

# Chapter 24 Hydrocarbon

## **Aliphatic Hydrocarbon**

Organic compounds composed of only carbon and hydrogen are called hydrocarbons. Hydrocarbons are two types

(1) Aliphatic Hydrocarbon (Alkanes, Alkenes and Alkynes).

#### (2) Aromatic Hydrocarbon (Arenes)

## (1) Sources of aliphatic hydrocarbon

Mineral oil or crude oil, petroleum [Petra  $\rightarrow$  rock; oleum  $\rightarrow$  oil] is the dark colour oily liquid with offensive odour found at various depths in many regions below the surface of the earth. It is generally found under the rocks of earth's crust and often floats over salted water.

## (2) Composition

(i) *Alkanes* : found 30 to 70% contain upto 40 carbon atom. Alkanes are mostly straight chain but some are branched chain isomers.

(ii) **Cycloalkanes :** Found 16 to 64% cycloalkanes present in petroleum are; cyclohexane, methyl cyclopentane etc. cycloalkanes rich oil is called asphaltic oil.

(iii) *Aromatic hydrocarbon* : found 8 to 15% compound present in petroleum are; Benzene, Toluene, Xylene, Naphthalene etc.

(iv) *Sulphur, nitrogen and oxygen compound* : Sulphur compound present to the extent of 6% include mercaptans [R-SH] and sulphides [R-S-R]. The unpleasant smell of petroleum is due to sulphur compounds. Nitrogenous compounds are pyridines, quinolines and pyrroles. Oxygen compounds present in petroleum are. Alcohols, Phenols and resins. Compounds like chlorophyll, haemin are also present in it.

(v) **Natural gas** : It is a mixture of Methane (80%), Ethane (13%), Propane (3%), Butane (1%), Vapours of low boiling pentanes and hexanes (0.5%) and Nitrogen (1.3%). L.P.G. Contain butanes and pentanes and used as cooking gas. It is highly inflammable. This contain, methane, nitrogen and ethane.

(vi) **C.N.G.** : When natural gas compressed at very high pressure is called compressed natural gas (CNG). Natural gas has octane rating of 130 it consists, mainly of methane and may contain, small amount of ethane and propane.

(3) **Theories of origin of petroleum :** Theories must explain the following characteristics associated with petroleum,

Its association with brine (sodium chloride solution). The presence of nitrogen and sulphur compounds in it. The presence of chlorophyll and haemin in it. Its optically active nature. Three important theories are as follows.

(i) Mendeleeff's carbide theory or inorganic theory

(ii) Engler's theory or organic theory

(iii) Modern theory

(4) **Mining of petroleum :** Petroleum deposits occurs at varying depth at different places ranging from 500 to 15000 feet. This is brought to the surface by artificial drilling.

(5) **Petroleum refining :** Separation of useful fractions by fractional distillation is called petroleum refining.

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Fraction	Boiling range (°C)	Approximate composition	Uses
Uncondensed gases	Upto room temperature	<i>C</i> <sub>1</sub> - <i>C</i> <sub>4</sub>	Fuel gases: refrigerants; production of carbon black, hydrogen; synthesis of organic chemicals.
Crude naphtha on refractionation yields,	30 - 150°	<i>C</i> <sub>5</sub> - <i>C</i> <sub>10</sub>	
(i) Petroleum ether	30 - 70°	<i>C</i> <sub>5</sub> - <i>C</i> <sub>6</sub>	Solvent
(ii) Petrol or gasoline	70 - 120º	C6 - C8	Motor fuel; drycleaning; petrol gas.
(iii) Benzene derivatives	120 - 150°	C <sub>8</sub> - C <sub>10</sub>	Solvent; drycleaning
Kerosene oil	150 - 250°	<i>C</i> <sub>11</sub> - <i>C</i> <sub>16</sub>	Fuel; illuminant; oil gas
Heavy oil	250 - 400°	C <sub>15</sub> - C <sub>18</sub>	As fuel for diesel engines; converted to gasoline by cracking.
Refractionation gives,			
(i) Gas oil, (ii) Fuel oil,			
(iii) Diesel oil			
Residualoilonfractionationbyvacuumdistillation gives,	Above 400°	C <sub>17</sub> - C <sub>40</sub>	
(i) Lubricating oil		<i>C</i> <sub>17</sub> - <i>C</i> <sub>20</sub>	Lubrication
(ii) Paraffin wax		C <sub>20</sub> - C <sub>30</sub>	Candles; boot polish; wax paper; etc
(iii) Vaseline		C <sub>20</sub> - C <sub>30</sub>	Toilets; ointments; lubrication.
(iv) Pitch		C <sub>30</sub> - C <sub>40</sub>	Paints, road surfacing
Petroleum coke			As fuel.
(on redistilling tar)			

## Table : 24.1

#### (6) Purification

(i) *Treatment with concentrated sulphuric acid* : The gasoline or kerosene oil fraction is shaken with sulphuric acid to remove aromatic compounds like thiophene and other sulphur compound with impart offensive odour to gasoline and kerosene and also make them corrosive.

(ii) Doctor sweetening process :

$$\frac{2RSH}{Mercaptan} + Na_2PbO_2 + S \rightarrow \frac{RSSR}{Disulphide s} + PbS + 2NaOH$$

(iii) **Treatment with adsorbents** : Various fractions are passed over adsorbents like alumina, silica or clay etc, when the undesirable compounds get adsorbed.

(7) Artificial method for manufacture of Petrol or gasoline

(i) Cracking, (ii) Synthesis

(i) *Cracking* : It is a process in which high boiling fractions consisting of higher hydrocarbons are heated strongly to decompose them into lower hydrocarbons with low boiling points. Cracking is carried out in two different ways.

(a) Liquid phase cracking : In this process, the heavy oil or residual oil is cracked at a high temperature  $(475 - 530^{\circ}C)$  under high pressure (7 to 70 atmospheric pressure). The high pressure keeps the reaction product in liquid state. The conversion is approximately 70% and the resulting petrol has the octane number in the range 65 to 70.

The cracking can be done in presence of some catalysts like silica, zinc oxide, titanium oxide, ferric oxide and alumina. The yields of petrol are generally high when catalyst is used.

(b) *Vapour phase cracking* : In this process, kerosene oil or gas oil is cracked in vapour phase. The temperature is kept 600 – 800°C and the pressure is about 3.5 to 10.5 atmospheres. The cracking is facilitated by use of a suitable catalyst. The yields are about 70%.

(ii) **Synthesis** : Two methods are applicable for synthesis.

(a) *Bergius process* : This method was invented by Bergius in Germany during first world war.

Coal 
$$+H_2 \xrightarrow{Fe_2O_3}_{450-500^{\,\circ}C}$$
 Mix. Of hydrocarbons or crude

oil

(b) *Fischer- tropsch process* : The overall yield of this method is slightly higher than Bergius process.

$$H_2O + C \xrightarrow{1200°C} CO \pm H_2$$
  
Watergas  
 $xCO + yH_2 \longrightarrow$  Mix. Of hydrocarbon  $+H_2O$ .

The best catalyst for this process is a mixture of cobalt (100 parts), thoria, (5 parts), magnesia (8 parts) and kieselguhr (200 parts).

## Characteristics of hydrocarbons

(1) **Knocking :** The metallic sound during working of an internal combustion engine is termed as knocking.

"The greater the compression greater will be efficiency of engine." The fuel which has minimum knocking property is always preferred. The tendency to knock falls off in the following order : Straight chain alkanes > branched chain alkanes > olefins > cyclo alkanes > aromatic hydrocarbons.

(2) **Octane number :** It is used for measuring the knocking character of fuel used in petrol engine. The octane number of a given sample may be defined as the percentage by volume of iso-octane present in a mixture of iso-octane and *n*-heptane which has the same knocking performance as the fuel itself.

$$CH_{3} - CH_{2} - CH_{2} - CH_{2} - CH_{2} - CH_{2} - CH_{3}$$
  
*n*-heptane; octane no. = 0  
 $CH_{3} - CH_{3} - CH_{3}$   
 $CH_{3} - C - CH_{2} - C - CH_{3}$ ; Octane no. = 100  
 $CH_{3} - CH_{3} - CH_{3} - CH_{3}$ ; Octane no. = 100

2, 2, 4-Trimethyl pentane or Iso-octane.

*For example* : a given sample has the knocking performance equivalent to a mixture containing 60% iso-octane and 40% heptane. The octane number of the gasoline is, therefore, 60.

Presence of following types of compounds increases the octane number of gasoline.

(i) In case of straight chain hydrocarbons octane number decreases with increase in the length of the chain.

(ii) Branching of chain increases the value of octane number

(iii) Introduction of double bond or triple bond increases the value of octane number.

(iv) Cyclic alkanes have relatively higher value of octane number.

(v) The octane number of aromatic hydrocarbons are exceptionally high

(vi) By adding gasoline additives (eg TEL)

(3) **Antiknock compounds :** To reduce the knocking property or to improve the octane number of a fuel certain chemicals are added to it. These are called **antiknock compounds**. One such compound, which is extensively used, is tetraethyl lead (TEL). TEL is used in the form of following mixture,

TEL = 63%, Ethylene bromide = 26%, Ethylene chloride = 9% and a dye = 2%.

However, there is a disadvantage that the lead is deposited in the engine. To remove the free lead, the ethylene halides are added which combine with lead to form volatile lead halides.

$$\begin{array}{c} Pb + Br - CH_2 - CH_2 - Br \rightarrow PbBr_2 + CH_2 = CH_2 \\ \text{Ethylene bromide} & \text{Volatile} & \text{Ethylene} \end{array}$$

However, use of TEL in petrol is facing a serious problem of Lead pollution, to avoid this a new compound cyclopenta dienyl manganese carbonyl

(called as AK-33-X) is used in developed countries as antiknocking compound.

(4) Other methods of improving octane number of hydrocarbon.

(i) **Isomerisation** [Reforming] : By passing an alkane over  $AlCl_3$  at 200°C.

$$CH_{3}CH_{2}CH_{2}CH_{2}CH_{3} \xrightarrow{AlCl_{3}} CH_{3} \xrightarrow{AlCl_{3}} CH_{3} \xrightarrow{CHC} H_{2}CH_{3}$$
Pentane
(Octane number = 62)
(Octane number = 90)

(ii) Alkylation :

$$\begin{array}{cccc} CH_3 & CH_3 & CH_3 & CH_3 \\ | & | & | \\ CH_3CH + CH_2 = C CH_3 & & H_2SO_4 \\ | & | & | \\ CH_3 & & | \\ Isobutylene & & | \\ CH_3 & & CH_3 \\ Isobutane & & | \\ Iso-octane \\ (Octane number = 100) \end{array}$$

#### (iii) Aromatisation :



Toluene

 $CH_{2}$ 

The octane no. of petrol can thus be improved.

• By increasing the proportion of branched chain or cyclic alkanes.

• By addition of aromatic hydrocarbons Benzene, Toluene and Xylene (BTX).

• By addition of methanol or ethanol.

• By additon of tetraethyl lead  $(C_2H_5)_4 Pb$ 

(5) **Cetane number :** It is used for grading the diesel oils.

 $CH_3 - (CH_2)_{14} - CH_3$  Cetane  $\rightarrow$  cetane no. =

100



 $\alpha$ -Methyl naphthalene

The cetane number of a diesel oil is the percentage of cetane (hexadecane) by volume in a mixture of cetane and  $\alpha$ -methyl naphthalene which has the same ignition property as the fuel oil under consideration.

(6) **Flash point :** The lowest temperature at which an oil gives sufficient vapours to form an explosive mixture with air is referred to as flash point of the oil.

The flash point in India is fixed at  $44^{\circ}C$ , in France it is fixed at  $35^{\circ}C$ , and in England at  $22.8^{\circ}C$ . The flash point of an oil is usually determined by means of "*Abel's apparatus*".

Chemists have prepared some hydrocarbons with octane number even less than zero (e.g., *n*-nonane has octane number – 45) as well as hydrocarbon with octane number greater than 100 (e.g., 2, 2, 3 trimethylbutane. has octane number of 124).

(7) **Petrochemicals :** All such chemicals which are derived from petroleum or natural gas called petrochemicals. Some chemicals which are obtained from petroleum are summarised in table :

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Hydrocarbons	Compounds derived
Methane	Methyl chloride, chloroform, methanol, formaldehyde, formic acid, freon, hydrogen for synthesis of ammonia.
Ethane	Ethyl chloride, ethyl bromide, acetic acid, acetaldehyde, ethylene, ethyl acetate, nitroethane, acetic anhydride.
Ethylene	Ethanol, ethylene oxide, glycol, vinyl chloride, glyoxal, polyethene, styrene, butadiene, acetic acid.
Propane	Propanol, propionic acid, isopropyl ether, acetone, nitromethane, nitroethane, nitropropane.
Propylene	Glycerol, allyl alcohol, isopropyl alcohol, acrolein, nitroglycerine, dodecylbenzene, cumene, bakelite.
Hexane	Benzene, DDT, gammexane.
Heptane	Toluene
Cycloalkanes	Benzene, toluene, xylenes, adipic acid.
Benzene	Ethyl benzene, styrene, phenol, BHC (insecticide), adipic acid, nylon, cyclohexane, ABS detergents.
Toluene	Benzoic acid, TNT benzaldehyde, saccharin, chloramine-T, benzyl chloride, benzal chloride.

## **Alkanes** [Paraffines]

"Alkanes are saturated hydrocarbon containing only carbon-carbon single bond in their molecules."

Alkanes are less reactive so called paraffins; because under normal conditions alkanes do not react with acids, bases, oxidising agents and reducing agent.

General formula :  $C_n H_{2n+2}$ 

Examples are  $CH_4, C_2H_6, C_3H_8$ ,

## (1) General Methods of preparation

(i) **By catalytic hydrogenation of alkenes and alkynes** (Sabatie and sanderen's reaction)

 $\begin{array}{c} C_n H_{2n} + H_2 \xrightarrow{Ni} C_n H_{2n+2} ; C_n H_{2n-2} + 2H_2 \xrightarrow{Ni} C_n H_{2n+2} \\ \text{Alkene} \end{array}$ 

□ Methane is not prepared by this method

#### (ii) **Birch reduction :**

$$R - CH = CH_2 \xrightarrow{1.Na / NH_3} R - CH_2 - CH_3$$

(iii) From alkyl halide

(a) By reduction :  $RX + H_2 \xrightarrow{Zn/HCl} RH + HX$ 

(b) With hydrogen in presence of pt/pd:  $RX + H_2 \xrightarrow{Pd orPt.} RH + HX$ 

(c) With HI in presence of Red phosphorus :  $RBr + 2HI \longrightarrow RH + HBr + I_2$ 

Purpose of Red *P* is to remove  $I_2$  in the form of  $\tilde{P}I_3$ (iv) **Bu Zn-Cu** couple :

$$2CH_{3}CH_{2}OH + Zn_{\text{Zn-Cu couple}} \xrightarrow{Cu} (CH_{3}CH_{2}O)_{2}Zn + 2H$$

$$RX + 2H \longrightarrow RH + HX$$
(v) Wurtz reaction:
$$R_{1}^{I}X + 2Na + \overline{X}_{1}^{I}R' \longrightarrow R - R + 2NaX$$
Alky Ihalide Alky Ihalide

 $\square$  *R*-*Br* or *RI* preferred in this reaction. The net result in this reaction is the formation of even no. of carbon atoms in molecules.

## (vi) Frankland's reaction :

$$2RX + Zn \longrightarrow R - R + ZnX_2$$

(vii) Corey-house synthesis

$$CH_3 - CH_2 - Cl \xrightarrow{1.Li} (CH_3 - CH_2)_2 LiCu \xrightarrow{CH_3 - CH_2 - Cl} \rightarrow$$

 $CH_3 - CH_2 - CH_2 - CH_3$ 

□ Reaction is suitable for odd number of Alkanes.

(viii) From Grignard reagent

(a) By action of acidic 'H' :

$$\begin{array}{ccc} RMgX &+HOH \longrightarrow RH + Mg(OH)X \\ AlkyImagnesium & Water & Alkane \\ halide & \end{array}$$

(b) By reaction with alkyl halide :

$$R - X + R'MgX \longrightarrow R - R' + MgX_2$$

#### (ix) From carboxylic acids

(a) *Laboratory method* [Decarboxylation reaction or Duma reaction]

$$R \ COONa + NaOH \xrightarrow{heat} R - H + Na_2CO_3$$

□ *NaOH* and *CaO* is in the ratio of 3 : 1. (Sodalime)

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(b) Kolbe's synthesis :

$$\begin{array}{c} & & & & & \\ R - C - O^{-} N a^{+} \underbrace{\text{Electrolysis}}_{\text{Ionization}} & R - C - O^{-} + N a^{+} \\ & & \\ O \end{array}$$

 $2R \longrightarrow R - R$  (alkane)

At cathode [Reduction] :

$$2Na^+ + 2e^- \longrightarrow 2Na \xrightarrow{2H_2O} 2NaOH + H_2$$
 (1)

□ Both ionic and free radical mechanism are involved in this reaction.

$$\begin{array}{c} CH_{3}COOH + 6HI \xrightarrow{\text{Reduction}} CH_{3}CH_{3} + 2H_{2}O + 3I_{2} \\ \text{Aceticacid} \end{array}$$

(x) By reduction of alcohols, aldehyde, ketones or acid derivatives

$$\begin{array}{c} CH_{3}OH + 2HI \xrightarrow{\text{Red }P} CH_{4} + H_{2}O + I_{2} \\ \text{Methanol} \\ (Methylalcohol) \end{array} \xrightarrow{\text{Red }P} C_{2}H_{6} + H_{2}O + 2I_{2} \\ \text{Acetaldehyde} \xrightarrow{\text{Red }P} C_{2}H_{6} + H_{2}O + 2I_{2} \\ \text{Acetaldehyde} \xrightarrow{\text{Red }P} C_{2}H_{6} + H_{2}O + 2I_{2} \\ \text{Acetanal} \xrightarrow{\text{Red }P} CH_{3}CHO_{3} + 4HI \xrightarrow{\text{Red }P} CH_{3}CH_{2}CH_{3} + H_{2}O + 2I_{2} \\ \xrightarrow{\text{Acetone}} (Propanone) \xrightarrow{O} CH_{3} - C - Cl + 6HI \xrightarrow{\text{Red }P} 200 \, ^{o}C \xrightarrow{O} CH_{3} - CH_{3} + H_{2}O + HCl + 3I_{2} \\ \text{Acetylehoride} \xrightarrow{O} CH_{3} - C - NH_{2} + 6HI \xrightarrow{\text{Red }P} 200 \, ^{o}C \xrightarrow{O} CH_{3} - CH_{3} + H_{2}O + NH_{3} + 3I_{2} \\ \xrightarrow{\text{Acetamide}} CH_{3} - C - NH_{2} + 6HI \xrightarrow{\text{Red }P} 200 \, ^{o}C \xrightarrow{O} CH_{3} - CH_{3} + H_{2}O + NH_{3} + 3I_{2} \end{array}$$

□ Aldehyde and ketones when reduced with amalgamated zinc and conc. *HCl* also yield alkanes.

#### **Clemmenson reduction :**

(Ethanamide)

$$\begin{array}{c} CH_{3}CHO+4H \xrightarrow{Zn-Hg} CH_{3}-CH_{3}+H_{2}O \\ \text{Acetaldehyde} \\ \text{(Ethanal)} \end{array} \\ CH_{3}COCH_{3}+4H \xrightarrow{Zn-Hg} CH_{3}CH_{2}CH_{3}+H \end{array}$$

$$\begin{array}{c} H_3COCH_3 + 4H \xrightarrow{H_1H_2} CH_3CH_2CH_3 + H_2O \\ \text{Acetone} \\ (Propanone) \end{array}$$

□ Aldehydes and ketones (> C = O) can be reduced to hydrocarbon in presence of excess of hydrazine and sodium alkoxide on heating.

## Wolff-kishner reduction :



#### (AI) Hyurobor actor of acteries

(a) On treatment with acetic acid

$$R - CH = CH_2 \xrightarrow{B_2H_6} (R - CH_2 - CH_2)_3 B \xrightarrow{CH_3COOH}$$
Alkene
Trialky l borane

 $R - CH_2 - CH_3$ Alkane

(b) Coupling of alkyl boranes by means of silver nitrate

 $6[R - CH = CH_2] \xrightarrow{2B_2H_6} [2R - CH_2 - CH_2 - ]_3B \xrightarrow{AgNO_3 25^oC} \rightarrow CH_2 - CH_2 - ]_3B \xrightarrow{AgNO_3 25^oC} \rightarrow CH_2 - CH_2 - CH_2 - CH_2 - ]_3B \xrightarrow{AgNO_3 25^oC} \rightarrow CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - ]_3B \xrightarrow{AgNO_3 25^oC} \rightarrow CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - ]_3B \xrightarrow{AgNO_3 25^oC} \rightarrow CH_2 - CH_2$  $3[RCH_2CH_2 - CH_2CH_2R]$ 

## (2) Physical Properties

(i) **Physical state :** Alkanes are colourless, odourless and tasteless.

> Alkanes State

 $C_1 - C_4$ Gaseous state

 $C_5 - C_{17}$ Liquid state [Except neo pentane which is gas]

> $C_{18}$  and above Solid like waxes

(ii) **Density** : Alkanes are lighter than water.

(iii) Solubility : Insoluble in water, soluble in organic solvents, solubility  $\propto \frac{1}{M \text{ olecular mass}}$ 

(iv) Boiling points and Melting points : Melting points and boiling points.  $\propto$  Molecular mass 1

$$\infty$$
 No. of branches

-					r	
Alkane	$C_3H_8$	$C_{4}H_{10}$	$C_{5}H_{12}$	$C_{6}H_{14}$	$C_{7}H_{16}$	$C_{8}H_{18}$
:						
M.P.(K ):	85.9	138	143.3	179	182.5	216.2

□ Melting points of even > Odd no. of carbon atoms, this is because, the alkanes with even number of carbon atoms have more symmetrical structure and result in closer packing in the crystal structure as compared to alkanes with odd number of carbon atoms.



(3) Chemical properties

## (i) Substitution reactions of Alkanes

(a) Halogenation :  $R - H + X - X \longrightarrow R - X + HX$ 

The reactivity of halogen is :  $F_2 > Cl_2 > Br_2 > I_2$ 

 $\Box$  Fluorine can react in dark  $Cl_2, Br_2$  require light energy.  $I_2$  does not show any reaction at room temperature, but on heating it shows iodination.

□ Iodination of methane is done in presence of oxidising agent such as HNO<sub>3</sub> / HIO<sub>3</sub> / HgO which neutralises HI.

#### **Chlorination of methane :**

$$\begin{array}{c} CH_4 + 2Cl - Cl & \xrightarrow{u.v.light} \\ -2HCl & \rightarrow \\ CHCl_3 & \xrightarrow{-HCl} \\ CHCl_3 & \xrightarrow{-HCl} \\ CCl_4 \end{array}$$

#### (ii) Reaction based on free radical mechanism Nitration (a)

:

 $R - H + HONO_2 \xrightarrow{High} R - NO_2 + H_2O$ 

Nitrating mixture : (i)  $(Con.HNO_3 + Con.H_2SO_4)$  at

250°C

(ii)  $(HNO_3 \text{ vapour at } 400^\circ - 500^\circ C)$ .

(b) Sulphonation : Free radical mechanism  $R - H + HOSO_3H \xrightarrow{SO_3} R - SO_3H + H_2O$ 

□ Lower alkanes particularly methane, ethane, do not give this reaction.

## (iii) Oxidation

(a) Complete Oxidation or combustion :

$$C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \longrightarrow nCO_2 + (n+1)H_2O + Q$$

□ This is exothermic reaction.

(b) Incomplete combustion or oxidation

$$2CH_4 + 3O_2 \xrightarrow{Burn} 2CO + 4H_2O$$

$$CH_4 + O_2 \longrightarrow C + 2H_2O$$

(c) Catalytic Oxidation :  

$$CH_4 + [O] \xrightarrow{Cu-tube}{100 \text{ atm } / 200^{\circ}C} CH_3OH$$

This is the industrial method for the manufacture of methyl alcohol.

□ Higher alkanes are oxidised to fatty acids in presence of manganese stearate.

 $CH_3(CH_2)_n CH_3 \xrightarrow[100-160^\circ C]{} CH_3(CH_2)_n COOH$ 

(d) Chemical oxidation :

$$(CH_3)_3 CH \xrightarrow{KMnO_4} (CH_3)_3 .C.OH$$
  
Isobutane Tertiary buty l alcohol

(iv) Thermal decomposition or cracking or pyrolysis or fragmentation

$$CH_{4} \xrightarrow{1000^{\circ}C} C + 2H_{2}$$

$$C_{2}H_{6} \xrightarrow{500^{\circ}C} C_{C_{2}O_{3}+Al_{2}O_{3}} CH_{2} = CH_{2} + H_{2}$$
Ethane
$$C_{3}H_{8} \xrightarrow{C_{2}H_{4}} C_{2}H_{4} + CH_{4} \text{ or } C_{3}H_{6} + H_{2}$$

□ This reaction is of great importance to petroleum industry.

#### (v) Isomerisation :



## (vi) Aromatisation :



#### (vii) Step up reaction

(a) Reaction with  $CH_2N_2$  (Diazo methane) :

$$R - CH_2 - H + CH_2N_2 \xrightarrow{hv} R - CH_2 - CH_2 - H_2$$

(b) Reaction with  $CHCl_3 / NaOH$  :

$$R - CH_2 \xrightarrow{-H} \underbrace{\xrightarrow{-CHCl_3/OH^-}}_{:CCl_2} R - CH_2 - CHCl_2$$

(c) Reaction with  $CH_2 = C$  :  $\parallel$ O

$$R - CH_2 - H \xrightarrow{CH_2 = C/\Delta}_{:CH_2 - CO} R - CH_2 - CH_3$$

## (viii) HCN formation :

$$2CH_4 \xrightarrow{N_2/electricarc} 2HCN + 3H_2$$
 or

$$CH_4 + NH_3 \xrightarrow{Al_2O_3} HCN + 3H_2$$

(ix) Chloro sulphonation/Reaction with SO<sub>2</sub>+Cl<sub>2</sub>

$$CH_3 - CH_2 - CH_3 + SO_2 + Cl_2 \xrightarrow{u.v.light}$$

 $CH_3 - CH_2 - CH_2SO_2Cl + HCl$ 

This reaction is known as reed's reaction.

□ This is used in the commercial formation of detergent.

(x) Action of steam :  

$$CH_4 + H_2O \xrightarrow{Ni/Al_2O_3} CO + 3H_2$$

## Individual members of alkanes

#### (1) Methane : Known as marsh gas.

(i) *Industrial method of preparation* : Mathane gas is obtained on a large scale from natural gas by liquefaction. It can also be obtained by the application of following methods,

(a) From carbon monoxide : A mixture of carbonmonoxide and hydrogen is passed over a catalyst containing nickel and carbon at  $250 \degree C$  when methane is formed.

$$CO + 3H_2 \xrightarrow{Ni+C} CH_4 + H_2O$$

(b) Bacterial decomposition of cellulose material present in sewage water : This method is being used in England for production of methane.

 $(C_6H_{10}O_5)_n + nH_2O \longrightarrow 3nCH_4 + 3nCO_2$ Cellulose

(c) Synthesis :  $\Box$  By striking an electric arc between carbon electrodes in an atmosphere of hydrogen at 1200°C, methane is formed.

$$C + 2H_2 \xrightarrow{1200^{\circ}C} CH_4$$

By passing a mixture of hydrogen sulphide and carbon disulphide vapour through red hot copper, methane is formed.

$$CS_2 + 2H_2S + 8Cu \xrightarrow{High \ temperatur \ e} CH_4 + 4Cu_2S$$

(ii) Physical properties

(a) It is a colourless, odourless, tasteless and non-poisonous gas.

(b) It is lighter than air. Its density at NTP is 0.71 g/L.

(c) It is slightly soluble in water but is fairly soluble in ether, alcohol and acetone.

(d) Its melting point is  $-182.5^{\circ}C$  and boiling point is  $-161.5^{\circ}C$ .

#### (iii) Uses

(a) In the manufacture of compounds like methyl alcohol, formaldehyde, methyl chloride, chloroform, carbon tetrachloride, etc.

(b) In the manufacture of hydrogen, used for making ammonia.

(c) In the preparation of carbon black which is used for making printing ink, black paints and as a filler in rubber vulcanisation.

- (d) As a fuel and illuminant.
- (2) Ethane
- (i) Methods of preparation
- (a) Laboratory method of preparation :

 $\begin{array}{c} C_2H_5I + 2H \xrightarrow{Zn-Cu \ couple} \\ C_2H_5OH \xrightarrow{C_2H_6} HI \\ \text{Ethyliodide} \end{array}$ 

(b) Industrial method of preparation :

 $CH_2 = CH_2 + H_2 \xrightarrow{Ni}_{300^{\,o}C} CH_3 - CH_3$ Ethylene (ethene)

#### (ii) Physical properties

(a) It is a colourless, odourless, tasteless and non-poisonous gas.

(b) It is very slightly soluble in water but fairly soluble in alcohol, acetone, ether, etc.

(c) Its density at NTP is 1.34 g/L

(d) It boils at – 89°C. Its melting point is –172°C. (iii) **Uses** 

(a) As a fuel. (b) For making hexachloroethane which is an artificial camphor.

#### (3) Interconversion of Alkanes

# Ascent of alkane series,

## (i) Methane to ethane :

$$CH_{4} \xrightarrow{Cl_{2}} CH_{3}Cl \xrightarrow{Wurtzreaction} CH_{3} - CH_{3}$$
  
Methane  $UV \xrightarrow{UV} CH_{3}Cl \xrightarrow{Wurtzreaction} CH_{3} - CH_{3}$ 

#### (ii) Butane from ethane :

 $\begin{array}{ccc} C_2H_6 & \xrightarrow{Cl_2} & C_2H_5Cl & \xrightarrow{\text{Wurtz reaction}} & C_2H_5 - C_2H_5 \\ \hline \text{Ethane} & UV & \text{Ethylchloride} & \text{Heat with } Na \text{ in ether} & C_2H_5 - C_2H_5 \\ \hline \text{Butane} & \text{Bu$ 

**Descent of alkane series :** Use of decarboxylation reaction is made. It is a multistep conversion.

#### Ethane to methane

$$\begin{array}{ccc} C_2H_6 & \xrightarrow{Cl_2} & C_2H_5Cl & \xrightarrow{Aq.KOH} & C_2H_5OH & \xrightarrow{[O]} & CH_3CHO \\ \text{Ethane} \\ (\text{excess}) & & \text{Ethylchloride} & & \text{Ethylalcohol} & & \text{Acetaldehyde} \end{array}$$

 $\begin{array}{c} \hline [O] \longrightarrow CH_{3}COOH \xrightarrow{NaOH} \longrightarrow CH_{3}COONa \xrightarrow{NaOH/CaO} \longrightarrow CH_{4} \\ Aceticacid & Sodium acetate & heat & Methane \\ \hline Higher & \xrightarrow{Cl_{2}} & Alkyl \xrightarrow{Aq.} & Alcohol \xrightarrow{[O]} & Aldehyde \xrightarrow{[O]} & \\ alkane & \xrightarrow{VV} & halide & KOH \\ \hline Acid \xrightarrow{NaOH} & Sodium salt of \xrightarrow{NaOH/CaO} & Lower alkane \\ \end{array}$ 

Acid  $\xrightarrow{\text{Nachr}}$  Sodium salt of  $\xrightarrow{\text{Nachr}}$  Lower alkane the acid  $\xrightarrow{\text{heat}}$ 

#### Alkenes

These are the acyclic hydrocarbon in which carbon-carbon contain double bond. These are also known as olefins, because lower alkene react with halogens to form oily substances. General formula is  $C_nH_{2n}$ . Examples,  $C_2H_4, C_3H_6, C_4H_8$ .

(1) Preparation methods

(i) From Alkynes :

$$R - C \equiv C - R + H_2 \xrightarrow{\text{Lindlar's Cataly st}}_{Pd. BaSO_4} R - \stackrel{H}{C} = \stackrel{H}{C}_{R-R}$$

$$H H H H H H H H$$

$$R - C - C - H + Alc. KOH \xrightarrow{-HX} R - C = C - H$$

$$H X H$$

$$H X$$

$$H$$

$$H$$

□ If we use alc. *NaOH* in place of *KOH* then trans product is formed in majority because of its stability. According to saytzeff rule.

#### (iii) From dihalides

 $\hfill \Box$  If we take two different types of gemdihalides then we get three different types of alkenes .

□ Above reaction is used in the formation of symmetrical alkenes only.

$$\begin{array}{cccc} H & H & H & H & H \\ | & | & \\ R - C - C - H + Zn \, dust \xrightarrow{\Delta} R - C = C - H + ZnX_2 \\ | & | & \\ X & X \end{array}$$

□ Alkene is not formed from 1, 3 dihalides. Cycloalkanes are formed by dehalogenation of it.

(iv) By action of Nal on vicinal dihalide :

(v) *From alcohols* [Laboratory method] :

$$CH_{3}CH_{2}OH \xrightarrow{H_{2}SO_{4} \text{ or } H_{3}PO_{4}}{443 \text{ K}} CH_{2} = CH_{2} + H_{2}O$$
  
Ethylakohol Ethene

#### (vi) Kolbe's reaction :

$$\begin{array}{c} CH_2COOK & CH_2 \\ | & +2H_2O \xrightarrow{\text{Electroly is}} || & +2CO_2 + H_2 + 2KOH \\ CH_2COOK & CH_2 \\ \text{Potassium succinate} & \text{Ethene} \end{array}$$

(vii) From esters [Pyrolysis of ester] :

$$\begin{array}{c} CH_{3} - CO - O & H \\ \hline \\ CH_{2} - CH_{2} \end{array} \xrightarrow{\text{Glass wool 450}^{o}} \begin{array}{c} CH_{3} - COOH \\ + \\ CH_{2} = CH_{2} \end{array} \xrightarrow{H} \\ \end{array}$$

(viii) **Pyrolysis of quaternary ammonium compounds :** 

$$(C_2H_5)_4 N OH \xrightarrow{heat} (C_2H_5)_3 N + C_2H_4 + H_2O$$
  
Tetraethylammonium  
hydroxide (Tert. amine)

(ix) Action of copper alkyl on vinyl chloride :

$$H_2C = CHCl \xrightarrow{CuR_2} H_2C = CHR$$
  
Viny lchloride

(x) By Grignard reagents :

$$Mg \left\langle \begin{array}{c} R \\ +X - CH = CH_2 \longrightarrow MgX_2 + R - CH = CH_2 \\ \end{array} \right\rangle$$

(xi) The wittig reaction :

$$(Ph)_{3}P = CH_{2} + CH - R \xrightarrow{} (Ph)_{3}P = O + R - CH$$

$$|| \qquad \qquad || \\ O \qquad \qquad CH_{2}$$

$$O$$

$$(Ph)_{3}P = CH - R + CH - R \xrightarrow{||} (Ph)_{3}P = O + R - CH = CH - R$$

(xii) **From**  $\beta$  **bromo ether** [Boord synthesis]

#### (2) Physical Properties

(i) Alkenes are colourless and odourless.

(ii) These are insoluble in water and soluble in organic solvents.

(iii) Physical state

$$C_1 - C_4 \longrightarrow$$
 gas  
 $C_4 - C_{16} \longrightarrow$  liquid  
 $> C_{17} \longrightarrow$  solid wax

(iv) *B.P.* and *M.P.* decreases with increasing branches in alkene.

(v) The melting points of cis isomers are lower than trans isomers because cis isomer is less symmetrical than trans. Thus trans packs more tightly in the crystal lattice and hence has a higher melting point.

(vi) The boiling points of cis isomers are higher than trans isomers because cis-alkenes has greater polarity (Dipole moment) than trans one.

(vii) These are lighter than water.

(viii) **Dipole moment :** Alkenes are weakly polar. The,  $\pi$ -electron's of the double bond. Can be easily polarized. Therefore, their dipole moments are higher than those of alkanes.

## (3) Chemical properties

(i) **Francis experiment :** According to Francis electrophile first attacks on olefinic bond.

$$CH_{2} = CH_{2} + Br - Br \xrightarrow{CCl_{4}} CH_{2} -$$

$$\begin{array}{c|c} & & & \\ & & & \\ & & & \\ & & & \\ \hline & & & \\ & & & & \\ & & & \\$$

(ii) Reaction with hydrogen :

$$\begin{array}{ccc} H & H & H & H & H \\ | & | & \\ R - C = C - R + H_2 & \xrightarrow{Ni} & R - C - C - R \\ | & | \\ H & H \end{array}$$

(iii) **Reduction of alkene via hydroboration :** Alkene can be converted into alkane by protolysis

$$RCH = CH_2 \xrightarrow{H-BH_2} (R - CH_2 - CH_2)_3 B$$
$$\xrightarrow{H^+/H_2O} R - CH_2 - CH_3$$

**Hydroboration** : Alkene give addition reaction with diborane which called hydroboration. In this reaction formed trialkylborane, Which is very important and used for synthesis of different organic compound

$$3R - CH = CH_{2} + BH_{3} \longrightarrow$$

$$(R - CH_{2} - CH_{2})_{3}B \text{ Trialkyl borane}$$

$$(R - CH_{2} - CH_{2})_{3}B \text{ Trialkyl borane}$$

$$R - CH_{2} - CH_{3} R - CH_{2} - CH_{2}OH R - CH_{2} - CH_{3}$$

The overall result of the above reaction appears to be antimarkownikoff's addition of water to a double bond.

(iv) **By treatment with AgNO<sub>3</sub> + NaOH :** This reaction gives coupling

$$CH_{3} = CH_{2} - CH_{2} - CH_{2} - CH_{2} - CH_{2} - CH_{2} \xrightarrow{B_{2}H_{6}}$$

$$CH_{3} = CH_{3} - (CH_{2})_{2} - C - CH_{2}]_{3}B \xrightarrow{Ag/NO_{3}NaOH}$$

$$H$$

$$CH_{3} - CH_{2} - CH$$

(v) **Birch reduction :** This reaction is believed to proceed via anionic free radical mechanism.

$$R - CH = CH_2 \xrightarrow[+e^-]{Na} R - CH - CH_2 \xrightarrow[+e^-]{Et-O-H} R - CH - CH_3$$
$$\xrightarrow[+e^-]{Na} R - CH - CH_3 \xrightarrow[+e^-]{Et-O-H} R - CH_2 - CH_3$$

#### (vi) Halogenation

$$CH_{3}CH = CH_{2} + Cl_{2} \xrightarrow{500^{\circ}C} ClCH_{2} - CH = CH_{2} + HCl$$
Ally chloride
or 3-Chloro-1-propene

□ If NBS [N-bromo succinimide] is a reagent used for the specific purpose of brominating alkenes at the allylic position.

 $CH_2 - CO$   $CH_3 CH = CH_2 + |$   $CH_2 - CO$  N - Br PropeneNBS

$$CH_2 - CH = CH_2 + | CH_2 - CO$$

$$H = CH_2 + | CH_2 - CO$$

□ In presence of polar medium alkene form vicinal dihalide with halogen.



Reactivity of halogen is  $F_2 > Cl_2 > Br_2 > I_2$ (vii) **Reaction with HX** [Hydrohalogenation]



According to markownikoff's rule and kharasch effect.

$$CH_{3} - CH = CH_{2} + HBr \longrightarrow CH_{3} - C - C - H$$
$$| \qquad | \qquad |$$
$$Br H$$

According to Anti Markownikoff rule (Based on F.R.M.)  $CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}}$ 

(viii) Reaction with hypohalous acids :

$$CH_{2} = CH_{2} + H O Cl \longrightarrow CH_{2}OH.CH_{2}Cl$$
  
Ethy lene Chlorohy drin

□ In case of unsymmetrical alkenes markownikoff rule is followed.

(ix) Reaction with sulphuric acid :

$$CH_{2} = CH_{2} + H^{+}HSO_{4}^{-} \longrightarrow CH_{3}CH_{2}HSO_{4}$$
  
Ethy lene Ethy l hy drogen sulphate  
$$CH_{3}CH_{2}HSO_{4} \longrightarrow CH_{2} = CH_{2} + H_{2}SO_{4}$$

□ This reaction is used in the seperation of alkene from a gaseous mixture of alkanes and alkenes.

## (x) Reaction with nitrosyl chloride

$$C = C + NOCl \longrightarrow C - C - C < (NOCl is called)$$

Tillden reagent)

 $\hfill\square$  If hydrogen is attached to the carbon atom of product, the product changes to more stable oxime.



(xi) **Oxidation** : With alkaline  $KMnO_4$  [Bayer's reagent] : This reaction is used as a test of unsaturation.

$$\begin{array}{c|c} H & H & H & H & H \\ | & | \\ R - C = C - H + [O] + H - OH \xrightarrow{Alk \ KMnO_4} R - C - C - H \\ | & | \\ -OH & | \\ HO & OH \\ gly col \end{array}$$

With acidic  $KMnO_4$ :

$$\begin{array}{ccc} H & H & O \\ | & | \\ R - C = C - H + [O] \xrightarrow{acidic} & H - C - O - H + CO_2 + H_2O \end{array}$$

(xii) Hydroxylation

(a) Using per oxy acid :  

$$\begin{array}{cccc}
CH_{3} & CH_{3} \\
H - C & H_{2O_{2},HCOOH} \\
H - C & H - C - OH \\
H - C & HO - C - H \\
CH_{3} & CH_{3} \\
2-Butene & Trans (racemic) \\
\end{array}$$

$$\begin{array}{cccc}
R & H \\
(b) & Hydroxylation & by & OsO_{4} \\
O_{4} + NaHSO_{4} \xrightarrow{I} & P \\
\end{array}$$

:



\*\*

□ If per benzoic acid or peroxy acetic acid is used then oxirane are formed.

Combustion

:

(xiii)

$$C_n H_{2n} + \frac{3n}{2} O_2 \longrightarrow nCO_2 + nH_2O$$

They burn with luminous flame and form explosive mixture with air or oxygen.

(xiv) Ozonolysis



□ Application of ozonolysis : This process is quite useful to locate the position of double bond in an alkene molecule. The double bond is obtained by Joining the carbon atoms. of the two carbonyl compounds.

(xv) Oxy - mercuration demercuration : With mercuric acetate (in THF), followed by reduction with *NaBH*<sub>4</sub> / *NaOH* is also an example of hydration of alkene according to markownikoff's rule.

