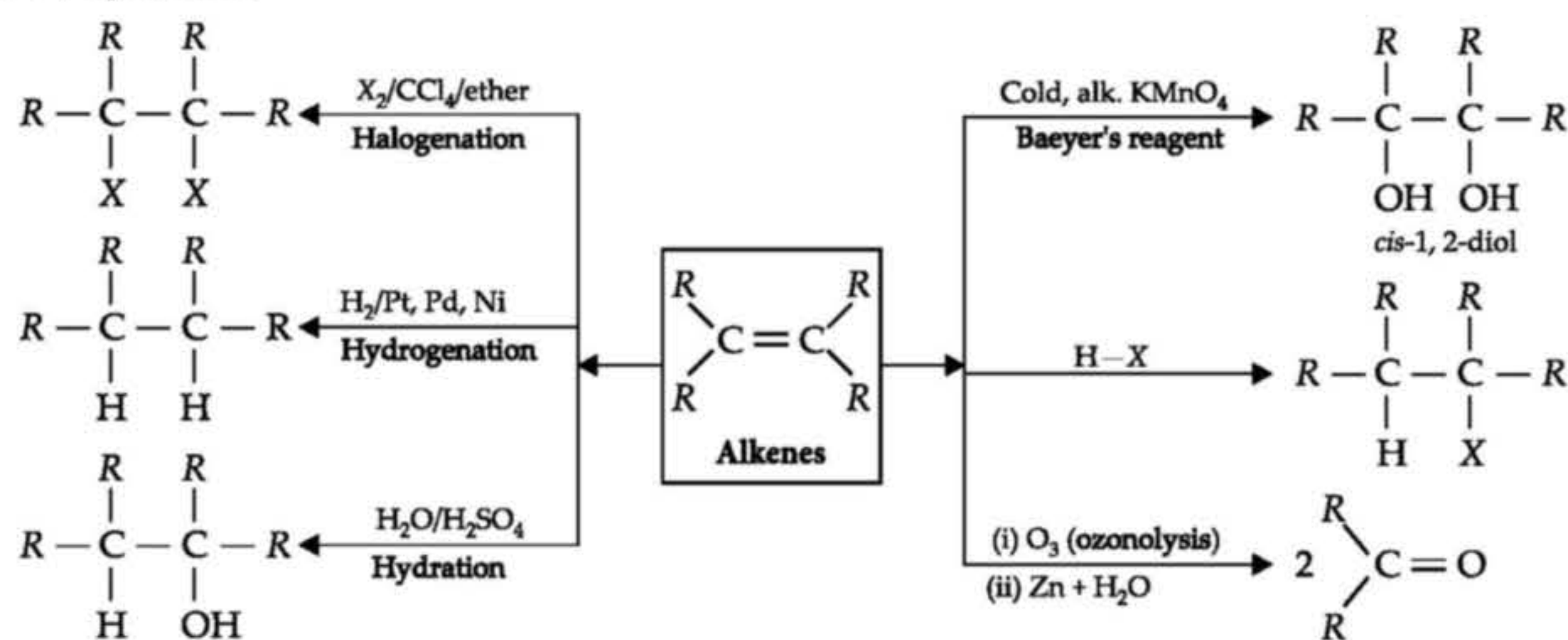
Nomenclature

- Alkane - ane + ene = alkene
e.g., $\overset{1}{\text{C}}\text{H}_2=\overset{2}{\text{C}}\text{H}-\overset{3}{\text{C}}\text{H}_2-\overset{4}{\text{C}}\text{H}_2-\overset{5}{\text{C}}\text{H}_3$
Pent-1-ene (Pentene)

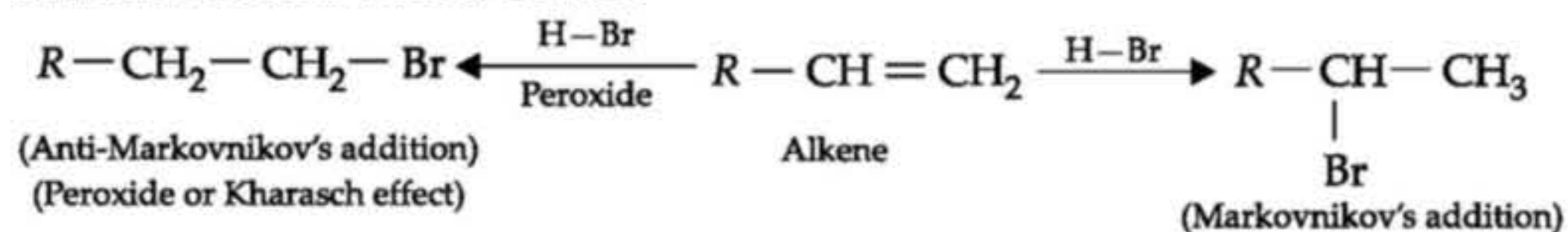
Isomerism

- Alkenes show following types of isomerism :
Chain isomerism, position isomerism, ring chain

Chemical Properties



- Markovnikov's and Anti-Markovnikov's rule :



ALKYNES

- Alkynes also called acetylenes are unsaturated hydrocarbons which have general formula $\text{C}_n\text{H}_{2n-2}$. They contain triple bond. e.g., C_2H_2 ($\text{HC}\equiv\text{CH}$) called acetylene or ethyne and $\text{HC}\equiv\text{CCH}_3$ called propyne (or methyl acetylene).

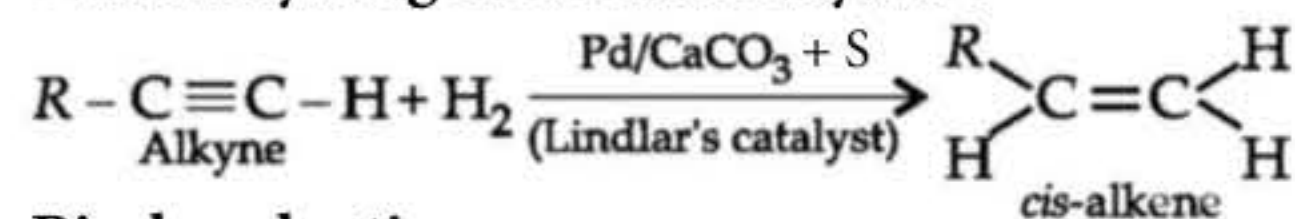
Structure

- In acetylene molecule, one of the sp -hybridised orbitals of one carbon atom overlaps axially with

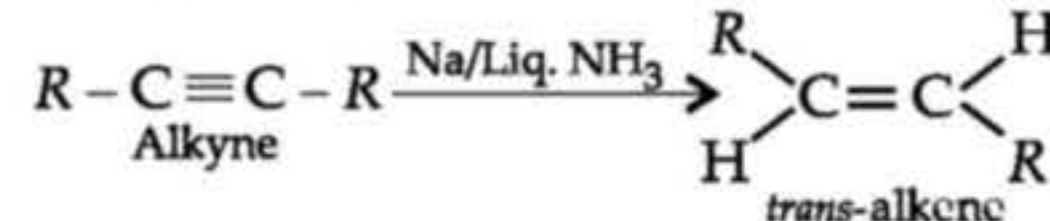
isomerism and geometrical isomerism (*cis-trans* isomerism).