(xvi) Epoxidation

(a) By 
$$O_2 / Ag$$

$$CH_2 = CH_2 + \frac{1}{2}O_2 \xrightarrow{Ag} CH_2 - CH_2$$

(b) Epoxidation by performic acid or perbenzoic acid :





 $3R - CH = CH_2 + BH_3 \longrightarrow (R - CH_2 - CH_2)_3 B \xrightarrow{H_2O_2/OH^-} \rightarrow$ Tri alky 1 bora ne  $R - CH_2 - CH_2 - OH + B(OH)_3$ (Anti markownikoff's rule)

(xviii) Hydroformylation :

$$R - CH = CH_{2} + CO + H_{2} \xrightarrow{CoH(CO)_{4}} R - C - C - H$$

$$| \qquad | \qquad H \qquad C = O$$

$$| \qquad H$$

 $\Box$  If  $CO + H_2O$  is taken then respective acid is formed.

$$R - CH = CH_2 + CO + H_2O \xrightarrow{CoH(CO)_4} R - CH_2 - CH_2$$
  
|  
COOH

If in polymerisation zeigler- natta catalyst  $[(R)_3 Al + TiCl_4]$  is used then polymerisation is known as zeigler-natta polymerisation.

> (xxi) *Isomerisation* :  $CH_3 - CH_2 - CH_2 - CH = CH_2$   $\overrightarrow{AlCl_3}$  $CH_3 - CH_2 - CH = CH - CH_3$

The mechanism proceeds via carbocation. (xxii) Addition of HNO3:

$$CH_{2} = CH_{2} + HO - NO_{2} \longrightarrow CH_{2}OH.CH_{2}NO_{2}$$
  
Ethene  
(xxiii) Addition of Acetyl chloride :  

$$CH_{2} = CH_{2} + CH_{2}COCl \longrightarrow CH_{2}CICH_{2}COCH_{2}$$

$$CH_2 = CH_2 + CH_3COCI \longrightarrow CH_2CICH_2COCH_3$$
  
Ethene 4-Chlorobuta none -2  
(4) Uses

(i) For the manufacture of polythene - a plastic material; (ii) For artificial ripening of fruits; (iii) As a general anaesthetic; (iv) As a starting material for a large number of compounds such as glycol, ethyl halides, ethyl alcohol, ethylene oxide, etc; (v) For making poisonous mustard gas (War gas); (vi) For making ethylene-oxygen flame.

## Alkynes

These are the acyclic hydrocarbons which contain carbon-carbon triple bond are called alkynes. General formula is  $C_nH_{2n-2}$ . Ex. Ethyne  $CH \equiv CH$ ; Propyne  $CH_3 - C \equiv CH$ 

#### (1) General methods of preparation



 $\Box$  In reaction with gem dihalide, Alc. *KOH* is not used for elimination in 2<sup>nd</sup> step.

□ In reaction with vicinal dihalide, if the reactant is 2-butylene chloride then product is 2-butyne as major product.

**Preparation of higher alkynes** (by metal acetylide)

□ Acetylene gives salt with  $NaNH_2$  or  $AgNO_3$  (ammonical) which react with alkyl halide to give higher alkyne.

$$\Box 2CH \equiv CH \xrightarrow{NaNH_2} Na - C \equiv C - Na \xrightarrow{2CH_3I} CH_3 - C \equiv C - CH_3$$
$$\Box CH_3 - C \equiv CH + CH_3 - Mg - X \longrightarrow$$
$$CH_3 - C \equiv C - Mg - X + CH_4 \xrightarrow{R-X} CH_3 - C \equiv C - R + MgX_2$$
Alkyne

#### (2) Physical properties

(i) Acetylene is a colourless gas. It has a garlic odour. The odour is due to presence of impurities of phosphorous and hydrogen sulphide. However, pure acetylene has pleasant odour.

(ii) It is insoluble in water but highly soluble in acetone and alcohol. Acetylene is transported under

high pressure in acetone soaked on porous material packed in steel cylinders.

(iii) Its boiling point is  $-84^{\circ}C$ .

(iv) It is lighter than air. It is somewhat poisonous in nature.

(v) It burns with luminous flame and forms explosive mixture with air.

(3) **Chemical reactivity of alkynes :**  $C \equiv C$  is less reactive than the carbon-carbon double bond towards electrophilic addition reaction. This is because in alkyne carbon has more S-character so more strongly will be the attraction for  $\pi$  electrons. Alkyne also undergo nucleophilic addition with electron rich reagents. Ex. Addition of water, cyanide, carboxylic acid, alcohols. Nucleophilic addition can be explained on the basis that alkynes form vinylic carbanion which is more stable than alkyl carbanion formed by alkene

$$Nu$$

$$| \qquad 0$$

$$C \equiv C - + Nu^{-} \longrightarrow -C = C^{-}$$
Vinylic carbanion
(more stable)
$$Nu$$

$$| \qquad 0$$

$$Nu$$

$$| \qquad 0$$

$$(alkyl carbanion)$$
(less stable)

(i) *Acidity of alkynes* : Acetylene and other terminal alkynes (1- alkynes) are weakly acidic in character

Ex. 
$$CH \equiv CH + NaNH_2 \longrightarrow H - C \equiv \overline{C}Na^+ + \frac{1}{2}H_2$$

(Monosodium acetylide)

The acetylenic hydrogen of alkynes can be replaced by copper (I) and silver (I) ions. They react with ammonical solutions of cuprous chloride and silver nitrate to form the corresponding copper and silver alkynides.

$$CH = CH + 2[Cu(NH_3)_2]Cl \longrightarrow Cu - C = C - Cu + 2NH_4Cl + 2NH_3$$
  
Dicopper acetylide (Red ppt)

$$CH = CH + 2[Ag(NH_3)_2]NO_3 \longrightarrow AgC = C - Ag + 2NH_4NO_3 + 2NH_3$$
  
Disilver acetylide (white ppt)

This reaction can be used to distinguish between 2-alkynes and 1-alkynes. 1-alkynes will give this test while 2-alkynes, will not give this test.

$$CH_3 - C \equiv CH + 2[Ag(NH_3)_2]NO_3 \longrightarrow CH_3 - C \equiv C - Ag$$
  
1-propy ne

$$CH_3 - C \equiv C - CH_3 + 2[Ag(NH_3)_2]NO_3 \longrightarrow NO_3$$

reaction

Explanation for the acidic character : It explained by *sp* hybridisation. We know that an electron in s – orbital is more tightly held than in a p orbital. In *sp* hybridisation *s* -character is more (50%) as compared to  $sp^2$  (33%) or  $sp^3$  (25%), due to large *s* -character the carbon atom is quite electronegative.

(ii) Reaction with formaldehyde

$$HC \equiv CH + 2CH_2O \longrightarrow CH_2 - C \equiv C - CH_2 \xrightarrow{II/NH_3} \\ | \\ OH \\ OH \\ CH_2 - CH = CH - CH_2OH$$
[Trans-product]  
|  $OH$ 

(4) Chemical properties of acetylene

0 11

$$\begin{array}{c|c} \hline Red hot & C_{6}H_{6} \\ \hline Renzene \\ \hline MH_{3} & C_{4}H_{3}N + H_{2} \\ \hline NH_{3} & C_{4}H_{4}S \\ \hline Thiophene \\ \hline AO^{+}_{C} & CH_{3}CHO \\ \hline NH_{3}COH & CH_{3}CHO \\ \hline Mg^{2+}, 80^{\circ}C & CH_{3}CHO \\ \hline Hg^{2+}, 80^{\circ}C & Acculatebylae \\ \hline CH = CH \\ \hline CL_{2} & CHCl_{2} & Alc. & CHCl_{2} \\ \hline Hg^{2+}, 80^{\circ}C & CHCl_{2} \\ \hline CHCl_{2} & CHCl_{2} & CHCl_{2} \\ \hline CHCl_{2} & CHCl_{2} & CHCl_{2} \\ \hline CHCl_{3} & CHCl_{4} \\ \hline CHCl_{3} & CHCl_{4} \\ \hline CHASCl_{2} & CHCl \\ \hline Hg^{2+} & CH_{2} = CHOOCCH_{3} \\ \hline Hg^{2+}/HCl & CH_{2} = CHCl \\ \hline O^{+}_{Viny | choride} \\ \hline Hg^{2+}/HCl & CH_{2} = CHCl \\ \hline O^{+}_{Viny | choride} \\ \hline HCN & CH_{2} = CHCN \\ \hline Ba(CN) & Viny | choride \\ \hline HCN & CH_{2} = CHCN \\ \hline NH_{4}Cl & Chloroprene \\ \hline CU_{2}O & Cuprene \\ \hline \hline MH_{4}Cl & Chloroprene \\ \hline CU_{2}O & Cuprene \\ \hline MH_{4}Cl & Chloroprene \\ \hline MH_{4}Cl$$

**Oxidative-Hydroboration** : Alkynes react with  $BH_3$  (in THF) and finally converted into carbonyl compounds.

$$3CH_{3} - C \equiv CH \xrightarrow{BH_{3} / THF} (CH_{3} - CH = CH)_{3}B \xrightarrow{H_{2}O_{2}} OH^{-}$$
Propy ne
$$CH_{3} - CH = CHOH \xrightarrow{Tautomeris es} CH_{3}CH_{2}CHO$$
(Propanal)
$$O$$
or
$$H_{2}SO_{4} \rightarrow CH_{3} - C - CH_{3}$$
(Acetone)

Thus it is useful for preparing aldehyde from terminal alkyne.

Reduction of Alkyne : Alkynes add on hydrogen in presence of suitable catalysts like finely divided Ni, Pd.

$$CH \equiv CH + H_2 \xrightarrow{Ni} CH_2 = CH_2 \xrightarrow{Ni} H_2 \rightarrow CH_3 - CH_3$$

If the triple bond is not present at the end of the carbon chain of the molecule, the alkene formed may be cis and trans depending upon the choice of reducing agents.

With  $Na/NH_3$  or  $Li/NH_3$  in (liquid ammonia) trans alkene is almost an exclusive product while catalytic reduction at alkyne affords mainly cis alkenes.



**Degree of unsaturation :** The number of degree of unsaturation in a hydrocarbon is given by

 $\frac{2n_1+2-n_2}{2}$ , Where  $n_1$  is the number of carbon

atoms;  $n_2$  is the number of hydrogen atoms.

For example in  $C_6H_{12}$ , the degree of unsaturation is  $=\frac{2 \times 6 + 2 - 12}{2} = 1$ 

#### Tests of unsaturation

(a) Baeyer's reagent : It is  $1\% KMnO_4$  solution containing sodium carbonate. It has pink colour. An aqueous solution of the compound, a few drops of Baeyer's reagent are added, the pink colour of the solution disappears. The decolourisation of pink colour indicates the presence of unsaturation in the compound.

Alkene without any hydrogen atom on the carbon forming the double bond  $\begin{array}{c} R & R \\ C = C \\ R \end{array}$  don't  $R \\ \end{array}$ 

show this test.

(b) *Bromine- carbon tetrachloride test* : The compound is dissolved in carbon tetrachloride or chloroform and then a few drops of 5% bromine solution in carbon tetrachloride are added to it, the colour of bromine disappears. It indicates the presence of unsaturation.

□ This test also fails in the case of alkene of the R C = C R.

(5) **Uses** 

(i) Acetylene is used as an illuminant.

(ii) It is used for the production of oxy-acetylene flame. The temperature of the flame is above  $3000 \,^{\circ}C$ . Is is employed for cutting and welding of metals.

(iii) Acetylene is used for artificial ripening of fruits.

(iv) It is used as a general anaesthetic under the name naracylene.

(v) Acetylene has synthetic applications. It serves as a starting material for the manufacture of a large variety of substances.

(vi) On electrical decomposition acetylene produces finely divided carbon and hydrogen. Hydrogen is used in airships.  $C_2H_2 \longrightarrow 2C + H_2$ 

(6) Interconversion

(i) **Conversion of ethane into ethene :** (Alkane into alkene)

$$CH_{3} - CH_{3} \xrightarrow{Br_{2}} C_{2}H_{5}Br \xrightarrow{Alc.} CH_{2} = CH_{2}$$
  
Ethane 
$$CH_{3} \xrightarrow{Br_{2}} C_{2}H_{5}Br \xrightarrow{Alc.} CH_{2} = CH_{2}$$

(ii) Ethene into ethane : (Alkene into alkane)

$$CH_{2} = CH_{2} \xrightarrow[Ni, 300^{\circ}C]{H_{2}} CH_{3} - CH_{3}$$
  
Ethane

(iii) **Ethane into ethyne (acetylene) :** *i.e.,* alkane into alkyne

$$CH_{3} - CH_{3} \xrightarrow{Br_{2}} CH_{3}CH_{2}Br \xrightarrow{Alc.} CH_{2} = CH_{2} \xrightarrow{Br_{2}} CH_{4}$$

$$CH_{2}Br - CH_{2}Br \xrightarrow{Alc.KOH} CH \equiv CH_{1}$$

$$CH_{2}Br - CH_{2}Br \xrightarrow{Alc.KOH} CH \equiv CH_{1}$$

 $CH \equiv CH \xrightarrow{H_2} CH_2 \xrightarrow{H_2} CH_2 = CH_2 \xrightarrow{H_2} CH_3 - CH_3$ Ethene  $Ni, 300^{\circ}C$  Ethene  $Ni, 300^{\circ}C$  Ethene

VON

г*т*т

(v) Ethene into propene : Ascending in alkene series

\*\*\*

$$CH_{2} = CH_{2} \xrightarrow{HI} CH_{3}CH_{2}I \xrightarrow{KCV} CH_{3}CH_{2}CN \xrightarrow{[H]} Reduction$$

$$CH_{3}CH_{2}CH_{2}NH_{2} \xrightarrow{HNO_{2}} CH_{3}CH_{2}CH_{2}OH \xrightarrow{[-Propanol]} CH_{3}CH_{2}CH_{2}NH_{2} \xrightarrow{HNO_{2}} CH_{3}CH_{2}CH_{2}OH \xrightarrow{[-Propanol]} CH_{3}CH = CH_{2} \xleftarrow{Alc.} CH_{3}CH_{2}CH_{2}Br \xleftarrow{PBr_{3}}$$

or

$$CH_{2} = CH_{2} \xrightarrow{HI} CH_{3}CH_{2}I \xrightarrow{Li(CH_{3})_{2}Cu} CH_{3}CH_{2}CH_{3}$$

$$\xrightarrow{Cl_{2}} CH_{3}CH_{2}CH_{2}CL_{2}Cl \xrightarrow{Alc.} CH_{3}CH_{2}CH_{2}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{2}CH_{3}CH_{3}CH_{2}CH_{3}CH$$

(vi) **Propene into ethene :** Descending an alkene series

$$CH_{3} - CH = CH_{2} \xrightarrow{O_{3}/H_{2}O} CH_{3}CHO \xrightarrow{[H]}_{\text{Ethanal}} \xrightarrow{[H]}_{\text{LiAlH}_{4}}$$
$$CH_{3}CH_{2}OH \xrightarrow{H_{2}SO_{4}}_{\text{Ethanol}} CH_{2} = CH_{2}$$

(vii) Acetylene into propyne (methyl acetylene) : (Ascent)

$$CH \equiv CH \xrightarrow{Na} CH \equiv CNa \xrightarrow{CH_3I} CH \equiv C - CH_3$$

$$Acety lide \xrightarrow{Monosodium} acety lide \xrightarrow{CH_3I} CH \equiv C - CH_3$$
Propy ne

(viii) Propyne into acetylene : (Descent)

$$CH_{3}C = CH \xrightarrow{\text{Lindlar's catalyst}} CH_{3}CH = CH_{2} \xrightarrow{O_{3}/H_{2}O} Propy \text{ lene}$$

$$CH_{3}CHO \xrightarrow{PCl_{5}} CH_{3}CHCl_{2} \xrightarrow{Alc.} CH = CH_{Acetylene}$$

$$CH_{3}CHO \xrightarrow{PCl_{5}} CH_{3}CHCl_{2} \xrightarrow{Alc.} CH = CH_{Acetylene}$$

(ix) 1-Butyne into 2-pentyne : (Ascent)

 $CH_{3}CH_{2}C \equiv CH \xrightarrow{NaNH_{2}} CH_{3}CH_{2}C \equiv C - Na \xrightarrow{CH_{3}I}$ 

$$CH_3CH_2 - C \equiv CCH_3$$
  
2-Pentyne

(x) **1-Butyne into 2-pentanone :** (Not more than three steps)

$$CH_{3}CH_{2}C \equiv CH \xrightarrow{NaNH_{2}} CH_{3}CH_{2}C \equiv CNa \xrightarrow{CH_{3}I} O$$

$$O$$

$$CH_{3}CH_{2}C \equiv CCH_{3} \xrightarrow{H_{2}O, H_{2}SO_{4}} CH_{3}CH_{2}CH_{2}CH_{2}CH_{3}C$$

## Separation of alkane, alkene and alkyne

The gaseous mixture is passed through ammonical cuprous chloride solution. The alkyne (acetylene) reacts with  $Cu_2Cl_2$  and forms a red precipitate. It is filtered. The alkyne or acetylene is **Distinction between alkanes, Alkenes and Alkynes** 

recovered by decomposition of the precipitate with an acid.

$$\begin{split} C_2H_2 + Cu_2Cl_2 + 2NH_4OH &\rightarrow C_2Cu_2 + 2NH_4Cl + 2H_2O \\ (\text{Red ppt.}) \end{split}$$

$$C_2Cu_2 + 2HNO_3 &\rightarrow C_2H_2 + Cu_2(NO_3)_2 \end{split}$$

The remaining gaseous mixture is passed through concentrated  $H_2SO_4$ . Alkene is absorbed. The Hydrogen sulphate derivatives is heated at 170°C to regenerate ethene.

$$C_2H_4 + H_2SO_4 \longrightarrow C_2H_5HSO_4 \xrightarrow{\Lambda} C_2H_4 + H_2SO_4$$

The methane or ethane is left behind unreacted.

Table : 24.3

Property	Alkane (Ethane)	Alkene (Ethene)	Alkyne (Ethyne)
Molecular formula	$C_n H_{2n+2}(C_2 H_6)$	$C_nH_{2n}(C_2H_4)$	$C_n H_{2n-2}(C_2 H_2)$
Nature	Saturated	Unsaturated	Unsaturated
	Single bond between carbon atoms. Each carbon atom is $sp^{3}$ -hybridized	Double bond between two carbon atoms. Both carbon atoms are $sp^2$ -hybridized	Triple bond between two carbon atoms both carbon atoms are <i>sp</i> - hybridized -C = C -
	Rond length 1 54 Å	1.24 Å	120 Å
	Bond energy : 83 Kcal mol <sup>-1</sup>	1.34 A 146 Kcal mol <sup>-1</sup>	200 Kcal mol <sup>-1</sup>
Burning	Burns with nonluminous	Burns with luminous flame	Burns with smoky flame
	flame	$C_2H_4+3O_2 \rightarrow 2CO_2+2H_2O$	$C_2H_2+5/2O_2 \rightarrow 2CO_2+H_2O$
	$C_2H_6+7/2O_2 \to 2CO_2+3H_2O$		
Reaction with $H_2$	-	Forms alkane	Forms alkene and alkane
		$C_nH_{2n} + H_2 \xrightarrow{Ni} C_nH_{2n+2}$ $300^{\circ}C$ Alkane	$C_nH_{2n} + H_2 \xrightarrow{Ni} C_nH_{2n+2}$ $300^{\circ}C$ Alkane
		$C_2H_4 + H_2 \to C_2H_6$	$C_n H_{2n-2} + H_2 \xrightarrow{Ni} C_n H_{2n}$ 300° C Alkene
Reation with conc.	-	Addition	Addition
$H_2SO_4$ and hydrolysis		$C_2H_4 + H_2SO_4 \rightarrow C_2H_5HSO_4$	$C_2H_2 \rightarrow CH_3CH(HSO_4)_2 \xrightarrow{H_2O} \rightarrow$
		$\xrightarrow{H_2O} C_2H_5OH$ Alcohol	<i>CH₃CHO</i> Aldehyde
$Br_2/CCl_4$	-	Decolourises	Decolourises
		Dibromo derivative,	Tetrabromo derivative,
		$C_2H_4 + Br_2 \to C_2H_4Br_2$	$C_2H_2Br_4$
Baeyer's reagent (Alk.	-	Decolourises	Decolourises
KMnO <sub>4</sub> )		Glycol is formed	Oxalic acid is formed
		$CH_2$ $CH_2OH$	СН СООН
		$   + H_2 O + O \rightarrow  $	$    + 4O \rightarrow  $
		$CH_2$ $CH_2OH$	СН СООН

Ammonical Cu <sub>2</sub> Cl <sub>2</sub>	-	-	Red precipitate	
			СН	ССи
			$    + Cu_2Cl_2 + 2$	$2NH_4OH \rightarrow \parallel \parallel$
			СН	CCu (Red)
				+ $2NH_4Cl + 2H_2O$
Ammonical silver	-	-	White precipitate	e
nitrate			СН	C - Ag
			$    + 2AgNO_3 + 2N$	${}^{V\!H}_{4}OH \rightarrow \parallel \parallel$
			СН	C - Ag
				+ $2NH_4Cl$ + $2H_2O$

#### Cycloalkane

## (1) Methods of preparation

(i) *From dihalogen compounds* (Freund reaction):



## (ii) From alkenes :







#### (2) Physical properties

(i) First two members are gases, next three members are liquids and higher ones are solids.

(ii) They are insoluble in water but soluble in alcohol and ether.

(iii) Their boiling points show a gradual increase with increase of molecular mass. Their boiling points are higher than those of isomeric alkenes or corresponding alkanes.

(iv) Their density increase gradually with increase of molecular mass.

(3) **Chemical properties :** Cycloalkanes behave both like alkenes and alkanes in their chemical properties. All cycloalkanes undergo substitution reaction with halogen in the presence of light (like alkane). All cycloalkane (lower members) undergo addition reaction (ex. Addition of  $H_2, HX, X_2$ ). Further the tendency of forming addition compounds decreases with increase in size of ring cyclopropane > Cyclobutane > Cyclopentane. Relative ring opening of ring is explained by Baeyer strain theory.

(i) *Addition in spiro cycloalkane* : If two cycloalkane fused with one another then addition take place in small ring



## Spiro compound

Because small ring is more unstable than large ring

Higher cycloalkanes do not give addition due to more stability.

#### (ii) Free radical substitution with Cl<sub>2</sub>

$$\begin{array}{c} CH_2 - CH_2 + Cl_2 \xrightarrow{hv} CH_2 - CH \ Cl + HCl \\ CH_2 \\ Cy \ clopropane \end{array} \xrightarrow{hv} CH_2 - CH \ Cl + HCl \\ CH_2 \\ Chlorocy \ clopropane \end{array}$$

#### (iii) Addition reaction









Cycloalkenes can be easily obtained by Diels-Alder reaction. These compounds undergo the electrophilic addition reactions which are characteristic of alkenes, while the ring remains intact. Cycloalkenes decolourise the purple colour of dilute or <u>red</u> colour nine in carbon cold Br tetrach Cyclopentene Br 1, 2-Dibromo cyclopentane KMnO<sub>4</sub>(aq.) ОН Cyclopent-1-OHCyclopentane 1,2- $CH_2$ СНО  $CH_2$ СНО (Cyclohexene)  $CH_2$  $CH_{2}$ 

## Dienes

These are hydrocarbon with two carbon-carbon double bonds. Dienes are of three types

(1) Conjugated dienes : Double bonds are seperated by one single bond.

Ex :  $CH_2 = CH - CH = CH_2$  (1, 3-butadiene)

(2) Cumulative dienes : Double bonds are adjacent to each other.

Ex :  $CH_2 = C = CH_2$  Propadiene [allene]

(3) Isolated or Non-conjugated : Double bonds are separated by more than one single bond.

Ex :  $CH_2 = CH - CH_2 - CH = CH_2$  (1, 4 pentadiene)

The general formula is  $C_n H_{2n-2}$ . The

predominant member of this class is 1, 3-butadiene.

(1) Method of preparation

(i) From acetylene :

$$2HC = CH \xrightarrow{Cu_{2}C_{3}} HC = C - CH = CH_{2} \xrightarrow{H_{2}} \frac{H_{2}}{M/4BO_{3}}$$

$$CH_{2} = CH - CH = CH_{2}$$

$$(ii) From 1, 4-dichlorobutane :$$

$$CI \qquad CI$$

$$CH_{2} CH_{2}CH_{2}CH_{2} \xrightarrow{Alc. KOH} CH_{2} = CH - CH = CH_{2}$$

$$I, 3-Bundiene$$

$$(iii) From 1, 4-butanediol :$$

$$OH \qquad OH$$

$$CH_{2}CH_{2}CH_{2}CH_{2} \xrightarrow{M_{2}O_{4}} CH_{2} = CH - CH = CH_{2}$$

$$I, 3-Bundiene$$

$$(iv) From butane :$$

$$CH_{3}CH_{2}CH_{2}CH_{2}CH_{2} \xrightarrow{M_{2}O_{4}} CH_{2} = CH - CH = CH_{2}$$

$$I, 3-Bundiene$$

$$(iv) From butane :$$

$$CH_{3}CH_{2}CH_{2}CH_{3} \xrightarrow{Cudyst} CH_{2} = CH - CH = CH_{2}$$

$$I, 3-Bundiene$$

$$(iv) From cyclohexene :$$

$$(iv) From cyclohexene :$$

$$(i) Addition of halogens :$$

$$(i) Addition of halogens :$$

$$(i) Addition of halogen acids :$$

$$(i) Addition of halogen acids :$$

$$(ii) Addition of halogen acids :$$

$$(iii) Addition of water :$$

$$(iii) Addition of (CH_{2} CH_{2} - CH_{2} - CH_{2} - CH_{2}$$

(Adduct)

С

**Stability of conjugated dienes** : It is explained on the basis of delocalisation of electron cloud between carbon atoms.

The four  $\pi$  electrons of 1, 3-butadiene are delocalised over all the four atoms. This delocalisation of the  $\pi$  electrons makes the molecule more stable.



(v) Ozonolysis :



# Aromatic Hydrocarbon

## (1) Source of Arenes

Source of arenes is coal. It contains benzene, xylene, naphthalene etc. Arenes are obtained by destructive distillation of coal.

# (2) Distillation of coal





#### • Coal tar is a mixture of large numbers of arenes.

(3) **Distillation of coal tar :** Arenes are isolated by fractional distillation of coal tar, **Table :** 24.4

	10010 1 -1	•1
Name of the	Temperature	Main constituents
fraction	range (K)	
Light oil (or	Upto 443	Benzene, toluene,
crude oil)		xylene
fraction		
Middle oil	443-503	Phenol, naphthalene,
fraction		pyridine
(Carbolic oil)		
Heavy oil	503-543	Naphthalene, naphthol
fraction		and cresol
(Creosote oil)		
Green oil	543-633	Anthracene,
(Anthracene oil)		phenanthrene
Pitch (left as	Non-volatile	Carbon
residue)		

□ The residue left after fractional distillation of coal-tar is called pitch.

#### (4) Isolation of benzene



#### General characteristics of arenes

(1) All arenes have general formula  $[C_nH_{2n}-6y]$ . Where *y* is number of benzene rings and *n* is not less than 6.

(2) Arenes are cyclic and planar. They undergo substitution rather than addition reactions.

(3) Aromaticity or aromatic character : The characteristic behaviour of aromatic compounds is called aromaticity. Aromaticity is due to extensive delocalisation of  $\pi$ -electrons in planar ring system. Huckel (1931) explained aromaticity on the basis of following rule.

**Huckel rule :** For aromaticity the molecule must be planar, cyclic system having delocalised  $(4n + 2)\pi$  electrons where *n* is an integer equal to 0, 1, 2, 3,-----.

Thus, the aromatic compounds have delocalised electron cloud of 2,6,10 or 14  $\pi$  electrons.



electrons

electrons

Similarly cyclolpentadienyl anion or tropylium ion are also aromatic because of containing  $6\pi$  electrons



Hetrocyclic compounds also have  $6\pi$  electrons (n = 1).



Molecules do not satisfy huckel rule are not aromatic.



(4) Antiaromaticity : Planar cyclic conjugated species, less stable than the corresponding acyclic unsaturated species are called antiaromatic. Molecular orbital calculations have shown that such compounds have  $4n\pi$  electrons. In fact such cyclic compounds which have  $4n\pi$  electrons are called antiaromatic compounds and this characteristic is called antiaromaticity.

*Example* : 1,3-Cyclobutadiene, It is extremely unstable antiaromatic compound because it has  $4n\pi$  electrons (n = 1) and it is less stable than 1,3 butadiene by about 83.6 *KJ* mol<sup>-1</sup>.



Thus, cyclobutanediene shows two equivalent contributing structures and it has n = 1.



## Benzene ( $C_6H_6$ )

Benzene is the first member of arenes. It was first discovered by Faraday (1825) from whale oil. Mitscherllich (1833) obtained it by distillating benzoic acid with lime. Hofmann (1845) obtained it from coal tar, which is still a commercial source of benzene.

(1) **Structure of benzene :** Benzene has a special structure, which is although unsaturated even then it generally behave as a saturated compound.

(i) *Kekule's structure* : According to Kekule, in benzene 6-carbon atoms placed at corner of hexagon and bonded with hydrogen and double bond present at alternate position.

(a) Evidence in favour of Kekule's structure

• Benzene combines with 3 molecules of hydrogen or three molecules of chlorine. It also combines with 3 molecules of ozone to form triozonide. These reactions confirm the presence of three double bonds.

• Studies on magnetic rotation and molecular refraction show the presence of three double bonds and a conjugated system.

• The synthesis of benzene from three molecule of acetylene also favour's Kekule's structure.

$$3CH = CH \xrightarrow{\Delta}$$

• Benzene gives cyclohexane by reduction with hydrogen.



(b) Objections against Kekule's formula

• Unusual stability of benzene.

• According to Kekule, two ortho disubstituted products are possible. But in practice only one ortho disubstituted product is known.

• Heat of hydrogenation of benzene is 49.8 *kcal/mole,* whereas theoretical value of heat of hydrogenation of benzene is 85.8 *kcal/mole.* It means resonance energy is 36 *kcal/mole.* 



• C-C bond length in benzene are equal, (although it contains 3 double bonds and 3 single bonds) and are 1.39 Å.

Kekule explained this objection by proposing that double bonds in benzene ring were continuously oscillating between two adjacent positions.



## (2) Methods of preparation of benzene

(i) Laboratory method :



#### (ii) From benzene derivatives

(a) From phenol :



(b) From chlorobenzene :



(c) By first preparing grignard reagent of chlorobenzene and then hydrolysed

$$C_{6}H_{5}Cl \xrightarrow{M_{g}} C_{6}H_{5}MgCl \xrightarrow{H_{2}O} C_{6}H_{6} + Mg \xrightarrow{OH} Cl$$
Chlorobenz ene chloride

0.11

(d) From benzene sulphonic acid :



(e) From benzene diazonium chloride :



(f) From acetylene :



Cyclic polymerisation takes place in this reaction.

(g) Aromatisation  $Cr_2O_3 / Al_2O_3$  $C_{6}H_{14}$  - $\rightarrow C_6 H_6 + 4 H_2$ 500°C Benzene n-Hexane at high pressure

#### (3) Properties of benzene

## (i) Physical properties

(a) Benzene is a colourless, mobile and volatile liquid. It's boiling point is 80°C and freezing point is 5.5°C. It has characteristic odour.

(b) It is highly inflammable and burns with sooty flame.

(c) It is lighter than water. It's specific gravity at 20°C is 0.8788.

(d) It is immiscible with water but miscible with organic solvents such as alcohol and ether.

(e) Benzene itself is a good solvent. Fats, resins, rubber, etc. dissolve in it.

(f) It is a non-polar compound and its dipole moment is zero.

(g) It is an extremely poisonous substance. Inhalation of vapours or absorption through skin has a toxic effect.

(ii) Chemical properties : Due to the presence of  $\pi$  electron clouds above and below the plane benzene ring, the ring serves as a source of electrons and is easily attacked by electrophiles (Electron loving reagents). Hence electrophilic substitution reaction are the characteristic reactions of aromatic compounds.

Substitution reactions in benzene are prefered rather than addition are due to the fact that in the former reactions resonance stabilised benzene ring system is retained while the addition reactions lead to the destruction of benzene ring. Principal reactions of benzene can be studied under three heads,

(a) Addition reactions

(b) Substitution reactions

(c) Oxidation reactions

(a) Addition reactions : In which benzene behaves like unsaturated hydrocarbon.

Addition of hydrogen : Benzene reacts with hydrogen in the presence of nickel (or platinum) as catalyst at 150°C under pressure to form cyclohexane.



 $NH_3$ 

\*H

 $NH_2$ 



Benzene hexachloride (BHC)

Y<sup>−</sup> attaches to the

charged carbon atom

(Fas

Y



(b) Substitution reactions :

Nucleophilic substitution :

Unimolecular : Mostly uncommon in aromatic substitution, there is only one example which obtain in benzene diazonium dichloride. HOH



Y Ζ

or

• Bimolecular :

Ζ

Υ Ζ



undergoes this reaction because it is an electron rich system due to delocalized  $\pi$ - electrons.





Example :

Cl

– HCl



Elimination-addition mechanism (Benzyne • mechanism)

(Benzen

$Cl^+$	Chloronium	$Cl_2 + AlCl_3$ or $FeCl_3$	Chlorination
$Br^+$	Bromonium	$Br_2 + AlBr_3$ or $FeBr_3$	Bromination
$NO_2^+$	Nitronium	$HNO_3 + H_2SO_4$	Nitration
SO <sub>3</sub>	Sulphur trioxide	Conc. $H_2SO_4$ , Fuming sulphuric acid	Sulphonation
$R^+$	Alkyl carbonium	$RX + AlX_3 (X = Cl \text{ or } Br), ROH + H^+$	Friedel-Craft's (Alkylation)
$R-\overset{+}{C}=O$	Acyl carbonium	$RCOCl + AlCl_3$	Friedel-Craft's (Acylation)

• Free radical aromatic substitution : The aromatic substitution reactions which follow free radical mechanisms are very few and have limited synthetic value. But some typical example of these reactions are:



The mechanism of chlorination of benzene at high temperature is similar to that of the free radical aliphatic substitution

 $Cl_{2} \longrightarrow \dot{C}l + \dot{C}l \text{ (Chain initiation)}$   $C_{6}H_{6} + \dot{C}l \longrightarrow \dot{C}_{6}H_{5} + HCl \text{ (H- abstraction)}$   $\dot{C}_{6}H_{5} + Cl_{2} \longrightarrow C_{6}H_{5}Cl + \dot{C}l \text{ (Chain propagation)}$   $(c) \text{ Oxidation } : 2C_{6}H_{6} + 15O_{2} \longrightarrow 12CO_{2} + 6H_{2}O$   $\Delta H = 6530 \text{ kJ/mole}$ 

When vapours of benzene and air are passed over vanadium pentoxide at  $450 - 500^{\circ}C$ , maleic anhydride is obtained.

$$C_6H_6 + 9[O] \xrightarrow{V_2O_5} H_{450-500^{\circ}C} CHCO > O + 2CO_2 + 2H_2O$$
  
Maleic anhy dride

 $\square$  Strong oxidising agents converts benzene slowly into  $CO_2$  and water on heating.

(d) Reduction :



(iii) **Uses**: (a) In dry cleaning (b) As a motor fuel when mixed with petrol. (c) As a solvent. (d) In the manufacture of gammexane (As insecticide). (e) In the preparation of nitrobenzene, chlorobenzene, benzene sulphonic acid, aniline, styrene, etc. Many of these are employed for making dyes, drugs, plastics, insecticides, etc.

## Directive effect in substituted benzene derivatives

(1) **Directive effect in mono substituted benzene derivatives :** The substituent already present on the benzene ring directs the incoming substituent to occupy ortho (2 or 6), meta (3 or 5) or para (4) position. This direction depends on the nature of the first substituent and is called *directive or the orientation effect.* 

The substituent already present can increase or decrease the rate of further substitution, *i.e.*, it either activates or deactivates the benzene ring towards further substitution. These effects are called **activity** *effects*.

There are two types of substituents which produce directive effect are,

(i) Those which direct the incoming group to ortho- and para-positions simultaneously (Neglecting meta all together).

(ii) Those which direct the incoming group to meta-position only (Neglecting ortho- and para-

Ortho-para directors	Meta directors
	Moderately deactivating
Strongly activating $-NH_2, -NHK, -NK_2OH, -O:$	$-C \equiv N, -SO_3H, -COOH, -COOR, -CHO, COR$
Moderately activating – NHCOCH 3, – NHCOROCH3, – OR	Strongly deactivating $-NO_2$ , $-NR_3^{\oplus}$ , $-CF_3$ , $-CCl_3$
Weakly activating $-CH_3, -C_2H_5, -R, -C_6H_5$	
Weakly deactivating $F: - Cl: - Br: - I:$ ,	

Theory of ortho - para directing group



The above mechanism is followed when S is -OH,  $-NH_2$ , -Cl, -Br, -I, -OR,  $-NR_2$ , -NHCOR etc.



In methyl or alkyl group, the +I effect of the methyl group or alkyl group initiates the resonance effect.

Thus, methyl or alkyl group directs all electrophiles to ortho and para positions.

Theory of meta directing group : The substituent, S withdraws electrons from ortho and para positions. Thus, *m*-position becomes a point of relatively high electron density and further substitution by electrophile occurs at meta position. For example, directing (Electron  $-NO_2$ group is a meta withdrawing). Its mechanism can be explained as :



positions all together).



All meta-directing groups have either a partial positive charge or a full positive charge on the atom directly attached to the ring.

## (2) Directive effect in disubstituted benzene

(i) If the directive effects of two substituents reinforce, then a single product is formed.

Example :



Thus, both  $(CH_3, NO_2)$  direct further substitution to the same position (Ortho with respect to  $CH_3$ ).

(ii) If the directing effect of two groups oppose each other strongly activating groups win over deactivating or weakly activating group. The sequence of directing power is

 $-NH_2 > -OH > -OCH_3 - > NHCOCH_3 > -C_6H_5 > CH_3 >$ 



(iii) There is normally little substitution when the two groups are meta to each other. Aromatic rings with three adjacent substituents are generally prepared by same other routes.



#### Toluene, methyl benzene or phenyl methane

Toluene is the simplest homolouge of benzene. It was first obtained by dry distillation of tolubalsam and hence named toluene. It is commercially known as tolual.

## (1) Methods of preparation





□ Alkyl halide employed may undergo an isomeric change

$$C_{6}H_{6} + \underbrace{ClCH_{2}CH_{2}CH_{3}}_{n-\operatorname{Propylchloride}} \xrightarrow{AlCl_{3}} C_{6}H_{5}CH \underbrace{CH_{3}}_{CH_{3}} + HCl$$
Isopropylbenzene (65–70%)
(Cumere)

~...

 $\hfill\square$  Catalysts can be used in place of an hydrous  $AlCl_3$  are,

$$AlCl_{3} > SbCl_{3} > SnCl_{4} > BF_{3} > ZnCl_{2} > HgCl_{2}$$
(ii) Wurtz fitting reaction :  

$$O - Br + 2Na + BrCH_{3} \xrightarrow{\text{Ethe}} O - CH_{3} + 2NaBr$$

Bromobenzene Methyl

(iii) Decarboxylation :

$$C_{6}H_{4} \underbrace{ \begin{array}{c} CH_{3} \\ COONa} \\ (o,m- \text{ or } p-) \\ \text{Sodium toluate} \end{array}}_{\text{Sodium toluate}} + NaOH \xrightarrow{\text{Soda lime}} C_{6}H_{5}CH_{3} + Na_{2}CO_{3}$$

Toluene

(iv) From cresol :



(v) From toluene sulphonic acid :



#### (vi) From toluidine :





## (viii) Commercial preparation

From coal tar : The main source of commercial production of toluene is the light oil fraction of coaltar. The light oil fraction is washed with conc.  $H_2SO_4$  to remove the bases, then with *NaOH* to remove acidic substances and finally with water. It is subjected to fractional distillation. The vapours collected between 80-110 °C is 90% benzol which contains 70-80% benzene and 14-24% toluene. 90% benzol is again distilled and the portion distilling between 108-110 °C is collected as toluene.





#### (2) Physical properties

(i) It is a colourless mobile liquid having characteristic aromatic odour.

(ii) It is lighter than water (*sp.* gr. 0.867 at 20°C).

(iii) It is insoluble in water but miscible with alcohol and ether in all proportions.

(iv) Its vapours are inflammable. It boils at  $110^{\circ}C$  and freezes at  $-96^{\circ}C$ .

(v) It is a good solvent for many organic compounds.

(vi) It is a weak polar compound having dipole moment 0.4D.

(3) Chemical properties : Toluene shows the behaviour of both an alipatic and an aromatic compound.  $CH_3$ 



(i) *Electrophilic substitution reactions* : Aromatic character (More reactive than benzene) due to electron releasing nature of methyl group.



 $\Box$  E<sup>+</sup> may be  $\stackrel{+}{Cl}$ ,  $\stackrel{+}{NO_2}$ ,  $SO_3\stackrel{+}{H}$  etc.

#### (ii) Reactions of side chain

(a) Side chain halogenation :



□ Benzyl chloride on hydrolysis with aqueous caustic soda forms benzyl alcohol.

 $C_6H_5CH_2Cl$ + NaOH  $\longrightarrow C_6H_5CH_2OH$  + NaCl (Benzy 1 chloride)

☐ Benzal chloride on hydrolysis forms benzaldehyde.

$$\begin{array}{c} C_{6}H_{5}CHCl_{2}+2NaOH \longrightarrow C_{6}H_{5}CH(OH)_{2}+2NaCl \\ (\text{Benzal chloride}) & \downarrow \\ C_{6}H_{5}CHO+H_{2}O \end{array}$$

 $\hfill\square$  Benzo trichloride on hydrolysis forms benzoic acid.

$$\begin{array}{c} C_{6}H_{5}CCl_{3} + 3NaOH \longrightarrow C_{6}H_{5}C(OH)_{3} + 3NaCl \\ \downarrow \\ C_{6}H_{5}COOH + H_{2}O \end{array}$$

(b) Oxidation :

• With hot acidic KMnO<sub>4</sub> :



• With acidic manganese or chromyl chloride (Etards reaction) : *CH*<sub>3</sub> *CHO* 



□ All alkyl benzenes on oxidation with hot acidic  $KMnO_4$  or  $Na_2Cr_2O_7$  form benzoic acid. The length of the side chain does not matter.



(4) **Uses** 

(i) In the manufacture of benzyl chloride, benzal chloride, benzyl alcohol, benzaldehyde, benzoic acid, saccharin, etc.

(ii) In the manufacture of trinitrotoluene (TNT), a highly explosive substance.

(iii) As an industrial solvent and in drycleaning.

(iv) As a petrol substitute.

(v) In the manufacture of certain dyes and drugs.

## T.N.T. (Tri-nitro toluene)



**Properties** : It is pale yellow crystalline solid (M.P. = 81°C).

**Uses** : • It is used as an explosive in shells, bombs and torpedoes under the name trotyl.

• When mixed with 80% ammonium nitrate it forms the explosive **amatol**.

• TNT is also used as a mixture of aluminium nitrate, alumina and charcoal under the name **ammonal**.



T.N.B. (Tri-nitro benzene)

Properties and uses: It is colourless solid (M.P. = 122°C). It is more explosive than T.N.T. and used for making explosive.

## Xylenes (Dimethyl benzene) $C_6H_4(CH_3)_2$



These are produced along with benzene, toluene ethylbenzene when aromatisation of  $C_6 - C_8$ and fraction of petroleum naphtha is done. The xylenes are isolated from the resulting mixture (BTX) by fractional distillation.

These can be prepared by Wurtz – Fittig reaction. A mixture of bromotoluene and methylbromide is treated with sodium in dry ethereal solution to form the desired xylene.  $CH_3$ 



• These can also be obtained by Friedel - craft's synthesis,

• *m*-Xylene can be obtained from mesitylene.

**Xylenes** are colourless liquids having characteristic odour. The boiling points of three isomers are,

o-Xylene=144°C; *m*-Xylene=139°*C*; p-Xylene=138°C.

undergo electrophilic substitution Xylenes reactions in the same manner as toluene. Upon oxidation with  $KMnO_4$  or  $K_2Cr_2O_7$ , Xylenes form corresponding dicarboxyli& age 45. СООН



Xylenes are used in the manufacture of lacquers and as solvent for rubber. o-Xylene is used for the manufacture of phthalic anhydride.

## Ethyl benzene ( $C_6H_5C_2H_5$ )

It can be prepared by the following reactions,

(1) By Wurtz-Fittig reaction :

 $C_6H_5Br + 2Na + BrC_2H_5 \longrightarrow C_6H_5C_2H_5 + 2NaBr$ 

(2) By Friedel-craft's reaction :

 $C_6H_5H + BrC_2H_5 \xrightarrow{AlCl_3} C_6H_5C_2H_5 + HBr$ 

(3) By catalytic reduction of styrene :

 $C_6H_5CH = CH_2 + H_2 \longrightarrow C_6H_5CH_2CH_3$ 

(4) By alkyl benzene synthesis :

 $C_6H_5H + H_2C = CH_2 \xrightarrow{AlCl_3, HCl} C_6H_5CH_2CH_3$ 

It undergoes electrophilic substitution reactions in the same way as toluene. When oxidised with dil. HNO3 or alkaline KMnO4 or chromic acid it forms benzoic acid.

$$C_6H_5C_2H_5 \xrightarrow{[O]} C_6H_5COOH$$

## Styrene ( $C_6H_5CH=CH_2$ )

It is present in storax balsam and coal-tar in traces.

#### (1) Preparation

Dehydrogenation (i) of side chain of  $CH = CH_2$ ethylbenzene :  $CH_2CH_3$ 



Benzene

(ii) **Decarboxylation of cinnamic acid :** This is the laboratory preparation and involves heating of cinnamic acid with a small amount of quinol.

$$C_6H_5CH = CHCOOH \xrightarrow{\text{Quinol}} C_6H_5CH = CH_2 + CO_2$$

(iii) Dehydration of 1-phenyl ethanol with  $H_2SO_4$ :  $C_6H_5CHOHCH_3 \xrightarrow{H_2SO_4}{-H_2O} C_6H_5CH = CH_2$ 

(iv) Dehydration of 2-phenyl ethanol with ZnCl<sub>2</sub> :  $C_6H_5CH_2CH_2OH \xrightarrow{ZnCl_2,heat} -H_2O \rightarrow C_6H_5CH = CH_2$ 

(v) **Dehydrohalogenation of 1-phenyl-1-chloro ethane** : On heating with alcoholic potassium hydroxide, a molecule of hydrogen chloride is eliminated by the chloroderivative.

$$C_6H_5CHClCH_3 \xrightarrow{\text{Alc.KOH}} C_6H_5CH = CH_2$$

(2) **Properties :** It is a colourless liquid, boiling point 145°*C*. On keeping, it gradually changes into a solid polymer called **metastyrene**. The polymerisation is rapid in sunlight or when treated with sodium. It shows properties of benzene ring (Electrophilic substitution) and unsaturated side chain (Electrophilic addition). However, the side chain double bond is more susceptible to electrophilic attack as compared to benzene ring.

At lower temperature and pressure, it reacts with hydrogen to produce ethylbenzene and at higher temperature and pressure, it is converted into ethyl cyclohexane.



With bromine, it gives the dibromide.



Halogen acids add to the side chain.

 $C_6H_5CH = CH_2 + HX \longrightarrow C_6H_5CHXCH_3$ 

Preparation of ring substituted styrenes is not done by direct halogenation but through indirect route.



When oxidised under drastic conditions, the side chain is completely oxidised to a carboxyl group.



In presence of peroxides, styrene undergoes free radical polymerisation resulting in the formation of polystyrene – an industrially important plastic.

$$nC_6H_5CH = CH_2 \xrightarrow{\text{Peroxide}} -CH - CH_2 -$$

Co-polymers of styrene with butadiene and other substances are also important since many of them are industrially useful products such as *SBR* ( A rubber substitute).

## Bi-phenyl ( $C_6H_5 - C_6H_5$ )

It occurs in coal-tar. It is the simplest example of an aromatic hydrocarbon in which two benzene rings are directly linked to each other.

#### (1) Methods of formation

(i) *Fittig reaction* : It consists heating of an ethereal solution of bromobenzene with metallic sodium.



(ii) **Ullmann biaryl synthesis :** Iodobenzene, on heating with copper in a sealed tube, forms biphenyl. The reaction is facilitated if a strong electron withdrawing group is present in ortho or para position.

$$\bigcirc -I + 2Cu + I - \bigcirc \rightarrow \bigcirc + 2CuI$$

(iii) *Grignard reaction* : Phenyl magnesium bromide reacts with bromo benzene in presence of  $CoCl_2$ .



(2) **Properties :** It is a colourless solid, melting point 71°C. It undergoes usual electrophilic substitution reactions. Since aryl groups are electron withdrawing , they should have deactivating and *m*-orientating effect. But, it has been experimentally shown that presence of one benzene ring activates the other for electrophilic substitution and directs the incoming group to *o*- and *p*- positions. It has been shown that monosubstitution in the bi-phenyl results in the formation of para isomer as the major product.

Another special feature of the biphenyl is the behaviour towards second substitution in a monosubstituted biphenyl. The second substituent invariably enters the unsubstituted ring in the ortho and para position no matter what is the nature of substituent already present.





 $\swarrow$  Octane number may be less than zero (*e.g.*, *n*-Nonane has an octane number-45) and higher than 100 (*e.g.*, Triptane or 2, 3, 3-Trimethylbutane has an octane number of 124).

To avoid lead pollution, a new compound cyclopentadienyl manganese carbonyl

(called as AK-33-X) is used as antiknock now a days in developed countries (unleaded pertol).

Acetylene has a garlic odour when impure due to impurities of phosphine and hydrogen sulphide.

E Fluorination is a violent reaction and can be controlled by diluting fluorine with nitrogen.

 $H_2O > ROH > HC \equiv CH > CH_3 > CH_2 = CH_2 > CH_3 - CH_3.$ 

Obviously, the basic character of their conjugate bases follows the reverse order, *i.e.*,

 $CH_3CH_2^- > CH_2 = CH^- > NH_2^- > HC = C^- > RO^- > HO^-.$ 

 It reduces alkenes and alkynes while other common functional groups such as C=O,  $NO_2$  and  $C \equiv N$  remain unaffected,

 $\mathscr{K}$  The order of reactivity of primary (1°), secondary (2°) and tertiary (3°) hydrogens in alkanes follows the sequence :  $3^{\circ} > 2^{\circ} > 1^{\circ}$ .

		n
		ry Thinking
		<b>Objective Questions</b>
	Alka	ine
1.	Which represents an al	kane [CPMT 1976]
	(a) $C_5 H_8$	(b) $C_8 H_6$
	(c) $C_9 H_{10}$	(d) $C_7 H_{16}$
2.	The decreasing order of	f boiling points is <b>[BHU 1999]</b>
	(a) <i>n</i> -Pentane > iso-Pentane > neo-Pentane	
	(b) iso-Pentane > $n$ -Pentane > $i_{co}$ liso I	itane > neo-Pentane
	(d) <i>n</i> -Pentane > $neo$ -Pe	$n_{\text{tane}} > i_{\text{so-Pentane}}$
3.	To prepare a pure s	ample of n-hexane using
	sodium metal as one r	eactant, the other reactant
	will be	[BHU 1999]
	(a) <i>n</i> -propyr bronnde (b) Ethyl bromide and	<i>n</i> -butyl bromide
	(c) Ethyl chloride and a	n-butyl chloride
	(d) Methyl bromide and	d <i>n</i> -pentyl chloride
4.	In the preparation on haloalkane, the metal	f Grignard reagent from [RPET 1999]
	(a) <i>Mg</i>	(b) <i>Zn</i>
	(c) <i>Li</i>	(d) <i>K</i>
5۰	Sodium acetate can be	converted to ethane by
	(a) Heating with LiAlH	
	(b) Electrolysing its aq	+ ueous solution
	(c) Heating with sodali	ime
	(d) Heating with calciu	m acetate
6.	Which of the following antiknock compositions of oxides of lead or chamber and exhaust p	ng compounds is used in s to prevent the deposition a spark plug, combustion ipe
		[KCET 1998]
	(a) Glycerol	(b) Glycol
-	(c) 1, 2-dibromoethane	(d) Benzene
7.	which of petroleum co	[DCE 1999]
	(a) $C_{15} - C_{18}$	(b) $C_{10} - C_{12}$
	(c) $C_5 - C_9$	(d) $C_1 - C_9$
8.	In the reaction $CH_3$ - product called	$-Br + 2Na + Br - CH_3 \rightarrow$ , the
	[Pb. CET 1999	); CPMT 1983. 86; KCET 1992;
	MP PMT 1994; BHU 1998;	MP PMT 2002; MP PET 1986]
	(a) wurtz reaction	(d) Levit reaction
	(c) I CI KIII S I CACLIOII	

9.	Iodoethane reacts w	ith sodium in the presence of	
	dry ether. The produ	Ct 15 [AFMC 1997; KCET 1998]	
	(a) Pentane	(b) Propane	
	(c) Butene	(d) Butane	
10.	Which of the following	ng is oxidised by $KMnO_4$	
	(a) Methane	(b) Pentane	
	(c) Isobutane	(d) Neopentane	
11.	Which of the following	ng has maximum stability[AIIN	
	+		
	(a) <i>CH</i> <sub>3</sub>	(b) $CH_3 - C - H$	
	Н	$\overset{+}{CH}_3$	
	(c) $CH_3 - CH_3 - CH_3$	(d) $CH_3 - C_+ - CH_3$	
12.	The most volatile cor (a) 2, 2-dimethyl pro	ompound is[DPMT 2000]ropane(b)2-methyl butane	
12	In Wurtz reaction th	(u) <i>n</i> -pentane	
3.	(a) $Na$	(b) Na/liquid NH	
	(a) $N_{\pi}/4m_{\pi}$ ether	(d) $N_{a}/dm alashal$	
_			
14.	Which of the following	ng has highest octane number	
	(a) <i>n</i> -heyane	(h) n-heptape	
	(c) $n$ -pentane	(d) 2. 2. 4-trimethyl	
	pentane	(, _, _, _, _, _, _, _, _, _, _, _, _, _,	
15.	What is freon-12	[RPET 1999]	
	(a) Pesticide	(b) Refrigerant	
	(c) Solvent	(d) Lubricant	
16.	The petrol having oc	tane number 80 has[MP PET 20	
	(a) 20% normal hept	tane + 80% iso-octane	
	(b) 80% normal hep	tane + 20% iso-octane	
	(c) 20% normal hep	tane + 80% normal octane	
	Which of the follow	ving reactions will not give	
./•	propage	ving reactions will not give	
	propune	[DPMT 2005]	
	(a) $CH_3CH_2CH_2Cl$	$H_2O \longrightarrow$	
	(b) $CH_3COCl - \frac{CH_3MgX}{H_2O}$	$\rightarrow$	
	(c) $CH_3CH = CH_2 \frac{B_2}{CH_3}$	$\xrightarrow{H_6}$	
	(d) $CH_3CH - CH_3 - \frac{P}{P}$	$\xrightarrow{HI}$	

18. The shape of methane molecule is[MP PET 1997, 2001](a) Linear(b) Trigonal planar

OH

- 19. Which of the following shows only one brominated compound [CPMT 1996]
  (a) Butene-2 (b) 2, 2-dimethylpropane (c) Butyne-1 (d) Butanol-3
- 20. Kerosene is used as fuel because it is [CPMT 1996]
  (a) Less volatile
  (b) More volatile
  (c) Cheap
  (d) Abundantly available
- **21.**  $CH_3 CH_2 CH_2 CH_3 \xrightarrow{AlCl_3} Product$ . Product in above reaction is **[RPMT 2003]**

(a)  $CH_3 - CH - CH_2 - CH_3$ (c)  $CH_3CHO$ (d)  $C_{2}H_{6}$ Which of the following compounds is insoluble 30. Rreven in hot concentrated  $H_2SO_4$ [IIT-JEE 1983] (b)  $CH_3 - CH - CH_3$ (b) Benzene (a) Ethylene  $CH_3$ (d) Aniline (c) Hexane (c)  $CH_2 - CH_2 - CH_2$ A reaction between methyl magnesium bromide 31. and ethyl alcohol gives[CPMT 1979; MNR 1986; UPSEAT 1999 **R**r  $CH_3$ (a) Methane (b) Ethane (d) All of these (c) Propane (d) Butane Which of the following statements is not true for 22. Methane and ethane both can be obtained in ethane 32. single step from [AIIMS 1996] (a) It can be chlorinated with chlorine [CPMT 1974; MP PET 1995; AFMC 1998, 2000; BHU 2005] (b) It can be catalytically hydrogenated (a)  $CH_2I$ (b)  $C_2 H_5 I$ (c) When oxidised produces  $CO_2$  and  $H_2O$ (c)  $CH_3OH$ (d)  $C_2H_5OH$ (d) It is a homologue of iso-butane **33.** Paraffin wax is [MP PMT 1986; CPMT 1993] Petroleum refining is [AIIMS 1996; KCET 2004] 23. (a) Ester (a) Distillation of petroleum to get different (b) Alcohol fractions (c) Unsaturated hydrocarbon (b) Obtaining aromatic compounds from aliphatic (d) Saturated hydrocarbon compounds present in petroleum The number of possible enantiomeric pairs that 34. (c) Cracking of petroleum to get gaseous can be produced during monochlorination of 2hydrocarbons methylbutane is (d) Purification of petroleum [IIT-JEE 1997] The chemical added to leaded petrol to prevent 24. (a) 2 (b) 3 the deposition of lead in the combustion chamber (d) 1 (c) 4 is Petroleum consists mainly of[CPMT 1985, 94; KCET 1991] 35. [Kerala (Med.) 2003] (a) Aliphatic hydrocarbons (b)Aromatic hydrocarbons (b) Ethylene dibromide (a) Iso-octane (c) Aliphatic alcohols (d) None of these (c) Tetraethyl lead (d) Mercaptan Petroleum ether can be used as 36. (e) n-Heptane (a) Solvent for fat, oil, varnish and rubber In the commercial gasolines, the type of 25. hydrocarbons which are more desirable is[CBSE PMT 1997; AFMC 1997] (c) Both (a) and (b) (a) Branched hydrocarbon (d) None of these (b) Straight-chain hydrocarbon Which of the following are produced from coaltar 37. (c) Linear unsaturated hydrocarbon [MNR 1987; UPSEAT 2002] (d) Toluene (a) Synthetic dyes (b) Drugs 26. Which of the following is not formed by the (c) Perfumes (d) All the three reaction of  $Cl_2$  on  $CH_4$  in sunlight [AIIMS 1987] 38. In alkanes, the bond angle is[MP PMT 1989; BHU 1996] (a)  $CHCl_3$ (b)  $CH_3Cl$ (a) 109.5° (b) 109° (c)  $CH_3CH_3$ (d)  $CH_3CH_2CH_3$ (c) 120° (d) 180° Which of the following has the highest boiling 27. In the preparation of alkanes; a concentrated 39. point aqueous solution of sodium or potassium salts of [DPMT 1986] saturated carboxylic acid are subjected to[CPMT 1985; MP (a) Neopentane (b) *n*-butane (b) Oxidation (a) Hydrolysis (c) *n*-heptane (d) Isobutane (c) Hydrogenation (d) Electrolysis Which gives  $CH_4$  when treated with water Halogenation of alkanes is an example of 28. 40. [MP PET 1993; KCET 1998] [CPMT 1974, 79; NCERT 1976; IIT-JEE 1990] (a) Electrophilic substitution (a) Silicon carbide (b) Calcium carbide (b) Nucleophilic substitution (c) Aluminium carbide (d) Iron carbide (c) Free-radical substitution Which of the following does not react with PCl<sub>5</sub> 29. (d) Oxidation [CPMT 1973] Propionic acid is subjected to reduction with 41. (a)  $CH_3OH$ (b) CH<sub>3</sub>COOH

hydroiodic acid in the presence of a little P, the product formed is

		[JIPMER 1997]	53.	In catalytic reduction o	f hydrocarbons which	
	(a) Ethane	(b) Propane		catalyst is mostly used	[DCE 2001]	
	(c) Butane	(d) None of these		(a) <i>Pt /Ni</i> (	b) Pd	
42.	When ethyl iodide and	propyl iodide react with		(c) $SiO_2$	d) Misch Metal	
	(a) One alkane	(b) Two alkanes	54.	Ethylene reacts with brom	ine to form[MP PET 2001]	
	(c) Four alkanes	(d) Three alkanes		(a) $Br - CH_2 - CH_3$ (	b) $CH_3 - CBr_3$	
43.	The alkane that yields	two isomeric monobromo		(c) $Br - CH_2 - CH_2Br$ (	d) <i>CHBr</i> <sub>3</sub>	
	derivatives is		55. <sup>[E</sup>	CAMCET 1993 obtained from	crude petroleum oil by	
	(a) Neopentane	(b) Ethane	55.	its		
	(c) Methane	(d) Propane			[MP PMT 1999]	
44.	Kerosene is a mixture of	[CPMT 1979; AFMC 1992]		(a) Fractional distillation	(b)Vacuum distillation	
	(a) Alkanes	(d) Aliphatic acids		(c) Steam distillation (	d) Pyrolysis	
45.	When petroleum is he	ated the vapours contain	56.	Which of the following doe	es not give alkane	
43.	mainly			[MP PMT 199		
	-	[CPMT 1981]		(a) Reaction of $CH_3I$ with	Na in ether	
	(a) Kerosene	(b) Petroleum ether		(b) Reaction of sodium ace	etate with sodalime	
	(c) Diesel	(d) Machine oil		(c) Electrolysis of concer	ntrated sodium acetate	
46.	Iso-octane is mixed to the	ne petrol [NCERT 1972]	solut	tion		
	(a) To precipitate inorg	anic substances		(d) Reaction of ethyl chlor	ide with alco. KOH	
	(b) To prevent freezing	of petrol	57.	LPG is a mixture of [I	$MP \ PMT \ 1999; \ KCET \ 2005]$	
	(c) To increase boiling p	point of petrol		(a) $C_6 H_{12} + C_6 H_6$ (	$C_4 H_{10} + C_3 H_8$	
	(d) As an antiknock			(c) $C_2H_4 + C_2H_2$ (4)	d) $C_2H_4 + CH_4$	
47.	Tetraethyl lead is used a	CPMT 1080, 01; PHU 10051	58.	Carbon black, which is u	sed in making printer's	
	(a) Fire extinguisher	(h) Pain reliever		ink, is obtained by decomp	osition of [MP PET 1993]	
	(c) Petroleum additive	(d) Mosquito repellent		(a) Acetylene (	b) Benzene	
48.	Cyclohexane. a hydro	carbon floats on water		(c) Carbon tetrachloride (	d) Methane	
1	because		59.	The addition of tetraethyl	lead to petrol[MP PET 1993]	
		[NCERT 1976]		(a) Lowers its octane num	ber	
	(a) It is immiscible with	n water		(c) May raise or lower the	octane number	
	(b) Its density is low as	compared to water		(d) Has no effect on octan	e number	
	(c) It is non-polar subst	ance	60	Which of the following of	ompound has maximum	
	(d) It is immiscible and	lighter than water	00.	boiling point [II]	-JEE 1982; MP PMT 1986;	
49.	Natural gas contains ma	inly		MADTI	Bihar 1995; Pb. PMT 1999]	
	[MNR 1990; UPSEAT 1999	), 2000, 01, 02; BCECE 2005]		(a) <i>n</i> -hexane (	b) <i>n</i> -pentane	
	(a) Methane	(b) <i>n</i> -butane		(c) 2, 2-dimethyl propane	(d) 2-methyl butane	
-0	(c) <i>n</i> -octane	(d) Mixture of octane	61.	Knocking sound occurs in	engine when fuel[CPMT 1981]	
50.	(a) CCI	(b) $C = U O H$		(a) Ignites slowly		
	(a) $CCl_4$	$(0) C_2 H_5 OH$		(b) Ignites rapidly		
	(c) $CH_4$	(d) $C_6 H_6$		(c) Contains water		
51.	Propane is obtained fr	om propene, by which of		(d) Is mixed with machine	oil	
	the following methods [	CBSE PMT 2001; AFMC 2001]	62.	Petroleum is mainly a mix	ture of	
	(a) Wurtz reaction	(b) Denydrogenation			PMT 1984; Pb. PMT 1999]	
	(c) Frankland reaction	(d) Catalytic		(a) Alkalles (	d) Cyclonexane	
52.	The organic compound	used as antiknock agent in	62	Which of the following	has maximum hoiling	
<b>.</b> .	petroleum is [DCE 1999	; CPMT 2000; Pb. CET 2000;	·3.	point	nuo muximum ooming	
		MP PET 2001]		- [IIT-JEE 1986; N	IP PMT 1986; CPMT 1989]	
	(a) $(C_2H_5)_4Pb$	(b) <i>TNT</i>		(a) <i>iso</i> -octane		
	(c) $CH_3MgBr$	(d) $(C_2H_5)_2Hg$		(b) <i>n</i> -octane		

(c) 2, 2, 3, 3-tetramethyl butane

			Hydrocarbon 1109	
	(d) <i>n</i> -butane		(d) May increase or decrease	
64.	Aqueous solution of the following compound on electrolysis gives ethane	73.	In the fractional distillation of crude petroleum [Roorkee 1989]	
	[NCERT 1983; MP PET 1985; CPMT 1975, 79]		(a) Petrol condenses at the bottom of the column	
	(a) Acetic acid (b) Acetamide		(b) The gases condense at the top of the column	
65.	(c) Potassium acetate (d) Ethyl acetate Which of the following does not decolourise		(c) High boiling constituents condense at the bottom of the column	
	(a) Acetylene (b) Propene		(d) High boiling constituents condense at the top of the column	
66.	(c) Ethane (d) Propyne Anhydrous sodium acetate on heating with	74.	Which of the following is not an endothermic reaction	
	sodalime gives		[J & K 2005]	
	[CPM1 19/2, 84; PD. CE1 2001, 2003]		(a) Dehydrogenation	
	(c) Calcium acetate (d) Ethane		(b) Ethane to ethene	
67	Water gas is [CPMT 1002 2004: Ph PMT 2004]		(c) Combustion of propane	
07.	(a) $CO + CO_2$ (b) $CO + N_2$	aton	(d) Change of chlorine molecule into chlorine ns.	
	(c) $CO + H_2$ (d) $CO + N_2 + H_2$	75.	Gasoline is the name of [Roorkee 1989]	
68.	A sample of gasoline contains 81% iso-octane and	, 0	(a) Crude oil	
	19% <i>n</i> -heptane. Its octane number will be[ <b>MP PMT 19</b>	95]	(b) The gaseous constituents of petroleum	
	(a) 19 (b) 81		(c) The mixture of uncondensed gases produced	
	(c) 100 (d) 62		in the distillation of crude oil	
69.	The natural petroleum contains [MP PMT 1995]		(d) The mixture of the residue and gas oil	
	(a) Saturated hydrocarbons		obtained in the distillation of crude oil	
	(b) Cyclic saturated hydrocarbons	76.	In the process of cracking [Roorkee 1989]	
	<ul><li>(c) Compounds of sulphur</li><li>(d) All of these</li></ul>		(a) Organic compounds decompose into their constituent elements	
7 <b>0.</b>	The preparation of ethane by electrolysis of aqueous solution of potassium acetate is called as[MI	b byyda	(b) Hydrocarbons decompose into carbon and	
	(a) Wurtz reaction		(c) High molecular weight organic compounds	
	(b) Sabatier-Senderen's reaction		organic compounds	
	(c) Kolbe's synthesis		(d) Hydrocarbons vield alkyl radicals and	
	(d) Grignard reaction	hydı	rogen	
71.	Action of hydrogen chloride on $CH_3 - C = CH_2$	77.	Octane number has 0 value for	
	CH <sub>3</sub>		[Roorkee 1989; MP PET 1999, 2002;	
	and on $CH = CH$ will predominantly give the		MP PMT 2001; KCET 2002]	
	compounds, respectively		(a) iso-octane (b) <i>n</i> -hexane	
	(a) $CH_3 - CH = CH_2Cl$ and $CH_2Cl - CH_2Cl$		(c) <i>n</i> -heptane (d) iso-heptane	
	CH <sub>3</sub>	78.	Dry distillation of sodium propanoate with sodalime gives	
	(b) $CH_3 - CCl = CH_3$ and $CH_3 - CHCl_2$		[CPMT 1996]	
	CH <sub>3</sub>		(a) Propane (b) Propene	
	(c) $CH_3 - CH = CH_2Cl$ and $CH_3 - CHCl_2$		(c) Ethane (d) Ethene	
	CH <sub>3</sub>	7 <b>9</b> .	What is the chief product obtained when <i>n</i> -butane is treated with bromine in the presence of light at	
	(d) $CH_3 - CH = CH_3$ and $CH_2Cl - CH_2Cl$		130 ° C	
	CH <sub>3</sub>		[IIT-JEE 1995]	
72.	As the number of carbon atoms in a chain		(a) $CH_3 - CH_2 - CH - Br$	
	increases the boiling point of alkanes [AFMC 1989]		CH <sub>3</sub>	
	(a) Increases		(b) $CH_3 - CH - CH_2 - Br$	

 $\overset{|}{CH_3}$ 

- (b) Decreases
- (c) Remains same

$$CH_{3} - CH_{3}$$

(c)

(d) 
$$CH_3 - CH_2 - CH_2 - CH_2 - Br$$

- **80.** A mixture of propene and methane is obtained by the cracking of
  - (b) 2-butene (a) 1-butene

(c) *n*-butane (d) Isobutane

- Which of the following fractions of petroleum 81. refining contains kerosene ? (Boiling ranges in <sup>o</sup> C are given below)
  - (a) 40 80 (b) 80 - 200
  - (c) 200 300 (d) Above 300
- Which of the following statements is incorrect ? 82. The members of the homologous series of alkanes [NCERT 1974]
  - (a) Are all straight chain compounds
  - (b) Have the general formula  $C_n H_{2n+2}$
  - (c) Have similar chemical properties
- (d) Show a regular gradation of physical properties
- 83. On mixing tetraethyl lead to gasoline available at petrol pumps [CPMT 1981]
  - (a) Calorific value of the fuel increases
  - (b) Odour diminishes
  - (c) Less smoke is obtained on combustion
  - (d) Antiknock property of fuel increases
- 84. A liquid hydrocarbon can be converted to gaseous hydrocarbon by [CPMT 1980; MP PMT 2001]
  - (a) Cracking
  - (b) Hydrolysis
  - (c) Oxidation
  - (d) Distillation under reduced pressure
- 85. The tetrahedral nature of carbon was first given by

	(a)	Kekule	
~~			

Hoff

(d) Armstrong and Bayer

[MP PMT 1994]

(b) Le Bell and Van't

- (c) Pauling **86.** Formation of alkane by the action of *Zn* on alkyl halide is called [DPMT 1984; MHCET 2004] (a) Frankland's reaction (b) Wurtz reaction
  - (c) Cannizzaro reaction (d) Kolbe's reaction
- Which of the following compounds will form a 87. (a)  $CH_3CH_2OH$ (b)  $CH_3CHO$ 
  - (c)  $CH_3COCH_3$ (d)  $CH_3CO_2CH_2$
- **88.** Name the hydrocarbon that is a liquid at STP
  - (a) Ethane (b) Propane (c) n-butane
  - (d) n-pentane
- **89.** Which statement is not true concerning alkanes

				[MP	PET 2	003]		
(a) Larg	(a) Large number alkanes are soluble in water							
(b) All a	(b) All alkanes have a lower density than water							
(c) At	room tem	perature	som	ne alk	anes	are		
liqui	ds, some so	olids and s	ome	gases				
(d) All alkanes burn								
Fischer Tropsch process is used for				for	the			
manufacture of								

	[DCE 1999: MP PET 2003]
(a) Synthetic petrol	(b) Thermosetting
(c) Ethanol	(d) Benzene

91. Which one of the following compounds cannot be prepared by Wurtz reaction[Kurukshetra CEE 2002; MP PMT 2002; MP PET 2003]

(a) 
$$CH_4$$
 (b)  $C_2H_6$ 

(c) 
$$C_3 H_8$$
 (d)  $C_4 H_{10}$ 

- 92. A fuel contains 25 % *n*-heptane and 75 % isooctane. Its octane number is[MP PMT 1993; MP PET 1994] (a) 50 (b) 75
  - (c) 100 (d) 25
- Sodium ethoxide is a specific reagent for[CPMT 1985] 93. (a) Dehydration
  - (b) Dehydrogenation

90.

- (c) Dehydrohalogenation
- (d) Dehalogenation
- Which of the following has highest percentage of 94. hydrogen

[CPMT 1975; 79]

- (a)  $CH_4$ (b)  $C_2 H_4$ (c)  $C_6 H_6$ (d)  $C_{2}H_{2}$
- What is the molecular formula of the alkane, the 95. 5.6 *litre* of which weight 11 *q* at STP[**MP PMT 2003**]
  - (a)  $C_6 H_{14}$ (b)  $C_4 H_{10}$
  - (d)  $C_2 H_6$ (c)  $C_3H_8$
- The reference compound `iso-octane' which is 96. used in determining the octane number of gasoline has the structure
  - (a)  $CH_3 CH(CH_3) CH(CH_3) CH(CH_3) CH_3$
  - (b)  $CH_3 C(CH_3)_2 CH_2 CH(CH_3) CH_3$
  - (c)  $CH_3 C(CH_3)_2 CH(CH_3) CH_2 CH_3$
  - (d)  $CH_3 C(CH_3)_2 C(CH_3)_2 CH_3$
- hydrocarbon on reaction with Grignard reagent[CPMT 9788, §3]mple of 2, 3-dibromo-3-methylpentane is heated with zinc dust. The resulting product is isolated and heated with HI in the presence of phosphorus. Indicate which is the structure that represent the final organic product formed in the reaction [CBSE PMT 1991]
  - (a)  $CH_3 CH_2 CH CH_2 CH_3$  $\dot{C}H_{3}$

(b) 
$$CH_2 = CH - CH_2 - CH_3$$
  
(c)  $CH_3 - CHI - CH - CH_2 - CH_3$   
(c)  $CH_3 - CHI - CH - CH_2 - CH_3$   
(d)  $CH_2 = CH - C(I) - CH_2 - CH_3$ 

 $\dot{C}H_3$ 

98. The order of appearance of the following with rising temperature during the refining of crude oil is

#### [MNR 1993; UPSEAT 2002]

- (a) Kerosene oil, gasoline, diesel
- (b) Diesel, gasoline, kerosene oil
- (c) Gasoline, diesel, kerosene oil
- (d) Gasoline, kerosene oil, diesel
- When sodium propionate is heated with soda 99. lime, the main product is
  - (b) Methane (a) Ethane
  - (c) Propane (d) Butane
- **100.** Gasoline is a mixture of alkanes with the number of carbon atoms [CPMT 1983, 84; BVP 2003]
  - (a)  $C_3 C_5$ (b)  $C_5 - C_6$
  - (c)  $C_6 C_8$ (d)  $C_7 - C_9$
- 101. The final product of complete oxidation of hydrocarbons is

	[CPMT 1981]
(a) Acid	(b) Aldehyde
(c) $H_2O + CO_2$	(d) Dihydric alcohol

- 102. Which of the following will have least hindered rotation about carbon-carbon bond[IIT-JEE 1987; CPMT 1989, <sup>the</sup> fact that
  - (a) Ethane (b) Ethylene
  - (c) Acetylene (d) Hexachloroethane
- 103. Which of the following represents the most oxidized form of hydrocarbon [MP PMT/PET 1988]
  - (a) *CO*<sub>2</sub> (b) RCHO
  - (c) RCOOH (d) RCOOOH
- **104.** Name the reaction

$$C_{10}H_{22} \xrightarrow{900K} C_4H_8 + C_6H_{14}$$

[MP PET 1995; MP PMT 1997] (b) Cracking

- (a) Alkylation (c) Pyrolysis (d) Fractionation
- **105.** How many types of carbon atoms are present in 2, 2, 3-trimethylpentane
  - (a) One (b) Two (c) Three (d) Four
- 106. Which one gives only one monosubstitution
- product on chlorination [AIEEE 2003] (a) *n*-pentane (b) Neopentane
  - (c) Isopentane (d) n-butane

- **107.**  $CH_{4}$  is formed when [AFMC 1987]
  - (a) Sodium acetate is heated with sodalime
  - (b) Iodomethane is reduced
  - (c) Aluminium carbide reacts with water
  - (d) All of these
- 108. A mixture of methane, ethylene and acetylene gases is passed through a Wolf's bottle containing ammoniacal cuprous chloride. The gas coming out [NCERT 1976] is
  - (a) Methane
  - (b) Acetylene
  - (c) A mixture of methane and ethylene
  - (d) The original mixture
- **109.** At room temperature solid paraffin is[**RPET/PMT 1999**]
  - (a)  $C_3 H_8$ (b)  $C_8 H_{18}$
  - (d)  $C_{20}H_{42}$ (c)  $C_4 H_{10}$
- 110. Which one of the following compounds does not give addition reactions [MADT Bihar 1981]
  - (a) Aldehydes (b) Alkanes
  - (c) Alkenes (d) Alkynes
  - (e) Ketones (f) All of these
- 111. The most important method of preparation of hydrocarbons of lower carbon number is[CBSE PMT 1989]

(a) Pyrolysis of higher carbon number hydrocarbons

- (b) Electrolysis of salts of fatty acids
- (c) Sabatier and Senderen's reaction
- (d) Direct synthesis
- **112.** The inorganic origin of petroleum is indicated by
  - (a) Its constituents can be separated by fractional distillation
  - (b) Carbon and hydrocarbon can combine by absorption of solar energy to give hydrocarbons
  - (c) Petroleum contains traces of chlorophyll

(d) Oil fields are located with the help of seismograph

113. Which of the following is a gemdihalide[CPMT 1976, 88] (a)  $CH_3.CHBr.CHBr.CH_3$  (b)  $CH_3Br.CH_3Br$ 

(c) 
$$CHBr = CHBr$$
 (d)  $CH_3CHBr_2$ 

- 114. Which one of the following contain isopropyl group
  - [BHU 2005]
  - (a) 2,2,3,3-tetramethylpentane
  - (b) 2-methylpentane
  - (c) 2,2,3-trimethylpentane
  - (d) 3,3-dimethylpentane
- 115. Natural gas is a mixture of [MP PMT 1986] (a)  $CO + CO_2$ (b)  $CO + N_2$

	(c) $CO + H_2 + CH_4$	(d) $CH_4 + C_2H_6 + C_3H_8$		(a) 2	(b) 3	
116.	By Wurtz reaction, a m	ixture of methyliodide and		(c) 4	(d) 5	
	ethyliodide gives [BHU 2003]		126.	Which of the following cycloalkane gives open chain compound, when reacts with bromine[Orissa JEE 20		
	(b) Ethane			(a) Cyclopropane	(b) Cyclopentane	
	(c) Propane			(c) Cyclohexane	(d) Cyclo-octane	
	(d) A mixture of the abo	ove three	127.	Grignard reagent is i	not prepared in aqueous	
117.	Product obtained by nit	ration of propane is[ <b>RPMT 200</b>	3]	medium but prepared; the reagent	in ether medium because	
	(a) Nitropropane	(b) Nitrometnane		-	[KCET 2002]	
	(c) Nitroethane	(d) All of these		(a) Reacts with water		
118.	Isomerism in saturated	nydrocarbons is due to		(b) Is insoluble in water		
	(a) Change in the valen	ce of carbon		(c) Is highly reactive in ether		
	(b) Change in the ratio	of elements in compounds		(d) Becomes inactive in water		
	(d) Formation of double	e bond	128.	A sample of petrol is a and 70% <i>iso</i> -octane.	mixture of 30% <i>n</i> -heptane The sample has octane	
119.	Photochemical chlorina by a process of	tion of alkane is initiated [DPMT 1985: NCERT 1978]		number	[MP PET 1985]	
	(a) Pvrolvsis	(b) Substitution		(a) 30	(b) 70	
	(c) Homolysis	(d) Peroxidation		(c) 15	(d) 35	
120.	Which of the following	is not linked with methane	129.	For the reduction of ke	tones to hydrocarbon, the	
	(a) Marsh gas	(b) Natural gas		appropriate agent is	[DPMT 2002]	
	(c) Producer gas	(d) Coal gas		(a) <i>HI</i>	(b) $Zn - Hg / HCl$	
121.	Which of the following	has highest octane number		(c) Red phosphorous	(d) $H_2 SO_4$	
	[MP PET 1996] (a) <i>n</i> -hexane		130.	Heating of alkanes with	h fuming sulphuric acid or	
				oleum at high tem sulphonic acid, is called	nperature, which forms	
	(c) Iso-octane				[MH CET 1999]	
	(d) <i>n</i> -heptane and iso-o	octane mixed in ratio 50 :		(a) Nitration	(b) Halogenation	
50	(u) it neptune unu ibe (			(c) Sulphonation	(d) Oxidation	
122.	A mixture of ethyl iodide and $n$ -propyl iodide is subjected to Wurtz reaction. The hydrocarbon			Propane is obtained method ?	from propene by which	
	that will not be formed	is		[	CPMT 1997; CBSE PMT 2001;	
		[IIT-JEE (Screening) 1990]		(a) Catalyst hydrogenat	ion (b) Wurtz reaction	
	(a) <i>n</i> -butane	(b) <i>n</i> -propane		(c) Dehydrogenation	(d) Frankland reaction	
	(c) <i>n</i> -pentane	(d) <i>n</i> -hexane	132.	B.P. of branched chair	alkanes as compared to	
123.	Most of the hydrocarbons from petroleum are obtained by			straight chain alkanes a	re[MP PMT 1987; AIIMS 1999]	
	[CPMT 1974, 80]			(b) Equal		
	(a) Fractional distillation (b)Fractional crystallizat			(c) Higher		
	(c) Vaporization (d) Polymerization			(d) Independent of the	chain	
124.	Which is the best anti-	knock compound or Which	133.	Daily use candles (parat	ffin wax) contain[ <b>CPMT 1996]</b>	
	one of the following	substances is used as an		(a) Higher saturated hydrocarbon		
	antiknock compound [CPMT 1974, 81, 99, 2000;RPMT 2002; CBSE PMT 1996;			<ul><li>(b) Lower saturated hydrocarbon</li><li>(c) Higher unsaturated hydrocarbon</li></ul>		
	KCE1 (Med.) 2000 MP PE1 1985, 87, 97, 2001;			(d) Lower unsaturated	hydrocarbon	
	MP PMT 1994, 96; AIIMS 2000]			The reaction $CH_4 + Cl_2$	$\xrightarrow{\text{uv light}} CH_3Cl + HCl$ is an	
	(c) Zinc ethyl	(d) Tetraethyl lead (TEL)		evample of	[CDSE DMT 1000 2000]	
175	In the dichlorination re	action of propage mixture		(a) Addition reactions	(b) Substitution reaction	
125.	of products are obtained. How many isomers, the			(c) Flimination reaction	(d) Rearrangement	
	mixture contains	[Orissa JEE 2003]		reaction		