Methods of Preparation

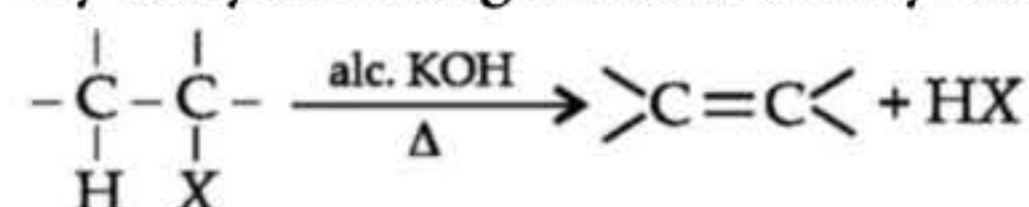
- Partial hydrogenation of alkynes :



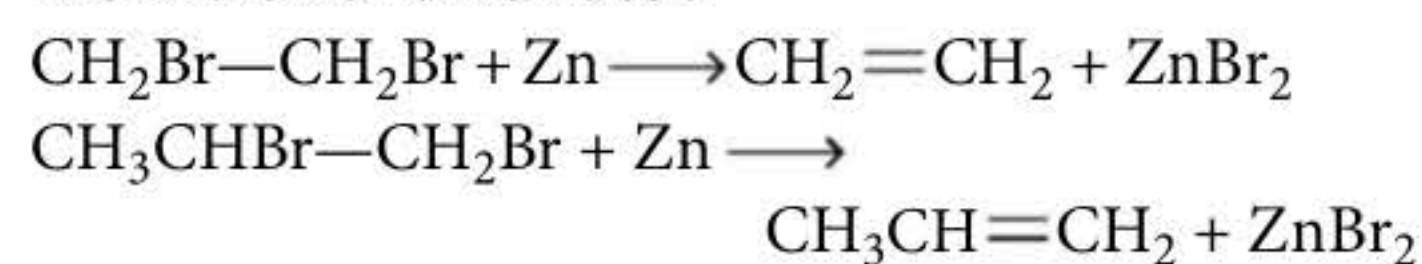
- Birch reduction :



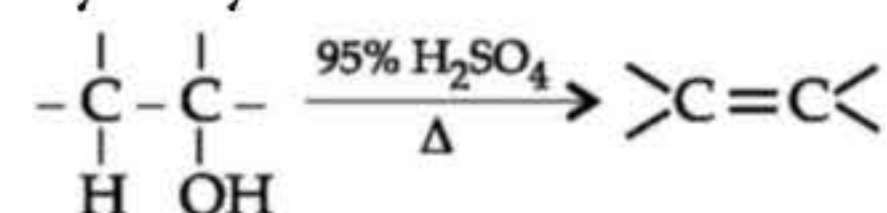
- By dehydrohalogenation of alkyl halides :

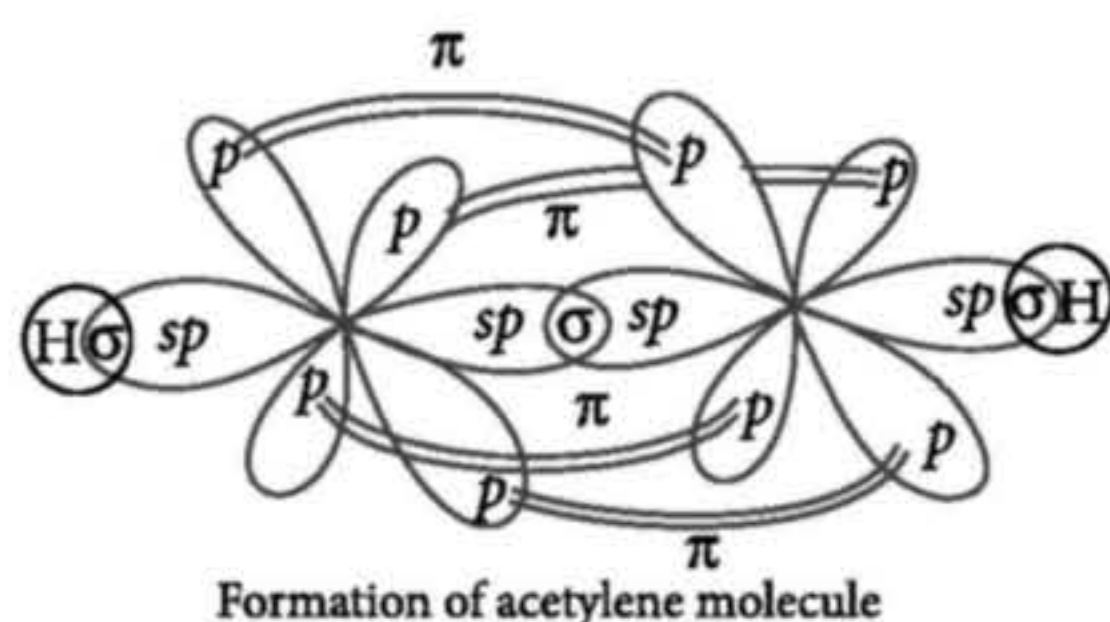


- From vicinal dihalides :



- By dehydration of alcohols :





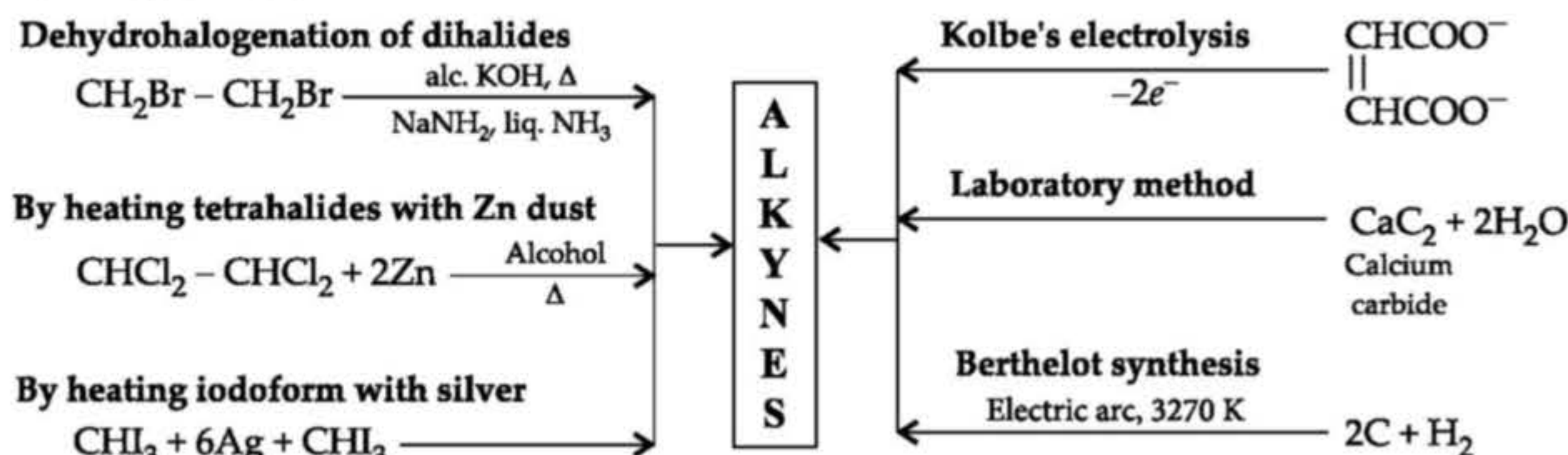
Nomenclature

- alkane - ane + yne = alkyne
e.g., $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
Hex-2-yne