				Ну	drocarbon 1113	
135.	Normal butane convert	into isobutane by[ <b>RPMT 2002</b> ]		(a) Wurtz reaction	(b) Kolbe's reaction	
	(a) $LiAlH_4$	(b) AlCl <sub>3</sub>		(c) Reduction of alkyl h	alide (d)Hydrogenation of alkene	
	(c) $NaBH$ .	(d) $Zn/HCl$	147.	Which hydrocarbon wil	ll be most stable	
400	(c) $MaBH_4$				[MP PET 2000, 03]	
136.	Alconolic solution of KO	H is used for		(a) Methane	(b) Ethane	
	(a) Dehudration	(h) Debudregenation		(c) Propane	(d) Butane	
	(a) Deliyuration	(b) Deligningenation	148.	C-H bond length is grea	test in	
100	(c) Dellyurollalogellatio	and Denalogenation		[IIT-JEE	1989; MNR 1990; AMU 2002]	
137.	Alumini cai bide on h	INCERT 1081; MD DET 1085		(a) $C_2 H_2$	(b) $C_2 H_4$	
	(a) Methane	(b) Ethane		(c) $C_2 H_6$	(d) $C_2H_2Br_2$	
	(c) Ethene	(d) Ethyne	149.	Which one of the follo	wing compounds does not	
128	Maximum carbon-carbo	an bond distance is found		form an ozonide	[EAMCET 1997]	
130.	in	in bond distance is found		(a) Ethene	(b) Propyne	
	[MP PMT 1987; II	T-JEE 1981; Bihar MEE 1995]		(c) Propene	(d) Propane	
	(a) Ethyne	(b) Ethene	150.	Which type of hybridisa	tion occurs in ethylene	
	(c) Ethane	(d) Benzene		[CBSE PMT 1991; Bi	har MEE 1996; JIPMER 1997]	
139.	Which of the following	g reaction is expected to		(a) <i>sp</i>	(b) <i>sp</i> <sup>2</sup>	
	readily give a hydrocart	oon product in good yields[ <b>CB</b> s	SE PM'	T <sup>(</sup> f997)}	(d) $sp^3d$	
	(a) RCOOKOxidation Electro	<sup>ly is</sup> →	151.	Silver acetylide when he	eated with <i>HCl</i> gives	
	(b) RCOOAg $\xrightarrow{I_2}$			(a) $C_2 H_2$	(b) $H_2$	
	(c) $CH$ $CH$ $Cl$ $a_2$			(c) $C_2 H_4$	(d) None of these	
	(c) $CH_3 - CH_3 \xrightarrow{hv}$		152.	When sodium reacts with ethyl iodide, which of the following hydrocarbons is produced		
	(d) $(CH_3)_2 CCl \xrightarrow{C_2H_5OH}$			the following hydrocart	INCERT 1984: BHU 1982	
140.	Out of the following fr	actions of petroleum, the		(a) Methane	(b) Ethane	
-	one having the lowest b	oiling point is or Which of		(c) Butane	(d) Ethene	
	the following is obtain	ed at lowest temperature	153.	Solid methane is [	DPMT 1983; CBSE PMT 1989]	
	by fractional distillation	n of petroleum[MP PMT 1993; N	IP PET	<b>(9) (</b> 1) <b>(</b> 1)	(b) Ionic solid	
	(a) Kerosene	(b) Diesel oil	1 - 4	(c) Covalent solid	(d) Not possible	
	(c) Gasoline	(d) Heavy oil	154.	(a) Triangular	(b) Tetrahedral	
141.	The marsh gas detector	used by miners works on		(c) Linear	(d) None of these	
	(a) Difference in the rat	rinciple of [AMU 1984]		$CH_3MgI$ will give metha	ane with [Roorkee 1995]	
	(b) Avogadro's hypothe			(a) $C_2H_5OH$	(b) $CH_3 - CH_2 - NH_2$	
	(c) Gay-Lussac's law of gaseous volumes			(c) $CH_2 - CO - CH_2$	(d) All of these	
	(d) Berzelius hypothesis		156.	Propane-1-ol can be pre	epared from propene by its	
142.	Methane can be prepare	d by [DCE 2001]	-9	reaction with	[MP PMT 2003]	
- 1	(a) Wurtz's reaction	(b) Decarboxylation		(a) <i>CH</i> <sub>3</sub> <i>COOH</i>	(b) $H_3BO_3$	
	(c) Hydrogenation reac	tion (d) All of these		(c) $B_2H_6 / NaOH, H_2O_2$	(d) $H_2 SO_4 / H_2 O$	
143.	The most strained cyclo	alkane is [IIT-JEE 1981]	157.	The process in which	higher hydrocarbons are	
	(a) Cyclopropane	(b) Cyclobutane		broken down into	lower hydrocarbons by	
	(c) Cyclopentane	(c) Cyclopentane (d) Cyclohexane		controlled pyrolysis, is	called	
144.	Which does not react wi	th chlorine in dark[Pb. PMT 20	000]	(a) Hydrolysis	[MP PMT 2002] (b) Cracking	
	(a) $C_2 H_4$	(b) $C_2 H_2$		(c) Oxidation	(d) Reduction	
	(c) <i>CH</i> .	$(d) CH_{2}CHO$	158.	Successive alkanes diffe	er by [MP PMT 2002]	
145	Main constituent of mar	sch abe is		(a) $> CH_2$	(b) <i>&gt;CH</i>	
145.	[IIT-IEE 1080: MP PMT 1004. AFMC 1007]			(c) $-CH_3$	(d) $C_2 H_4$	
	(a) C H (b) CH 15			General formula of alka	ne is	
	(a) H S	(d) CO		[EAMC	ET 1979; Manipal MEE 1995]	
_	$(C) \Pi_2 S$			(a) $C_n H_{2n+2}$	(b) $C_n H_{2n-1}$	
146.	Which of the following preparation of methane	method can be used for the		(c) $C_n H_{2n}$	(d) $C_n H_{2n+1}$	
160. 161.	<ul> <li>Methane and ethane bo step by which of the foll</li> <li>(a) C<sub>2</sub>H<sub>4</sub></li> <li>(c) CH<sub>3</sub>Br</li> <li>Photochemical chlorina by a process of</li> </ul>	th can be prepared in one lowing compound [BHU 2004] (b) $CH_3O$ (d) $CH_3CH_2OH$ tion of alkane is initiated [Kerala PMT 2004]	172.	Pick out the alkane will members of the group. (a) 2,2-dimethyl propa (b) Pentane (c) 2-methyl butane (d) 2,2-dimethyl butane	hich differs from the other [KCET 2004] ne e	
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162.	<ul><li>(a) Pyrolysis</li><li>(c) Cracking</li><li>(e) Homolysis</li><li>A petroleum fraction</li></ul>	<ul><li>(b) Substitution</li><li>(d) Peroxidation</li><li>having boiling range 70-</li></ul>	-/5	presence of sunlight gir (a) 1-bromo-2-methylb (b) 2-bromo-2-methylb	ves mainly [AIEEE 2005] utane utane	
102.	200°C and containing	6-10 carbon atoms per		(d) 1-bromo-3-methylb	utane	
	molecule is called	[UPSEAT 2004]	174.	Of the five isomeric h	nexanes, the isomer which	2005]
	(a) Natural gas	(b) Gas oil		(a) <i>n</i> -hexane	Infaced compounds Is[AIEEE	2005]
	(c) Gasoline	(d) Kerosene		(b) 2, 3-dimethylbutan	e	
163.	Producer gas is a mixtu	re of Ph. CET 2002: UBSEAT 2004]		(c) 2, 2-dimethylbutan	e	
	(a) CO and $N_{\rm a}$	(b) $CO_2$ and $H_2$	185	(d) 2-methylpentane	on position of C U Cl with	
	(c) $N$ and $Q$	(d) $CH$ and $N$	1/5.	hudro son soon nelled in	Sin reaction of $C_2H_5Cl$ with	
164	The highest bailing pair	(d) $CH_4$ and $W_2$		nydrogen over palladiu $(a) C H$	$\begin{array}{c} \text{Im carbon 1s}  [\text{AFMC 2005}] \\ \text{(b)}  C  H \end{array}$	
104.	(a) $n$ – butane	It is expected for[DEC. 2003]		(a) $C_3 H_8$	(d) $C_4 H_{10}$	
	(b) iso-octane			(c) $C_2 \pi_6$	(d) $C_2 H_4$	
	(c) $n$ -octane					
	(d) 2,2,3,3-tetramethyl	butane		Alke	ene	
165.	Which of the following	is a good conductor of heat				
	of electricity	[Pb. CET 2003]	1.	Addition of bromine to	1. 3-butadiene gives	
	(a) Diamond	(b) Graphite			[CPMT 1987, 93]	
400	(c) Anthracite	(d) Charcoal		(a) 1, 2 addition produc	ct only	
166.	boiling point	lowing has the minimum		(b) 1, 4 addition produc	ct only	
	bolling politi	[AIEEE 2004]		(c) Both 1, 2 and 1, 4 a	ddition products	
	(a) 1-Butene	(b) 1-Butyne		(d) No reaction		
	(c) n-Butane	(d) Isobutane	2.	When ethylene bromide	e is treated with <i>Zn</i> , we get	
167.	Octane number can be c	hanged by [AFMC 2004]			[RPMT 1997]	
	(a) Isomerisation	(b) Alkylation		(a) Alkane	(b) Alkene	
	(c) Cyclisation	(d) All of these		(c) Alkyne	(d) All	
168.	Gasoline has compositio	on [AFMC 2004]	3.	Ethene when treated v	with $Br_2$ in the presence of	
	(a) $C_8 - C_{12}$	(b) $C_2 - C_5$		$CCl_{4}$ which compound	is formed	
	(c) $C_6 - C_{11}$	(d) None of these			DCE 2001: KCET (Med.) 1999]	
169.	The complete combustic	on of $CH_4$ gives [BHU 2004]		(a) 1, 2-dibromoethane	, (, - <b>555</b> ]	
	(a) $CO + H_2$	(b) $CO + N_2$		(b) 1-bromo-2-chloroet	hane	
	(c) $CO_2 + H_2O$	(d) $CO + N_2O$		(c) Both (a) and (b)		
170.	Which of the following	has highest knocking		(d) 1, 1, 1-tribromoetha	ine	
	-	[UPSEAT 2004]	4.	In a reaction		
	(a) Olefins				$CH_2 - OH$	
	(b) Branched chain olef	ins		$CH_2 = CH_2$ <u>Hypochlorous</u>	$\rightarrow M \xrightarrow{R}  $	
	(c) Straight chain olefin	15		acid	$CH_2 - OH$	
171	(u) Aroinatic nyarocarb	uns		Where $M = molecule \cdot R$	R = reagent M and R are	
1/1.	methane on treatment w	vith water[Kerala PMT 2004: M	н сет	[ 2004]	[CBSE PMT 1997: CPMT 2001]	
	(a) $Al_4C_3$	(b) $CaC_2$		(a) $CH_3CH_2Cl$ and $Na($	)H	
	(c) VC	(d) SiC		(b) $CH_{-}CI_{-}CH_{-}OH_{-}2NC$	d ag NaHCO	
	··/ · -			$(0)$ $(1)_2 (1)$ $(1)_2 (1)$ and	- m. m. m. 2003	
	(e) $B_4C$			(c) CIL CIL OIL and II	ור	

(c)  $CH_3CH_2OH$  and HCl

(d) CH<sub>2</sub> = CH<sub>2</sub> and heat
5. Alkenes usually show which type of reaction
[AIIMS 1999; MADT Bihar 1980]
(a) Addition (b) Substitution
(c) Elimination (d) Superposition

6. The propene reacts with HBr to form

	[AIIMS 1999; RPET 1999]
(a) Ethane	(b) Hexane
(c) 1-bromo-propane	(d) 2-bromo propane

7. Ethylene may be obtained by dehydration of which of the following with concentrated  $H_2SO_4$  at  $160 - 170 \,^o C$ 

		[RPET 1999]
(a)	$C_2H_5OH$	(b) <i>CH</i> <sub>3</sub> <i>OH</i>
(c)	$CH_3CH_2CH_2OH$	(d) $(CH_3)_2 CHCH_2 OH$

8.

$H_3C$	$CH_3$		CH <sub>3</sub>		$CH_3$
Ç =	= C	$\xrightarrow{X}$	C = 0	O + O = C	
$H_3C$	$CH_3$	KOH (neat)	CH <sub>3</sub>		$CH_3$

*X* in the above reaction is

- (a)  $HNO_3$  (b)  $O_2$
- (c)  $O_3$  (d)  $KMnO_4$
- **9.** The disappearance of the characteristic purple colour of  $KMnO_4$  in its reaction with an alkene is the test for unsaturation. It is known as

#### [CPMT 1989, 94; CBSE PMT 1990]

[CPMT 2003]

- (a) Markownikoff's test (b) Baeyer's test
- (c) Wurtz's test (d) Grignard test
- **10.** A gas formed by the action of alcoholic *KOH* on ethyl iodide, decolourises alkaline *KMnO*<sub>4</sub>. The gas is

(a)  $C_2H_6$  (b)  $CH_4$ (c)  $C_2H_2$  (d)  $C_2H_4$ 

**11.**  $CH_3 - CH_2 - Cl \xrightarrow{alc.KOH} A$ , the product is

(a) 
$$CH_3CH_2OK$$
 (b)  $CH_3CHO$ 

- (c)  $CH_3CH_2OCH_2CH_3$  (d)  $CH_2 = CH_2$
- 12. The final product formed when ethyl bromide is treated with excess of alcoholic *KOH* is[MP PET 1999]
  (a) Ethylene
  (b) Ethane
  - (c) Ethyne (d) Vinyl bromide
- **13.** Which of the following hydrocarbons cannot be obtained by Sabatier and Senderen's reaction
  - (a)  $CH_4$  (b)  $C_2H_6$
  - (c)  $C_3 H_8$  (d) All
- 14. When 3, 3-dimethyl-2-butanol is heated with  $H_2SO_4$  the major product obtained is[CBSE PMT 1995]

- (a) *cis* and *trans* isomers of 2, 3-dimethyl-2butene
  - (b) 3, 3-dimethyl-1-butene
  - (c) 2, 3-dimethyl-2-butene
  - (d) 2, 3-dimethyl-1-butene
- **15.** The intermediate during the addition of *HCl* to propene in the presence of peroxide is[**IIT-JEE 1997**]

(a) 
$$CH_3 CHCH_2 Cl$$
 (b)  $CH_3 CHCH_2$ 

(c) 
$$CH_3CH_2CH_2$$
 (d)  $CH_3CH_2CH_2$ 

**16.**  $CH_2 = CH_2 \xrightarrow{KMnO_4} X$ . Product 'X' in above reaction is

	_	
(a) Ethylene glycol	(b) Glucose	
(c) Ethanol	(d) All of these	

17. Which of the following compounds represents acrylonitrile

[JIPMER	1997]
---------	-------

[RPMT 2003]

- (a) Vinyl cyanide (b) Cyanoethene
- [CPMT #985-23 ne nitrile (d) All of them
- **18.** When acetylene reacts with arsenic trichloride in the presence of anhydrous aluminium chloride, it produces

#### [AFMC 1999]

- (a) Lewisite
- (b)  $\beta$ -chlorovinyl dichloroarisine
- (c) Nitrobenzene
- (d) Both (a) and (b)
- **19.** Ozonolysis of which one of the following will give two molecules of acetaldehyde

[Bihar MEE 1997; MP PET 2000]

- (a) 1-butene (b) 2-butene
- (c) 1-pentene (d) 2-pentene
- (e) None of these
- **20.** In which of the following, addition of *HBr* does not take place against Markownikoff's rule **or** Anti-Markownikoff addition of *HBr* is not observed for

#### [IIT-JEE 1985; CBSE PMT 1994; MADT Bihar 1995; MP PMT 1999; AMU 2002]

- (a) Propene (b) But-1-ene
- (c) But-2-ene (d) Pent-2-ene
- **21.** Which one of the following characteristics apply to both ethene and ethyne
  - (a) Explode when mixed with chlorine

(b) Decolourise Baeyer's reagent giving brown precipitate

(c) Rapidly absorbed by cold conc.  $H_2SO_4$ 

(d) Form white precipitate with silver nitrate solution

- **22.** Which of the following has highest knocking property
  - (a) Aromatic hydrocarbons
  - (b) Olefins

### 1116 Hydrocarbon (c) Branched chain paraffins

- (d) Straight chain paraffins Dilute aqueous  $KMnO_4$ , at room temperature 23. reacts with R - CH = CH - R to give [Roorkee 1992] (b) *R* – *COOH* (a) *R* – *CHO* (c) RCHOH - CHOHR (d)  $CO_2 + H_2O$
- Aqueous sulphuric acid reacts with 2-methyl-1-24. butene to give predominantly
  - (a) Isobutyl hydrogen sulphate
  - (b) 2-methyl-2-butanol
  - (c) 2-methyl-1-butanol
- (d) Secondary butyl hydrogen sulphate 25.
  - How can ethene be produced from ethanol [BHU 1996] (a) By dehydrohalogenation
    - (b) By dehydrogenation
    - (c) By dehydration with conc.  $H_2SO_4$  at  $170^{\circ}C$
    - (d) By reduction with hydrogen iodide
- Baeyer's reagent is used in the laboratory for 26. [CBSE PMT 1991, 92; AIIMS 1998; AFMC 1999]
  - (a) Detection of double bonds
  - (b) Detection of glucose
  - (c) Reduction
  - (d) Oxidation
- Isopropyl alcohol is obtained by reacting which of 27. the following alkenes with conc.  $H_2SO_4$  and  $H_2O$ 
  - [MP PMT 1999]
  - (a) Ethylene (b) Propylene
  - (c) 2-methyl propene (d) Isoprene
- 28. Which of the following compound is produced when  $CH_2 = CH - (CH_2)_2 COOH$  reacts with *HBr* in presence of peroxides [AIIMS 2000] (a)  $CH_3CH(CH_2)_5COOH$ 
  - (b)  $BrCH_2CH_2(CH_2)_5COOH$
  - (c)  $CH_3CH_2CH_2(CH_2)_5COOH$
  - (d) CH<sub>3</sub>CH<sub>2</sub>BrCH<sub>2</sub>CH<sub>2</sub>COOH
- One mole of each of the following alkenes is 29. catalytically hydrogenated. The quantity of heat evolved will be the lowest in the case of
  - (a) 1-butene (b) Trans-2-butene
  - (c) Cis-2-butene (d) 1, 3-butadiene
- **30.** Which of the following is not used to distinguish ethene from ethane

[KCET (Med.) 2001; UPSEAT 2002; CBSE PMT 2002]

- (a) Iodine in  $CCl_4$ (b) Bromine in  $CCl_4$
- (c) Alkaline  $KMnO_4$ (d) Ammonical  $Cu_2Cl_2$
- A hydrocarbon X adds on one mole of hydrogen to 31. give another hydrocarbon and decolourised bromine water. X reacts with  $KMnO_4$  in presence of acid to give two moles of the same carboxylic acid. The structure of X is

[JIPMER 2001]

(a) 
$$CH_2 = CH - CH_2CH_2CH_3$$
  
(b)  $CH_3CH_2CH_2 - CH = CHCH_3$ 

- (c)  $CH_3CH_2CH = CHCH_2CH_3$
- (d)  $CH_3CH = CHCH_2CH_2CH_3$

When 2-bromobutane reacts with alcoholic KOH, 32. the reaction is called [KCET (Med.) 2001] (a) Halogenation (b) Hydrogenation (d) Dehydro-

(c) Chlorination

(a) HCHO

33.

- halogenation [Roorkee 1992] 1, 3-butadiene reacts with ethylene to form[BHU 2001]
- (b) Cyclohexane (a) Benzene
- (c) Cyclohexene (d) 2, 3 dimethyl butane Ethylene reacts with ozone gas to form the 34. compound [UPSEAT 2001]
  - (b)  $C_2H_5OH$

(c) 
$$O < \begin{bmatrix} CH_2 - O \\ I & I \\ CH_2 - O \end{bmatrix}$$
 (d)  $CH_3CHO$ 

- Oils are converted into fats by [Kerala (Med.) 2002] 35.
  - (a) Hydration (b) Decarboxylation (d) Dehydrogenation
  - (c) Hydrogentation (e) Hydrogenolysis
- Which process converts olefins into parafins 36.

- (a) Halogenation (b) Dehydration (c) Hydrogenation (d) Hydrolysis
- Of the following the formula which represents a 37. saturated cyclic compound is
  - (b)  $C_3H_8$ (a)  $C_3 H_6$
  - (c)  $C_8 H_{10}$ (d)  $C_8 H_{12}$
- 38. In a reaction, if half of the double bond is broken and two new bonds are formed, this is a case of

#### [AMU 1983; NCERT 1978; CPMT 1983]

- (a) Elimination (b) Addition
- (c) Displacement (d) Rearrangement
- Which of the following are formed on addition 39. reaction of DCI with 3-methyl-1-butene[Roorkee 2000]
  - (a)  $CH_2DCHClCH(CH_3)_2$  (b)  $CH_2DCH_2CCl(CH_3)_2$ [Roorkee 2000]

(c) 
$$CH_3CDClCH(CH_3)_2$$
 (d)  $ClCH_2CHDCH(CH_3)_2$ 

- Major product of the following reaction is 40. Br
  - $CH_3 C CH_2 CH_3 + alco. KOH \rightarrow$  [MP PMT 1986] H

41. Cyclopentene on treatment with alkaline  $KMnO_A$ gives

#### [CPMT 1987]

- (a) Cyclopentanol
- (b) trans 1, 2-cyclopentanediol
- (c) cis 1, 2-cyclopentanediol

(d) 1 : 1 mixture of cis and trans 1, 2cyclopentanediol

**42.** Which of the following is the most stable alkene

	[AIIMS 1998; KCE	ET (Med.) 2000; CPMT 2003]		(a) Ethyl alcohol	(b) Acetaldehyde
	(a) $R_2 C = C R_2$	(b) $RCH = CHR$		(c) Acetic acid	(d) Ethylene glycol
	(c) $RCH_2 = CH_2R$	(d) $CH_2 = CH_2$	53.	A gas decolourised KM	$nO_4$ solution but gives no
43.	Ethene gives with acidic (a) Ethylene glycol (c) Formaldehyde	<ul> <li><i>KMnO</i><sub>4</sub> solution [<b>MP PMT 1</b>]</li> <li>(b) Ethylene oxide</li> <li>(d) Acetaldehyde</li> </ul>	997]	or Which of the follow precipitate with ammonitrate but decolouri	niacal cuprous chloride is <i>r</i> ing gases does not give a oniacal solution of silver zes <i>KM</i> nO <sub>4</sub> (neutral or
44.	<ul> <li>(a) Freezing point decrea</li> <li>(b) Boiling point decrea</li> <li>(c) Boiling point increas</li> </ul>	eases ses ses	[(	slightly alkaline) CPMT 1974] [NCERT MP (a) Ethane	<b><sup>7</sup> 1974, 77; CPMT 1974, 77, 78;</b> <b>PMT 1996; MP PET 1996, 99]</b> (b) Methane
	(d) Vapour pressure dec	reases		(c) Ethene	(d) Acetylene
45.	When alcoholic solution heated with granulat formed is	n of ethylene dibromide is ed zinc, the compound [CPMT 1990]	54.	A hydrocarbon reacts give 1-chloro-2-hydrox is	with hypochlorous acid to yethane. The hydrocarbon
	(a) Ethylene	(b) Ethyne			[CBSE PMT 1989]
	(c) Cyclobutane	(d) Butane		(a) Ethylene	(b) Methane
46.	A gas formed by the ad ethyl iodide, decolorises	ction of alcoholic $KOH$ on salkaline $KMnO_4$ solution.	55.	(c) Ethane When ethene is heate	(d) Acetylene ed at $400^{\circ}C$ under high
	The gas is			pressure, the product is	(h) Delvethylene
	[CPMT 1974, 91;	MP PET 1985; IIT-JEE 1982]		(a) Carbon and $H_2$	(b) Polyetnylene
	(a) $CH_4$	(b) $C_2 H_6$		(c) Acetylene and $H_2$	(d) None of these
47.	(c) $C_2H_4$ Markownikoff's rule	(d) $C_2 H_2$ provides guidance of	56.	Which decolorize aqu white fumes of <i>HCl</i> on r	eous bromine and gives reaction with <i>PCl</i> <sub>5</sub> <b>[Pb. PMT 1999]</b>
		[MNR 1994]		(a) $CH_3COCH_2CH = CH_2$	2
	(a) $CH_2 = CH_2$	(b) $CH_3 - CH_2 - CH_3$		(b) $CH_3CH_2CH_2CH_2CH_3$	3
	(c) $CH_3CH = CHCH_3$	(d) $CH_2 = CHBr$		(c) $CH_3CH = CHCH_2CH_2$	2 <i>OH</i>
48.	Ethyl bromide gives eth	vlene when reacted with		(d) $CH_3OCH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2$	H <sub>2</sub> OH
401	[CPMT 1982, 93	; RPET 2000; Pb. PMT 2001]	57.	During debromination	of meso-dibromobutane,
	(a) Ethyl alcohol	(b) Dilute $H_2SO_4$	•,	the major compound for	rmed is [IIT-JEE 1997]
	(c) Aqueous KOH	(d) Alcoholic KOH		(a) <i>n</i> -butane	(b) 1-butane
49.	Ethylene is prepared by	the dehydration of		(c) <i>cis</i> -2-butene	(d) <i>trans</i> -2-butene
	[CPMT 1974	, 79; DPMT 1985; BHU 1989]	58.	What product is form	ned when 1-chlorobutane
	(a) Ethyl alcohol	(b) Methyl alcohol		(a) 1-butene	(h) 2-butene
-0	(c) Acetic acid	(d) Oxalic acid		(a) 1-butanol	(d) 2-butanol
50.	which reactions are mos		50	The olefin which on ozo	(d) 2 butanon
	(a) Electrophilic substit	ution reactions	55.	and <i>CH_CHO</i> is	[Roorkee 1992]
	(b) Nucleophilic substit	ution reactions		(a) 1 butono	(b) 2 hutono
	(c) Electrophilic additio	n reactions		(a) 1-butelle	(d) 2-pentene
	(d) Nucleophilic additio	n reactions	60	Rond length between	(u) 2-pentene
51.	A mixture of 1-c chloropropane when tr	chloropropane and 2- eated with alcoholic <i>KOH</i>	00.	molecule is	[MP PET 1997]
	(a) 1-propene	(b) 2-propene		(a) 1.54 <i>Å</i>	(b) 1.35 <i>Å</i>
	(c) Isopropylene	(d) All the three		(c) 1.19 <i>Å</i>	(d) 2.4 <i>Å</i>
52.	The compound formed	by passing ethylene gas	61.	The compound having b	both $sp$ and $sp^2$ hybridised
-	into cold alkaline solutio	on of $KMnO_4$ is		carbon atom is	[IIT-JEE 1981]
	[NCERT	1974, 81; CPMT 1979, 86, 88;		(a) Propene	(b) Propyne

ICERT 1974, 81; CPMT 1979, 86, 88; MP PET 1985, 95; AFMC 1998]

(c) Propadiene (d) None of these

Hydrocarbon 1117

- The halogen which is most reactive in the 73. 62. halogenation of alkenes under sunlight is [IIT-JEE 1981] (a) Chlorine (b) Bromine (c) Iodine (d) All equal When ethene reacts with bromine, it forms 63. [AFMC 2000; KCET 2001] (a) Chloroethane (b) Ethylene dibromide (c) 1 bromopropane (d) 1,2-dichloroethene 64. Paraffins are soluble in [NCERT 1978] (a) Distilled water (b) Benzene (c) Methanol (d) Sea water 65. Addition of HCl to propene in presence of 74. peroxides gives [BHU 1981, 98] (a) 1-Chloropropane (b) 2-Chloropropane (c) 3-Chloropropane (d) Propene dichloride 66. The name of the product obtained by the addition of HI to propene in presence of peroxide catalyst is [KCET 2000] (a) Isopropyl iodide (b) 2-Iodopropene (d) 1-Iodopropane (c) 2-Iodopropane **67.** In the reaction  $C_2H_5CH = CH_2 + H - X \rightarrow$  Product. What is the product [BHU 2002] (a)  $C_2H_5 - CH_3$ 76. (b)  $C_2H_5CH_2 - CH_2X$ (c)  $C_2H_5 - CHX - CH_3$ (d)  $CH_3 - CH_2X - CH = CH_2$ 68. Alkene can be prepared from alkyl halide by the following reagent  $R - X + Nu^- \rightarrow \text{Alkene} + NuH$  [**RPET 2000**] (a) Alc. *KOH* + heat (b) Aq. KOH + cold water(c) NaOH (d) LiOH **69.** 2-chlorobutane is heated with alcoholic *NaOH*, the product formed in larger amount is[RPET 1999; AMU 2000] (a) 1-Butene (b) 1-Butyne (c) 2-Butene (d) All of these 70. Ethylene has high b.p. and high vapour pressure at  $100^{\circ}C$  and does not dissolve in water. Hence 78. ethylene is separated by this method (a) Simple distillation (b) Vacuum distillation (c) Vapour distillation (d) Alkali treatment Addition of bromine to 1, 3-butadiene gives[AMU 1999]<sup>79</sup> 71. (a) 1, 4-addition product only (b) 1, 2-addition product only (c) Both 1, 2-and 1, 4 addition product (d) None of these In the presence of peroxide, hydrogen chloride 72. and hydrogen iodide do not give anti-Markovnikoff's addition to alkenes because[IIT-JEE Screening 2001] (a) Both are highly ionic (b) One is oxidising and the other is reducing (c) One of the steps is endothermic in both the
  - (d) All the steps are exothermic in both the cases

cases

The compound most likely to decolourize a solution of potassium permanganate is[NCERT 1978] (a)  $CH_3CH_3$ 

(b) 
$$CH_3CH = CHCH_2CH_3$$
  
(c)  $CH_3CH = CHCH_2CH_3$   
(d)  $CH_3 - C - CH_3$   
 $CH_3$ 

- Ethylene is converted to X on passing through a mixture of an acidified aqueous solution of palladium chloride and cupric chloride. Which of the following reagents readily take part in addition reaction with X[UPSEAT 2003] (b) HBr (a)  $Br_2$ 
  - (c) HCl (d) HCN
- Addition of HCl does not obey antimarkownikoff's 75. rule because

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[UPSEAT 2003]
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(a) It is a strong acid (b) It is a gas

(c) Its bond energy is high (d)Its bond energy is less

- Correct statement about1, 3-dibutene[UPSEAT 2003]
- (a) Conjugated double bonds are present
- (b) Reacts with HBr
- (c) Forms polymer
- (d) All of these

At low temperatures, the slow addition of molecular bromine to  $CH_2 = CH - CH_2 - C \equiv CH$ gives

#### [Roorkee Qualifying 1998]

 $CH_3 CH_3$ 

- (a)  $CH_2 = CH CH_2 CBr = CHBr$
- (b)  $BrCH_2 CHBr CH_2 C \equiv CH$
- (c)  $CH_2 = CH CH_2 CH_2 CBr_3$
- (d)  $CH_3 CBr_2 CH_2 C \equiv CH$
- *PCl*<sub>5</sub> reacts with propanone, to give **[Pb. PMT 2001] [UPSEAT 1999]** (a) vic-dichloride (b) Propanal
  - (c) propane-chloride (d) gem-dichloride
  - The compounds that will give an isomer of 2; 2dimethyl propane on catalytic hydrogenation are [AMU 19  $(1) \quad CH_3CH = C - CH_3$ (2)  $CH_3CH = CHCH_3$ 1

(3) 
$$CH_{3}C = CHCH_{2}CH_{3}(4)$$
  $CH_{3}C = C - CH_{3}$ 

(a) 1 and 4	(b) 2 and 4
(c) 1 and 3	(d) 1 and 2

**80.** Alkene  $R - C - H = CH_2$  reacts readily with  $B_2H_6$ and the product on oxidation with alkaline hydrogen peroxides produces

	(a) $R - CH_2 - CHO$	(b) $R - CH_2 - CH_2 - OH$	
	(c) $R-C-CH_3$	(d) $R - CH - CH_3$	
	$\overset{\scriptscriptstyle \parallel}{O}$	OH OH	92
81.	Bayer's reagent is used	for detection of[RPMT 2002]	
	(a) Amines	(b) Glucose	
	(c) Unsaturated bond	(d) Alcohol	
82.	Which of the following	ng is(are) example(s) of	93
	(a) Addition of water	(b) Addition of HCN	
	(a) Addition of $A_{s}Cl$	(d) All	
0-2	(c) Human formula for $k_3$		_
83.			hy
	(a)	$(\mathbf{h})$	94
	$(a) \parallel$		
		cimiser 3	
	$(c) \parallel$	(d) None of these	95
	CHAsCl .	(u) None of these	
84	Propene when heated	with chlorine at about	
04.	$500^{\circ}C$ forms	with emornic at about	
		[MP PET 1997]	
	(a) $CH_2Cl.CH = CH_2$	(b) $CH_3.CHCl.CH_2Cl$	96
	(c) $CH_2Cl.CHCl.CH_2Cl$	(d) All the three	
85.	PVC is obtained from vi	nyl chloride by a reaction	
	called		
	(a) Addition	(b) Isomerization	
	(c) Polymerization	(d) Substitution	97
86.	Reaction of $Br_2$ on ethy	ylene in presence of <i>NaCl</i>	
	gives		
	(a) $BrCH_2 - CH_2Br$	(b) $ClCH_2 - CH_2Br$	
_	(c) Both (a) and (b) $(a) = a + b + b + b + b + b + b + b + b + b +$	(d) None of these	
87.	$CH_3 - CH = CH_2 + HBr$	$\rightarrow$	
	formed is[AIIMS 1983; CI	PMT 1997; RPMT 1999, 2003]	
	(a) $CH_3 - CH_2 - CH_2 - B$	$r$ (b) $CH_3 - CHBr - CH_3$	98
	(c) $BrCH_2 - CH = CH_2$	(d) $CH_2 = C = CH_2$	
88.	The product of reaction	between propene and <i>HBr</i>	
	(a) $CH = CH = CH Br$	(b) $CH = CHBr = CH$	
	(a) $CH_3 - CH_2 - CH_2 Dr$	(d) $CH_3 = CHD_7 = CHD_7$	
0	(c) $CH_3 = CH_2Br$	$(u) CH_3 - CH = CHBr$	00
89.	(a) Only aldohydo	Sutene-2 yields	93
	(a) Only aldenyde (b) Only ketone		
	(c) Both aldehyde and k	etone	
	(d) None of these	econe	10
90.	The final product form	ned by the ozonolysis of	
	compound $RCH = CR_2$ is	[NCERT 1978]	
	(a) <i>RCHO</i>	(b) $R_2 CO$	
	(c) Both (a) and (b)	(d) None of these	10
91.	Which one is an unsatur	ated compound [BIT 1990]	10

	(a) $C_6 H_{14}$ (b) $C_4 H_8$	
	(c) $C_3H_7OH$ (d) $CH_3OH$	
2.	Ethyl alcohol on heating with conc. $H_2SO_4$ gi	ives
	[EAMCET 1979; MP PMT	1996]
	(a) $CH_3COOC_2H_5$ (b) $C_2H_6$	
	(c) $C_2H_4$ (d) $C_2H_2$	
3.	Monohalides on reacting with alcoholic KOH	give
	[MP PET 1982, 86; DPMT 1981; CPMT 197	9, 83]
	(a) Alkanes (b) Alkenes	
	(c) Alkynes (d) Aromatic	
yar 4	IFUCATOONS	10-0]
4.	(a) Allympe (b) Olofin	1979]
	(a) AIKYIIE (D) UIEIIII (c) Paraffin (d) Amina	
=	(c) ratatilit (u) Allille	ms of
3.	ethene, there are [NCERT	<b>1981</b> ]
	(a) Two sigma bonds perpendicular to each o	ther
	(b) One sigma and one pi bond	
	(c) Two pi bonds perpendicular to each other	
	(d) Two pi bonds at an angle of $60^{o}$	
6.	. The formation of alkene from alkyl halide example of	is an
	[CPMT 1983; AMU 1982; Pb. CET	1986]
	(a) Addition (b) Elimination	
_	(c) Substitution (d) (a) and (c)	
7.	In the following reaction	
	$CH_3 - CH_2 - CH_2 - CH_3 \xrightarrow{H_2, 0, 0, 4}{475 K}$ [AIIMS	1983]
	(a) $CH_{3}CH = CHCH_{3}$ predominates	
	(b) $CH_2 = CHCH_2CH_3$ predominates	
	(c) Both are formed in equal amounts	
	(d) The amount of production depends or nature of catalyst	n the
8.	• The compound <i>B</i> formed in the follo sequences of reactions is	owing
	$CH_{3}CH_{2}CH_{2}OH \xrightarrow{PCl_{3}} A \xrightarrow{Alco. KOH} B$	
	[NCERT	1981]
	(a) Propyne (b) Propene	
	(c) Propanol (d) Propane	
9.	. <i>n</i> -propyl bromide on treatment with etha potassium hydroxide produces[IIT-JEE 1987; N	anolic <b>AP PMT 19</b> 9
	(a) Propane (b) Propene	
	(c) Propyne (d) Propanol	
00.	D. The dehydrohalogenation of neopentyl browith alcoholic KOH mainly gives	omide
	LIIT-JEE (Screening) 1990; MP PET	1993]
	(a) 2-methyl-1-butene (b) 2-methyl-2-bute	utero
<b>D1.</b>	(c) 2, 2-dimetriyi-1-butene (d) 2-b 1. Which is the most reactive hydrocarbon in following	n the

		[JIPMER 2002]	
	(a) Ethane	(b) Ethyne	
	(c) Ethene	(d) Methane	
102.	Shape of ethylene molect	ule is [MP PET 1993]	
	(a) Tetrahedral	(b) Pyramidal	
	(c) Planar	(d) Linear	
103.	Electrophilic addition of bond involves the inter more stable carbocation.	n a carbon-carbon double rmediate formation of a . This statement is called	
	(a) Saytzeff's rule	(b) Baeyer's effect	
	(c) Markownikoff's rule	(d) None of these	
104.	$CH_2 = CHCl$ reacts with	<i>HCl</i> to form[ <b>CPMT 1985, 93</b> ]	
	(a) $CH_2Cl - CH_2Cl$	(b) $CH_3 - CHCl_2$	
	(c) $CH_2 = CHCl.HCl$	(d) None of these	
105.	Deviation from Markov presence of	wnikoff's rule occurs in	1
	(a) Zinc	(b) Peroxides	
	(c) $Hg - Zn / HCl$	(d) All of these	
106.	Presence of peroxides af	fects the addition of[BHU 1987	7
	(a) <i>HBr</i>	(b) <i>HCl</i>	
	(c) <i>HI</i>	(d) All of these	
107.	Catalyst used in dime prepare chloroprene is	risation of acetylene to [BHU 1984]	
	(a) $HgSO_4 + H_2SO_4$	(b) $Cu_2Cl_2$	1
	(c) $Cu_2Cl_2 + NH_4Cl$	(d) $Cu_2Cl_2 + NH_4OH$	
108.	Chloroprene is		
	(a) 2-chloro-1, 3-butadie	ene	1
	(b) 3-chloro-2, 3-butadie	ene	
	(c) 2, 3-dichlorobutadie	ne	
	(d) None of these		
109.	Chloroprene is used in m	naking [MP PET 1985]	а
	(a) Synthetic rubber	(b) Plastic	
	(c) Petrol	(d) All of these	
110.	treated with absolute efformed are	Im bromide in dry ether is thy alcohol, the products	1
		[IIT-JEE 1995]	
	(a) $CH_3 - CH - CH_2OH$ a	and $CH_3CH_2M_gBr$	
		<u> </u>	1
	(b) $CH = CH = CH$	CII and Ma(OII)Pr	_
	$(b) CH_3 - CH - CH_2 - CH$	$_2 - CH_3$ and $Mg(OH)Br$	
	$CH_3$		
	(c) $CH_3 - CH - CH_3$ and $U_{CH_3}$	$CH_3 - CH_2 OMgBr$	
	(d) $CH_{2} - CH - CH_{2} - CH_{3} = CH_{3} + CH_{3} + CH_{3} + CH_{3} = CH_{3} + C$	= $CH_{2}$ and $Mg(OH)Br$	
	CH <sub>3</sub> CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub>	<u>.</u>	1
111.	The predominant produce 2-pentene reacts with <i>He</i>	t formed, when 3-methyl- OCl, is [IIT-JEE 1995]	

(a) 
$$CH_{3} - CH_{2} - C - CH - CH_{3}$$
  
 $CH_{3} - CH_{2} - C - CH - CH_{3}$   
 $CH_{3}$   
(b)  $CH_{3} - CH_{2} - C - CH - CH_{3}$   
 $CH_{3}$   
(c)  $CH_{3} - CH_{2} - C - CH - CH_{3}$   
 $CH_{3} - CH_{2} - C - CH - CH_{3}$   
 $CH_{3} - CH - CH_{3}$   
 $CH_{3} - CH - CH_{3}$   
 $CH_{3} - CH_{3} - CH - CH_{3}$   
 $CH_{3} - CH - CH_{3}$   
 $CH_{3} - CH - CH_{3}$ 

112. Which of the following occurs easily in ethylene[MNR 1987; NCERT 1979]

- (a) Addition(b) Substitution(c) Elimination(d) Rearrangement
- **13.** How many gm of bromine will react with 21 gm $C_3H_6$

#### [MP PET 1985]

- (a) 80(b) 160(c) 240(d) 320
- 114. Conjugate double bond is present in [MP PMT 1987](a) Propylene(b) Butadiene
  - (c) Isobutylene (d) Butylene
- **115.** On passing vapours of an organic liquid over finely divided Cu at 573 K the product was an alkene. This reaction is
  - (a) Catalytic oxidation of primary alcohol

(b) Catalytic dehydrogenation of secondary alcohol

- (c) Catalytic dehydrogenation of tertiary alcohol
- (d) Catalytic dehydration of tertiary alcohol
- **116.** The total number of sigma  $\sigma$  and  $pi(\pi)$  bonds in an ethylene molecule are
  - (a)  $4\sigma, 2\pi$  (b)  $4\sigma, 1\pi$
  - (c)  $5\sigma, 2\pi$  (d)  $5\sigma, 1\pi$
- 117. Cyclic hydrocarbon molecule A has all the carbon and hydrogens in a single plane. All the carboncarbon bonds are of same length and less that  $1.54 \text{ } \mathring{A}$  but more than  $1.34 \text{ } \mathring{A}$ . C-C-C bond angle will be [CBSE PMT 1989]
  - (a)  $120^{\circ}$  (b)  $180^{\circ}$
  - (c)  $100^{\circ}$  (d)  $109^{\circ}28'$
- 118. General formula of alkenes is
  - [CPMT 1975, MNR 1987; NCERT 1987; MP PMT 1994]
  - (a)  $C_n H_{2n}$  (b)  $C_n H_{2n-2}$
  - (c)  $C_n H_{2n+2}$  (d)  $C_n H_{2n-1}$
- 119. The product of following reaction is

$$\begin{array}{c} CF_{3} \\ CH_{1} - C - CH = CH_{2} - \frac{(2F_{3}CH)(2F_{3})(H_{2})}{(2F_{3})(2F_{3})(H_{3})(H_{3})} \\ CH_{3} \\ CH_{3} \\ (HP PMT 1986; MP PET 1997] \\ (HP PMT 1986; MP PT 1997] \\ (HP PMT 1986; MP MT 1986; AD PMT 1986; AD PMT$$

- (a) Ethylene (b) Propene
- (c) 1-butene (d) 2-butene
- 133. Indicate the organic structure for the product expected when 2-methyl propene is heated with acetyl chloride in presence of anhydrous zinc chloride [CBSE PMT 1989] CH

(a) 
$$CH_{3} - \overset{C}{C} - CH_{2} - CO - CH_{3}$$
  
 $\downarrow Cl$   
(b)  $CH_{3} - \overset{L}{C} - CH_{2} - CO - CH_{3}$   
 $\downarrow CH_{3}$   
(c)  $CH_{3} - \overset{O}{C} - O - C \swarrow \overset{Me}{Me}$   
 $O - CH_{3}$   
(d)  $CH_{3} - \overset{H}{C} - C - C = CH_{2}$ 

134. The reaction

$$CH_{3} \xrightarrow[]{} CH_{3} \xrightarrow[]{} CH_$$

is the example of

[AMU 1983]

- (a) Sulphonation (b) Dehydration (c) Alkylation (d) Decomposition
- **135.** Olefins can be hydrogenated by [AIIMS 1991] (a) Zinc and HCl (b) Nascent hydrogen (c) Raney Ni and  $H_2$ (d) Lithium hydride in

ether

- **136.** Electrolysis of cold concentrated aqueous solution of potassium succinate yields
  - (a) Ethane (b) Ethyne (c) Ethene
  - (d) Ethane-1, 2-diol
- 137. A hydrocarbon containing 2 carbon atoms gives Sabatier and Senderen's reaction but does not give precipitate with ammoniacal silver nitrate solution. The hydrocarbon in the question is[MADT Bihar 1983] (a) Ethane (b) Acetylene
  - (c) Ethylene (d) None of these

138. The reaction

 $CH_2 = CH - CH_3 + HBr \rightarrow CH_3 CHBr - CH_3$  is

#### [CBSE PMT 1996]

- (a) Nucleophilic addition (b)Electrophilic addition
- (d) (c) Electrophilic substitution
- 139. What is the product of the reaction of 1, 3butadiene with  $Br_2$ 
  - (a) 1,4 -dibromobutene (b) 1,2 -dibromobutene (c) 3,4-dibromobutene (d) 2,3-dibromo-2butene
- 140. An alkene given two moles of HCHO, one mole of  $CO_2$  and one mole of  $CH_3COCHO$  on ozonolysis. What is its structure [Orissa JEE 2003]

(a) 
$$CH_2 = C = CH - CH_2 - CH_3$$
  
 $CH_3$   
(b)  $CH_2 = CH - CH - CH = CH_2$   
(c)  $CH_2 = C = C - CH_3$   
 $CH_3$   
 $CH_3$   
(d)  $CH_2 = C = C - CH = CH_2$ 

**141.** In the reaction

$$CH_{3}CH = CH_{2} + H_{2}O + [O] \xrightarrow{KMnO_{4}}_{Acid} \rightarrow$$
$$CH_{3} - CH - CH_{2} \xrightarrow{[O]} X + HCOOH$$
$$\stackrel{|}{OH} OH$$

- (a)  $CH_3CH_2COOH$ (b)  $CH_3COOH$
- (c)  $CH_3CH_2CHO$ (d)  $CH_3CH_2OH$
- 142. Which of the following alkenes gives only acetic acid and on oxidation with potassium permanganate solution

[MP PET 2003]

(a) Ethylene	e (b)	1-Butene
(c) Propene	(d)	2-Butene

143. Butene-1 may be converted to butane by reaction with

[AIEEE 2003]

(a) <i>Zn-HCl</i>	(b) Sn-HCl
(c) <i>Zn-Hg</i>	(d) $Pd/H_2$

144. The major product formed when propene reacts [CPNith1649; inppropriation of peroxides is[NCERT 1980; CBSE PM

- (a) *n*-propyl bromide (b) Isopropyl bromide
- (c) *n*-propyl alcohol (d) 1, 3-dibromopropane
- 145. Ethyl hydrogen sulphate is obtained by the reaction of  $H_2SO_4$  on [CPMT 1985]
  - (b) Ethane
  - (c) Ethyl chloride (d) Ethanol
- 146. Ethylene reacts with ozone to give [DPMT 1981] (a) Formaldehyde (b) Ethyl alcohol
  - (c) Ozonide (d) Acetaldehyde
- 147. Which of the following aliphatic compounds will discharge red colour of bromine
  - (a)  $C_2H_4$ Free radical addition (b)  $C_3 H_6$ (d) All of these (c)  $C_4 H_8$

1480 Gide JHE ations (an be done on

- (a)  $CH_3 CH = CH_2$ (b)  $CH_2 = CH_2$
- (c)  $CH \equiv CH$ (d) None of these
- 149. Addition of HI on the double bond of propene yields isopropyl iodide and not *n*-propyl iodide as the major product. This is because the addition proceeds through

				пу	urocarbon 1123	
		[CPMT 1988]		(c) 1-pentene	(d) 2-pentene	
	(a) A more stable carbor	nium ion	159.	Which doesn't follow M	Iarkownikoff's rul	е
	(b) A more stable carbar	nion		[JEE Orissa 2004	; MP PMT 2004; BCI	ECE 2005]
	(c) A more stable free ra	adical		(a) $CH_3 - CH = CH_2$		
	(d) None of the above be	eing a concerted reaction		(b) $CH_3CH = CHCH_3$		
150.	When butene-1 is mixed the expected reaction pr	d with excess of bromine, oduct is[CPMT 1974; BHU 198	<b>o</b> ]	(c) $CH_3 - CH - CH = CH$		
	(a) 1, 2-dibromobutane	(b) 1, 1-dibromobutane		CH <sub>3</sub>		
	(c) 2, 2-dibromobutane	(d) Perbromobutane		$(d) CH_3 - CH_2 - CH = CH$	$H_2$	
151.	The compound $X$ of molecules of <i>HCHO</i> . Com	ipound 'X' is[AIIMS 1987; CPM	160. IT 1993	The product of acid phenyl propene is	catalyzed hydrati [IIT JEE (Screeni	on of 2- ng)2004]
	(a) $C_2 H_4$	$(0) C_2 H_2$		(a) 3-phenyl-2-propand	ol (b) 1-phenyl-2-p	oropanol
	(c) $C_2 H_6$	(d) $C_6 H_6$		(c) 2-phenyl-2-propand	ol (d) 2-phenyl-1-p	oropanol
152.	For the reaction		161.	A reagent used to test	for unsaturation of	of allkene
	$CH_3 - CH = CH_2 + HOCl$	$\rightarrow A$ the product A is		15	ſŦ	HII 2004]
		[Orissa JEE 2002]		(a) conc. $H_{a}SO$	(b) Ammonical	$Cu_{\circ}Cl_{\circ}$
	(a) $CH_3 - CHCl - CH_2OH$			(a) $Ammonical AnNO$	(d) Solution	$f D_{n}$ in
	(b) $CH_3 - CH - CH_2 - Cl$		CCI	(c) Annionical Agno <sub>3</sub>	(u) solution 0	$Dr_2 III$
	OH					
	(c) $CH_3 - CH_2 - CH_$	DCl	162.	Propylene on hydrolysi	s with sulphuric a [MH (	cid forms CET-2003]
	Cl			(a) <i>n</i> -propyl alcohol	(b) Isopropyl al	cohol
	(d) $CH_3 - C - CH_3$			(c) Ethyl alcohol	(d) Butyl alcoho	1
	OH Catalust		163.	An alkene, on ozonolys acetaldehyde. The alke	sis gives formalde ne is :	hyde and
153.	$(CH_3)_2 C = CH \xrightarrow{\text{Catalyst}}_{H_2} O$	Optical isomers [BHU 2003]		(a) Ethene	(b) Propene	
	CH <sub>3</sub>			(c) Butene-1	(d) Butene-2	
	(a) 2	(b) 4	164.	In the reaction, $H_2C = 0$	$CH_2 \xrightarrow{\text{cold alkaline}} (A)$	:
	(c) Zero	(d) 3		Product A is :	ΓPb. (	ET 2000]
154.	Isobutene + <i>HBr</i> — Peroxide	→ product is [BHU 2003]		(a) Ethylene glycol	(b) Acetic acid	,
	(a) Tertiary butyl bromi	de (b) Isobutyl bromide		(c) Ethane	(d) Butyric acid	
	(c) Tertiary butyl alcoho	ol (d) Isobutyl alcohol	165.	Using anhydrous AlCl <sub>3</sub>	as catalyst, which	ch one of
155.	Which of the following n of hybridisation $sp^{2}$ - $sp^{2}$ -	represents the given mode - <i>sp-sp</i> from left to right		the following reaction ( <i>PhEt</i> )	on produces ethy	lbenzene
		[IIT-JEE (Screening) 2003]			[CBSE P	MT 2004]
	(a) $H_2C = CH - C \equiv CH$	(b) $HC \equiv C - C \equiv CH$		(a) $H_2C = CH_2 + C_6H_6$		
	(c) $H C = C = C = C H$	(d) $CH = CH_2$		(b) $H_3C - CH_3 + C_6H_6$		
	(c) $H_2 c - c - c - c H_2$	(u) $CH_2^{2} \sim$		(c) $H_3C - CH_2OH + C_6H$	I <sub>6</sub>	
156.	"The negative part of	addenda adds on to the		$(d)  CH_3 - CH = CH_2 + C$	$G_6H_6$	
	carbon atom linked hydrogen atoms". This s	with least number of tatement is called <b>[DPMT 198</b> 3	166. 2; AIIM	Which of these of SM9&&0AFMCo20941	does not follo	w Anti-
	(a) Thiele's principle	(b) Bayer's strain theory			[Orissa]	JEE 2005]
	(c) Markownikoff's rule	(d) Peroxide effect		(a) 2-butene	(D) 1-Dutene	
157.	The product obtained, h	eating ethanol with conc.	167.	Reaction of <i>HBr</i> with	propene in the pro	esence of
	$H_2SO_4$ at $165^o$ –170 $^o$ , is	[MP PMT 2003]	,•	peroxide gives	[CBSE P	MT 2004]
	(a) $(C_2H_5)_2SO_4$	(b) $CH_{2} = CH_{2}$		(a) Allyl bromide	(b) <i>n</i> -propyl bro	mide

(c) Isopropyl bromide (d) 3-bromo propane

[BCECE 2005]

**168.** Which of the following react with  $KMnO_4$  but does

not react with  $AgNO_3$ ?

- (b)  $CH_2 = CH_2$ (a)  $(C_2H_5)_2SO_4$
- (c) *CH*<sub>3</sub>*COOH* (d)  $C_2H_5HSO_4$
- **158.** Which of the following is the most stable (a) 1-butene (b) 2-butene

- (a)  $C_2 H_6$ (b) *CH*<sub>4</sub> (c)  $C_2H_4$ (d)  $C_2H_2$
- **169.** 3-Phenylpropene on reaction with *HBr* gives (as a major product) [AIIMS 2005]
  - (a)  $C_6H_5CH_2CH(Br)CH_3$
  - (b)  $C_6H_5CH(Br)CH_2CH_3$
  - (c)  $C_6H_5CH_2CH_2CH_2Br$
  - (d)  $C_6H_5CH(Br)CH = CH_2$
- 170. Reaction of one molecule of HBr with one gives molecule of 1,3-butadiene at  $40^{\circ}C$ [AIEEE 2005] predominantly
  - (a) 3-bromobutene under kinetically controlled conditions
  - (b) 1-bromo-2-butene under thermodyanamically controlled conditions
  - (c) 3-bromobutene under thermodynamically controlled conditions
  - (d) 1-bromo-2-butene under kinetically controlled conditions
- 171. The only alcohol that can be prepared by the indirect hydration of alkene is [AFMC 2005] (a) Ethyl alcohol (b) Propyl alcohol (c) Isobutyl alcohol (d) Methyl alcohol
- $CH_{2}$ **172.** The reaction of *HBr* with  $CH_3 - C = CH_2$  in the presence of peroxide will give [BHU 2005]
  - (a)  $CH_3CBrCH_3$ (b) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>Br  $\dot{C}H_3$  $CH_3$  $CH_3$

(c) 
$$CH_{2}CHCH_{2}Br$$
 (d)  $CH_{2}CH_{2}CHCH_{2}$ 

**173.** A gas decolourised by  $KMnO_4$  solution but gives no precipitate with ammoniacal cuprous chloride is [VCET 2005]

				LKCET 200	551
	(a) Ethane	(b) Me	ethane		
	(c) Ethene	(d) Ac	etylen	е	
•	Cyclohexene on reacti	on with	$OsO_4$	followed	by
	reaction with NaHSO $_3$	gives	[Ori	ssa JEE 200	<b>05</b> ]
	(a) cis-diol	(b) tra	ans-dic	ol	
	(c) epoxy	(d) ald	cohol		

Which of the following gases is used for welding 1.

Alkyne

[CPMT 1996]

(a) Methane (b) Ethane (c) Acetylene (d) Ethene

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A metallic carbide on treatment with water gives 2. a colourless gas which burns readily in air and which gives a precipitate with ammoniacal silver nitrate solution. Gas evolved is

[NCERT 1975; CPMT 1977; MP PET 2002]

- (b) Ethane (a) Methane
- (c) Acetylene (d) Ethylene
- 1-butyne reacts with cold alkaline KMnO<sub>4</sub> to 3. produce

[AIIMS 1997]

- (a)  $CH_3CH_2COOH$
- (b)  $CH_{2}CH_{2}CH_{2}COOH$
- (c)  $CH_3CH_2COOH + CO_2$
- (d)  $CH_3CH_2COOH + HCOOH$
- Identify the product D in the following series of 4. reaction

 $CH_{3}COOH \xrightarrow{\text{LiAlH}_{4}} A \xrightarrow{H^{+}} B \xrightarrow{Br_{2}} C \xrightarrow{alc.} D$ 

- [CBSE PMT 1998] (a) Methane (b) Alcohol (c) Acetylene (d) Benzaldehyde
- 5٠ The correct order towards bond length is

[RPMT 1997]

(a) 
$$C - C < C = C < C \equiv C$$
 (b)  $C \equiv C < C = C < C - C$ 

(c)  $C = C < C \equiv C < C - C$  (d)  $C = C < C - C < C \equiv C$ 

6. In the molecule  $CH \equiv C - CH = CH_2$ , the hybridisation of C-C bond is

(a) 
$$sp^2 - sp$$
 (b)  $sp^3 - sp^3$ 

(c)  $sp^2 - sp^2$ (d)  $sp^{3} - sp$ 

- The product formed when acetylene is passed 7. through red hot tube is [BHU 1989; RPMT 2003]
  - (a) Benzene (b) Cyclohexane
  - (c) Neoprene (d) Ethane
- 8. Acetylenic hydrogens are acidic because

[CBSE PMT 1989; Pb. PMT 1999]

(a) Sigma electron density of C-H bond in acetylene is nearer to carbon, which has 50% s-character

(b) Acetylene has only one hydrogen on each carbon

- (c) Acetylene contains least number of hydrogens among the possible hydrocarbons having two carbons
- (d) Acetylene belongs to the class of alkynes with molecular formula  $C_n H_{2n-2}$
- Which is the most suitable reagent among the 9. following to distinguish compound (iii) from rest of the compounds
  - (i)  $CH_3 C \equiv C CH_3$
  - (ii)  $CH_3 CH_2 CH_2 CH_3$

(iii)

 $CH_3 - CH_2 - C \equiv CH$ 

(iv)  $CH_3 - CH = CH_2$ 

- (a) Bromine in carbon tetrachloride
- (b) Bromine in acetic acid
- (c) Alkaline KMnO<sub>4</sub>
- (d) Ammoniacal silver nitrate reagent
- **10.** A hydrocarbon of formula  $C_6H_{10}$  absorbs only one molecule of  $H_2$  upon catalytic hydrogenation. Upon ozonolysis, the hydrocarbon yields

$$H H H O = C - CH_2 -$$

The hydrocarbon is

- (a) Cyclohexane (b) Benzene
- (c) Cyclohexene (d) Cyclobutane
- **11.** Poisonous gas 'Lewissite' is obtained by the reaction of

[MP PMT 2003]

[MP PMT 1986]

[CBSE PMT 1989]

- (a)  $CH \equiv CH$  and  $AsCl_3$
- (b)  $CH_2 = CH_2$  and  $AsCl_3$

(c)  $CH \equiv CH$  and  $S_2Cl_2$ 

- (d)  $CH_2 = CH_2$  and NOCl
- **12.** Products of the following reaction  $CH_3C \equiv C CH_2 CH_3 \xrightarrow{(1) O_3} \dots \text{ are}$

[CBSE PMT 2005]

- (a)  $CH_3CHO + CH_3CH_2CHO$
- (b)  $CH_3COOH + CH_3CH_2CHO$
- (c)  $CH_3COOH + HOOCCH_2CH_3$
- (d)  $CH_3COOH + CO_2$
- **13.** By coaltar distillation, which is not obtained

[SCRA 1990; MP PMT 1986](a) Light oil(b) Middle oil

- (c) Heavy oil (d) Mobil oil
- 14. Hydrocarbon containing following bond is most reactive[AIIMS 1987]

(a) $C \equiv C$	(b) $C = C$
(c) <i>C</i> – <i>C</i>	(d) All of these

- **15.** The shapes of methane, ethene and ethyne molecules are, respectively
  - (a) Tetrahedral, planar and linear
  - (b) Tetrahedral, linear and planar
  - (c) Pyramidal, planar and linear
  - (d) Tetrahedral, pyramidal and planar
- **16.** To synthesize the unsymmetrical alkyne  $CH_3 C \equiv C CH_2 CH_3$  the reagents needed
  - would be

(a) Ethene, iodoethane, iodomethane and potassium hydroxide

(b) Acetaldehyde, 1-bromopropane and conc.  $H_2SO_4$ 

- (c) 1, 2-dichloroethane, 1-propanol and alcoholic potassium hydroxide
- (d) Ethyne, iodomethane, iodoethane and sodamide
- 17. When propyne is treated with dilute  $H_2SO_4$  and  $H_gSO_4$ , the major product is[Kurukshetra CEE 2002]
  - (a) Propanal
  - (b) Propanol
  - (c) Propyl hydrogen sulphate
  - (d) Propanone
- **18.** Which of the following will be the final product when  $C_2H_2$  reacts with *HCl* 
  - [DPMT 1984; AFMC 1982; Bihar MEE 1982]
  - (a) || *CH CHCl CHCl CHCl* (c) ||(d) None of

**19.** What is the end product of the following sequences of operations  $CaC_2 \xrightarrow{H_2O} A \xrightarrow{\text{dil}.H_2SO_4}_{H_0^{++}} B \xrightarrow{Ni}_{H_2} C$ 

#### [CPMT 1978; MP PMT 1996]

(a) Methyl alcohol	(b) Acetaldehyde
(c) $C_2H_5OH$	(d) $C_2 H_4$

- **20.**  $R CH_2 CCl_2 R \xrightarrow{\text{Reagent}} R C \equiv C R$ The reagent is **[CBSE PMT 1989; MP PET 1995]** (a) Na (b) HCl and  $H_2O$ 

  - (c) KOH in  $C_2H_5OH$  (d) Zn
- 21. Acetylene can be prepared from [CPMT 1988]
  (a) Potassium fumarate (b) Calcium carbide
  (c) Ethylene bromide (d) All of these
  - (c) Ethylene bronnue (u) An or these
- 22. Acetylene is obtained by the electrolysis of [BHU 1986]
  (a) Sodium succinate
  (b) Potassium fumarate
  (c) Both (a) and (b)
  (d) None of these
- **23.** The compound  $C_3H_4$  has a triple bond, which is indicated by its reaction with
  - (a) Bromine water (b) Bayer's reagent
  - (c) Fehling solution (d) Ammonical silver nitrate
- **24.**  $CH \equiv CH \xrightarrow{H_2O/H_8^{2+}} X \xrightarrow{LIAIH_4} Y \xrightarrow{P_4/B_{P_2}} Z$  Here Z is

#### [JIPMER 2002]

- (a) Ethylene bromide (b) Ethanol
- (c) Ethyl bromide (d) Ethylidene bromide
- **25.**  $CH \equiv CH \xrightarrow{Ni(CN)_2} X$ . Here X in the reaction Pressure

#### Hydrocarbon 1125

-		
		[JIPMER 2002]
	(a) Benzene	(b) Ethane
_	(c) Cycloctatetraene	(d) Cyclohexane
26.	A salt producing hy compounds is	ydrocarbon among these
		[KCET (Engg.) 2002]
	(a) Ethane	(b) Methane
	(c) Ethene	(d) Ethyne
27.	An unknown compound $C_4H_6$ . When <i>A</i> is treat	A has a molecular formula ed with an excess of $Br_2$ a
	new substance B with f	ormula $C_4H_6Br_4$ is formed.
	A forms a white pre silver nitrate solution.	cipitate with ammoniacal A may be
		[MP PET/PMT 1998]
	(a) Butyne-1	(b) Butyne-2
	(c) Butene-1	(d) Butene-2
28.	Which of the following the elimination of hydr	g reacts with sodium with ogen
	(a) <i>CH</i> <sub>4</sub>	(b) $C_2 H_6$
	(c) $C_2 H_4$	(d) $C_2 H_2$
29.	Acetylene gives	[CPMT 1985]
	(a) White precipitate w	with $A_{gNO_3}$ and red
	precipitate with Cu	$_2Cl_2$
	(b) White precipitate w	with $Cu_2Cl_2$ and red
	precipitate with Ag	NO 3
	(c) White precipitate w	with both the reagents
	(d) Red precipitate wit	h both the reagents
30.	The bond length betwe	een $sp^3$ hybridised carbon
0	atom and other carbon	atom is minimum in
	[CI	BSE PMT 1996; Pb. PMT 1999]
	(a) Propane	(b) Butane
	(c) Propene	(d) Propyne
31.	The $C - H$ bond length formed by	n is minimum in the bond
	(a) <i>sp</i> - <i>s</i> overlapping (	as in alkynes)
	(b) $sp^2 - s$ overlapping	(as in alkenes)
	(c) $sp^3 - s$ overlapping	(as in alkanes)
	(d) None of these	
32.	Which of the C - C bond	is strongest
	(a) Formed by $sp^3 - sp$	<sup>3</sup> hybridised carbon atoms
	(as in distance) (b) Economic theorem $2^{2}$	<sup>2</sup> hubbidized carbon atoms
	(U) Formed by $sp^2 - sp$	nyoriuised carbon atoms
	(as in dikelles)	whridized carbon atoms (as

- (c) Formed by sp sp hybridised carbon atoms (as in alkynes)
- (d) All are equal
- **33.** Which of the following pairs has the same bond angle
- (a) Ethane and ethylene (b) Ethylene and acetylene
  - (c) Ethylene and benzene (d)Acetylene and benzene

- **34.** The product(s) obtained via oxymercuration  $(HgSO_4 + H_2SO_4)$  of 1-butyne would be[IIT-JEE 1999]
  - (a)  $CH_3 CH_2 CH_3 = CH_3$ (b)  $CH_3 - CH_2 - CH_2 - CH_3$
  - (c)  $CH_3 CH_2 CHO + HCHO$
  - (d)  $CH_3CH_2COOH + HCOOH$
- **35.** A compound is treated with  $NaNH_2$  to give sodium salt. Identify the compound [AFMC 1998] (a)  $C_2H_2$  (b)  $C_6H_6$ (c)  $C_2H_6$  (d)  $C_2H_4$
- **36.** A gas decolourises bromine in  $CCl_4$  and forms a precipitate with ammoniacal silver nitrate. The gas is [EAMCET 1998] (a)  $C_2H_2$  (b)  $C_2H_4$ 
  - $\begin{bmatrix} \mathbf{BHU} & \mathbf{1983} \\ (\mathbf{C}) & \mathbf{C}_2 H_6 \end{bmatrix}$  (d)  $CH_4$
- 37. Among the following compounds which have more than one type of hybridisation for carbon atom(i) CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>

	(i) $CH_3CH_2CH_2CH_3$		
	(ii) $CH_3 - CH = CH - CH_3$	3	
	(iii)	$CH_2 = CH$	$-C \equiv CH$
	(iv) $H - C \equiv C - H$		[EAMCET 1998]
	(a) (ii) and (iii)	(b) (ii)	
	(c) (iii) and (iv)	(d) (iv)	
38.	The homologue of ethyn	e is	[EAMCET 1998]
	(a) $C_2 H_4$	(b) $C_2 H_6$	
	(c) $C_3 H_8$	(d) $C_3 H_4$	
39.	When acetylene reacts v	vith <i>HCl</i> in	the presence of

39. When acetylene reacts with *HCl* in the presence of *HgCl*<sub>2</sub>, the product is[MNR 1985; MP PET 1996; UPSEAT 200

(a) Methyl chloride	(b) Dichloroethane
(c) Vinyl chloride	(d) Ethylidine chloride

**40.** When propyne reacts with aqueous  $H_2SO_4$  in the presence of  $H_8SO_4$ , the major product is

#### [IIT-JEE 1983; AFMC 1991; KCET 1993]

(a) Propanal	(b) Propyl	hydrogen
sulphate		

- (c) Acetone (d) Propanol
- 41. Propyne on polymerisation gives [CPMT 1999, 2002](a) Mesitylene (b) Benzene
  - (c) Ethyl benzene (d) Propyl benzene
- **42.** When treated with ammoniacal cuprous chloride, which one among the following forms copper derivative

#### [CBSE PMT 1989; MP PMT 1993]

(a)	$C_2H_6$	(b)	$C_2H_4$
(c)	$C_2H_2$	(d)	$C_6H_6$

				H	ydrocarbon 1127
43.	Which of the follow polymerisation of <i>CH</i>	ing catalyst is used in the $\equiv CH$ to $C_6H_6$ [CPMT 1999]	53.	(c) Metal silver Ethylidine dichloride	(d) Silver mirror can be prepared by the
	(a) $AlCl_3$	(b) $HgSO_4$		reaction of HCl and	
	(c) $NbCl_3$	(d) <i>HCl</i>		(a) $C_2 H_4$	(b) $C_2 H_2$
44.	$KMnO_4$ will oxidise a	cetylene to [CPMT 1999]		(c) $C_2 H_5$	(d) All of these
	(a) Ethylene glycol (c) Oxalic acid	(b) Ethyl alcohol (d) Acetic acid	54.	Which of the followin to prepare 1, 3-butadie	g order of reagent is chosen ene from $C_2H_2$ [RPET 2000]
<b>45</b> .	Ethyne on reaction	with dil. $H_2SO_4$ and $H_g(II)$		(a) $CuCl / NH_4Cl$ and	$H_2/Pd(BaSO_4)$
	gives			(b) $NH_{\perp}Cl/CuCl$ and	$H_2/Pd(BaSO_A)$
	(a) Ethanol			(c) $H_{a}/Pd(BaSO_{a})$ and	$C_{\mu}C_{l} / NH \cdot C_{l}$
	(b) Ethanal			(d) $H_2/H(Base_4)$ and (d) $H_2/H(Base_4)$ and	
	(c) Methoxymethane	Inhoto		(u) $H_2/Pa(BasO_4)$ and	$MH_4Cl/CuCl$
46	(d) Etnyl nydrogen su	ipnate	55.	Benzene is the polyme	er of[ <b>RPET 1999; Bihar MEE 19</b> 9
40.	ethylene and acetylen	e[ <b>MP PET 2000: KCET 2000: IIP</b> ]	MER 20	(a) Methane	(b) Ethane
	CPMT 1977: NCERT 1973]			(č) Ethylene	(d) Ethyne
	(a) Alkaline $KMnO_4$	2	56.	CH reacts with acetic $CH$	acid in presence of $Hg^{2+}$ to
	(b) Bromine water			give	[D]
	(c) Ammoniacal cupro	ous chloride		СН.	[BHU 2005] <i>CH(CH,COO</i> ).
	(d) Conc. $H_2SO_4$			(a) $\downarrow$	(b) $+$
47.	The distinguishing te acidic hydrogen is	est for triple bond containing [JIPMER 2000]		$(c) \xrightarrow{CH_3} (c) $	(d) None of these
	(a) $Ag(NH_3)_2^+$	(b) $Br_2$ in $CCl_4$		$CH_2(CH_3COO)$	
	(c) Alkaline $KMnO_4$	(d) AlCl <sub>3</sub>	57.	Acetylene is prepare electric discharge thr	ed industrially by passing ough graphite electrodes in
48.	If acetylene is passed	d through an electric arc in		the atmosphere of	
	the atmosphere of nitrogen, the compound formed is			(a) Air	(b) N.
		[RPMT 1999]		(c) H	(d) $CQ$
	(a) <i>HCN</i>	(b) Pyrrole	- 9	When acetylene is n	(d) $co_2$
	(c) Pyrazole	(d) Pyridine	50.	acid containing $Hg^{2+}$	ions the product formed is
49.	Ozonolysis of acetyler	ne gives [RPMT 1999]		[DPMT 1996: Roorke	e 1995: BHU 1998: KCET 1999:
	(a) Glycol	(b) Glyoxal,formic acid		MP PET 1985, 86	; DCE 1999; DPMT 1999, 2002;
	(c) Formaldehyde	(d) None		CPMT 1975	, 82, 83, 90; MP PMT 1994, 97;
50.	The bond length bet	ween the hybridised carbon		CBSE PMT 1999	; AIIMS 2002; CBSE PMT 1999;
	atom and other carbo	n atom is minimum in [Pb. PMT	[ 2000]	(a) Acetone	(h) Acetic acid
	(a) Butane	(b) Propyne		(a) Acetaldehyde	(d) Formaldehyde
	(c) Propene	(d) Propane	59.	Which of the following	g has acidic hydrogen
51.	The reaction of prope the addition of	ene with <i>HOCl</i> proceeds via [IIT-JEE (Screening) 2001]		[IIT-JEE 1985, 89	; CPMT 1986; Bihar MEE 1997; RPET 1999; AFMC 1999]
	(a) $H^+$ in the first step	р		(a) Ethyne	(b) Ethene
	(b) $Cl^+$ in the first step <b>6</b>			(c) Ethane	(d) Benzene
			60.	Xylenes on oxidation v	with acidic $KMnO_4$ gives
	(d) $Cl^+$ and $OH^-$ in a c	ingle sten			[JIPMER 2000]
52	$(u) \cup a = u \cup n = u = x$	$ammonical A_{a}NO = forming$		(a) Terphthalic acid	(b) Phthalic acid
J <b>∠</b> .		animonical Agivo <sub>3</sub> for ming		(c) Isophthalic acid	(d) All of these
	[MH CET 1999;	CPMT 1984, 86; MP PMT 1997]			
	(a) Silver acetylene	(b) Silver acetate			

The structure of the product(Z) in the reactions 61. given below - +

 $\mathbf{0}$ 

$$HC = CH \xrightarrow{NaNH_2, CH_3COCH_3} X \xrightarrow{Hg^{2+}, H_3O^+} Z \text{ is}$$

[Roorkee 2000]

Carbon-carbon bond length is minimum in 62. [CBSE PMT 1988, 91; MNR 1984; CPMT 1989; RPMT 1997; Pb. PMT 2001]

(a) Ethane	(b) Ethene

- (c) Ethyne (d) Benzene
- (e) Ethanol
- Triple bond of ethyne is made of or Cylindrical 63. shape of an alkyne is due to

[EAMCET 1978; NCERT 1979; CBSE PMT 1997; Manipal MEE 1995; Bihar MEE 1996]

- (a) Three  $\sigma$  bonds
- (b) Three  $\pi$  bonds
- (c) Two  $\sigma$  and one  $\pi$  bond
- (d) Two  $\pi$  and one  $\sigma$  bond
- An organic compound has a triple bond and not 64. double bond. It can be tested by [MP PMT 2000, 03] (a) Bromine water

  - (b) Bayer's reagent
  - (c) Fehling solution
  - (d) Ammonical silver nitrate

Which of these will not react with acetylene 65.

	[AIEEE 2002; DCE 2002]
(a) <i>NaOH</i>	(b) Ammonical $AgNO_3$

	(c) Na	(d) <i>HCl</i>						
66.	What is the product	when acetylene reacts w	vith					
	hypochlorous acid	[RPMT 2002; AIEEE 20	02]					
	(a) $CH_{2}COCl$	(b) CICH_CHO						

(4)	01130001	(0)	even 2ente
(c)	Cl <sub>2</sub> CHCHO	(d)	ClCHCOOH

The alkene  $C_6H_{10}$  producing  $OHC - (CH_2)_4 - CHO$ 67. on ozonolysis is [Roorkee 1999]

(a) Hexene-1	(b) Hexene-3
(c) Cyclohexene	(d) 1-
methylcyclohexene-1	

The number of moles of proton which can be 68. easily given by butyne-1(1 mole) is [MP PMT 2000] (b) 2 (a) 1

69. Which will undergo reaction with ammoniacal AgNO 3

(a) 
$$\frac{CH_3}{CH_3}$$
  $CH - CH_2 - CH = CH - CH_3$ 

(b) 
$$CH_3 - CH = CH - C \equiv CH$$

(c) 
$$CH_3 - CH_2 - CH = CH - CH_2 - CH_3$$

(d) 
$$CH_2 = CH - CH_2 - CH_3$$

(e) None

- 70. Acetylene gas when passed through the 20%  $H_2SO_4$  at 80° C gives acetaldehyde. The catalyst required for this conversion is
  - (a) Anhydrous AlCl<sub>3</sub> (b)  $HgSO_4$

Which of the following reactions will yield 2, 2-71. dibromopropane [MNR 1993; UPSEAT 2001] (a) HC = CH + 2HB

(a) 
$$HC \equiv CH + 2HBr \rightarrow$$

- (b)  $CH_3C \equiv CH + 2HBr \rightarrow$
- (c)  $CH_3CH = CH_2 + HBr \rightarrow$
- (d)  $CH_3CH = CHBr + HBr \rightarrow$
- Which of the following does not give white 72. precipitate with ammoniacal AgNO<sub>3</sub>

(a) 
$$CH \equiv CH$$
 (b)  $CH_3 - C \equiv CH$ 

(c) 
$$CH_3 - C \equiv C - CH_3$$
 (d)  $CH_2 - C \equiv CH_3$ 

 $\begin{array}{c} CH \\ ||| & \xrightarrow{O_3 / NaOH} X \xrightarrow{Zn / CH_3COOH} Y 'Y' \text{ is[AIIMS 1988]} \end{array}$ 73. CH

(a) 
$$| \\ CH_2OH \\ CH_2OH$$
 (b)  $CH_3CH_2OH$ 

(c)  $CH_3COOH$ (d)  $CH_3OH$ 

Which is represented by the formula  $C_n H_{2n-2}$ 74.

CI

What is the major product of the following 75. reaction  $CH_3C \equiv C - CH_2 - CH_3 \xrightarrow{1 \text{ mole of } Cl_2}$ 

(a) 
$$CI \\ CH_3 > C = C < CI \\ CH_2 CH_3$$
  
(b)  $CH_3 - CH_2 - CH_2 - CH_2 CH_3$   
 $CI \\ CI \\ CI \\ CI$ 

	(c) $\frac{Cl}{CH} > C = C < \frac{CH_2CH}{CH}$	3	86.	The hybridisation in me	thane, ethene and Ethyne
	CH <sub>3</sub> Cl			(a) $sp^3$ , $sp^2$ and $sp$	(b) $sp^{3}$ , $sp$ , $sp^{2}$
	$\begin{array}{ccc} Cl & Cl \\ & & \\ \end{array}$			(c) $sp^2$ , $sp^3$ and $sp$	(d) $sp^3$ , $sp^2$ , $sp$
	(d) $CH_3 - C - C - CH_2CH_2$	<i>I</i> <sub>3</sub>	87.	Number of acidic hydrog	gen atoms in butyne-1 are
	Cl $Cl$		,		[MP PET 1986]
76.	A compound $C_{eH_{o}}$ wh	nich give white ppt, with		(a) 2	(b) 3
/01	ammonical $A_{qNO}$ . A	give $(CH_{2})_{2}$ CHCOOH with		(c) 1	(d) 4
	hot alcoholic <i>KOH</i> then	compound is [ <b>RPMT 2002</b> ]	88.	Which of the following s	shows linear structure <b>[CPMT 2003</b>
	(a) $CH_2CH_2 - CH_2 - CH_3$	$= CH_{2}$		(a) Ethane	(b) Ethene
	(b) $CH - CH - C = CH$	- 2		(c) Acetylene	(d) $CCl_4$
	(c) $CH_3$ $CH_2$ $C=CH_3$		89.	Calcium carbide on reac	ting with water gives
	(c) $(CH_3)_2 CH - C = CH$			[CBSE PMT 1991; MI	P PMT 1993, 94; RPMT 2002;
	(d) $CH_2 = CH - CH_2 - CH$	$=CH_2$			J & K 2005]
77.	1, 2-dibromoethane wh	ien heated with alcoholic		(a) Methane	(b) Ethane
	(a) Ethane	(b) Acetylene		(C) Etnene	(d) Acetylene
	(c) Ethylene	(d) Methane	90.	Addition of HCN to ethy	The in presence of $Ba(CN)_2$
	(e) None of these			(a) 1 1 dicyano othano	[AFMC 1991]
78.	Which of the following	ng is not a member of		(a) 1, 1-ulcyallo etilalle	(d) Divinyl cyanide
	homologous series	[RPMT 2002]	01	Which compound will	react with an aqueous
	(a) Ethene	(b) 1-butene	91.	solution of $Ag(NH_2)^+_2OH^+_2$	-
	(c) 2-butene	(d) 2-butyne		(a) $CH = CH$	(b) $CH = CH$
79.	ne compound formed	as a result of potassium		(a) $CH_2 = CH_2$	$ \begin{array}{c} (0) & \mathbf{C}\mathbf{H}_3 \\ (0) & \mathbf{C}\mathbf$
	permanganate ontaation	[MP PET/PMT 1998]		$(c)  c \Pi_3 c \Pi_2 c = c \Pi$	$(\mathbf{u})  c \mathbf{h}_3 - \mathbf{c} = \mathbf{c} - c \mathbf{h}_3$
	(a) Benzoic acid	(b) Benzyl alcohol	92.	Which of the following g	give $H_2$ gas with $Na$ [ <b>RPMT 2002</b> ]
	(c) Benzophenone	(d) Acetophenone		(a) $CH_4$	(b) $C_2 H_6$
80.	What is the product w	when 2-butyne is treated		(c) $C_2 H_4$	(d) $C_2 H_2$
	with liquid $NH_3$ in prese	ence of lithium[ <b>Orissa JEE 200</b>	3] 93.	$CH_3 - C \equiv CH \xrightarrow{O_3} Produce$	uct .Product in above
	(a) <i>n</i> -butane	(b) <i>cis</i> -2-butene		$Zn/H_2O_2$	
	(c) <i>trans</i> -2-butene	(d) 1-butene		reaction is	[PPMT 2002]
81.	Distinction in pentene-1	and pentyne-1 is done by		(a) $CH COOH$	(b) <i>HCOOH</i>
		[CPMT 1996]		(a) $CH_3COOM$	
	(a) $[Ag(NH_3)_2]^+$	(b) Conc. $H_2SO_4$		(c) Both (a) and (b) $(a) = (a) + ($	(d) $CH_3CHO + HCHO$
	(c) HCl	(d) $Br_2$	94.	The number of $\pi$ – bonds	in the product formed by
82.	A mixture of ethane, et	hene and ethyne is passed		passing acetylene through	ugh dilute sulphuric acid
	through ammoniacal A	$gNO_3$ solution. The gases		(a) Zoro	
	which remain unreacted	l are	[0	CPMT 1990]	(d) Three
	(a) Ethane and ethene	(b) Ethane and ethyne	0-	(C) IWO	(d) Illiee
	(c) Ethene and ethyne	(d) Ethane only	95.	(a) CH CH	(b) C U
83.	In its reaction with silve	er nitrate acetylene shows		(a) $CH_2 = CH_2$	$(\mathbf{b}) \ \mathbf{c}_6 \mathbf{h}_6$
		[MP PET 1999]		(c) $CH_3 - C \equiv CH$	(d) $CH_3 - C \equiv C - CH_3$
	(a) Oxidising property	(b) Reducing property	96.	Which of the followin	g reactions is shown by
•••	(c) Basic property	(d) Actuic property		alkynes	
<b>0</b> 4.	Simplest alkyne is repre	(b) CU			[AMU 1984; RPMT 2000]
	(a) UT			(a) Addition	(b) Substitution
	(c) $C_2 H_2$	(d) $C_2 H_4$		(c) Polymerization	(a) All of these
85.	Which of the following l	bonds is most acidic	<b>9</b> 7.	Shortest C–C bond lengt	h is present in [BVP 2004]
	(a) = C - H	(b) $-C - H$		(a) $CH_3 - CH_2 - CH_3$	(b) $CH_3CH_2CH_2CH_3$
	$(c) \equiv C - H$	(d) All are equally acidic			

1130 Hydrocarbon(c) 
$$CH_{+} = CH = CH_{+}$$
 (d)  $CH = C - C = CH98. Acctylene can be obtained by the reaction[MH CET 200](a)  $HOOK_{-\frac{Oliver A(B)}{A}}$ (b)  $CH_{+} + 6A_{+} + CH_{-} \xrightarrow{A}$ (c)  $CH_{+} (CH_{-} \xrightarrow{A})$ (d)  $R_{+} (C+H_{-} \xrightarrow{A})$ (e)  $CH_{+} (CH_{-} \xrightarrow{A})$ (f)  $R_{+} (C+H_{-} \xrightarrow{A})$ (g)  $R_{+} (CH_{+} \xrightarrow{A})$ (h)  $R_{+} (CH_{+} (C$$ 

(c)  $Mg_2C_3$ (d)  $Al_4C_3$ 

(e)  $Be_2C$ 

## Aromatic hydrocarbon

	[MNR 1986, 199	5; Roorkee 1999; BHU 2001;
		CPMT 2002; MPPET 2001]
	(a) Absorb water	(b) Absorb <i>HCl</i>
	(c) To produce electroph	ile (d)To produce nucleophile
2.	Benzene reacts with CH	$_{3}COCl$ in the presence of
	$AlCl_3$ to give [I	OPMT 1983; CBSE PMT 1991]
	(a) $C_6 H_5 Cl$	(b) $C_6H_5COCl$
	(c) $C_6H_5CH_3$	(d) $C_6H_5COCH_3$
3.	Acylation process is alkylation because ( reaction)	preferred than direct by the Friedel-Craft's
	(a) In alkylation, a poiso	nous gas is evolved
	(b) In alkylation, large a	mount of heat is evolved
	(c) In alkylation, polyall	vylated product is formed
	(d) Alkylation is very cos	stly
4.	Benzene cannot undergo	
	(a) Substitution	(b) Addition
	(c) Elimination	(d) Oxidation
5۰	Coaltar is main source of	[ [DPMT 1984]
	(a) Aromatic compounds	
	(b) Aliphatic compounds	
	(c) Cycloalkanes	
	(d) Heterocyclic compou	nds
6.	Which of the following ozonolysis of <i>o</i> -xylene	g is not formed by the
	(a) Glyoxal	(b) Ethyl glyoxal
	(c) Dimethyl glyoxal	(d) Methyl glyoxal
7.	The number of $\sigma$ and $\beta$ benzene is	$\tau$ bonds in a molecule of
	[MP PMT/PET 1	988; BHU 1995; CPMT 1997]
	(a) $6\sigma$ and $9\pi$	(b) $9\sigma$ and $3\pi$
	(c) $12\sigma$ and $3\pi$	(d) $6\sigma$ and $6\pi$
8.	The ratio of $\sigma$ and $\pi$ bo	nds in benzene is
		[CPMT 1991; BHU 1995]
	(a) 2	(b) 4
	(c) 6	(d) 8
9.	Carbon atoms in benzen	e molecule is inclined at
	an angle of	
	(a) $120^{\circ}$	[BHU 1905]
	(a) $120$	(d) $60^{\circ}$
10	When henzene is treated	with excess of $Cl$ in the
10.	presence of $I$ the end r	product is
	(a) Monochlorohonzono	(b) Trichlorobonzono
	(c) Hexachlorobenzene	(d) Benzene
hexa	chloride	(a) Benzene
11.	Chemical name of the ins	secticide gammexene is
	[CPMT 1981; N	MP PET 1995; MP PMT 1996;