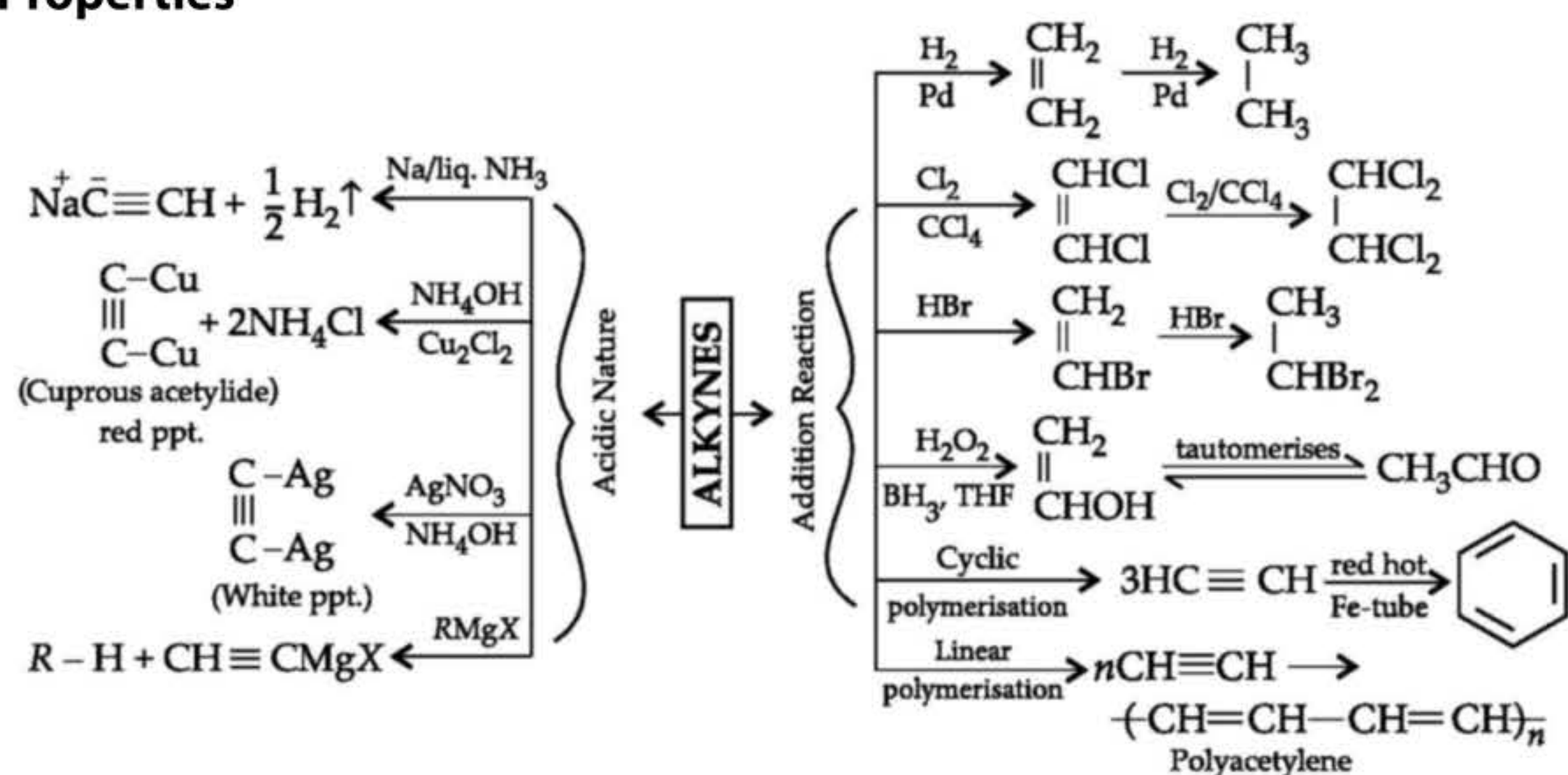
Isomerism

- Ethyne does not show any type of isomerism. Alkynes form chain, position, functional and ring chain isomerism.

Methods of Preparation

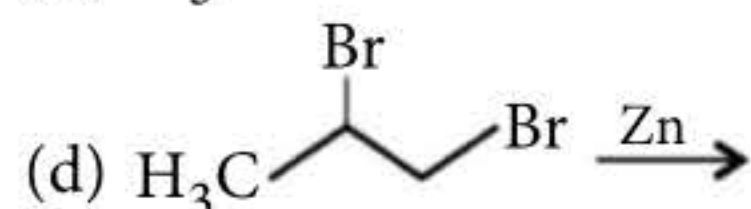


Chemical Properties

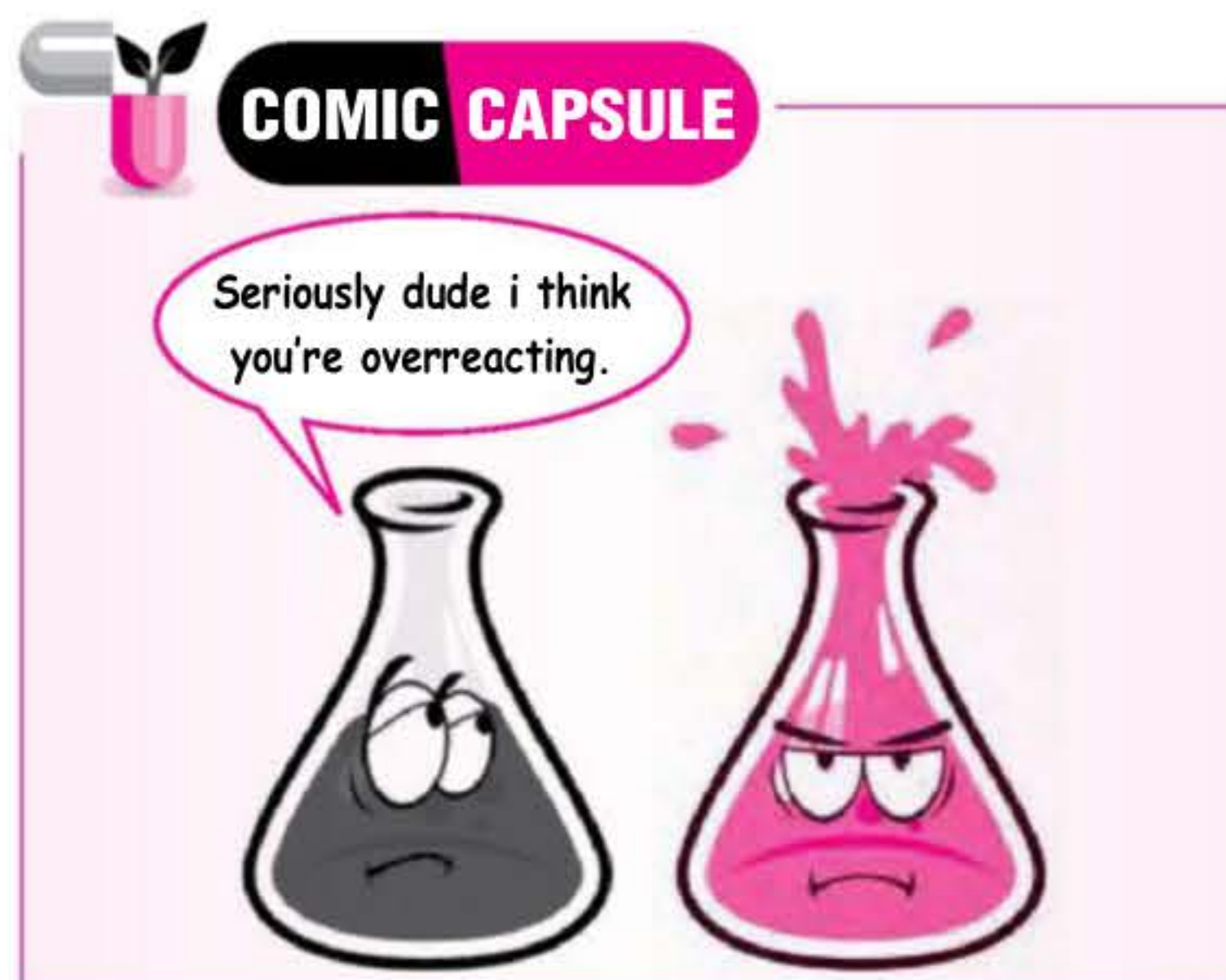


PEEP INTO PREVIOUS YEARS

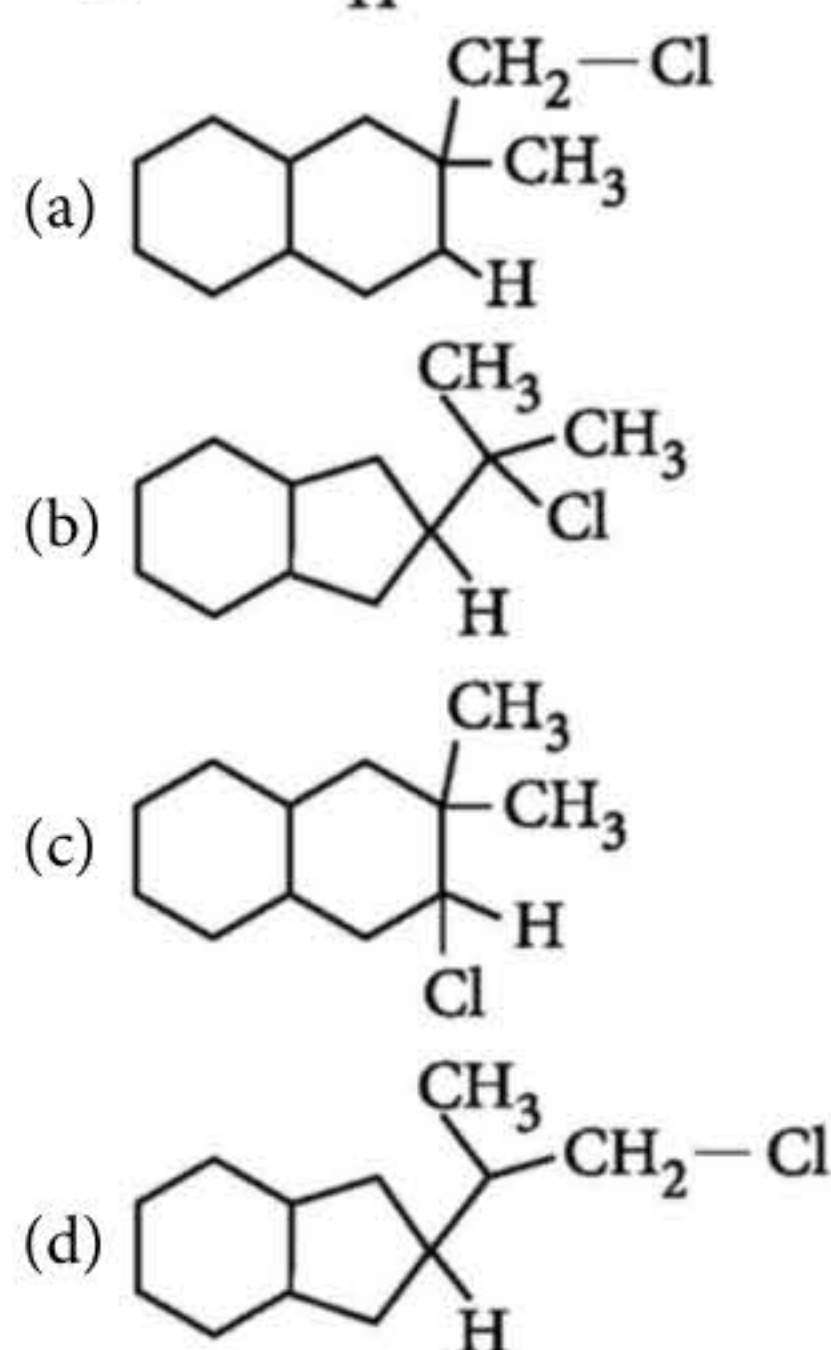
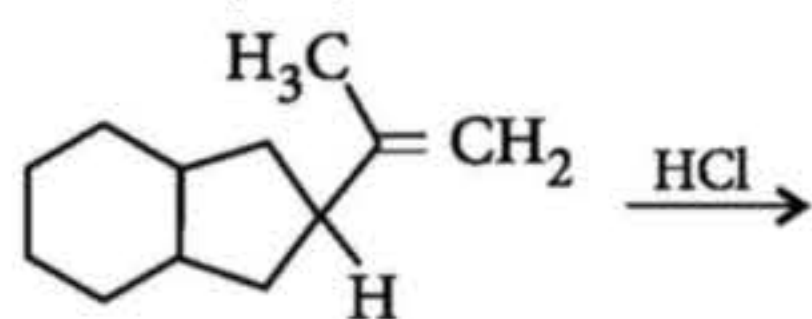
1. Which of the following reactions produce(s) propane as a major product?