Hydrocarbon	1131
-------------	------



- (a) Sulphonation (b) Nitration
- (c) Hydrogenation (d) Dehydration

	acid is			-		
	[MNR 198	89; CPMT 19	90; BCECE	2005]		
	(a) Electrophilic substit	ution		(b)		
	(c) Nucleophilic substit	ution(d)Fr	ee radical	substitution		
21.	Necessary conditions fo	r halogena	tion are <b>[c</b>	PMT 1976]		
	(a) Cold and dark					
	(b) Presence of halogen	carrier				
	(c) Both (a) and (b)					
	(d) None					
22.	$C_6H_6 + CH_3Cl$ anhydrous AlCl <sub>3</sub>	$\rightarrow C_6 H_5 C H_3$	+ HCl			
	is an example of [NCE	ERT 1979; CI	PMT 1974, 8	85, 90;		
	Bihar CEE 1995; Bl	HU 1979, 20	01; MP PET	Г 1995;		
	MP PMT 1995; KCET 1993	; EAMCET 1	998; AIIMS	5 1998;		
	CBSE PMT 2000	; AFMC 200	0; JIPMER	2000]		
	(a) Friedel-Craft's react	tion (b) K	loibe's syr	ithesis		
	(c) Wurtz reaction	(d) Grign	ard reacti	on		
23.	The reaction of benze	ene with	chlorine	in the		
	presence of from gives			[ 1993]		
	(a) Benzene nexachiorid	ae (b)		enzene		
	(c) Benzyl chloride	(a) Benzo	byl chiorid			
24.	Benzene was discovered	1 DY	[NCER]	ľ 1981]		
	(a) Ramsay	(b) Dalto	n			
	(c) Faraday	(d) Priest	lley			
25.	The correct structure of	benzene w	vas propos	sed by		
	(a) Faraday	(h) Darry	[CPM]	[ 1972]		
	(a) Faraday	(d) Davy	~ <b>m</b>			
26	(c) Kekule	(u) wom	er na nnon og	ad hr		
20.	The centric structure of	belizelle w	as propos			
	(a) Dewar	(b) Lader	horg	53, 89]		
	(a) Dewal	(d) Arms	trong	and		
Baev	(c) Kekule	(u) Aims	uong	and		
27	The bond order of indiv	ridual carbo	on-carbon	bonds		
-/·	oin benzene is	IIIT-IEE 198	31: MP PET	20001		
JCE 20	(a) One	(b) Two		,		
	(c) Between one and tw	vo(d) One	and	two.		
alter	nately			/		
28.	Six carbon atoms of ben	zene are o	f			
	(a) One type	(b) Two t	ypes			
	(c) Three types	(d) Six ty	pes			
29.	On heating a mixture	of sodiun	n benzoat	e and		
-	sodalime, the following is obtained					
	[CPMT 1990; AIIMS 199	6; MP PET 1	999; AFMC	2 1999]		
	(a) Toluene	(b) Pheno	ol			
	(c) Benzene	(d) Benzo	oic acid			
30.	Benzene on treatment w	vith a mixt	ure of con	с.		
0	$HNO_{2}$ and conc. $H_{2}SO_{2}$	at 100°C	gives			
	11103 and $12004$		·····			
	(a) Nitrobenzene	(D) m-din	itropenze	ne		
	(c) <i>p</i> -dinitrobenzene	(a) o-din	itrobenzer	ne		
31.	on the					
	nitration of toluene	[M]	PMT/PET	1988]		
ſ	(a) o-nitrotoluene	(b) p-nitr	otoluene			

(c) 2, 4-dinitrotoluene (d) 2, 6-4, trinitrotoluene

32.	Which of the following p	processes is reversible		(c) Toluene	(d) Phenol
	(a) Halogenation	(b) Sulphonation	45.	Select the true state	ement about benzene from
	(c) Nitration	(d) None		amongst the following	g [CBSE PMT 1992]
33.	The attacking (ele	ctrophilic) species	in	(a) Because of uns	saturation benzene easily
	sulphonation of benzene	e is[ <b>RPMT 1997; CPMT 19</b>	99, 2002]	(h) There are two true	n reactions
	(a) $SO_2$	(b) $SO_3$		molecule	es of C - C bonds in benzene
	(c) $SO_4^{2-}$	(d) $HSO_{3}^{-}$		(c) There is a cyclic de	elocalisation of $\pi$ electrons in
34.	Which xylene is most ea	sily sulphonated		benzene	
	(a) Ortho	(b) Para		(d) Monosubstitution	of benzene group gives
<u> </u>	(c) Meta	(d) All at the same ra	te	three isomeric sub	ostances
35.	Toluene on oxidation	with dilute HNO <sub>3</sub>	and <b>40</b> .	Annyarous $AlCl_3$ is	used in the Friedel-Craft's
	alkaline $KMnO_4$ gives	LDPMT 1	981]	reaction because it is	[CBSE PMT 1991]
	(a) Benzaldehyde	(b) Phenol		(a) Electron fich (b) Soluble in ether	
- 6	(c) Nitrotoluene	(d) Benzoic acid		(c) Insoluble to chlori	de and aluminium ions
36.	Benzene vapour mixed v $V_{O}$ catalyst at 775 K of	with air when passed ov	ver	(d) Electron deficient	
		CDWT 2001: MD DWT 20	47.	(i) Chlorobenzene an	d (ii) benzene hexachloride
	(a) Glyoval	(b) Ovalic acid	003]	are obtained from b	penzene by the reaction of
	(c) Maleic anhydride	(d) Fumaric acid		chlorine, in the preser	nce of
37.	Most common reaction	ns of benzene (arom	atic	(a) (i) Direct sunlight	and (ii) anhydrous $AlCl_3$
0,	hydrocarbon) and its de	rivatives are		(b) (i) Sodium hydrox	ide and (ii) sulphuric acid
	[DPMT 1984; MP PMT 1989	; AFMC 1997; BHU 1996,	98]	(c) (i) Ultraviolet ligh	it and (ii) anhydrous $FeCl_3$
	(a) Electrophilic additio	n reactions		(d) (i) Anhydrous AlC	$l_3$ and (ii) direct sunlight
	(b) Electrophilic substit	ution reactions	48.	In Friedel Craft's all	kylation, besides <i>AlCl</i> <sub>3</sub> the
	(c) Nucleophilic additio	n reactions		other reactants are	[AFMC 1997; CBSE PMT 1999]
28	(d) Nucleophilic substitu	itrated <b>[Beerlyse 1</b>	2021	(a) $C_6H_6 + CH_3Cl$	(b) $C_6H_6 + CH_4$
30.	(a) Benzene	(h) Phenol	992]	(c) $C_6H_6 + NH_3$	(d) $C_6H_6 + CH_3COCl$
	(c) Aniline	(d) Nitrobenzene	49.	Nitration of benzene i	sa [RPMT 1999]
39.	o, <i>p</i> -directing groups are	e mostly	10	(a) Electrophilic displ	acement
	(a) Activating groups	(b) Deactivating grou	ps	(b) Electrophilic addit	tion
	(c) Neutral groups	(d) None of these		(c) Nucleophilic addit	ion
40.	Which among the follow	wing is the strongest o	o, p-	(d) Nucleophilic displ	acement
	directing group	[CBSE PMT 19	989] <b>50.</b>	Benzene shows	[RPMT 1999]
	(a) <i>OH</i>	(b) <i>Cl</i>		(a) Substitution	(b) Addition
	(c) $C_6 H_5$	(d) <i>Br</i>		(c) Oxidation	(d) All of these
41.	The compound that is	s most reactive towa	ards <b>51.</b>	Benzene can be obtain	led in the reaction
		) ИS 1008• MD DFT/DMT 10	180	(a) Ethene + 1 3-buta	diene
	(a) Toluene	(b) Benzene	<u>[</u> ]	(b) Trimerisation of e	thyne
	(c) Benzoic acid	(d) Nitrobenzene		(c) Reduction of <i>PhCH</i>	10
42.	Amongst the following,	the compound that car	n be	(d) All of these	
	most readily sulphonate	d is	52.	Thiophene and benzer	ne are separated by[ <b>RPET 2000</b> ]
	[IIT-JEE 1982; M	ADT Bihar 1995; KCET 20	005]	(a) Sulphonation of th	niophene
	(a) Benzene	(b) Nitrobenzene		(b) Sulphonation of be	enzene
	(c) Toluene	(d) Chlorobenzene	+:	(c) Nitration of thiopl	hene
43.	towards bromine	g would be least reac	11Ve	(d) Nitration of benze	ne
	(a) Nitrobenzene	(b) Phenol	53.	Which of the following	g is a hydrocarbon[AFMC 1992]
	(c) Anisole	(d) Chlorobenzene		(a) Urea	(b) Benzene
44.	Amongst the following	g, the compound that	t is	(c) Ammonium cyanat	te (d) Phenol
	nitrated with difficulty	is	54.	Aromatic compounds	s burn with sooty flame
	(a) Benzene	(b) Nitrobenzene		because	

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CET 2000]
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	(c) $Cl_2$ (d) $Cl_2^-$			(c)
75.	Which of following having delocalised e	lectron CECE 2005]	88.	Whi ben
	(a) Benzene (b) Cyclohexan	e		(a)
	(c) $CH_4$ (d) $C_2H_6$			(c)
76.	Benzene molecule is [MP PET 2001; Pb.	PMT 2004]	89.	Hyd
	(a) Tetrahedral (b) Planar			give
	(c) Pyramidal (d) Trigonal			can
77.	Pyridine is less basic than triethylamine	because		
	[A	IIMS 2005]		(a)
	(a) Fyriume has aromatic character $(b)$ Nitro and in particular $\frac{2}{2}$ halo $\frac{1}{2}$			(c)
	(b) Nitrogen in pyridine is <i>sp</i> hybridize	ea	90.	Dec
	(c) Pyridine is a cyclic system			(a)
delo	(d) in pyridine, ione pair of ni	trogen is		(c)
<b>78.</b>	Electrophile in the case of chlorination	of benzene		(a)
,	in the presence of $FeCl_3$ is		[0	: BSE
	(a) $Cl^+$ (b) $Cl^-$		91.	Ben
	$ \begin{array}{c} (a) & C_i \\ (b) & C_i \\ (c) & C_i \\ (c) & C_i \\ (d) & F_{\alpha}C_i \\ (c) & C_i \\ (c) &$			acid
-0	Which one of the following will und	anga mata		resp
79.	substitution on monochlorination	ergo meta		(-)
	(a) Ethoxy ethane (b) Chlorobenz	ene		(a)
	(c) Ethyl benzoate (d) Phenol	ene		(D)
80.	Nitration of toluene takes place at [N	CERT 1000]		(0)
00.	(a) $o$ -position (b) $m$ -position			(u)
	(c) $p$ -position (d) Both $q$ -	and <i>p</i> -	92.	Ora
posi	itions			(a)
81.	Which of the following is not <i>o</i> , <i>p</i> -direc	ting group		(a)
	(a) $-NH_2$ (b) $-OH$			(c)
	(c) $-X$ (halogens) (d) $-CHO$		react	tive
82.	Benzene can react with [UP	SEAT 2003]	93.	Whi
	(a) $Br_2$ water (b) $HNO_3$			aike
	(c) $H_2O$ (d) $CH_2OH$			(a)
82	The compound 'A' having formu			svn
03.	(anomatic) which gives 4 managing	$C_8 H_{10}$		(c)
	(aromatic) which gives 1 mononitro	substitute	94.	Aro
	(a) $m$ -Xylene (b) $n$ -Xylene			$(Al_2$
	(c) $\rho$ -Xylene (d) Fthyl henzyl	ene		(a)
8⊿.	Catalytic hydrogenation of henzene give	S[AIIMS 1006]		(c)
04.	(a) Xvlene (b) Cvclohexan	e	95.	Amo
	(c) Benzoic acid (d) Toluene	-		is
85.	Benzene is obtained from	CPMT 1996]		
-	(a) Coaltar (b) Plant			(a)
	(c) Animal (d) Charcoal			(c)
86.	The 'middle oil' fraction of coaltar of	listillation	96.	Whe
	contains			pro
	[MI	9 PET 2001]		
	(a) Benzene (b) Anthracene	2		(a)
	(c) Naphthalene (d) Xylene			(c)
87.	Lindane can be obtained by reaction of	of benzene	97.	In p
	WITU			rea
	(a) $CH$ $Cl$ (apply $MCl$ (b) $Cl$ (applied)	LDCE 2000]		(a)
	$(a) \cup (a) $	10		(4)

(c)	$C_2 I$	$H_5I/$	'anhy	$AlCl_3$	(d	) <i>Cl</i>	$H_3C$	OCl / AlCl 3	
Whi	ich	of	the	followin	g	oil	is	obtained	from

- benzene after fractional distillation of coal tar[**BHU 2004**] (a) Light oil (b) Heavy oil (c) Middle oil (d) Anthracene oil
- **39.** Hydrocarbon  $C_6H_6$  decolourise  $Br_2$  water and gives ppt. with ammonical  $AgNO_3$  Hydrocarbon can be

[MP PET 2004]

- (a) 1, 3, 5 Cyclohexatriene (b) 1, 5 Hexadiyne
- (c) 2, 4 Hexadiyne (d) None
- Decreasing order of C-C bond length is[JEE Orissa 2004]
  (a) C<sub>2</sub>H<sub>4</sub>
  (b) C<sub>2</sub>H<sub>2</sub>
  - (c)  $C_6H_6$  (d)  $C_2H_6$

(a) IV > III > I > II (b) I > II > IV > III

- $[CHSÈ PWPT h ggb] > III \qquad (d) IV > I > III > II$
- **91.** Benzene can be obtained by heating either benzoic acid with *X* or phenol with *Y*. *X* and *Y* are respectively
  - [KCET 2004]
  - (a) Zinc dust and soda lime
  - (b) Soda lime and zinc dust
  - (c) Zinc dust and sodium hydroxide
    - Soda lime and copper
- **92.** Order of reactivity of  $C_2H_6, C_2H_4$  and  $C_2H_2$  is

[MH CET 2004]

(a)  $C_2H_6 > C_2H_4 > C_2H_2$  (b)  $C_2H_2 > C_2H_6 > C_2H_4$ 

(c)  $C_2H_2 > C_2H_4 > C_2H_6$  (d) All are equally

- **93.** Which of the following yield both alkane and alkene
  - [AFMC 2004] Kolbe's reaction (b) Williamson's thesis Wurtz reaction (d) Sandmeyer reaction matisation of *n*-heptane by passing over  $O_3 + Cr_2O_3$ ) catalyst at 773 K gives [DCE 2004] Benzene (b) Toluene (d) Heptylene Mixture of both ongst the following the most basic compound [AIEEE 2005] Benzylamine (b) Aniline Acetanilide (d) *p*-nitroaniline en toluene is treated with  $KMnO_4$ , what is duced

#### [AFMC 2005]

				-	
(a) Benzene		(t	o) Chlor	obenzene	
(c) Benzalde	hyde	(0	l) Benzo	oic acid	
-	<b>C</b> 11 <b>1</b> · · ·				

**97.** In presence of light & heat toluene chlorinated & react with aqueous *NaOH* to give

a) o-Cresol

#### [Kerala CET 2005]

- (b) p-Cresol
- (c) Mixture of o- Cresol & p-Cresol
- (d) Benzoic acid
- (e) 1, 3, 5 trihydroxy toluene

Critical Thinking **Objective Questions** 

- In the case homologous series of alkanes, which 1. one of the following statements is incorrect [JIPMER 2000
  - (a) The members of the series are isomers of each other
  - (b) The members of the series have similar chemical properties
  - (c) The members of the series have the general formula  $C_n H_{2n+2}$ , where *n* is an integer
  - (d) The difference between any two successive members of the series corresponds to 14 unit of relative atomic mass
- How many primary, secondary, tertiary and 2. quaternary carbons are present in the following hydrocarbon

$$CH_3 - CH(CH_3) - C(CH_3)_2 - CH_2 - CH(CH_3) - CH_2 - CH_3$$

	Primary	Secondar v	Tertiary	Quaterna rv
(a )	6	2	2	1
(b )	2	6	3	0
(c )	2	4	3	2
(d )	2	2	4	3

The octane number of a sample of petrol is 40. It 3. means that its knocking property is equal to the mixture of

[MP PMT 2003]

3

- (a) 40% *n*-heptane + 60% *iso*-octane
- (b) 40% petrol + 60% *iso*-octane
- (c) 60% *n*-heptane + 40% *iso*-octane
- (d) 60% petrol + 40% iso-octane
- Formation of 2-butene as major product by 4. dehydration of 2-butanol is according to [MP PMT 1995] (a) Markownikoff rule (b) Saytzeff rule

(c) Peroxide effect (d) Anti-Markownikoff

rule

5. 
$$CH_3C \equiv CCH_3 \xrightarrow{(i)X}_{(i)H_2O/Zn} CH_3 - C - C - CH_1 \xrightarrow{|} OOO_1$$

<i>X</i> in the above reaction is <b>[CPMT 1985; MP PET</b> <b>Roorkee Qualifying 1998: DPMT</b>	1997; 2001]
(a) $HNO_3$ (b) $O_2$	,
(c) $O_3$ (d) $KMnO_4$	
6. Which of the following is Friedel-Craft's reac: [MP PET]	tion 1 <b>994]</b>
(a) $C_6H_6 + FeCl_3 + Cl_2 \rightarrow C_6H_5Cl$	
(b) $C_6H_5CHO + CH_3CHO + KOH \rightarrow C_6H_5CH = CH - CH - CH - C_6H_5CH = CH - $	CHO
0 	
(c) $C_6H_6 + CH_3COCl + AlCl_3 \rightarrow C_6H_5 - C - CH_3$	
(d) $C_6H_5OH + CHCl_3 + KOH \longrightarrow$ Salicy laid ehyde	
<b>Gool</b> Condition for maximum yield of $C_2H_5Cl$ is	
[IIT-JEE	1986]
(a) $C_2H_6$ (excess) $+ Cl_2 \xrightarrow{UV \text{ Light}}$	
(b) $C_2H_6 + Cl_2 \xrightarrow{\text{Dark}}_{\text{Room temp.}}$	
(c) $C_2H_6 + Cl_2 \text{ (excess)} \xrightarrow{UV \text{ Light}}$	
(d) $C_2H_6 + Cl_2 \xrightarrow{UV \text{Light}}$	
8. When ethyl alcohol is heated with red phospl and <i>HI</i> , then which of the following is formed	norus
[Kurukshetra CEE	1998]

(c) 
$$C_3H_8$$
 (d)  $C_2H_4$ 

In the Fischer-Tropsch synthesis of petrol..... and 9. ..... are used as the raw materials [KCET 1998] (a)  $H_2;CO$ (b)  $CH_4$ ;  $H_2$ 

(c)  $CH_4$ ;  $CH_3OH$ (d)  $CH_3OH;CO$ 

- Which one of the following reactions is most 10. suitable for the preparation of *n*-propyl benzene[**MP PET**/] (a) Friedel-Craft's reaction (b) Wurtz reaction (c) Wurtz-Fittig reaction(d) Grignard reaction
- Propane cannot be prepared from which reaction 11. [DCE 2003]

(a) 
$$CH_3 - CH = CH_2 \xrightarrow{B_2H_6} OH^-$$

(b) 
$$CH_3CH_2CH_2I \xrightarrow{HI}_P$$

(c) 
$$CH_3CH_2CH_2Cl \xrightarrow{Na}$$

(d) None of these

The reaction 12.

$$CH_{3}CH = CH_{2} \xrightarrow{(CO+H_{2})} CH_{3} - CH - CH_{3}$$
 is  
 $H^{+} \xrightarrow{I} COOH$ 

known as

(a) Wurtz reaction (b) Koch reaction

(c) Clemmensen reduction (d) Kolbe's reaction  $CH_3$ 

The compound  $CH_3 - C = CH - CH_3$  on reaction 13. with  $NaIO_4$  in the presence of  $KMnO_4$  gives [CBSE PMT 2003] (a)  $CH_3CHO + CO_2$ (h) OU COC

(b) 
$$CH_3COCH_3$$

	(c) $CH_3COCH_3 + CH_3COOH$									
	(d) $CH_3COCH_3 + CH_3CHC$	)								
14.	In the reaction :									
	$HC \equiv CH + 2AgNO_3 - \frac{NH_4O}{2}$	$\xrightarrow{H} X + 2NH_4 NO_3 + 2H_2O$								
	<i>'X'</i> is									
	(a) $Ag_2C$	(b) $Ag_{2}C_{2}$								
	(c) $AgC$	(d) AgOH								
15.	Naphthalene is a/an	[AFMC 2004]								
-	(a) Ionic solid	(d) Covalent solid								
	(c) Metallic solid	(d) Molecular solid								
16.	Which of the following is	not aromatic [Pb. CET 2000]								
	(a) Benzene	(b) Naphthalene								
	(c) Pyridine	(d) 1,3,5 heptatriene								
17.	$Ba(CN)_2$ to yield	In the presence of [UP SEAT 2004]								
	(a) 1, 1-dicyanoethane	(b) 1, 2-dicyanoethane								
	(c) Vinyl cyanide	(d) None of these								
18.	Write the products of	the addition reaction								
	$\rangle C = C \prec + XY \rightarrow$	[Kerala (Med.) 2002]								
	(a) $\rangle C - C <$	(b) $X - C = C - Y$								
	XY									
	(c) $C = C - 1$	(d) $X - C - C - X$								
	Y									
	X									
	(e) $C = C$									
	Y									
19.	Formation of polyethyle	ne from calcium carbide								
	takes place as follows									
	$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 +$	$-C_2H_2$								
	$C_2H_2 + H_2 \rightarrow C_2H_4$									
	$n(C_2H_4) \rightarrow (-CH_2 - CH_2 -),$	1								
CaC	The amount of polyethyle	ene obtained from 64.1 kg								
cuc <sub>2</sub>	15	[AIIMS 1997]								
	(a) 7 <i>kg</i>	(b) 14 <i>kg</i>								
	(c) 21 <i>kg</i>	(d) 28 <i>kg</i>								
20.	Nitrobenzene can be pr	epared from benzene by								
	using a mixture of conc.	$HNO_3$ and conc. $H_2SO_4$ .								
	In the nitrating mixture,	$HNO_3$ acts as a[IIT-JEE 1997]								
	(a) Base	(b) Acid								
	(c) Reducing agent	(d) Catalyst								

21. A group which deactivates the benzene ring towards electrophilic substitution but which directs the incoming group principally to the *o*-and *p*-positions is

[Pb. PMT 1998]

(a)  $-NH_2$  (b) -Cl

(c)  $-NO_2$  (d)  $-C_2H_5$ 

**22.** Which order is correct for the decreasing reactivity to ring monobromination of the following compounds

	$\begin{array}{ccc} C_6H_5CH_3, & C_6H_5COOH \\ I & II \end{array}$	$\begin{array}{ccc} H_{6} & C_{6}H_{5}NO_{2} \\ HI & IV \end{array}$
23.	<ul> <li>(a) I &gt; II &gt; III &gt; IV</li> <li>(c) II &gt; III &gt; IV &gt; I</li> <li>Benzene is obtained by</li> <li>(a) Substitution of three</li> <li>(b) Addition of three C<sub>2</sub></li> </ul>	<ul> <li>(b) I &gt; III &gt; II &gt; IV</li> <li>(d) III &gt; I &gt; II &gt; IV</li> <li>[DPMT 2002]</li> <li>e acetylene molecules</li> <li>H<sub>2</sub> molecules</li> </ul>
	<ul><li>(c) Polymerisation of th</li><li>(d) Condensation of three</li></ul>	ree $C_2H_2$ molecules
24.	Toluene can be oxidised (a) $KMNO_4$	to benzoic acid by[AIIMS 1999] (b) $K_2Cr_2O_7$
25.	(c) $H_2SO_4$ $CaC_2 + H_2O \rightarrow A \xrightarrow{H_2SO_4/H}$ in the given reaction	(d) Both (a) and (b) $g^{SO_4} \rightarrow B$ . Identify A and B [CPMT 2000; BVP 2004]
26.	(a) $C_2H_2$ and $CH_3CHO$ (c) $C_2H_4$ and $CH_3COOH$ The compound X on read	(b) $CH_4$ and $HCOOH$ (d) $C_2H_2$ and $CH_3COOH$ ction with $HgSO_4 + H_2SO_4$
	gives Y which on oxidati (a) $C_2H_2$ (c) $C_3H_4$	fon gives acetic acid. X is[ <b>MP PM</b> ' (b) $C_2H_4$ (d) $C_4H_6$
27.	What is formed when c heavy water (a) $C_2D_2$	alcium carbide react with [CPMT 1999] (b) <i>CaD</i> <sub>2</sub>
28.	(c) $CaD_2O$ The addition of <i>HBr</i> is early addition of <i>HBr</i> is early a second statement of the transformation of transformation of the transformation of	(d) <i>CD</i> <sub>2</sub> asiest with <b>[MP PMT 2000]</b>
	(a) $ClCH_2 = CHCl$ (c) $CH_3 - CH = CH_2$	(b) $ClCH = CHCl$ (d) $(CH_3)_2 C = CH_2$
29.	Identify the species X in Propene + O (conc. acidic KM (a) Acetone (c) Isopropanol	the reaction : $AnO_4$ ) $\rightarrow X$ + Formic acid (b) Acetaldehyde (d) Acetic acid
30.	(c) Isopropanor In benzene 1, 3 position (a) Meta (c) Ortho	(d) Add position
31.	Which of the following biological oxidation of t dog	is formed as a result of benzene in the body of the
	(a) Acrylic acid (c) Maleic acid	<b>[Manipal MEE 1995]</b> (b) Cinnamic acid (d) Gluconic acid
32.	When acetylene is reacted	ed with <i>HBr</i> , we get [CPMT 1979; JIPMER 2002] (b) Ethyl bromide
33.	(c) Ethylene bromide The only o, p-dired	(d) Ethylidene bromide cting group which is
	(a) $-NH_2$ (c) $-X$ (halogens)	, (b) – <i>OH</i> (d) – <i>R</i> (alkyl groups)
34.	Which kind of isomerism (a) Geometrical	n will butene-2 show (b) Optical

	(c) Position		(d) None of	these		Reason	:	It has
<b>35</b> ∙	In presence	of light	toluene on re	eaction with	ı			electro
	chlorine give	S				A = = = = + : = ==	_	<u>cu</u>
	(a) Benzovi (	chloride	(b) Ortho ch	[RPET 1999]	5.	Assertion	:	$CH_4$
	(c) Para chlo	pro toluene	(d) Benzyl c	hloride		Peacon		Chlori
6.	If ethylene, o	carbon mor	noxide and wa	ter is heated	1	Reason	•	sunlig
	at high tem	perature, v	which of the	following is	<sup>s</sup> 6.	Assertion	:	Alkvl
	formed						•	Friede
	(2) C H O		(b) $C H CO($	[AIIMS 2000]	J			benzei
	(a) $C_4 H_8 O_2$	T T	(b) $C_2 H_5 COC$			Reason	:	Alkyl
	(c) $CH_3COOL$	H 	(d) $CH_2 = CH_2$	1-COOH	. 7	Assertion		acyl na
37.	Compound C	$E_6H_{12}$ is an		[AMU 1983]	] 7.	Assertion	•	2-BIOI sodiur
	(a) Aliphatic	saturated	compound					butene
	(b) Alicyclic	compound				Reason	:	1-Bute
	(c) Aromatic	compound	und		-			butene
28.	Identify Z in	the followi	ng series		8.	Assertion	:	Styren
,	CH = CH =	$HBr \rightarrow Y = Hy$	droly sis $V = \frac{Na_2Ca}{2}$	$0_3 \rightarrow 7$		Reason	:	Benzv
	$cH_2 - cH_2$	77	$I_2 \exp \left( \frac{1}{I_2} \right)$	ess		11000011	•	alkyl r
			[AIIMS 1983	3; RPMT 1999	9.	Assertion	:	Meltin
	(a) $C_2 H_5 I$		(b) $C_2 H_5 OH$					than p
	(c) $CHI_3$		(d) $CH_3CHO$	1		Reason	:	It is ca
9.	<i>n</i> -pentane an	ıd iso penta	ane can be dist	inguished by	, <b>10.</b>	Assertion	:	Iodina
				[BVP 2004]	]	Reason	•	preser
	(a) $Br_2$	<i>a</i>	(b) $O_3$		11.	Assertion	:	Isobut
	(c) conc. $H_{2}$	$SO_4$	(d) $KMnO_4$					gives t
0.	$CH \equiv CH + HH$	$3r \rightarrow X$ , pro	duct X is [	Pb. CET 2003	]	Reason	:	Oxidis
	(a) Ethylene	bromide	(b) Vinyl bro	omide				alkane
	(c) Bromo et	inane	(d) Ethyledi	ne bromide	12.	Assertion	:	Haloge
						Reason	•	Haloge
						neubon	·	radica
	AS AS	sertior	i & Reas	son	13.	Assertion	:	Neope
			For ANM	lS Aspirants				monos
				/		Reason	:	Neope
	Assortion :	1-Butono	on reaction	with UDr in	14.	Assertion	:	Freezi
L•	Assertion .	the prese	nce of a perox	kide produce:	S	Reason	•	Increa
		1-bromo-l	butane.		neubon	•	increa	
	Reason :	It invol	lves the f	ree radica	l <b>15.</b>	Assertion	:	Knock
		mechanis	m.		_			the en
	Accontion	Addition	[IIT-JEE (Scr	eening) 2000	]	Reason	:	Fuel
•	Assertion :	Addition	of $Br_2$ to 1-	butelle gives	5			proper
	Poacon :	two optic	al isomers.	tains on	16.	Assertion	:	The p
	Reason .	asymmetr	ric carbon.	<b>FIIT 1998</b>	1	Decen		SOIUDI
	Assertion :	Cyclobuta	ane is less	stable than	1 17	Assertion	•	AIKelle
		cyclopent	ane		17.	ASSELLIOII	•	
	Reason :	Presence	of bent bonds	causes "loss	5	Reason	•	Bives.
	A	of orbital	overlap".	[AIIMS 1996]	]	100000	•	saytze
•	Assertion :	compound	s an aromatic d.	neterocyclic	ن ن			-

			Hydrocarbon 1137
-	Reason	:	It has a cyclic, delocalised $6\pi$
			electrons.
			[AIIMS 1995]
	Assertion	:	$CH_4$ does not react with $Cl_2$ in
			dark.
	Reason	:	Chlorination of $CH_4$ takes place in
			sunlight. [AIIMS 2001]
	Assertion	:	Alkyl benzene is not prepared by Friedel-Crafts alkylation of benzene.
	Reason	:	Alkyl halides are less reactive than acyl halides. [AIIMS 2003]
	Assertion	:	2-Bromobutane on reaction with sodium ethoxide in ethanol gives 1- butene as a major product. [AIIMS 2004]
	Reason	:	1-Butene is more stable than 2- butene.
	Assertion	:	Styrene on reaction with <i>HBr</i> gives 2-bromo-2- phenyl-ethane.
	Reason	:	Benzyl radical is more stable than alkyl radical. [AIIMS 2004]
	Assertion	:	Melting point of <i>n</i> -butane is higher than propane.
	Reason	:	It is called oscillation effect.
).	Assertion	:	Iodination of alkanes is reversible.
	Reason	:	Iodination is carried out in
			presence of iodic acid.
•	Assertion	:	Isobutane on oxidation with KMnO <sub>4</sub>
	Deeee		gives tert-butyl alcohol.
	Reason	•	alkanes.
•	Assertion	:	Halogenation of alkanes is catalysed by tetraethyl lead.
	Reason	:	Halogenation proceeds through free radical mechanism.
•	Assertion	:	Neopentane forms only one monosubstituted compound.
	Reason	:	Neopentane has high bond energy.
•	Assertion	:	Freezing point of neopentane is more than <i>n</i> -pentane.
	Reason	:	Increase in Van der Waals forces increases freezing point.
•	Assertion	:	Knocking lowers the efficiency of the engine.
	Reason	:	Fuel with minimum knocking property is preferred.
	Assertion	:	The presence of $Ag^+$ enhances the solubility of alkenes in water.
	Reason	:	Alkenes are weakly polar in nature.
	Assertion	:	2-Butanol on heating with $H_2SO_4$
			gives 1-butene and 2-butene.
	Reason	:	Dehydration of 2-butanol follows saytzeff rule.

18.	Assertion :	Ethene on treating with $Br_2$ in		Reas	on :	:	Nitrosc	o grou	p is a	ctivat	ing gr	oup.		
		presence of <i>NaCl</i> forms	30.	Assei	rtion :	:	Benzen	e rea	icts v	vith	$CH_3CC$	OCI to		
		$CH_2CICH_2Br$ and $CH_2Br - CH_2 - Br$ .		Deee	~ ~ ~		give ch	lorobe	enzen	e.	ala atra	onhilia		
	Reason :	This addition involves the formation of free radicals.		Reas		•	substit	ution	reacti	on.	electi	opinite		
19.	Assertion :	Straight chain alkanes have very	31.	Assei	rtion :	:	Conjug	ated p	olyen	es co	es containing odd			
	_	low octane number.					number	r of c	arbon	aton	ns is	known		
	Reason :	Quality of gasoline is measured in terms of octane number		Reas	on :	:	General formula of annulenes is				nes is			
20.	Assertion :	Corey-House reaction can be used					(CH = C	$(H)_n$ v	vhere	n = 2,	3,4 et	с.		
		to prepare both symmetrical and	32.	Assei	rtion :	:	Tropyli	um o	cation	is	aroma	atic in		
	Reason :	unsymmetrical alkanes.					nature							
	Reason .	interaction between lithium dialkyl		ĺ			$\left  \right  \geq$	+						
		copper with an alkyl halide both of												
		which may contain even or odd		Reas	on :	:	The on	ly pr	operty	/ that	dete	rmines		
21.	Assertion :	All the hydrogen atoms in					its aroi	matic	behav	/iour	1S 1ts	planar		
		$CH_2 = C = CH_2$ lie in one plane.	22	Assei	rtion ·			nnule	ene i	s no	nt ar	omatic		
	Reason :	All the carbon atoms in it are $sp^2$	33.	115501	t			it co	ontain	s Hu	ckel n	umber		
		hybridized.					of $\pi$ -electrons.							
22.	Assertion :	Propene reacts with <i>HBr</i> in		Reas	Steric interaction between internal									
		presence of benzoyl peroxide to	24	Assei	rtion ·		Rates of nitration of benzene and							
	Reason :	In presence of peroxide, the	54.	110001		•	hexade	utero	benze	ne are	e diffe	rent.		
		addition of <i>HBr</i> to propene follows		Reason :			C-H	bon	d is	stro	onger	than		
		ionic mechanism.					$C - D \mathbf{b}$	ond				_		
23.	Assertion :	Acetylene reacts with sodamide to evolve $H_2$ gas.	35.	Assei	rtion :	:	Cyclolp more st	entad table 1	lienyl than a	anio Ilvl a	n is nion.	much		
	Reason :	Acetylene is a weaker acid than ammonia.	Reason : Cyclopentadienyl anion is arom in character.							omatic				
24.	Assertion :	Aryl halides are less reactive					1							
		towards substitution of halogen			(	7								
	Reason :	atom. Halogens are on directing in			/	4	nswers							
	Reason .	nature.					110	• •		U				
25.	Assertion :	Benzene is a solvent for the Friedel												
		Craft's alkylation of bromobenzene.				-								
	Reason :	Friedel Craft's reaction is used to	_	_	_	_	AII	kane	_	_	_	_		
		benzene nucleus.	1	d	2	а	3	а	4	а	5	b		
26.	Assertion :	Benzene removes a butter stain	6	с	7	b	8	а	9	d	10	с		
	_	from a table cloth.	11	d	12	а	13	с	14	d	15	b		
	Reason :	benzene.	16	а	17	b	18	d	19	b	20	b		
27.	Assertion :	Nitration of toluene is easier than	21	b	22	b	23	а	24	b	25	a		
		benzene.	26	d	27	с	28	с	29	d	30	с		
	Reason :	The methyl group in toluene is electron-releasing.	31	а	32	а	33	d	34	a	35	а		
28.	Assertion :	Benzene forms benzene sulphonic	36	а	37	d	38	а	39	d	40	C		
		acid with fuming $H_2SO_4$ at high	41	b	42	d	43	d	44	а	45	b		
		temperature.	46	d	47	С	48	d	49	а	50	с		
	Reason :	The attacking species is $SO_3$ .	51	d	52	a	53	а	54	с	55	а		
29.	Assertion :	Activating groups are electron donors.	56	d	57	b	58	d	59	b	60	a		

61         b         62         a         63         b         64         c         65         c           66         b         67         c         68         b         69         d         70         c           71         b         72         a         73         c         74         c         75         b           76         c         77         c         78         c         79         a         80         c           81         c         82         a         83         d         84         a         85         b           86         a         87         a         88         d         89         a         90         a           91         a         92         b         93         c         94         a         95         c           96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108										
66         b         67         c         68         b         69         d         70         c           71         b         72         a         73         c         74         c         75         b           76         c         77         c         78         c         79         a         80         c           81         c         82         a         83         d         84         a         85         b           86         a         87         a         88         d         89         a         90         a           91         a         92         b         93         c         94         a         95         c           96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108         c         109         d         110         b           1111         a         112         b         113 </td <td>61</td> <td>b</td> <td>62</td> <td>а</td> <td>63</td> <td>b</td> <td>64</td> <td>C</td> <td>65</td> <td>C</td>	61	b	62	а	63	b	64	C	65	C
71       b       72       a       73       c       74       c       75       b         76       c       77       c       78       c       79       a       80       c         81       c       82       a       83       d       84       a       85       b         86       a       87       a       88       d       89       a       90       a         91       a       92       b       93       c       94       a       95       c         96       b       97       a       98       d       99       a       100       d         101       c       102       a       103       a       104       b       105       d         106       b       107       d       108       c       109       d       110       b         111       a       112       b       113       d       114       b       115       d         1106       b       107       d       118       c       119       c       120       c         121       c       122 <t< td=""><td>66</td><td>b</td><td>67</td><td>C</td><td>68</td><td>b</td><td>69</td><td>d</td><td>70</td><td>C</td></t<>	66	b	67	C	68	b	69	d	70	C
76         c         77         c         78         c         79         a         80         c           81         c         82         a         83         d         84         a         85         b           86         a         87         a         88         d         89         a         90         a           91         a         92         b         93         c         94         a         95         c           96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108         c         109         d         110         b           111         a         112         b         113         d         114         b         115         d           116         d         117         d         118         c         119         c         120         c           121         c         122         b	71	b	72	а	73	С	74	C	75	b
81         c         82         a         83         d         84         a         85         b           86         a         87         a         88         d         89         a         90         a           91         a         92         b         93         c         94         a         95         c           96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108         c         109         d         110         b           111         a         112         b         113         d         114         b         115         d           111         a         112         b         113         d         114         b         115         d           111         a         112         b         113         d         120         c           121         c         122         b         123         a	76	C	77	C	78	C	79	а	80	C
86         a         87         a         88         d         89         a         90         a           91         a         92         b         93         c         94         a         95         c           96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108         c         109         d         110         b           111         a         112         b         113         d         114         b         115         d           116         d         117         d         118         c         119         c         120         c           121         c         122         b         123         a         124         d         125         c           124         d         127         a         128         b         129         b         130         c           131         a         132         a <td>81</td> <td>C</td> <td>82</td> <td>а</td> <td>83</td> <td>d</td> <td>84</td> <td>а</td> <td>85</td> <td>b</td>	81	C	82	а	83	d	84	а	85	b
91         a         92         b         93         c         94         a         95         c           96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108         c         109         d         110         b           111         a         112         b         113         d         114         b         115         d           111         a         112         b         113         d         114         b         115         d           111         a         112         b         113         d         114         b         115         d           111         a         112         b         113         d         114         b         115         d           121         c         122         b         123         a         124         d         125         c           121         c         132	86	а	87	а	88	d	89	а	90	а
96         b         97         a         98         d         99         a         100         d           101         c         102         a         103         a         104         b         105         d           106         b         107         d         108         c         109         d         110         b           111         a         112         b         113         d         114         b         115         d           111         a         112         b         113         d         114         b         115         d           116         d         117         d         118         c         119         c         120         c           121         c         122         b         123         a         124         d         125         c           126         a         127         a         128         b         129         b         130         c           131         a         132         a         133         a         134         b         135         b           136         c         137	91	а	92	b	93	C	94	а	95	C
101       c       102       a       103       a       104       b       105       d         106       b       107       d       108       c       109       d       110       b         111       a       112       b       113       d       114       b       115       d         111       a       112       b       113       d       114       b       115       d         116       d       117       d       118       c       119       c       120       c         121       c       122       b       123       a       124       d       125       c         126       a       127       a       128       b       129       b       130       c         131       a       132       a       133       a       134       b       135       b         136       c       137       a       138       c       139       a       140       c         141       a       142       b       143       a       144       c       145       b         146       c	96	b	97	а	98	d	99	а	100	d
106         b         107         d         108         c         109         d         110         b           111         a         112         b         113         d         114         b         115         d           116         d         117         d         118         c         119         c         120         c           121         c         122         b         123         a         124         d         125         c           126         a         127         a         128         b         129         b         130         c           131         a         132         a         133         a         134         b         135         b           136         c         137         a         138         c         139         a         140         c           141         a         142         b         143         a         144         c         145         b           146         c         147         d         148         c         149         d         150         b           151         a         152	101	С	102	а	103	а	104	b	105	d
111       a       112       b       113       d       114       b       115       d         116       d       117       d       118       c       119       c       120       c         121       c       122       b       123       a       124       d       125       c         126       a       127       a       128       b       129       b       130       c         131       a       132       a       133       a       134       b       135       b         136       c       137       a       138       c       139       a       140       c         141       a       142       b       143       a       144       c       145       b         146       c       147       d       148       c       149       d       150       b         151       a       152       c       153       a       154       b       155       ab	106	b	107	d	108	C	109	d	110	b
116       d       117       d       118       c       119       c       120       c         121       c       122       b       123       a       124       d       125       c         126       a       127       a       128       b       129       b       130       c         131       a       132       a       133       a       134       b       135       b         136       c       137       a       138       c       139       a       140       c         141       a       142       b       143       a       144       c       145       b         146       c       147       d       148       c       149       d       150       b         151       a       152       c       153       a       154       b       155       ab	111	а	112	b	113	d	114	b	115	d
121       c       122       b       123       a       124       d       125       c         126       a       127       a       128       b       129       b       130       c         131       a       132       a       133       a       134       b       135       b         136       c       137       a       138       c       139       a       140       c         141       a       142       b       143       a       144       c       145       b         146       c       147       d       148       c       149       d       150       b         151       a       152       c       153       a       154       b       155       ab	116	d	117	d	118	C	119	С	120	C
126       a       127       a       128       b       129       b       130       c         131       a       132       a       133       a       134       b       135       b         136       c       137       a       138       c       139       a       140       c         141       a       142       b       143       a       144       c       145       b         146       c       147       d       148       c       149       d       150       b         151       a       152       c       153       a       154       b       155       ab	121	C	122	b	123	а	124	d	125	C
131         a         132         a         133         a         134         b         135         b           136         c         137         a         138         c         139         a         140         c           141         a         142         b         143         a         144         c         145         b           146         c         147         d         148         c         149         d         150         b           151         a         152         c         153         a         154         b         155         ab	126	а	127	а	128	b	129	b	130	C
136         c         137         a         138         c         139         a         140         c           141         a         142         b         143         a         144         c         145         b           146         c         147         d         148         c         149         d         150         b           151         a         152         c         153         a         154         b         155         ab	131	а	132	а	133	а	134	b	135	b
141         a         142         b         143         a         144         c         145         b           146         c         147         d         148         c         149         d         150         b           151         a         152         c         153         a         154         b         155         ab	136	С	137	а	138	С	139	а	140	C
146         c         147         d         148         c         149         d         150         b           151         a         152         c         153         a         154         b         155         ab	141	а	142	b	143	a	144	С	145	b
151 a 152 c 153 a 154 b 155 ab	146	C	147	d	148	C	149	d	150	b
	151	а	152	C	153	a	154	b	155	ab
156 c 157 b 158 a 159 a 160 c	156	C	157	b	158	a	159	a	160	C
161 e 162 c 163 a 164 c 165 b	161	е	162	С	163	a	164	С	165	b
166 d 167 d 168 c 169 c 170 c	166	d	167	d	168	С	169	С	170	C
171 a 172 d 173 b 174 b 175 c	171	а	172	d	173	b	174	b	175	C