(JEE Advanced 2019)

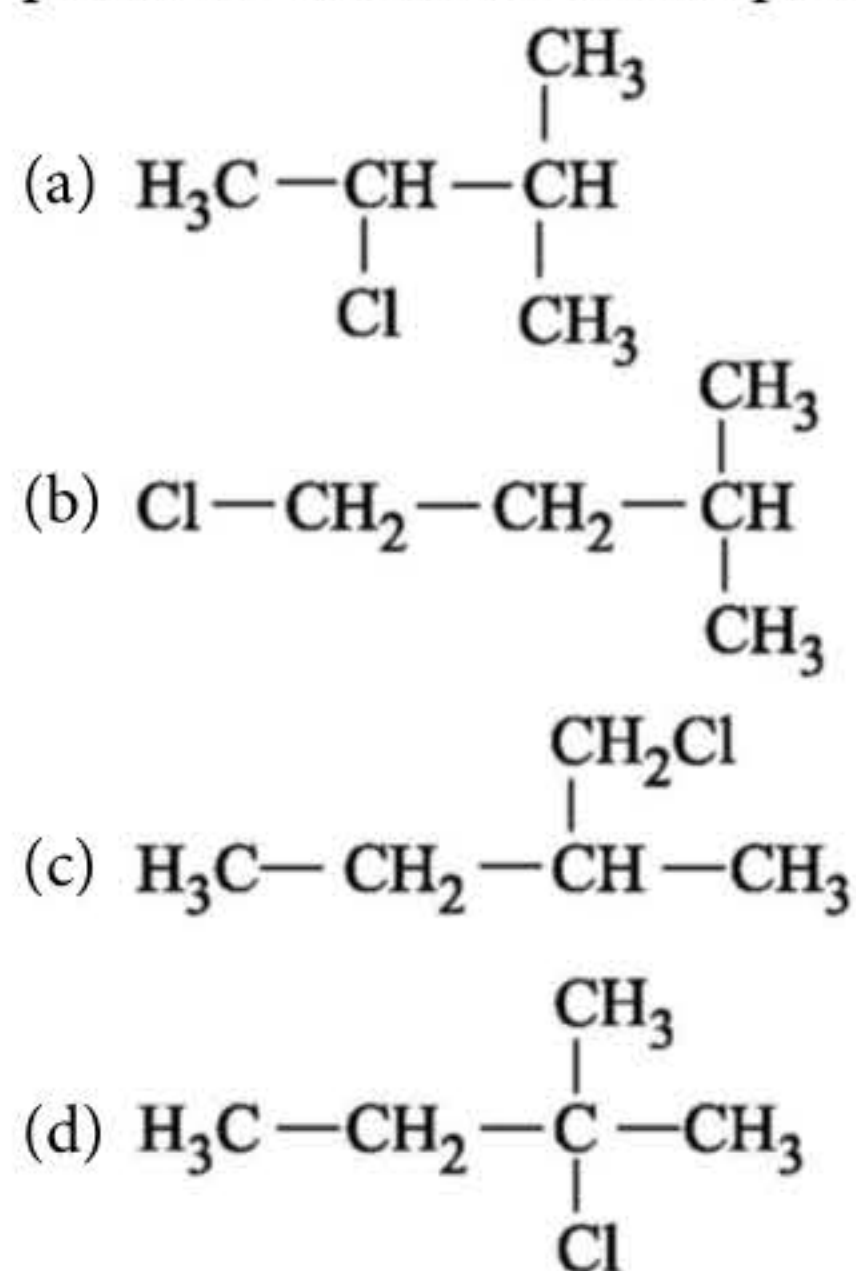


2. The major product of the following reaction is



(JEE Main 2019)

3. An alkene A on reaction with O_3 and $Zn-H_2O$ gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene A gives B as the major product. The structure of product B is



(NEET 2019)

4. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is

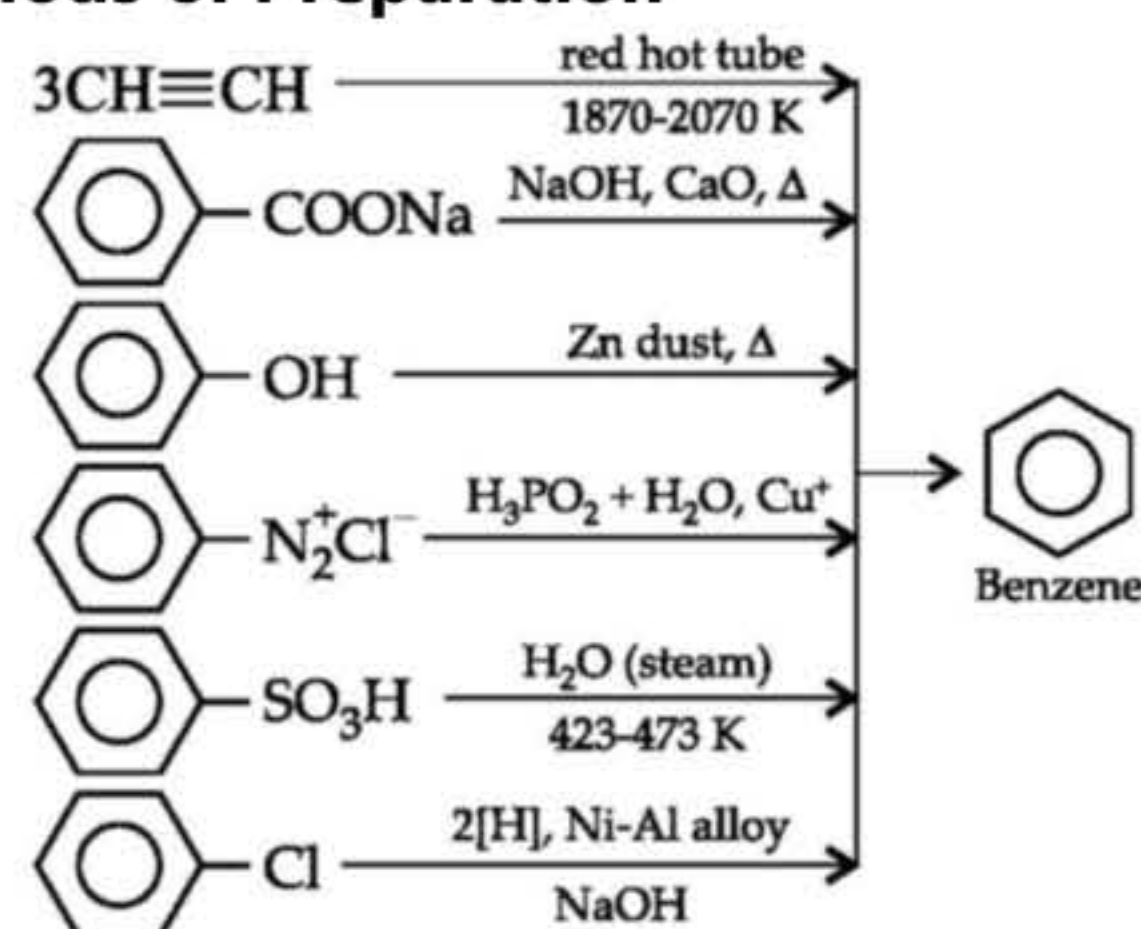


(NEET 2018)

AROMATIC HYDROCARBONS

- Hydrocarbons which contain one or more benzene rings either fused or isolated in their molecules are called aromatic hydrocarbons or arenes.