Alkene

1	С	2	b	3	a	4	b	5	a
6	d	7	а	8	d	9	b	10	d
11	d	12	а	13	а	14	C	15	b
16	а	17	d	18	d	19	b	20	C
21	b	22	d	23	C	24	b	25	C
26	а	27	b	28	d	29	d	30	d
31	C	32	d	33	C	34	a	35	C
36	C	37	а	38	b	39	ac	40	b
41	с	42	a	43	c	44	c	45	a
46	с	47	d	48	d	49	a	50	С
51	а	52	d	53	C	54	а	55	b
56	с	57	d	58	a	59	d	60	b
61	c	62	a	63	b	64	b	65	b
66	d	67	c	68	a	69	C	70	C
71	C	72	C	73	C	74	d	75	C
76	d	77	а	78	d	79	C	80	b
81	C	82	d	83	C	84	a	85	C
86	C	87	b	88	а	89	C	90	C
91	b	92	C	93	b	94	b	95	b

96	b	97	а	98	b	99	b	100	b
101	b	102	C	103	C	104	b	105	b
106	a	107	C	108	a	109	a	110	c
111	C	112	a	113	a	114	b	115	d
116	d	117	а	118	а	119	а	120	b
121	b	122	C	123	C	124	b	125	C
126	c	127	b	128	b	129	а	130	a
131	C	132	b,d	133	а	134	b	135	C
136	C	137	C	138	b	139	a	140	d
141	b	142	C	143	d	144	a	145	d
146	а	147	d	148	abc	149	а	150	a
151	а	152	b	153	C	154	b	155	а
156	C	157	b	158	d	159	b	160	C
161	d	162	b	163	b	164	а	165	а
166	а	167	b	168	C	169	b	170	b
171	а	172	С	173	c	174	а		

### Alkyne

1	C	2	C	3	C	4	C	5	b
6	а	7	a	8	а	9	d	10	C
11	а	12	C	13	d	14	а	15	а
16	d	17	d	18	b	19	C	20	C
21	d	22	b	23	d	24	C	25	C
26	d	27	а	28	d	29	а	30	d
31	а	32	C	33	C	34	а	35	а
36	а	37	C	38	d	39	C	40	C
41	а	42	C	43	а	44	C	45	b
46	C	47	а	48	а	49	b	50	b
51	d	52	а	53	b	54	а	55	d
56	а	57	C	58	C	59	а	60	d
61	C	62	С	63	d	64	d	65	а
66	C	67	C	68	а	69	b	70	b
71	b	72	С	73	а	74	b	75	d
76	C	77	b	78	d	79	а	80	C
81	а	82	а	83	d	84	C	85	C
86	а	87	C	88	C	89	d	90	C
91	С	92	d	93	С	94	b	95	d
96	d	97	d	98	b	99	d	100	а
101	b	102	а	103	а	104	а	105	C

## Aromatic hydrocarbon

1	C	2	d	3	с	4	c	5	а
6	b	7	C	8	b	9	а	10	С
11	b	12	b	13	а	14	а	15	а

16	d	17	a	18	b	19	b	20	a
21	C	22	a	23	b	24	C	25	С
26	d	27	C	28	а	29	C	30	b
31	d	32	b	33	b	34	С	35	d
36	С	37	b	38	b	39	а	40	а
41	а	42	C	43	а	44	b	45	c
46	d	47	d	48	а	49	а	50	d
51	b	52	b	53	b	54	C	55	С
56	C	57	C	58	C	59	b	60	d
61	е	62	C	63	C	64	b	65	b
66	a	67	d	68	C	69	b	70	C
71	b	72	C	73	а	74	а	75	a
76	b	77	d	78	а	79	C	80	d
81	d	82	b	83	b	84	b	85	a
86	С	87	b	88	а	89	d	90	а
91	b	92	C	93	a	94	b	95	а
96	d	97	d						

#### **Critical Thinking Questions**

1	a	2	a	3	с	4	b	5	с
6	C	7	a	8	а	9	а	10	C
11	а	12	b	13	d	14	b	15	d
16	d	17	C	18	a	19	d	20	a
21	b	22	b	23	C	24	b	25	а
26	а	27	а	28	d	29	d	30	а
31	b	32	d	33	С	34	а	35	d
36	b	37	b	38	C	39	d	40	b

### Assertion and Reason

1	а	2	а	3	c	4	а	5	b
6	b	7	d	8	b	9	b	10	b
11	b	12	е	13	C	14	b	15	b
16	b	17	a	18	C	19	b	20	а
21	d	22	d	23	C	24	b	25	е
26	b	27	а	28	е	29	С	30	е
31	е	32	C	33	а	34	b	35	а



**1.** (d)  $C_7 H_{16} (C_n H_{2n+2})$ 

3. (a) According to wurtz reaction.  $2CH_3CH_2CH_2Br + 2Na \xrightarrow{\text{ether}} \rightarrow$ 

$$CH_3(CH_2)_4 CH_3 + 2NaBr$$

5. (b) 
$$2CH_3COONa + 2H_2O$$
 Electolysis  
Sodium acetate

6.

$$CH_3 - CH_3 + 2CO_2 + 2NaOH + H_2$$

(c) 
$$Pb(C_2H_5)_4 \xrightarrow{\text{heat}} Pb + 4CH_3CH_2$$
  
Ethylradical  
 $CH_2 - CH_2 + Pb \longrightarrow CH_2 = CH_2 + PbBr_2$   
 $|$  Ethene Lead bromide  
 $Br = Br$ 

As leaded gasoline burns, lead metal gets deposited in the engine which is removed by adding ethylene dibromide. The lead bromide is volatile and is carried off with the exhaust gases from the engine

9. (d)  $C_2H_5I + 2Na + IC_2H_5 \xrightarrow{\text{Dry}} C_2H_5 - C_2H_5 + 2NaI$ Butane

**10.** (c) 
$$(CH_3)_3 CH \xrightarrow{KMnO_4} (CH_3)_3 C - OH$$
  
tertiary butyl alcohol

**13.** (c) 
$$RCl + 2Na + RCl \xrightarrow{Dry} 2NaCl + R - R$$
  
Ether Alkane

- 14. (d) *iso*-octane *i.e.* 2,2,4-trimethyl pentane has highest octane number.
- **17.** (b) With calculated amount of Grignard reagent, acetyl chloride forms ketones.

$$CH_3COCl + XMgCH_3 \rightarrow CH_3COCH_3 + Mg < Cl_X$$

**18.** (d)  $CH_4$  is tetrahedral



- **22.** (b) Ethane is a saturated compound it can not be catalytically hydrogenated.
- **25.** (a) Branched hydrocarbons are more desirable because they are more volatile.
- **26.** (d)  $CH_4 \xrightarrow{Cl_2} CH_3Cl \xrightarrow{Cl_2} CH_2Cl_2 \xrightarrow{Cl_2}$

 $CHCl_3 \xrightarrow{Cl_2} CCl_4$ . Since this reaction takes place by free radical mechanism. Hence, there is a possibility of formation of ethane.

$$CH_3 + CH_3 \rightarrow CH_3 - CH_3$$
  
Methyl free radicals Ethane

**28.** (c)  $Al_4C_3 + 6H_2O \rightarrow 3CH_4 + 2Al_2O_3$ Aluminium Methane

**31.** (a) 
$$C_2H_5O[H+CH_3] - Mg - Br \to CH_4 + Mg$$

- 32. (a)  $CH_3I + 2H \xrightarrow{Zn/HCl} CH_4 + HI$  $CH_3I + 2Na + ICH_3 \xrightarrow{Dry} CH_3 - CH_3 + 2NaI$
- **36.** (a) Solvent for fat, oil, varnish and rubber
- **37.** (d) Synthetic dyes, drugs, perfumes all are made from coal tar.
- **38.** (a) In alkanes, hybridization is  $sp^3$ . Hence bond angle is  $109^{\circ}.5'$ .

**39.** (d) 
$$2CH_3COONa + 2H_2O \xrightarrow{\text{Electrolysis}}$$

$$CH_3 - CH_3 + 2CO_2 + 2NaOH + H_2$$

**41.** (b) 
$$CH_3 - CH_2 - COOH + 6HI \xrightarrow{\text{Red } P}$$
  
Propanoic acid

$$CH_3 - CH_2 - CH_3 + 2H_2O + 3I_2$$
  
Propane

42. (d) 
$$C_2H_5I + 2Na + C_3H_7I \xrightarrow{\text{Dry}} C_2H_5 - C_3H_7 + 2NaI$$
  
 $C_2H_5I + 2Na + C_2H_5I \xrightarrow{\text{Dry}} C_2H_5 - C_2H_5 + 2NaI$   
 $C_3H_7I + 2Na + C_3H_7I \xrightarrow{\text{Dry}} C_3H_7 - C_3H_7 + 2NaI$   
Hexane

**48.** (d) Cyclohexane, is immiscible and lighter than water. Hence, floats on the surface of water.

- **49.** (a) Methane is the main component of natural gas.
- **53.** (a) *Pt./Ni* is used in catalytic reduction of hydrocarbon.
- **55.** (a) Fractional distillation is used because the difference between the boiling point of different component is less.

**56.** (d) 
$$CH_3 - CH_2 - Cl + KOH \rightarrow CH_2 = CH_2 + KCl + H_2O$$
  
(alc.) Ethene

In presence of alc. *KOH* dehydrohalogenation occur and alkene is formed.

**57.** (b) Liquefied petroleum gas is a mixture of ethane, propane and butane. The main component is butane.

**58.** (d) 
$$CH_4 + O_2 \xrightarrow{\Delta} C + 2H_2O$$
  
supply  
of air

It contains 98-99% carbon. It is used in making black ink, paints and shoe polishes.

- **59.** (b) Tetraethyl lead is anti-knocking agent it increases the octane no. of the fuel.
- **60.** (a) *n*-hexane because it is linear therefore strong Vander Waal force.
- **61.** (b) Knocking Sudden and irregular burning of the fuel mixture causing jerks against the piston and gives rise to violent sound. This is known as knocking.
- **63.** (b) *n*-octane
  - Boiling point depends on molecular mass. Greater the molecular mass higher will be the boiling point.
  - Boiling point also depends on the structure. If two compounds have same molecular mass then straight chain or linear compound has higher boiling point.

64. (c) 
$$2CH_3COOK + 2H_2O \xrightarrow{\text{Electrolysis}}$$
  
Potassium acetate  $CH_2 - CH_2 + 2CO_2 + 2KOH + H_2$ 

$$CH_3 - CH_3 + 2CO_2 + 2KOH + H_2$$
  
Anode Cathode

**65.** (c) Ethane does not decolourise bromine solution because it is a saturated compound.

**66.** (b) 
$$CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$$
  
Sodium acetate Methane

68. (b) Octane number is related to the percentage of *iso*-octane since *iso*-octane is 81% hence octane number is 81%.

**70.** (c) 
$$2CH_3COOK + 2H_2O \xrightarrow{\text{Electrolyss}}$$

$$\underbrace{2CO_2 + CH_3 - CH_3 + 2KOH + H_2}_{\text{Anode}}$$

71. (b) 
$$CH_3 - C = CH_2 + HCl \rightarrow CH_3 - C - CH_3$$
  
 $CH_3 - CH_3 - CH_3$   
 $CH_3 - CHCl_2$ 

- (a) Boiling point of alkanes increases with the 72. number of carbon atoms because surface area increases which increases the Vander Waal forces.
- (c) The enthalpy of combustion *i.e.*,  $\Delta H$  is always 74. negative. It means combustion is an exothermic reaction.

**78.** (c) 
$$CH_3CH_2COONa + NaOH \xrightarrow{CaO} C_2H_6 + Na_2CO_3$$

~ ~

79. (a) 
$$CH_3 - CH_2 - CH_2 - CH_3 + Br_2 \xrightarrow[130]{\text{Light}}_{130^{\circ}C}$$
  
 $CH_3 - CH - CH_2 - CH_3 + CH_3 - CH_2 - CH_2 - CH_2 - Br$   
 $Br$   
(Minor)  
2-Bromo butane  
(Main product)

2-Bromobutane is the main product because

 $2^{o}$  carbonium ion is more stable than  $1^{o}$ .

**80.** (c) 
$$CH_3CH_2CH_2CH_3 \xrightarrow{Cracking}_{n-\text{Butane}}$$

$$CH_4 + CH_3 - CH = CH_2$$

- (d) Anti-knocking properties of fuel increases. 83.
- (a)  $C_6H_{14} \xrightarrow{\Delta} C_4H_{10} + C_2H_2$ Hexane Ethene Ethene Gas 84.
- 87. (a) Compounds having active hydrogen  $(ROH, H_2O, R - NH_2)$  can form alkane when treated with Grignard's reagent

$$CH_3CH_2OH + CH_3M_gBr \rightarrow CH_4 + M_g < {Br} OCH_2CH_3$$

- (a) It is not possible to prepare  $CH_4$  by wurtz 91. reaction.
- (b) Octane number is the percentage by volume of 92. iso-octane in the mixture of iso-octane and *n*heptane which has the same antiknocking properties as the fuel under examination. Given fuel (25% *n*-heptane +75% iso-octane) Hence, octane number = 75 (because iso octane is 75%)

**93.** (c) 
$$CH_3 - CH_2 - CH_2 - Br \xrightarrow[Dehydro halogenation]{CH_3 - CH = CH_2 + HBA}$$

94. (a) % of hydrogen = 
$$\frac{\text{Mass of hydrogen}}{\text{Mass of compound}} \times 100$$

$$CH_4 = \frac{4}{16} \times 100 = 25\%$$
 .

(c) Molecular mass can be obtained by the victor 95. mayer process

Molecular mass 
$$=\frac{\text{Weight}}{Vml.} \times 22400$$

$$=\frac{11}{5600} \times 22400 = 44$$

97. (a) 
$$CH_3 - CH - CH_2 - CH_3 + Zn \rightarrow Br Br$$
  
 $2,3 - dibromo - 3 - methyl pentane$ 

$$CH_{3}$$

$$CH_{3} - CH = C - CH_{2} - CH_{3} + ZnBr_{2}$$

$$HI + \downarrow \text{Red P (Reduction)}$$

$$CH_{3} - CH_{2} - CH - CH_{2} - CH_{3}$$

$$\downarrow CH_{3}$$

$$3 - Methyl pentane$$

98. (d) Gasoline, kerosene oil, diesel

**99.** (a) 
$$CH_3 - CH_2 - COONa \xrightarrow{\text{Soda lime}} CH_3 - CH_3$$

**100.** (d) Gasoline or petrol composition  $C_7 - C_{12}$ .

**101.** (c) 
$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$
  
Methane  
 $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$   
Ethene  
All hydrocarbons saturated or unsaturated on  
complete combustion always produce  $CO_2$  and  
 $H_2O$ .

- 102. (a) Free rotation around carbon-carbon bond takes place easily in alkanes. Now ethane and hexachloroethane both are alkanes. But in hexachloroethane bulky chlorine atom hinders the rotation. Therefore least hindered rotation takes place in ethane.
- 103. (a) Hydrocarbons on complete oxidation produce  $CO_2$  and water

$$CH_3 - CH_3 + 3\frac{1}{2}O_2 \rightarrow 2CO_2 + 3H_2O_2$$

**104.** (b) 
$$C_{10}H_{22} \xrightarrow{900 K} C_4H_8 + C_6H_{14}$$
  
Decane  $CH_3$ 

**106.** (b) 
$$CH_3 - C - CH_3$$

Replaceable hydrogen atoms are present only on 4 primary carbon atoms. Hence, it gives only are monochloro Substituted product.

**107.** (d) 
$$CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$$
  
Sod. acetate  
 $CH_3I + 2H \xrightarrow{Reduction} CH_4 + HI$   
Iodomethan e  
 $Al_4C_3 + 6H_2O \rightarrow 3CH_4 + 2Al_2O_3$   
Aluminium carbide

108. (c) Acetylene reacts with ammonical cuprous chloride to form red ppt. of copper acetylide while methane and ethylene do not react (since they do not have acidic hydrogen) They come out from the bottle CH

$$I \equiv CH + 2[Cu(NH_3)_2]OH \rightarrow$$

$$Cu - C \equiv C - Cu + 4NH_3 + 2H_2O$$

 $CH_4$  + Ammonical  $Cu_2Cl_2 \rightarrow$  No reaction

 $C_2H_4$  + Ammonical  $Cu_2Cl_2 \rightarrow$  No reaction

- 110. (b) Alkanes do not give addition reactions because multiple bond is absent.
- **111.** (a)  $C_6H_{14} \xrightarrow{Pyrolysis} C_2H_4 + C_4H_{10}$ Hexane  $\Delta$  Ethene Butane

114.

113. (d) In gemdihalide both the halogen atoms are present on the same carbon atom while in vicdihalide both the halogen atoms are present on adjacent carbon atoms.

$$CH_{3} - CHBr_{2}$$
Gemdihalide
$$CH_{2} - CH_{2}$$

$$Br$$

$$Br$$

$$vic-dihalide$$

$$CH_{3} CH_{3}$$
(b)
$$H_{3}C - H_{2}C - C - C - CH_{3}$$

$$CH_{3} CH_{3}$$

$$CH_{3} CH_{3}$$

$$CH_{3} CH_{3}$$

$$CH_{3} CH_{3}$$

$$CH_{3} CH_{3}$$

$$CH_{3} CH_{3}$$

$$H_{3}C - H_{2}C - H_{2}C - HC - CH_{3}$$
  
isopropyl group 2-methylpentane  

$$CH_{3}CH_{3} \qquad CH_{3}$$

$$H_{3}C - H_{2}C - HC - C - CH_{3}H_{3}C - H_{2}C - C - CH_{2} - CH_{3}$$

$$H_{3}C - H_{2}C - HC - C - CH_{3}H_{3}C - H_{2}C - C - CH_{2} - CH_{3}$$

$$H_{3}C - H_{2}C - HC - C - CH_{3}H_{3}C - H_{2}C - C - CH_{2} - CH_{3}$$

$$H_{3}C - H_{2}C - HC - C - CH_{3}H_{3}C - H_{2}C - C - CH_{2} - CH_{3}$$

$$H_{3}C - H_{2}C - HC - C - CH_{3}H_{3}C - H_{2}C - C - CH_{2} - CH_{3}$$

$$H_{3}C - H_{2}C - HC - C - CH_{3}H_{3}C - H_{2}C - C - CH_{3}H_{3}C - H_{2}C - CH_{3}$$

- **116.** (d) All-butane, Ethane and Propane are possible in this reaction.
- **118.** (c) Formation of branches in the chain of C atoms C - C - C - Cstraightchain C - C - C - C

- 119. (c) Chlorination of alkane in photochomical reaction which takes place by free radical mechanism. Free radicals are formed by homolytic bond fission or homolysis.
- **120.** (c) Marsh gas, Natural gas and coal gas contains  $CH_4$  but producer gas is a mixture of CO and  $N_2$

$$2C + \underbrace{O_2 + 4N_2}_{\text{Coke}} \rightarrow \underbrace{2CO + 4N_2}_{\text{Air}} \xrightarrow{\text{Producer gas}}$$

- **123.** (a) Fractional distillation is based on the difference in the boiling point of different components.
- **124.** (d) Tetraethyl lead (TEL) is an anti-knocking compounds when mixed with petrol tend to improve the octane no. and therefore, decreases the knocking in the cylinder of the combustion engine.
- **128.** (b) Petrol sample 30% *n*-heptane + 70% *iso*-octane since *iso*-octane is 70%. Hence, octane no. is 70.

**131.** (a) 
$$CH_3 - CH = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_2 - CH_3$$
  
Propene Propane

**132.** (a) As the number of branches increases, surface area decreases, due to which Vander Waal

forces of attraction decreases. Hence, boiling point also decreases.

135. (b)

$$CH_{3}CH_{2}CH_{2}CH_{3} \xrightarrow{\text{Anhyd. AlCl}_{3}} CH_{3} - CH_{3} - CH_{3}$$

$$CH_{3} = CH_{3} - CH_{3}$$
iso butane
$$H_{3} = CH_{2} - Br + KOH \xrightarrow{\text{Dehydrohal ogenation}} H_{3}$$

$$CH_2 = CH_2 + KBr + H_2O$$

In alcoholic *KOH* alkoxide ions (*RO*<sup>-</sup>) are present which is a strong base. They abstract proton from  $\beta$ -carbon of alkyl halide and favours elimination reaction  $ROH + KOH \rightarrow ROK + H_2O$ Alcohol Potassium alkoxide

$$ROK \rightarrow \frac{RO^{-}}{\text{Alkoxideion}} + K^{+}$$

$$RO^{-} + H - CH_{2} - CH_{2} - Br \rightarrow ROH + CH_{2} = CH_{2} + Br$$

$$RO^{-} + H - CH_{2} - CH_{2} - Br \rightarrow ROH + CH_{2} = CH_{2} + Br$$

**137.** (a)  $Al_4C_3 + 6H_2O \rightarrow 3CH_4 + 2Al_2O_3$ Methane

**138.** (c) In  $C_2H_6$ , C-C bond length is 1.54Å.

139.

(a)

$$R - COOK + 2H_2O \xrightarrow{\text{Electrolysis}} R - R + CO_2 + 2KOH + H_2$$

**142.** (b) 
$$CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$$
  
**143.** (a)  $90$ 

Cyclopropan Cyclopentane Cyclobutane

Cyclopropane with a bond angle of  $60^{\circ}$  is very strained and hence very reactive.

- 145. (b) Marsh gas mainly consists of methane.
- **146.** (c)  $CH_3 Cl + 2H \xrightarrow{Zn/HCl} CH_4 + HCl$
- **149.** (d) Propane is a saturated compound. Ozonide is formed only by alkenes or alkynes

$$CH_2 = CH_2 + O_3 \rightarrow \bigcup_{\substack{CH_2 \\ O \\ Ethene \text{ ozoniele}}}^{O} CH_2$$

$$CH = CH + O_3 \rightarrow \begin{array}{c} O \\ CH - CH \\ O - O \\ CH \\ O \\ O - O \\ CH \\ O \\ O \\ O \\ O$$

**150.** (b)  $H - \overset{sp^2}{C} = \overset{sp^2}{C} - H$   $sp^2$ -hybridisation (trigonal  $\overset{|}{H} \overset{|}{H} \overset{|}{H}$ 

planar).

- **151.** (a)  $Ag C \equiv C Ag + 2HCl \rightarrow CH \equiv CH + 2AgCl$
- **152.** (c) Wurtz reaction

$$C_2H_5 - I + 2Na + I - C_2H_5 \xrightarrow{\text{Dry}} C_2H_5 - C_2H_5 + 2NaI$$
  
Butane

- **154.** (b) All the C-C bond are single bonds. Hence  $sp^3$ -hybridization and tetrahedral structure.
- **155.** (a.b)  $CH_3MgI + CH_3 CH_2 NH_2 \rightarrow$

$$CH_4 + CH_3 CH_2 NHMgI$$

$$CH_3MgI + C_2H_5OH \rightarrow CH_4 + C_2H_5OMgI$$

Alkyl group of Grignard's reagent is involved in the formation of alkane.

- **159.** (a) General formula of alkane  $C_n H_{2n+2}$  (n = no. of atoms).
- **160.** (c)  $CH_3Br + H_2 \xrightarrow{LiAlH_4} CH_4$  (methane)

$$\xrightarrow{Na} CH_3 - CH_3$$
 (Ethane)

**161.** (e) Photochemical chlorination of alkane take place by free radical mechanism which are possible by Homolysis of C - C bond  $Cl = \frac{hv}{c} \rightarrow Cl^{\bullet} + Cl^{\bullet}$ 

$$Cl_2 \longrightarrow Cl + Cl$$

$$CH_3 - CH_3 + Cl^{\bullet} \rightarrow CH_3Cl^{\bullet} + CH_3$$

- **163.** (a) Producer gas CO and  $N_2$
- 164. (c) Among alkanes, boiling point increase with increasing molecular weight. For isomeric alkanes straight chain alkanes have higher boiling point than the branched alkanes.
- **165.** (b) Graphite is a good conductor of heat of electricity.
- 166. (d) Among the isomeric alkanes, the normal isomer has a higher boiling point than the branched chain isomer. The greater the branching of the chain, the lower is the boiling point. The *n*-alkane have larger surface area in comparison to branched chain isomer (as the shape approaches that of a sphere in the branched chain isomers). Thus, intermolecular forces are weaker in branched chain isomers, there fore they have lower point in comparison to straight chain isomers.
- 167. (d) The octane numbers of Fuel can be improved by increasing the percentage of branched chain alkanes, alkenes and aromatic hydrocarbon. Thus octane number can be changed by isomerisation (reforming), alkylation and aromatisation (cyclisation) etc.
- **168.** (c) The approximate composition of gasoline is  $C_6 C_{11}$  at boiling point 70-200°C and is used in motor fuel, dry cleaning, petrol gas etc.

**169.** (c) 
$$CH_4 + O_2 \rightarrow CO_2 + 2H_2C$$

- **170.** (c) Straight chain olefins has highest knocking.
- **171.** (a)  $Al_4C_3 + 12H_2O \rightarrow 3CH_4 + 4Al(OH)_3$

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

**172.** (d) Except 2,2 dimethyl butane rest compound contain 5 carbon i.e., pantane while 2,2 dimethyl butane contain 6 carbon i.e., Hexane *CH*<sub>2</sub>

$$CH_3 - CH_2 - C - CH_3$$

**173.** (b) 
$$H_3C - CH - CH_2 - CH_3 + Br_2 \longrightarrow$$

$$Br$$

$$|$$

$$H_{3}C - C - CH_{2} - CH_{3}$$

$$|$$

$$CH_{3}$$
Maior

$$CH_{3} CH_{3}$$

$$| |$$
174. (b)  $H_{3}C - C - C - CH_{3} \xrightarrow{Cl_{2}}$ 

$$| |$$

$$H H$$

$$CH_{2}Cl CH_{3} CH_{3} CH_{3}$$

$$| | |$$

$$H_{3}C - C - C - CH_{3} + H_{3}C - C - C - CH_{3}$$

$$| | |$$

$$H H Cl H$$

**175.** (c) 
$$C_2H_5Cl + H_2 \xrightarrow{Pd/C} C_2H_6 + HCl$$

This reaction is used for the preparation of pure alkanes.

#### Alkene

2. (b) 
$$CH_2 - CH_2 + Zn \rightarrow CH_2 = CH_2 + Br_2$$
  
| | | Alkene  
 $Br \quad Br$   
3. (a)  $CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} - CH_2 - CH_2$   
 $Br \quad Br$   
 $1, 2 - dibromo$   
ethane  
4. (b)  $CH_2 = CH_2 \xrightarrow{HOCl} - CH_2 - CH_2 \xrightarrow{aq \, NaHCO_3} - CH_2 - CH_2 \xrightarrow{cH_2 - CH_2} - CH_2 - CH_2$ 

 $CH_2 - OH_{Glycol}$ 

- (a) Alkenes are unsaturated hydrocarbon having double bond so generally gives addition reaction.
- 6. (d) According to markownikoff's rule.
- 7.

14.

(a)

$$CH_{3} - CH_{2} - OH \xrightarrow{Conc. H_{2}SO_{4}} CH_{2} = CH_{2} + H_{2}O$$
8. (d) 
$$CH_{3} - CH_{3} - CH_{3} \xrightarrow{KMnO_{4}} CH_{3} - CH_{3} - CH_{3} \xrightarrow{KMnO_{4}} CH_{3} - CH_{3} - CH_{3} \xrightarrow{CH_{3}} CH_{3} - CH_{3} \xrightarrow{CH_{3}} CH_{3} - CH_{3} \xrightarrow{CH_{3}} CH_{3$$

10. (d)  $C_2H_5I + alc.KOH \rightarrow C_2H_4 + KI + H_2O$ 

12. (a) 
$$CH_3 - CH_2 - Br + KOH \rightarrow CH_2 = CH_2 + KBr + H_2O$$

13. (a) Methane can not be obtained by Sabatier and Sendern's reaction because in this the product obtained contain minimum two carbon atoms.

$$CH_{2} = CH_{2} + H_{2} \xrightarrow{Ni} CH_{3} - CH_{3}$$

$$CH \equiv CH + 2H_{2} \xrightarrow{Ni} CH_{3} - CH_{3}$$

$$CH_{3}$$

$$(c) \quad CH_{3} - CH - C - CH_{3} \xrightarrow{H_{2}SO_{4}}$$

$$OH \quad CH_{3}$$

$$CH_{3} \xrightarrow{+} CH_{3} + OH^{-} \xrightarrow{\text{Methyl shift}} CH_{3} \xrightarrow{+} CH_{3} + OH^{-} \xrightarrow{\text{Methyl shift}} Rearrangem ent}$$

$$CH_{3} CH_{3} CH_{3} CH_{3} CH_{3} CH_{3} CH_{3}$$

$$CH_{3} - C = C - CH_{3} \leftarrow -H^{+} CH_{3} - CH - C - CH_{3}$$

$$2.3 - \text{dimethy} |-2 - \text{Butene}$$
[Most synnetrialStructure]  $3^{0}$  Carbonium ion (More stable)

**20.** (c) 
$$CH_3 - CH = CH - CH_3 + HBr \xrightarrow{\text{Peroxide}}$$

$$CH_3 - CH_2 - CH_1 - CH_3$$
  
 $Br$   
2-Bromobutan e

Anti-markownikoff's rule is not applicable to symmetrical alkenes.

**21.** (b) 
$$CH_2 = CH_2 + KMnO_4 \xrightarrow{[O]} CH_2 - CH_2 + MnO_2$$
  
alk.  $H_2O \xrightarrow{[]} H_2O \xrightarrow{[]} Brown$   
 $OH OH$   
 $Colour less$   
 $CH = CH + KMnO_4 \xrightarrow{[O]} COOH + MnO_2$   
 $COOH$   
 $COOH$   
 $Oralic acid$   
 $Brown$ 

22. (d) Octane number increases in the order Straight chain alkanes < Branched chain alkanes < Olefins < Cyclo alkanes < Aromatic compounds Since, straight chain alkane has minimum octane number. Hence, it produces maximum knocking.

**23.** (c) 
$$R - CH = CH - R \xrightarrow{\text{dil. aqueous } KMnO_4} \rightarrow R - CH - CH - R$$
  
room temp.  
 $OH OH$   
(Alcohol)

 $R - CH = CH - R \xrightarrow{\text{Conc. } KMnO_4} R - COOH + R - COOH$ heat  $CH_3$ 

24. (b) 
$$CH_{2} = \stackrel{|}{C} - CH_{2} - CH_{3} + H_{2}O \xrightarrow{H_{2}SO_{4}}_{\text{Markowniko ffs rule}}$$

$$CH_{3}$$

$$CH_{3} - \stackrel{|}{C} - CH_{2} - CH_{3}$$

$$OH$$
2-Methyl-2-butanol

**27.** (b) 
$$CH_3 - CH = CH_2 + H_2O \xrightarrow{Conc. H_2SO_4} CH_3 - CH_3 - CH_3 - CH_3$$
  
Markowniko ffs rule  $OH$   
Isopropy lakohol

32. (d)  

$$CH_3 - CH - CH_2 - CH_3 \xrightarrow{alc. KOH} CH_3 CH = CHCH_3$$
  
 $Br$ 

The reaction is dehydrohalogenation.

 $\sim$ 

34. (a) 
$$CH_2 = CH_2 + O_3 \longrightarrow CH_2 \xrightarrow{CH_2} CH_2 \longrightarrow 2HCHO$$
  
 $0 \longrightarrow 0$ 

**35.** (c) Oil are unsaturated esters which are converted into fats by saturating it by catalytic hydrogenation.

**36.** (c) 
$$>C = C < \xrightarrow{\text{Hydrogenation}} >C - C < \xrightarrow{H}$$

**37.** (a) 
$$CH_2$$
  
 $CH_2$   $CH_2$   
Cyclo Propane

. ...

**38.** (b) e.g.  $CH_2 = CH_2 + Br_2 \rightarrow CH_2 - CH_2$ 

Half of the double bond is broken. It means  $\pi$  bond is broken while sigma bond is retained also two new C-Br bonds are formed.

**40.** (b) 
$$CH_3 - CH - CH_2 - CH_3 + KOH \rightarrow$$
  
 $CH_3 - CH = CH - CH_3 + KBr + H_2O$   
Butene -2  
 $CH_3 - CH = CH - CH_3 + KBr + H_2O$ 

**42.** (a) We know that greater the number of alkyl groups attached to double bonded carbon atoms, more stable is the alkene. Therefore most stable is  $R_2C = CR_2$ 



- **43.** (c)  $CH_2 = CH_2 + 2[O] \xrightarrow{KMnO_4} HCHO + HCHO$ Formaldehy de
- 44. (c) Paraffins are non-polar compounds. The intermolecular forces are weak Vander Waal's forces. As the molecular mass increases Vander Waal's forces increases. Hence boiling point increases.
- **45.** (a)  $CH_2 CH_2 + Zn \rightarrow ZnBr_2 + CH_2 = CH_2$ | | Br Br

**46.** (c) 
$$CH_3CH_2I + KOH(alc) \rightarrow CH_2 = CH_2 + KI + H_2O$$
  
 $CH_2 = CH_2 + KMnO_4 \xrightarrow{H_2O} CH_2 - CH_2 + MnO_2$   
Alk.Pink  $OH OH$   
Colourless

47. (d) 
$$CH_2 = CH - Br \xrightarrow{HBr} CH_3 - CH < Br_{Br}$$

According to Markownikoff's rule H atom or positive part goes to that carbon atom which is more hydrogenated.

**48.** (d) 
$$CH_3 - CH_2 - Br + KOH \rightarrow CH_2 = CH_2 + KBr + H_2O$$
  
(alc) Ethene

**49.** (a) 
$$CH_3 - CH_2 - OH \xrightarrow{\text{Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$
  
Dehydration

**50.** (c) Electrophillic addition reactions are shown by alkenes or alkynes in these reactions attacking species is electrophiles

$$CH_{3} - CH = CH_{2} + H^{+} \xrightarrow{\text{Slow}} CH_{3} - CH - CH_{3}$$

$$2^{\circ} \text{ carbonium ion}$$

$$CH_{3} - \overset{+}{CH} - CH_{3} + Br^{-} \xrightarrow{\text{Fast}} CH_{3} - CH - CH_{3}$$

$$Br$$
2-Bromo propane

51.

(a) 
$$CH_3CH_2CH_2Cl + KOH \rightarrow$$
  
 $CH_3 - CH = CH_2 + KCl + H_2O$   
 $CH_3 - CH - CH_3 + KOH \rightarrow CH_3 - CH = CH_2 + KCl + H_2O$ 

52. (d) 
$$CH_2 = CH_2 \xrightarrow{\text{Cold.alk.}KMnO_4} CH_2 - CH_2$$
  
Ethene  $H_2 = CH_2 \xrightarrow{\text{Cold.alk.}KMnO_4} CH_2 - CH_2$   
 $H_2 = CH_2 \xrightarrow{\text{Cold.}KMnO_4} CH_2$   
 $H_2 = CH_2 \xrightarrow{\text{$ 

**53.** (c) Ethane and Methane does not decolourise  $KMnO_4$  and does not react with ammonical cuprous chloride. Acetylene decolourise  $KMnO_4$  solution and also gives red ppt. with ammonical cuprous chloride. On the other hand ethene decolourize  $KMnO_4$  solution but does not react with ammonical cuprous chloride.

54. (a) 
$$CH_2 = CH_2 + HOCl \rightarrow CH_2 - CH_2$$
  
| | |  
 $OH Cl$   
1-Chloro-2-hydroxy ethane

55. (b) 
$$n(CH_2 = CH_2) \xrightarrow{400^{\circ}C} (-CH_2 - CH_2 -)_n$$
  
(ethylene) (polyethylene)

57. (d)  

$$\begin{array}{c}
CH_{3} \\
H-C-Br \\
H-C-Br \\
H-C-Br \\
CH_{3} \\
CH \\
H-C-Br \\
CH_{3} \\
CH \\
CH_{3} \\
CH \\
CH_{3} \\
CH \\
CH_{3} \\
CH$$

**58.** (a) 
$$ClCH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{alc. KOH}$$

$$CH_2 = CH - CH_2 - CH_3$$
  
1-butene

**59.** (d) 
$$CH_3CH_2CH = CHCH_3 \xrightarrow[Zn/H_2O]{O_3} CH_3CH_2CHO + CHOCH_3$$
  
Propanal Ethanal

**61.** (c) 
$$CH_3 = C = CH_2$$
  
 $sp^2 sp sp^2$   
Propadiene

Propadiene has both sp and  $sp^2$  -hybridized carbon atoms.

**62.** (a) 
$$C_2H_4 + Cl_2 \xrightarrow{CCl_4} Cl - CH_2 - CH_2 - Cl_2$$
  
Ethelene Chloride

**64.** (b) Paraffins or alkanes are non-polar compounds. Hence soluble in benzene.

**65.** (b) 
$$CH_3 - CH = CH_2 + HCl \xrightarrow{Peroxide} CH_3 - CH - CH_3$$

Peroxide rule is applicable only to HBr.

**66.** (d) 
$$CH_3 - CH = CH_2 + HI \xrightarrow{\text{Peroxide}} CH_3 - CH_2 - CH_2 I$$

**69.** (c) 
$$CH_3 - CH - CH - CH_2 \xrightarrow{alc. NaOH} -HCl \rightarrow H Cl H$$

$$CH_3CH = CH - CH_3$$

**73.** (c)  $CH_3 - CH = CH - CH_2 - CH_3$  it decolourizes  $KMnO_4$  solution because double bond is present.

77. (a) 
$$CH_2 = CH - CH_2 - C \equiv CH + Br_2 \rightarrow$$
  
 $CH_2 = CH - CH_2 - C = CH$   
 $Br$   $Br$ 

78. (d) 
$$CH_3COCH_3 + PCl_5 \rightarrow CH_3 - CCl_2 - CH_3 + POCl_3$$

**80.** (b) 
$$3R - CH = CH_2 + \frac{1}{2}B_2H_6 \xrightarrow[\text{Ether}]{\text{Ether}} (R - CH_2CH_2)_3B$$
  
 $OH^-_H_{2O}H^-_H_{2O}$   
 $3R - CH_2CH_2OH_{Alcohol}$ 

83. (c) CH Cl Anhydrous  $AlCl_3$  ||| ||| || Arsenictrichloride CHCl ||  $CH AsCl_2$ Lewisite  $(\beta$ -Chlorovinyl dichloroarsine)

Lewisite is more poisonous than mustard gas and was used in world war -II.

**84.** (a) 
$$CH_3 - CH = CH_2 + Cl_2 \xrightarrow{500^{\circ}C} CH_2 - CH = CH_2 + HCl$$

This reaction is called allylic halogenation reaction because halogenation occurs at the allylic position of an alkene

85. (c) 
$$n(CH_2 = CH - Cl) \xrightarrow{\text{Polymerization}} (-CH_2 - CH_2 - CH_2)_n$$
  
(PVC)  
86. (c)  $CH_2 = CH_2 + Br_2 \xrightarrow{NaCl} CH_2 - CH_2$   
 $Br Br$   
 $1,2 - \text{dibromo ethane}$   
 $+ CH_2 - CH_2$   
 $Cl Br$ 

87. (b) 
$$CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Markownikoff rule}} CH_3 - CH - CH_3$$

2-Bromopropa ne

88. (a) 
$$CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}} CH_3 - CH_2 - CH_2 - Br$$
  
89. (c)  $CH_3 - CH_2 - CH_3 \xrightarrow{(1)O_2} CH_3 \xrightarrow{(2)Zn/H_2O} CH_3 \xrightarrow{(2)Zn/H_2O} CH_3 + CHOCH_3$ 

$$CH_3COCH_3 + CHOCH_3$$
  
Ketone Aldehyde

**90.** (c) 
$$R - CH = C - R \xrightarrow{(1)O_3} R - CHO + R_2CO$$
  
|  $(2)Zn/H_2O$  Aldehyde  $R$  Ketone

**92.** (c) 
$$CH_3 - CH_2 - OH \xrightarrow{\text{Conc.}} CH_2 = CH_2 + H_2O$$

**93.** (b) 
$$CH_3 - CH_2 - Cl \xrightarrow{\text{alc. KOH}} CH_2 = CH_2 + KCl + H_2O$$
  
Ethyl Chloride Alkene

- 94. (b) Olefin because double bond is present.
- **95.** (b) In  $CH_2 = \frac{\pi}{\sigma} CH_2$  double bond consist of one  $\sigma$ and one  $\pi$  bond

**96.** (b) 
$$R - CH_2 - CH_2 - X \xrightarrow{\text{Elimination}} alc. KOH$$
  
Alkylhalide  $R - CH = CH_2 + HX$ 

9

$$-CH = CH_2 + HX$$
  
Alkene Halogen acid

7. (a) 
$$CH_3 - CH_2 - CH_2 - CH_3 \xrightarrow{H_2SO_4} 475 K$$
  
 $CH_3 - CH = CH - CH_3$   
More symmetrica l(major product)  
 $CH_3 - CH_2 - CH_2 - CH_3 \xrightarrow{H_2SO_4} 475 K$   
 $CH_2 = CH - CH_2 - CH_3$   
Less symmetrica l or  
unsymmetric cal  
(minor product)

It is based on Saytzeff's rule. According to this more symmetrical or more alkylated alkene predominates.