Methods of Preparation

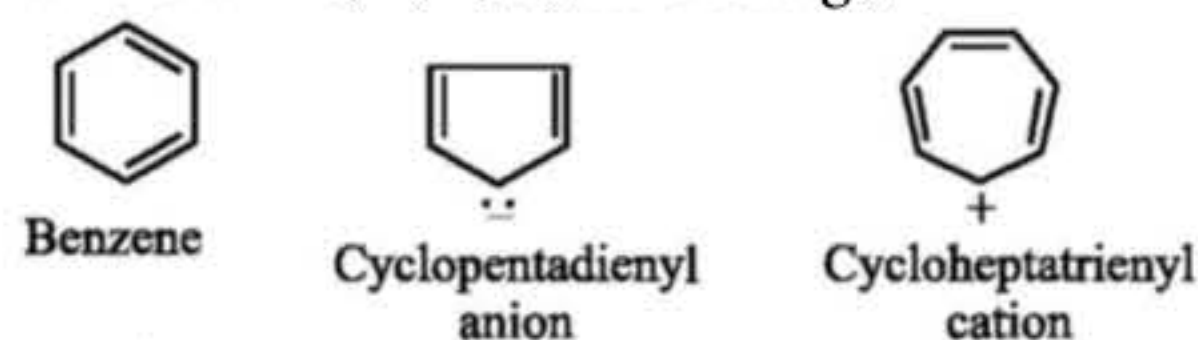


Physical Properties

- Aromatic hydrocarbons are non-polar molecules.
- These are colourless liquids or solids with a characteristic aroma.
- These are immiscible with water but miscible in organic solvents and burn with sooty flame.

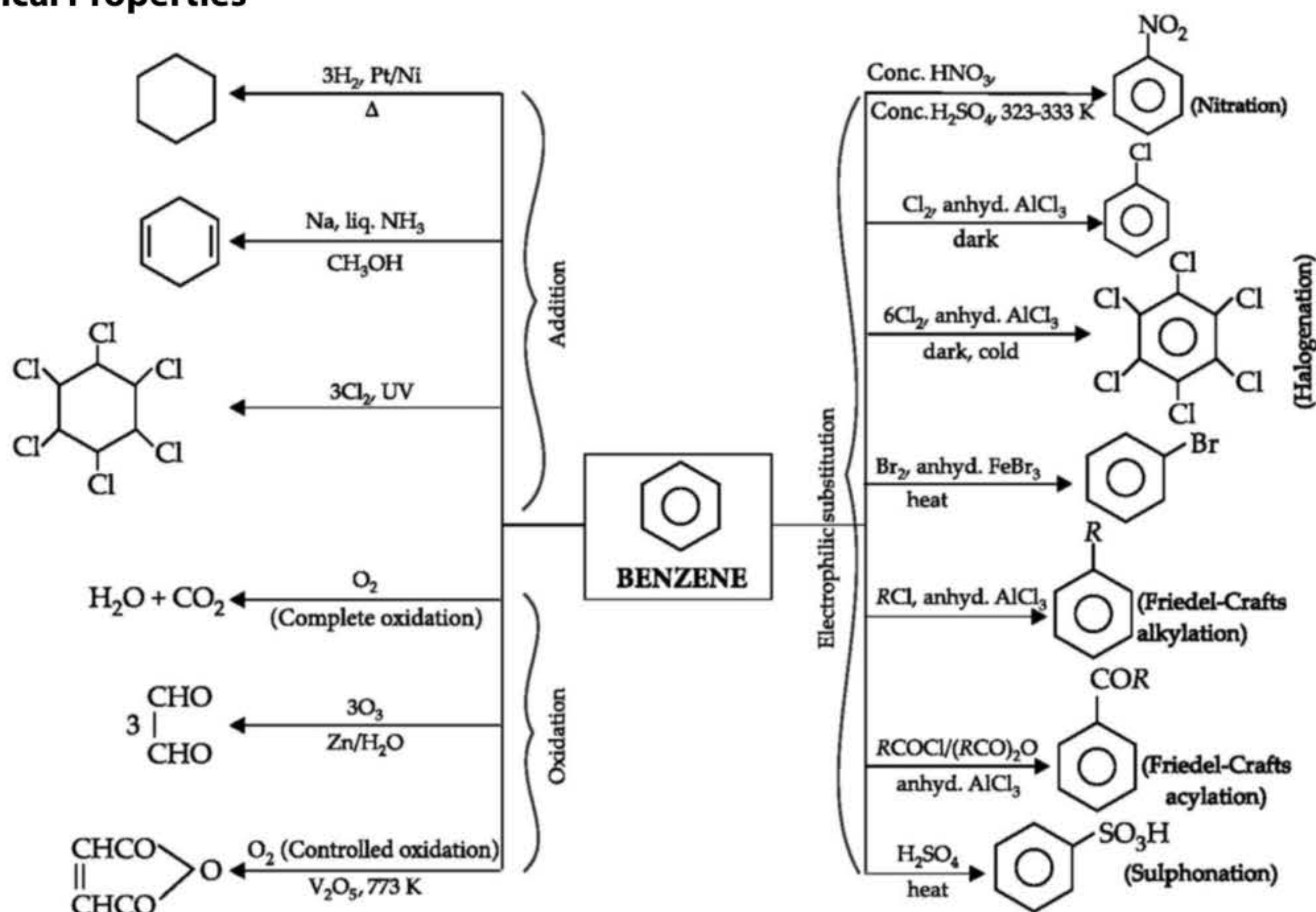
Huckel Rule of Aromaticity

- Huckel rule of aromaticity is applied to all the ring systems whether they have benzene ring or not and possess the following characteristics :
 - Planarity
 - Complete delocalisation of π -electrons in the ring.
 - Presence of $(4n + 2)\pi$ -electrons in the ring where $n = 0, 1, 2, 3, \dots$ etc. e.g.,



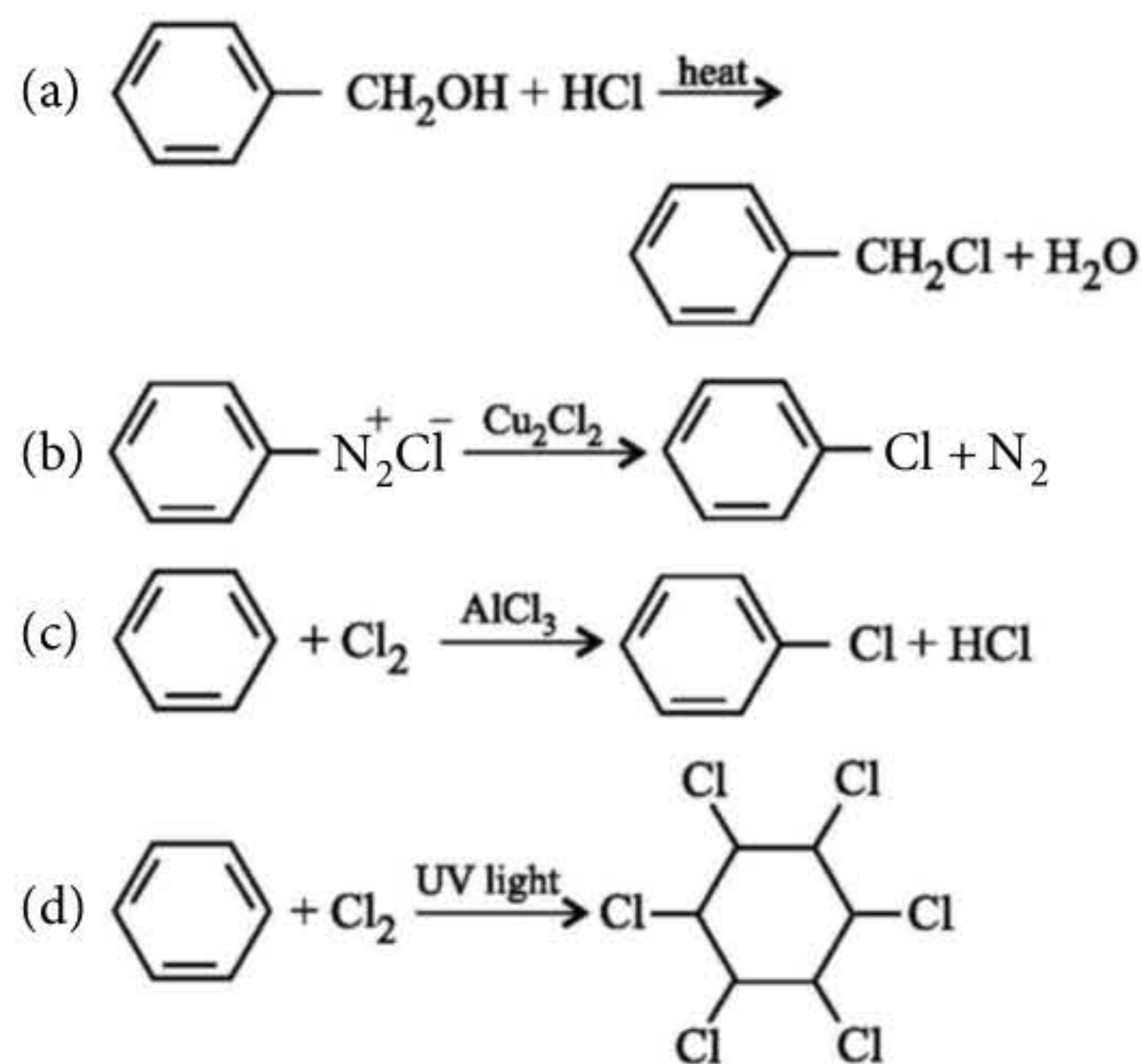
- Aromatic :**
 - Cyclic, planar molecule
 - Complete delocalisation of π electrons
 - Follow Huckel rule $(4n + 2) \pi e^-$ s
- Anti-aromatic :**
 - Cyclic, planar molecule
 - Complete delocalisation of π electrons
 - Follow $4n \pi e^-$ s
- Non-aromatic :**
 - Either non-cyclic, non-planar
 - No delocalisation of π electrons.
 - May or may not follow Huckel rule.

Chemical Properties



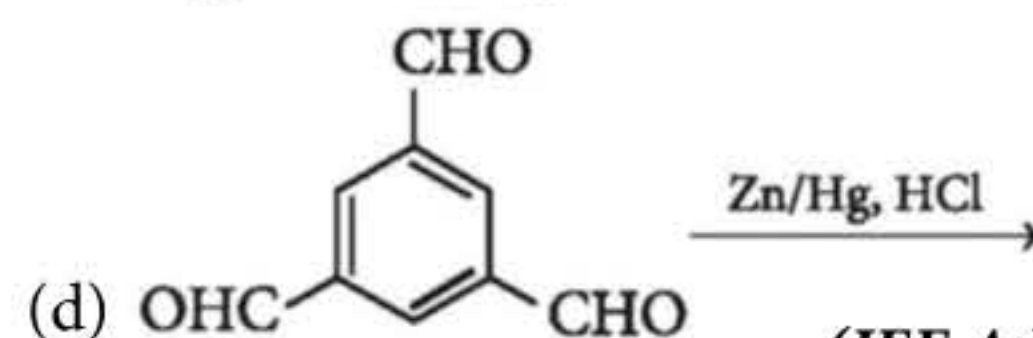
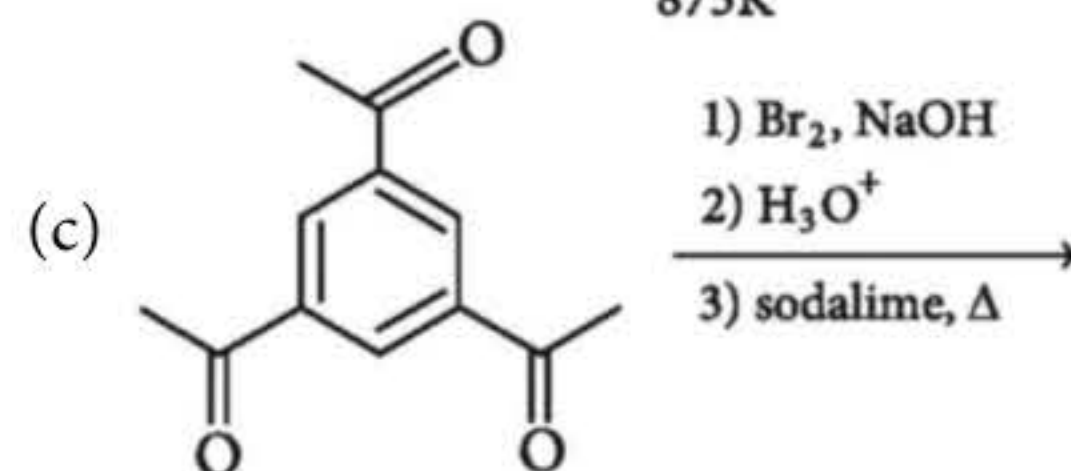
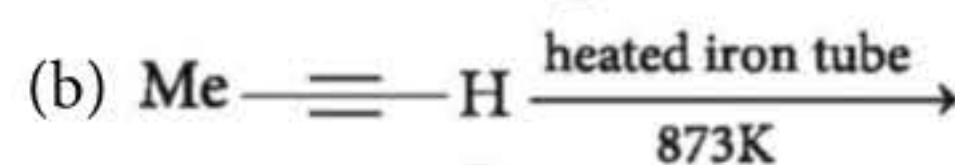
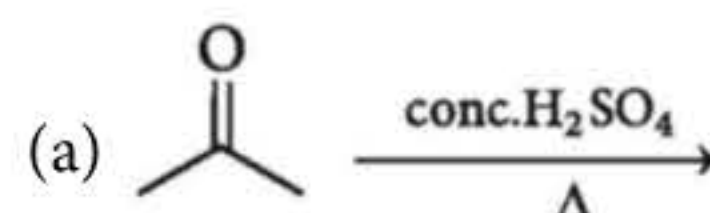
PEEP INTO PREVIOUS YEARS

5. Among the following the reaction that proceeds through an electrophilic substitution is



(NEET 2019)

6. The reaction(s) leading to the formation of 1,3,5-trimethylbenzene is (are)



(JEE Advanced 2018)

POINTS FOR EXTRA SCORING

- The number of degree of unsaturation in a hydrocarbon is given by: $\frac{2n_1 + 2 - n_2}{2}$.
- Addition of symmetrical reagents over symmetrical alkenes can be generalised as
 - cis-alkene + syn addition \rightarrow meso product
 - trans-alkene + syn addition \rightarrow racemic product
 - cis-alkene + anti addition \rightarrow racemic product
 - trans-alkene + anti addition \rightarrow meso product.

Environmental Chemistry

- Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment.

ENVIRONMENTAL POLLUTION

- Any undesirable change in the surrounding which has harmful effects on living beings is called environmental pollution. A substance which causes pollution, is known as pollutant.
- **Primary and secondary pollutants** : Primary pollutants are those which remain as such in the environment after their formation like NO, SO₂, NO₂ whereas secondary pollutants are formed from the primary pollutants like PAN (Peroxyacetyl nitrate).

AIR POLLUTION

- It is the addition of undesirable materials into the atmosphere either due to natural phenomena or due to human activity on the earth which adversely affect the quality of the air and hence, affects the life on the earth.

Greenhouse Effect and Global Warming

- The retention of heat by the earth and atmosphere from the sun and its prevention to escape into the outer space is known as greenhouse effect.
 - Greenhouse gases such as CO₂, ozone, methane, chlorofluorocarbon compounds and water vapour form a thick cover around the earth which prevents the IR rays emitted by the earth to escape.
 - It gradually leads to increase in temperature of atmosphere. This phenomenon of increasing earth's temperature is called global warming.

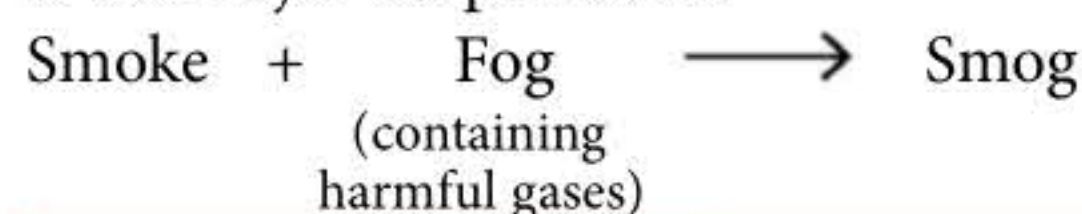
Acid Rain

- Rain water normally has a pH of 5.6 due to dissolution of CO₂ present in the atmosphere.

$$\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$$
- When this pH falls below 5.6, the rain water becomes acidic. The main gases responsible for acid rain are SO₂ and NO₂.
- **Harmful Effects of Acid Rain**
 - Damage to buildings and statues made of marble, limestone, slate, etc.
 - It is toxic to vegetation and aquatic life.
 - It corrodes water pipes resulting in the leaching of the heavy metals such as Fe, Pb and Cu into the drinking water which have toxic effects.

Smog

- The word smog is derived from smoke and fog. It is the major air pollutant.



Classical smog	Photochemical smog
Also called as London smog.	Also called as Los Angeles smog.
Formed due to oxides of sulphur.	Formed due to oxides of nitrogen.
Contains primary pollutants.	Contains secondary pollutants.
It is reducing in nature.	It is oxidising in nature.

Stratospheric Pollution (Ozone depletion)

- Ozone (O₃) present in the stratosphere prevents about 99.5% of UV radiations from reaching the earth's surface and thereby protecting humans and other animals from its harmful effects.
- A dynamic equilibrium exists between the production and decomposition of ozone molecules.

$$\text{O}_{2(g)} \xrightarrow{\text{UV}} \text{O}_{(g)} + \text{O}_{(g)}; \text{O}_{(g)} + \text{O}_{2(g)} \xrightleftharpoons{\text{UV}} \text{O}_{3(g)}$$
- The main reason of ozone layer depletion is the release of chlorofluorocarbon compounds (CFCs), also known as freons.

WATER POLLUTION

- Water pollution may be defined as any change in its physical, chemical or biological properties or contamination with foreign materials that can adversely affect human beings or reduce its utility for the intended use.

Effects of Water Pollution

- High concentrations of fluoride are poisonous and are harmful to bones and teeth at levels over 10 ppm.
- Excess nitrate in drinking water can lead to blue baby syndrome.
- Excess sulphate (> 500 ppm) have a laxative effect.

Biochemical Oxygen Demand (BOD)

- The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called BOD. It is a measure of the amount of organic material in the water.

Chemical Oxygen Demand (COD)

- It is the measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals.

Eutrophication

- The process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as eutrophication.

SOIL POLLUTION

- Soil pollution is the addition of such chemical substances (in an indefinite proportion) which deteriorates the quality, texture and mineral content of the soil and disturbs the biological balance of the organisms in it and has lethal effect on the plant growth.
- Some major soil pollutants and their sources are :

Pollutants	Major sources
Industrial wastes	Waste products from paper, sugar, chemical industries dumped into the soil.
Agricultural wastes	Chemicals such as fertilizers, pesticides, etc. used for killing insects, fungi and weeds.
Radioactive pollutants	Dumping of nuclear wastes into the soil.

CONTROL OF ENVIRONMENTAL POLLUTION

- Waste management :** Environmental pollution can be controlled to a certain extent by managing the waste disposal in a proper way.
- Recycling :** A large amount of disposed waste material can be reused by recycling the waste. Thus, it reduces the land fill and converts waste into usable forms.
- Sewage treatment :** It can be done by :
 - Incineration
 - Digestion
 - Dumping

GREEN CHEMISTRY

- Green chemistry is a process that would bring about minimum pollution or deterioration to the environment.

- It is a chemical philosophy encouraging the design of products and processes that reduces or eliminates the use and generation of hazardous substances.
- Green chemistry in day-to-day life :
 - Dry cleaning of clothes
 - Bleaching of paper
 - To clean turbid water

PEEP INTO PREVIOUS YEARS

7. The compound that is not a common component of photochemical smog is
- (a) $\text{H}_3\text{C} - \overset{\text{O}}{\parallel}{\text{C}} - \text{OONO}_2$
- (b) $\text{CH}_2 = \text{CHCHO}$
- (c) CF_2Cl_2 (d) O_3 (JEE Main 2019)
8. Among the following, the one that is not a greenhouse gas is
- (a) sulphur dioxide (b) nitrous oxide
- (c) methane (d) ozone. (NEET 2019)
9. Water filled in two glasses A and B have BOD values of 10 and 20, respectively. The correct statement regarding them, is
- (a) A is suitable for drinking, whereas B is not
- (b) A is more polluted than B
- (c) both A and B are suitable for drinking
- (d) B is more polluted than A. (JEE Main 2019)
10. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?
- (a) N_2O_5 (b) NO_2
- (c) N_2O (d) NO (NEET 2018)

POINTS FOR EXTRA SCORING

- The carboxyhaemoglobin is about 300 times more stable than the oxyhaemoglobin complex.
- Clean water has a BOD value of less than 5 ppm whereas highly polluted river water may have BOD value of 17 ppm or more.
- pH of drinking water should be between 5.5 and 9.5.
- Excess nitrate in drinking water lead to methemoglobinemia (blue-baby syndrome).
- International standards for drinking water :** Fluorides < 1 ppm, Lead < 50 ppb, Sulphates < 500 ppm, Nitrates < 50 ppm.

Answer Key For Peep Into Previous Years

1. (a, c) 2. (b) 3. (d) 4. (d) 5. (c) 6. (a, b, d)
7. (c) 8. (a) 9. (d) 10. (a)