**98.** (b) 
$$CH_3 - CH_2 - CH_2 - OH \xrightarrow{PCl_3}$$
  
 $CH_3 - CH_2 - CH_2 - Cl \xrightarrow{Alc.KOH} CH_3 - CH = CH_2$   
(a) (b)  
propylchloride Propene

**99.** (b) 
$$CH_3 - CH_2 - CH_2 - Br + KOH \xrightarrow{C_2H_5OH}_{n-\text{Propyl bromide}} CH_3 - CH = CH_2 + KBr + H_2O$$

**100.** (b) 
$$CH_3 \xrightarrow{-C} - CH_2 - Br + KOH \xrightarrow{-C} - CH_3 = CH_3$$

$$CH_{3}$$

$$CH_{3} - C = CH - CH_{3} + KBr + H_{2}O$$

Propene

In this reaction  $1^{o}$  carbonium ion is formed which rearranges to form  $3^{o}$  carbonium ion from which base obstruct proton. Hence 2methyl-2-butene is formed as a main product.

$$CH_{3} \xrightarrow{CH_{3}} CH_{3} \xrightarrow{CH_{3}} CH_{3}$$

$$CH_{3} \xrightarrow{-C} CH_{2} \xrightarrow{Methyl shift} CH_{3} \xrightarrow{-C} CH_{2} - CH_{3}$$

$$CH_{3}$$
1° carbonium less stable
Elimination of proton from  $\beta$ 

$$CH_{3} \xrightarrow{CH_{3}} CH_{3} \xrightarrow{-C} CH_{3} \xrightarrow{-C} CH_{3}$$

$$CH_{3} \xrightarrow{-C} CH_{3} \xrightarrow{-$$

 $CH_3 - C = CH - CH_3$ 2-Methyl-2-Butene

**101.** (b) Alkyne > Alkene > Alkane

**102.** (c) 
$$H = C = C H$$

Ethylene  $sp^2$ -hybridization; Shape = Planar.

**104.** (b) 
$$CH_2 = CH - Cl \xrightarrow{HCl} CH_3 - CH < \binom{Cl}{Cl}$$

According to Markownikoff's rule *H* atom of the reagent goes to that carbon atom which is more hydrogenated.

Markownikoffs rule

**105.** (b) 
$$CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Presence of peroxid e}}$$
  
 $CH_3 - CH - CH_3 + HBr \xrightarrow{\text{Presence of peroxid e}}$   
 $Br$   
2-Bromopropa ne  
 $CH = CH = CH$ 

 $CH_3 - CH_2 - CH_2 - Br$ 1-Bromopropa ne

**106.** (a) Peroxide rule is applicable only to *HBr* and not for *HCl*, *HF* and *HI*.

**109.** (a) 
$$n \begin{pmatrix} CH_2 = C - CH = CH_2 \\ | \\ Cl \\ Chloroproe ne \end{pmatrix} \xrightarrow{\text{Polymerization}} \begin{pmatrix} -CH_2 - C = CH - CH_2 \end{pmatrix}$$

**110.** (c) 
$$CH_3 - CH_2 - CH_2 - H_2 - H_2 - H_2 - H_2 - H_3 - H_2 - H_3 - H_3 + C_2 - H_3 - H_3 + H_3 - H_$$

ClNeoprene

**111.** (c) 
$$CH_3 - CH_2 - C = CH - CH_3 + HOCl \rightarrow | CH_3$$

$$CH_3 - CH_2 - CH_2 - CH_3 -$$

Addition takes place according to

Markownikoff's rule in which  $Cl^+$  goes to that carbon atom which is more hydrogenated.

- 112. (a) In case of ethene double bond is present. Hence, addition reactions occur easily.
- **113.** (a)  $CH_3 CH = CH_2 + Br_2 \rightarrow CH_3 CH_2 CH_2$ Propane 1 mole Br Br 42 gms 1 mole 42 gms 1,2-dibromo propane

:: 42 gms of propene reacts with 160 gms of bromine.

$$\therefore$$
 21gms of propene  $\frac{160}{42} \times 21 = 80 \text{ gms}$ .

**114.** (b) Butadiene  $CH_2 = CH - CH = CH_2$ 

A single bond separated by two double bonds is known as conjugated double bond.

CH.

**115.** (d) 
$$CH_3 \xrightarrow[]{CH_3} CH_3 \xrightarrow[]{Cu} CH_3 \xrightarrow[]{CH_3} CH_3 \xrightarrow[]{CH_3} CH_3 \xrightarrow[]{CH_3} CH_2 \xrightarrow[]{CH_2} CH_2$$
  
Isobutene

117. (a) Cyclic hydrocarbon in which all the carbon atoms are present in the same plane is benzene. In this C-C bond length is 1.39Å which is more than 1.34*A*° but less than 1.54Å. Hence bond angle is  $120^{\circ}$ with  $sp^2$ hybridization.

**119.** (a) 
$$CH_3 - \overset{(H_3)}{C} - CH = CH_2 \xrightarrow{(h_g(OAc)_2; H_2O)}_{(i) NaBH_4} \rightarrow CH_3$$

CH

$$CH_{3} = CH_{3} = C$$

**120.** (b)  $C_3H_6$  is an alkene therefore decolourizes alkaline  $KMnO_4$  solution.

123. (c) 
$$CH_3 - C = C - CH_3 \xrightarrow{(1)O_3} (2)Zn/H_2O$$
  
 $CH_3 CH_3$   
 $CH_3 - CO + OC - CH_3$   
 $CH_3 - CH = CH - CHO \xrightarrow{Acidic} CH_3 - CH = CH - CHO$   
 $I24.$  (b)  $CH_3 - CH = CH - CHO \xrightarrow{Acidic} KMnO_4$   
 $CH_3 - CH = CH - COOH$   
127. (b)  $CH_3 - CH_2 - CH = CH_2 \xrightarrow{HBr} CH_3 - CH_2 - CH - CH_3$   
 $Br$   
 $2$ -Bromo butane

**128.** (b) 
$$CH_2 = C - CH_3 + HCl \rightarrow CH_3 - C - CH_3$$
  
 $CH_3 \qquad CH_3$   
 $2$ -chloro-2-methyl  
propane

129. (a) Ozonolysis is useful in locating the position of a double bond in an alkene. The double bond is obtained by joining the carbon atoms of the two carbonyl compounds. For example Let the product of ozonolysis be two molecules of ethanal.

$$H \qquad H \qquad H \\ CH_3 - C = O + O = C - CH_3 \rightarrow CH_3 - CH = CH - CH_3$$
  
2-Butene

**131.** (c)  

$$CH_3 - CH - CH_2 - CH_3 \rightarrow CH_3 - CH = CH - CH_3 + HBr$$
  
 $Br$   
 $2-Bromo butane$   
 $CH_3$   
 $CH_3$   
 $CH_3$ 

**134.** (b) 
$$CH_3 - \stackrel{|}{C} - CH_3 \xrightarrow{H_2SO_4} CH_3 - \stackrel{|}{C} = CH_2 + H_2O$$
  
 $OH$   
2Methyl-2-hydroxy propane  
Isobutene

 $\| C$ 

**135.** (c) 
$$CH_2 = CH_2 + H_2 \xrightarrow[-300]{Ni} CH_3 - CH_3$$
  
Ethene  $CH_2COOK$  Electrolucie

**136.** (c) 
$$\downarrow$$
  $H_2COOK$   $+ 2H_2O \xrightarrow{\text{Electrolysis}}$ 

$$\begin{array}{c} CH_2 + 2CO_2 + 2KOH + H_2 \\ \parallel \\ CH_2 \\ \text{Anode} \end{array}$$

**137.** (c) 
$$CH_2 = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_3$$

Ethylene does not give precipitate with ammonical silver nitrate solution because it does not have acidic hydrogen.

**139.** (a)

 $CH_{2} = CH - CH = CH_{2} \xrightarrow{Br_{2}} CH_{2} - CH = CH - CH_{2}$   $| \qquad | \qquad |$   $Br \qquad Br$  1,4 - di bromo -2 - butene

**143.** (d) *Pd* acts as catalyst.

**144.** (a) 
$$CH - CH = CH_2 + HBr \xrightarrow{\text{peroxide}}$$

$$CH_3 - CH_2 - CH_2 - Br$$
  
*n*-propyl bromide

In presence of peroxide addition takes place according to Anti Markownikoff's rule and hydrogen atom goes to that carbon atom which is less hydrogenated.

**145.** (d) 
$$CH_3 - CH_2 - OH + H_2SO_4 \xrightarrow{110^{\circ}C} Conc.$$
  
Ethanol Conc.  $CH_3CH_2HSO_4$   
Ethylhydrogen sulphate

**146.** (a) 
$$CH_2 = CH_2 \xrightarrow{1)O_3} HCHO + HCHO$$
  
 $\xrightarrow{2)Zn/H_2O}$  Formaldehy de

**147.** (d)  $C_2H_4, C_3H_6$  and  $C_4H_8$  all an alkene. Therefore they discharge the red colour of bromine.

**149.** (a) 
$$HI \to H^+ + I^-$$

$$CH_3 - CH = CH_2 + H^+ \rightarrow$$

$$CH_{3} - CH_{2} - CH_{2} + CH_{3} - CH - CH_{3}$$
(Minor)
(Major)
(Major)
(Major)
(Major)
(Major)
(More stable)
(More stable)

и

$$CH_{3} - CH - CH_{3} + I^{-} \rightarrow CH_{3} - CH - CH_{3}$$

$$2^{o} \text{ Carbonium ion}$$

$$I$$
Isopropyliodide
(Major product)

**150.** (a) 
$$CH_3 - CH_2 - CH = CH_2 + Br_2 \rightarrow CH_3 - CH_2 - CH - CH_2$$
  
 $|$   $|$   $|$   $Br$   $|$   $Br$   
 $1.2$ -dibromo butane

**151.** (a) 
$$CH_2 = CH_2 \xrightarrow{(1)O_3} HCHO + HCHO$$
  
**153.** (c)  $(CH_3)_2 - C = CH \xrightarrow[]{\text{Catalytic}} Hydro genation (CH_3)_2 - CH - CH_2 \\ H_3 \xrightarrow[]{\text{CH}_3} (CH_3)_2 - CH - CH_3 \\ H_3 \xrightarrow[]{\text{CH}_3} (CH_3)_3 - CH - CH - CH - CH_3 \\ H_3 \xrightarrow[]{\text{CH}_3} (CH_3)_3 - CH - CH - CH - CH - CH - CH - CH$ 

**154.** (b) 
$$CH_3 - C = CH_2 + HBr \xrightarrow{Peroxide} CH_3 - C = CH_2 - Br$$
  
 $CH_3 \xrightarrow{C} CH_3 - C = CH_2 - Br$ 

**155.** (a) 
$${}^{sp^2}_{CH_2} = {}^{sp^2}_{CH-C} = {}^{sp}_{CH}$$
  
**156.** (c)  $CH_3 - CH = CH_2 + H^+Br^- \to CH_3 - CH - CH_3$   
 $Br$   
2-Bromopropa ne

**157.** (b) Reaction is of dehydration  

$$C_2H_5OH \xrightarrow{\text{Conc. } H_2SO_4} CH_2 = CH_2$$

- **158.** (d)  $CH_3 CH = CH CH_2 CH_3$  will be the most stable because greater the number of alkyl groups attached to double bonded carbon atoms, more stable is the alkene.
- **159.** (b) Markownikoff's rule can not be applied for symmetrical alkene.

**160.** (c) 
$$CH_3 - C = CH_2 \xrightarrow{H_3O^+} CH_3 - CH_3 \xrightarrow{Ph} CH_3 = OH_3$$

**161.** (d) Solution of bromine in carbon tetrachloride is used to test for unsaturation of alkene. Red colour of bromine disappears due to the formation of colourless dibromo ethane  $(C_2H_4Br_2)$ .

$$CH_{2} = CH - CH_{3} + H_{2}O \xrightarrow{H_{2}So_{4}} \rightarrow OH$$

$$OH$$

$$CH_{3} - CH - CH_{3}$$
Isopropyl alcohol

Thus in this reaction isopropyl alcohol is formed.

**163.** (b) Propene gives formaldehyde and acetaldehyde on ozonolysis.

$$CH_{2} = CH.CH_{3} \xrightarrow{O_{3}} CH_{2} - CH.CH_{3} - \frac{Z_{1}/H_{2}O}{H_{2}O_{2}} HCHO + CH_{3}CHO$$

**164.** (a) When ethylene is treated with cold alkaline *KMnO*4 , ethylene glycol is formed.

$$H \rightarrow C = C < H \xrightarrow{KMnO4} H \rightarrow C - C < H \\ H \xrightarrow{Cold alkaline} H \rightarrow C - C < H \\ H \xrightarrow{OH OH} H \\ Ethylene glycol$$

**165.** (a) 
$$C_6H_6 + H_2C = CH_2 \xrightarrow{AlCl_3.Hl} C_6H_5CH_2CH_3$$

- **166.** (a) Markownikoff as well as anti-Markownikoff's rule is valid only for unsymmetrical alkenes.
- 167. (b) The formation of *n*-propyl bromide in presence of peroxide can be explained as follows.Step-1: Peroxide undergo fission to give free

radicals  $R - O - O - R \rightarrow 2 - R - O$ Step-2 : *HBr* combines with free radical to form bromine free radical  $R - O + HBr \rightarrow R - OH + Br$ 

Step-3 :  $B\dot{r}$  attacks the double bond of the alkene to form a more stable free radical

$$CH_3 - CH - CH_2Br$$
  
(more stable)  
 $CH_3CH = CH_2 + Br$
$$Br$$

$$| \dot{C}H_3 - CH - \dot{C}H_2$$
(less stable)

Step-4 : More stable free radical attacks the *HBr* 

$$CH_3 - CH - CH_2 - Br + HBr \rightarrow CH_3 CH_2 CH_2 Br + Br$$
  
n-propyl bromide

Step-5:  $B\dot{r} + B\dot{r} \rightarrow Br_2$ 

**169.** (b) According to Markownikoff's rule, the negative part of the unsymmetrical reagent adds to less hydrogenated (more substituted) carbon atom of the double bond.

$$C_{6}H_{5}CH = CH - CH_{3} + HBr \rightarrow C_{6}H_{5}CHCH_{2}CH_{3}$$

**171.** (a)

 $\begin{array}{c} CH_2 \\ \parallel \\ CH_2 \end{array} + H_2 SO_4 \rightarrow | \\ CH_2 HSO_4 \end{array} \xrightarrow{H_2O} \begin{array}{c} CH_3 \\ \parallel \\ CH_2 OH \end{array} + H_2 SO_4$ 

Except ethyl alcohol, no other primary alcohol can be prepared by this method as the addition of  $H_2SO_4$  follows Markownikoff's rule. Generally secondary and tertiary alcohols are obtained.

**172.** (c) 
$$CH_3 - C = CH_2 \xrightarrow{HBr / peroxide} CH_3 - CHCH_2 - Br$$
  
 $CH_3 \xrightarrow{I} CH_3 \xrightarrow{I} CH_3$ 

**173.** (c) Decolourisation of  $KMnO_4$ 



1. (c)  $2CH \equiv CH + 5O_2 \rightarrow 4CO_2 + 2H_2O \Delta H = -1300 KJ$ The combustion of acetylene is highly exothermic and the heat produced during the combustion can be used for welding purposes in the form of oxy acetylene flame.

2. (c) 
$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$
  
 $CH \equiv CH + 2[Ag(NH_3)_2]OH \rightarrow$   
 $Ag - C \equiv C - Ag + 4NH_3 + 2H_2O$   
Whiteppt.

3. (c) 
$$CH_3 - CH_2 - C \equiv CH \xrightarrow{\text{Cold}} CH_3 CH_2 COOH + CO_2$$

4. (c) 
$$CH_3 - COOH \xrightarrow{LiAlH_4} CH_3 - CH_2 - OH \xrightarrow{H^+}_{443 K}$$
  
 $CH_2 = CH_2 \xrightarrow{Br_2} CH_2 - CH_2 \xrightarrow{alc.}_{KOH}$   
 $Rr = Rr$ 

$$CH \equiv CH + 2KBr + 2H_2O$$
Acetylene

5. (b) 
$$C \equiv C < C = C < C - C$$
  
1.20 $A^{\circ}$  1.34 $A^{\circ}$  1.54 $A^{\circ}$ 

6. (a) 
$$HC \equiv C - CH = CH_2$$

7. (a) 
$$3 CH \equiv CH \xrightarrow{\text{Re } d \text{ hot}} \bigcirc$$
  
Fe tube
Benzene

10. (c) 
$$H_2$$
  
Cyclohexene Cyclohexane  
 $Cyclohexene$   $H_2$   
 $Cyclohexene$   $Cyclohexane$   
 $CH_2$   
 $CH$ 

**11.** (a) 
$$HC \equiv CH + AsCl_3 \longrightarrow ClHC = CH AsCl_2$$
  
2-chlorovinyl dichloroarsine

**12.** (c) 
$$CH_3 - C \equiv C - CH_2 - CH_3 \xrightarrow{O_3}$$

$$CH_{3} - C \longrightarrow C - CH_{2} - CH_{3}$$

$$O \longrightarrow O$$

$$\xrightarrow{H_{2}O} CH_{3} - C - C - CH_{2} - CH_{3} + H_{2}O_{2} - CH_{3} -$$

14. (a)  $-C \equiv C - is$  most reactive because *sp*-hybridization.

16. (d)  $CH = CH \xrightarrow{NaNH_2} CH = C^-Na^+ \xrightarrow{CH_3I} CH = C - CH_3$   $C_2H_5 - C \equiv C - CH_3 \xleftarrow{C_2H_5I} Na^+ C^- \equiv C - CH_3$ Pent-2-yne 17. (d)  $CH_3 - C \equiv CH + H_2O \xrightarrow{H_2SO_4 / HgSO_4}$ 

$$CH_{3}-C-CH_{3} \underbrace{\text{Toutonaris m}}_{O} \begin{bmatrix} OH\\ CH_{3}-C=CH_{2} \\ Prop-1-ene 2-ol \end{bmatrix}$$
Prop-1-ene 2-ol  
18. (b)  $CH = CH + HCl \rightarrow CH_{2} = CH - Cl \xrightarrow{HCl} CH_{2} \\ CH_{3} - CH \leqslant Cl_{1} \\ I-di-chloroethane$ 
19. (c)  $CaC_{2} \xrightarrow{H_{2}O} HC \equiv CH \xrightarrow{Dil.H_{2}SO_{4}} CH_{3}CH_{2} - OH \\ Acceylene \xrightarrow{N_{1}} CH_{3}CH_{2} - OH \\ Hg^{+2} \xrightarrow{N_{1}} CH_{3}CH_{2} - OH \\ Hg^{+2} \xrightarrow{N_{2}} CH_{3}CH_{2} - OH \\ Ethylalcohol
20. (c)  $R - CH_{2} - CCl_{2} - R \xrightarrow{KOH + C_{2}H_{3}OH} \\ R - C = C - R + 2HCl \\ This reaction is an example of dehydrohalogenation Hence, alcoholic KOH is used as a reagent. CH - COOK
21. (d) ||| + 2H_{2}O \xrightarrow{Electrolysis} \\ CH - COOK
22. (b) CH - COOK + 2H_{2}O \xrightarrow{Electrolysis} CH + 2CO_{2} \\ || \\ Br Br
22. (b) CH - COOK + 2H_{2}O \xrightarrow{Electrolysis} CH + 2CO_{2} \\ || \\ CH - COOK \xrightarrow{CH + 2KOH + H_{2}O} \\ CH_{2} - COONa + 2H_{2}O \xrightarrow{Electrolysis} \\ CH_{2} - COONa + C = C - Ag \\ CH_{2} - COONa + C = C - Ag \\ CH_{2} - COONa + C = C - Ag \\ CH_{2} - COONA + C = C - Ag \\ CH_{2} - COONA + C = C - Ag \\ CH_{2} - CH_{2} - CH + AgOA_{2} - C \xrightarrow{C} CH + AgOA_{2} + C \xrightarrow{C} CH + AgOA_{2} - C \xrightarrow{C} C$$ 

$$CH_{3} - CH_{2} - OH \xrightarrow{P_{4}/Br_{2}} C_{2}H_{5}Br$$

$$(c) \quad 4CH \equiv CH \xrightarrow{Ni(CN)_{2}} Cyclo$$

**26.** (d) Ethyne have acidic hydrogen to form salt.

27. (a)  

$$CH_3 - CH_2 - C \equiv CH + 2Br_2 \rightarrow CH_3 - CH_2 - \begin{bmatrix} Br & Br \\ & - & C \\ CH_3 - Butyne \end{bmatrix}$$

Since the molecule takes 2 moles of  $Br_2$ . Therefore it is alkyne. Also it gives white *ppt* with Tollen's reagent therefore acidic *H* is present. Hence it is 1-Butyne.

**28.** (d) 
$$2CH = CH + 2Na \rightarrow 2CH = C^{-}Na^{+} + H_{2}$$

**29.** (a) 
$$CH_3 \equiv CH + AgNO_3 \rightarrow Ag - C \equiv C - Ag$$
  
(Animonical) Whiteppt.

$$CH_3 \equiv CH + CuCl_2 \rightarrow Cu - Cl_R \equiv C - Cu$$
  
(Ammonica)

**32.** (c) 
$$sp - sp > sp^2 - sp^2 > sp^3 - sp^3$$
  
Order of bond strength

**33.** (c) Ethylene and Benzene  $120^{\circ}$   $120^{\circ}$  $sp^2$   $sp^2$ 

**34.** (a) 
$$CH_3 - CH_2 - C \equiv CH \xrightarrow{H_8 SO_4, 60^\circ C} CH_3 - CH_2 - CH_2 - CH_3$$

**35.** (a) 
$$CH \equiv CH + NaNH_2 \rightarrow CH \equiv C^-Na^+ + NH_3$$

**36.** (a) 
$$CH = CH + 2Br_2 \xrightarrow{CCl_4} \xrightarrow{CCl_4} \xrightarrow{CH - CH} \stackrel{|}{\underset{Br Br}{\overset{CH}{\underset{Br}{\atopBr}{\underset{Br}{\atopBr}{\underset{Br}{\atopBr}{\underset{Br}{\atopBr}{I}{I}}}}}}}}}}}}}}}}}}}}}}$$

$$CH \equiv CH + NH_4OH + AgNO_3 \rightarrow Ag - C \equiv C - Ag$$
  
Di-silver acety lide  
white ppt.

**38.** (d)  $C_2H_2$  and  $C_3H_4$  are homologue because they differ by  $-CH_2$  group. Both have triple bond in their molecule.

**39.** (c) 
$$CH \equiv CH + HCl \xrightarrow{HgCl_2} CH_2 = CH - Cl$$
  
Vinylchloride

**40.** (c) 
$$CH_3 - C \equiv CH + H_2O \xrightarrow{40\% H_2SO_4} 1\% HgSO_4$$

41. (a) 
$$3CH_3 - C = CH_2 \xrightarrow{\text{Rearrangem ent}} CH_3 - C - CH_3$$
  
 $OH$   
 $CH_3 - C = CH \xrightarrow{OH} CH_3$   
 $CH_3 - C = CH \xrightarrow{CH} CH_3$   
 $CH_3 - CH_3$ 

Mesitylene or 1,3,5-trimethyl benzene

**42.** (c) 
$$2NH_4OH + Cu_2Cl_2 \rightarrow 2CuOH + 2NH_4Cl$$

 $NH_4OH + CuOH \rightarrow [Cu(NH_3)_2]OH$ Diamnine copper (l)hydroxide

$$2[Cu(NH_3)_2]OH + HC \equiv CH -$$

 $Cu - C \equiv C - Cu + 4NH_3 + 2H_2O$ copper acetylide Red ppt.

**43.** (a) 
$$3CH \equiv CH \xrightarrow{\text{Hot } Cu \text{ tube}}$$

**45.** (b) 
$$CH = CH + H_2O \xrightarrow{40\% H_2SO_4} CH_3 - CHO$$
  
 $1\% HgSO_4$ 

- **46.** (c) Acetylene reacts with ammonical cuprous chloride to give brown *ppt* where as ethylene does not give this reaction.
- **47.** (a)  $Ag(NH_3)_2^+$  gives white *ppt* with terminal alkynes.
- **50.** (b) Bond length decreases with increase in number of bonds.

**55.** (d)  $3 HC \equiv CH \xrightarrow{\text{Red}}$  Benzene

**56.** (a) Reaction of acetic acid with acetylene is catalysed by  $Hq^{2+}$  salts.

$$HC \equiv CH \xrightarrow{CH_3COOH} CH_2 = CHOOCCH_3$$
  
<sub>vinylacetate</sub>

$$\xrightarrow{CH_3COOH}_{Hg(OOCCH_3)_2} CH_3 - CH(OOCCH_3)_2$$
  
ethylidene diacetate

**57.** (c) 
$$2C + H_2 \xrightarrow{Electricarc} CH \equiv CH$$

**58.** (c) 
$$CH \equiv CH \xrightarrow{40\% H_2SO_4} CH_2 = CH - OH$$
  
 $1\% HgSO_4 \qquad Vinylalcohol$ 

 $\frac{\text{Rearrangem ent}}{\text{Acetaldehyde}} \rightarrow CH_3 - CHO$ 

- **63.** (d) In CH = CH triple bond consists of one  $\sigma$  and two  $\pi$  bonds.
- 65. (a) Nucleophiles and alkalies normally do not react with acetylene. Thus *NaOH* does not react.

66. (c) 
$$HC \equiv CH + 2HOCl \rightarrow [CHCl_2 - CH(OH)_2]$$
  
 $\downarrow -H_2O$   
 $CHCl_2 - CHO$   
Dichloroacetal dehyde

**69.** (b) 
$$CH_3 - CH = CH - C \equiv C - H$$
. Acidic hydrogen (*H* atom attached to triple bond) is present therefore it gives reaction with ammoniacal  $AgNO_3$ .

**72.** (c)  $CH_3 - C \equiv C - CH_3$ , 2-butyne does not have acidic hydrogen. Hence, does not give white ppt. with ammonical  $AgNO_3$  solution.

73. (a) 
$$(CH = CH) \xrightarrow[NaOH]{O_3} CH - CH \xrightarrow[Hydrolysis]{Hydrolysis}$$

$$CHO - CHO \xrightarrow{Zn} CH_2 - OH$$

$$Glyoxal \xrightarrow{CH_3COOH} CH_2 - OH$$

$$CH_2Br$$

77. (b) 
$$|$$
 + 2*KOH* (alcoholic)  $\xrightarrow{\Lambda} CH = CH + 2KBr$   
 $CH_2Br$ 

$$+2H_2O$$

- **78.** (d) All are alkenes but 2-butyne is not.
- **80.** (c) Reduction of alkynes with liquid  $NH_3/Li$  gives trans alkenes.
- **82.** (a) Ethyne reacts with ammonical  $A_{gNO_3}$  to give white ppt of silver acetylide while ethane and ethene do not react because acidic hydrogen is absent.
- **83.** (d) Acidic property because H atoms are replaced by Silver metal atoms.
- **87.** (c) The hydrogen atom which is attached to triple bond is acidic.
- **88.** (c) In acetylene both carbons are *sp*-hybridised so it has linear structure.

**89.** (d) 
$$CaC_2 + 2H_2O \rightarrow CH \equiv CH + Ca(OH)_2$$
  
Acetylene

**90.** (c) 
$$CH \equiv CH + HCN \xrightarrow{Ba(CN)_2} CH_2 = CH - C \equiv N$$
  
Vinylcyanide

**91.** (c) Because  $CH_3CH_2 - C \equiv CH$  has one acidic hydrogen.

**92.** (d) 
$$CH \equiv CH + 2Na \xrightarrow{Liq.NH_3} C.Na \equiv C.Na + H_2$$

**94.** (b) 
$$CH = CH + H_2O \xrightarrow{\text{dil}.H_2SO_4} CH_2 = C - OH \rightarrow H_gSO_4$$

$$CH_3 - C - H$$

- **95.** (d)  $CH_3 C \equiv C CH_3$  has not acidic character.
- **96.** (d) Addition  $CH \equiv CH + 3H_2 \xrightarrow{Ni} CH_3 CH_3$ Substitution –

$$CH = CH + Na \longrightarrow CH = C^{-}Na^{+} + \frac{1}{2}H_{2}$$

Polymerization -

$$3CH \equiv CH \xrightarrow{\text{hot } Cu \text{ tube}} C_6H_6$$
  
Polymerization Benzene

- (d) Bond length decrease with increase in Bond 97. order. Hence triple bonded carbon has minimum bond length.
  - C C bond length = 1.54 Å
  - C = C bond length = 1.33 Å C = C bond length = 1.22 Å
- (b) Acetylene can be obtained by the reaction of 98. silver and chloroform (or iodo form)

$$2CHI_3 + 6Ag \xrightarrow{\Delta} C_2H_2 + 6AgA_{acetylene}$$

- 99. (d) The partial reduction of alkynes by active metal in liquid ammonia takes place through trans vinylic anion which ultimately produces trans alkene.
- 100. (a) We know that C C bond length = 1.54 A, C = C bond length =1.34A and  $C \equiv C$  bond length = 1.20A. Since propyne has triple bond; there fore it has minimum bond length.

**101.** (b) 
$$CH \equiv CH + H_2 \xrightarrow[Catalyst]{Catalyst}_{pd. BaSO_4} CH_2 = CH_2$$
  
Ethylene

- **102.** (a)  $HC\sigma = CH$  one sigma and two  $\pi$  bond
- 103. (a) Propyne reacts with ammoniacal  $AgNO_3$  due to presence of acidic hydrogen atom.  $CH C = CH + A_{q}NO + NH OH \rightarrow$

104. (a) 
$$CH \equiv CH - \frac{HgSO_4}{H_2SO_4} \rightarrow CH_3C \equiv CAg + NH_4NO_3 + H_2O$$
  
 $OMgBr \qquad OH$ 

**105.** (c)  $Mg_2C_3 + 4H_2O \rightarrow CH_3C \equiv CH + 2Mg(OH)_2$ 

#### **Aromatic Hydrocarbon**



(a) Coal tar is a main source of aromatic 5٠ hydrocarbons like benzene, naphthalene, anthracene, phenol etc



$$C - C\pi$$
 bonds = 3

 $C - C\sigma$  bonds = 6  $C - H\sigma$  bonds = 6

Hence  $12\sigma$  and  $3\pi$  bonds

12

 $\sigma$  bonds

7.

(c)

8. (b) Ratio = 
$$\frac{\sigma \text{ bonds}}{\pi \text{ bonds}} = \frac{12}{3} = 4$$
  
11. (b)  $\bigcirc$  + 3Cl<sub>2</sub>  $\xrightarrow{\text{Sunlight}}_{\text{Addition reaction}} Cl \leftarrow Cl$   
(BHC)

4. (a) 
$$C_6H_6 + C_2H_5Cl \xrightarrow{AlCl_3} C_6H_5 - C_2H_5 + HCl_3$$

(a)  $C_6H_5CHC_6H_5$  is the most stable carbonium 15. ion due to resonance.

 $\sim$ 





(b)  $HO - NO_2 + H^+ HSO_4^- \rightarrow H_2O + NO_2^+ + HSO_4^-$ 18. Nitroniumion (attacking species)

**19.** (b) 
$$\bigcirc$$
 +  $HNO_3 \xrightarrow{\text{Conc.} H_2SO_4}$   $\bigcirc$  NO 2

anhyd. **22.** (a)  $C_6H_6 + CH_3Cl \rightarrow C_6H_5CH_3 + HCl$ , it is a AlCl<sub>3</sub> Friedel-craft's reaction.



*m*-xylene *o*-xylene *p*-xylene

m-xylene is most easily sulphonated because O and P both positions are free with respect to methyl group.



Toluene

Benzoic acid

**36.** (c) 
$$+\frac{9}{2}O_2 \xrightarrow{V_2O_5} H \xrightarrow{CH-COOH} \xrightarrow{-H_2O}$$
  
Maleic acid

- $O \\ CH C \\ U \\ CH C \\ U \\ CH C \\ 0 \\ O$ Maleic anhydride
- **38.** (b) Phenol is most easily nitrated.

$$\begin{array}{c} \mathbf{H}_{1} \quad (a) \quad \overbrace{}^{CH_{3}} \quad \overbrace{}^{CH_{2}H^{+}} \quad \overbrace{}^{CH_{2}H^{+}} \quad \overbrace{}^{CH_{2}H^{+}} \quad \overbrace{}^{CH_{2}H^{+}} \quad \overbrace{}^{H_{2}H^{+}} \quad \overbrace{}^{H_{$$

**43.** (a) Nitrobenzene is least reactive towards bromine because of presence of  $-NO_2$  group decreases electron density at *o* and *p* positions and hence attack of electrophile on the benzene nucleus is difficult because + *ve* charge on *o* and *p* position repel the incoming electrophile.

$$O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) O^{-} \underbrace{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right) \xrightarrow{\bullet} O \left( \begin{array}{c} 0 \\ 0 \end{array} \right)$$

**46.** (d)  $AlCl_3$  is an electron deficient compound. It generates electrophile in the reaction



- **51.** (b) Benzene can be obtained by polymerisation of acetylene.
- **53.** (b) Benzene  $C_6H_6$  is made up of hydrogen and carbon only.
- **54.** (c) They have a relatively high percentage of carbon
- **55.** (c) All 6 carbons of Benzene are  $sp^2$ -hybridised so it is planar.



**58.** (c) 2,4,6-Trinitro toluene (TNT) is used as explosive.  $NO_2$   $NH_2$ 



- 71. (b) In benzene due to resonance all the carboncarbon bond lengths are equal 1.39Å which is between C - C(1.54 Å) and C = C(1.34 Å)
- 72. (c)  $C_6H_5COONa + NaOH \xrightarrow{CaO} C_6H_6 + Na_2CO_3$ Sodium benzoate Benzene
- **73.** (a) Friedel-Craft's reaction involves the introduction of an alkyl or acyl group into benzene ring in the presence of a catalyst. The presence of an electron withdrawing group in the ring hinders the reaction. Therefore phenyl acetanilide is not used.
- **74.** (a) Halogenation is initiated by free redical.
- **76.** (b) In benzene all the six carbon atoms are present in the same plane. All the carbon atoms are  $sp^2$  hybridized. Hence, it is a planar molecule.
- 77. (d) Basicity of amines is due to availability of an unshared pair (lone pair) of electrons on nitrogen. This lone pair of electrons is available for the formation of a new bond with a proton or Lewis acid.
  Pyridine is less basic than triethylamine because lone pair of nitrogen in pyridine is delocalised.

**78.** (a) In chlorination electrophile is  $Cl^+$  (chloronium ions).





Presence of -CHO decrease electron density at *o* to *p* positions. Hence, attack of an electrophile occurs at *m*-position. therefore it is meta directing group.



- **88.** (a) Benzene on fractional distillation gives light oil [It is lighter than water and hence called as light oil]
- **89.** (d) Because Ammonical  $AgNO_3$  reduce C = CH bond of yne.
- **90.** (a) Bond length  $\propto \frac{1}{\text{Bond order}}$ Bond order =  $\frac{\text{Bonding} - \text{ antibondin g electron}}{2}$

Bond order is highest for  $C_2H_6$  so it has minimum bond strength.

(b)  $C_6H_5COOH + NaOH \rightarrow C_6H_5COONa + H_2O$ 91. (x)

$$\xrightarrow{\text{NaOH}} C_6H_6 + Na_2CO_3$$

$$C_6H_5OH + Zn \xrightarrow{\text{distill}} C_6H_6 + ZnO$$

N OU

- (c) Unsaturated hydrocarbons are more reactive 92. than saturated hydrocarbons. Among ethyne  $(C_2H_2)$  and ethene  $(C_2H_4)$  the later is more reactive as  $C \equiv C$  triple bond is quite strong bond and therefore ethyne generally require catalysts (like  $Hg^{2+}$  etc) in its reactions.
- (a) Kolbe's methods Electrolysis of a 93. concentrated aqueous solution of either sodium or potassium salts of saturated mono carboxylic acids yields higher alkanes at anode.

$$CH_{3}COONa \rightleftharpoons CH_{3}COO^{-} + Na +$$
Anode :  $2CH_{3}COO^{-} \xrightarrow{-2e^{-}} CH_{3} - CH_{3} + 2CO_{2}$ 
Cathode :  $2Na^{+} + 2e^{-} \rightarrow 2Na$ 
 $2Na + 2H_{2}O \rightarrow 2NaOH + H_{2}$ 



96.

(d)

 $CH_3$ 

(a)  $-NH_2$  group is not linked with benzene ring. 95.

СООН



### **Critical Thinking Question**

1. (a) The difference between any two successive members of the homologous series  $-CH_2$  i.e., the molecular weight of every two adjacent members differ by 14.  $(CH_2 = 12 + 2 = 14)$ 

2. (a) 
$$\begin{array}{c} \overset{1^{o}}{CH_{3}} \\ \overset{3^{o}}{CH_{3}} - \overset{3^{o}}{CH_{3}} - \overset{2^{o}}{CH_{3}} - \overset{3^{o}}{CH_{2}} - \overset{2^{o}}{CH_{2}} - \overset{3^{o}}{CH_{2}} - \overset{2^{o}}{CH_{2}} - \overset{1^{o}}{CH_{2}} \\ \overset{1^{o}}{CH_{3}} \\ \overset{1^{o}}{CH_{3}} \\ \overset{1^{o}}{CH_{3}} \\ \overset{1^{o}}{CH_{3}} \\ \overset{1^{o}}{Primary} \\ \overset{1^{o}}{S} \Rightarrow \text{Secondary } 2 \\ 3^{o} \Rightarrow \text{Tertiary } 2, 4^{o} \Rightarrow \text{Quanternar } y1 \\ 3. (c) \text{ Octane number of fuel is the percentage of } \end{array}$$

iso- octane in mixture. (b)  $CH_3 - CH - CH_2 - CH_3 \rightarrow CH_3 - CH = CH - CH_3$ 4.

According to this rule *H* atom goes from that  $\beta$ - carbon which is less hydrogenated.

5. (c) 
$$CH_3 - C \equiv C - CH_3 \xrightarrow{(1)O_3} CH_3 - C - C - CH_3$$
  
(ii) $Zn / H_2O$   $\parallel \parallel \parallel O O$ 

6. (c) Friedel-craft's reaction

OH

$$\begin{array}{c} CH_3COCl + C_6H_6 & \xrightarrow{\text{anhydrous } AlCl_3} \\ \text{Acetykhloride} & \text{Benzene} & \text{Acetophenone} \end{array}$$

(a)  $C_2H_6(\text{excess}) + Cl_2 \xrightarrow{U.V.Light} C_2H_5Cl + HCl$ 7. Ethylchloride (Major product)

8. (a) 
$$CH_3CH_2 - OH + 2HI \xrightarrow{Red P} CH_3 - CH_3 + H_2O + I_2$$
  
Ethylalcohol Ethane

(a) Fischer-Tropsch process -9.

$$\underbrace{CO + H_2}_{\text{Water gas}} + \underbrace{H_2}_{\text{Excess}} \xrightarrow{\text{CO or Ni}}_{\text{heat}} \text{Mixture of hydrocarbo ns} + H_2C$$

Br

**10.** (c) 
$$CH_3 - CH_2 - CH_2 - Br + \bigcirc + 2Na \xrightarrow{Dry}_{ether} + 2Na \xrightarrow{Dry}_{ether}$$

$$2NaBr + CH_3 - CH_2 - CH_2$$

n-propyl benzene

(a) Hydroboration of alkenes followed 11. bv hydrolysis in basic medium yield alcohols and not the alkanes.

$$R - CH = CH_2 \xrightarrow{B_2H_6} (R - CH_2 - CH_2)_3 - B$$

$$\xrightarrow{OH} R - CH_2 - CH_2OH$$

(b) Koch reaction : (Carboxylation of Alkene) 12. СООН

$$CH_3 - CH = CH_2 \xrightarrow{\text{Water gas}(CO + H_2)} CH_3 - CH_3 - CH_3 - CH_3$$
  
 $400^{\,o} C, H_3 PO_4 \xrightarrow{\text{Isobuty ric acid}} CH_3 - CH_3 - CH_3$ 

**13.** (d) 
$$CH_3 - \overset{|}{C} = CH - CH_3 \xrightarrow{NaIO_4} CH_3COCH_3$$

CH<sub>3</sub>

14.

(b) 
$$HC = CH + 2AgNO_3 \xrightarrow{NH_4OH}$$

$$Ag - C \equiv C - Ag + 2NH_4NO_3 + 2H_2O$$

+CH<sub>3</sub>CHO

- 15. (d) Naphthalene is a molecular solid. If the crystals contains only individuals atoms; as in solid argon or krypton or if they are composed of non polar molecules as in naphthalene, the only attraction between the molecules are the London forces.
- 16. (d) A compound is said to be aromatic if it is planar and there is complete delocalization of π electrons, which is only possible if it is a conjugated cyclic system and number of electrons used in delocalization is (4n+2). 1, 3, 5 heptatriene is not an aromatic compound because complete delocalization of π electrons, is not possible in it.



**17.** (c) 
$$CH = CH + HCN \xrightarrow{Ba(CN)_2} CH_2 = CHCN$$
  
Acetylene Vinylcyanide

- **18.** (a) Addition reaction means addition on double bond.
- **19.** (d)  $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$ 64 g

 $C_2H_2 + H_2 \rightarrow C_2H_4$ 

64g of  $CaC_2$  gives 28g of ethylene

 $\therefore$  64kg of  $CaC_2$  will give 28kg of polyethylene



21. (b) Electron accepting groups which make the substitution difficult are known of deactivating groups. the group or substituent already present on the ring also decides the position of incoming group.

ortho and para directing groups are as follow  $-CH_3, C_2H_5(-R), -NH_2, -OH$ , halogens, (Cl, Br, I)





25. (a) Wohler reaction :

(c) Polymerisation

$$CaC_2 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)_2$$

$$C_{2}H_{2} \xrightarrow[60^{o}C]{dil.H_{2}SO_{4}/H_{g}SO_{4}} [CH_{2} = CHOH] \rightarrow CH_{3}CHO$$
  
Acetylene  $60^{o}C$  Unstable Acetaldehyde

26.

33.

(a)

23.

$$CH_{3}CHO \xrightarrow{\text{Oxidation}} CH_{3}COOH$$
Acetic acid

- **27.** (a)  $CaC_2 + 2D_2O \longrightarrow C_2D_2 + Ca(OD)_2$
- **28.** (d) It is a unsymmetrical olefin. In such cases addition of H-X is governed by 'Markownikoff's rule'

**29.** (d) 
$$CH_3 - CH = CH_2 \xrightarrow{\text{Conc.}} CH_3COOH + HCOOH$$

**30.** (a) 
$$\bigcirc$$
 1, 2 or 1, 6 = ortho  
1, 3 or 1, 5 = meta  
1, 4 = para.

**31.** (b) Biological oxidation of benzene gives cinnamic acid.

**32.** (d) 
$$CH \equiv CH \xrightarrow{HBr} CH_2 = CH - Br \xrightarrow{HBr}$$

 $CH_3CH \leq \frac{Br}{Br}$ Ethylidenedibromide

(c) Electron accepting groups which make the substitution difficult are known or deactivating groups.

o. p. directing groups are as follow :

$$-CH_3, C_2H_5(-R), -NH_2, -OH$$
, halogens  $(Cl, Br, I)$ .

34. (a) 2-butene shows geometrical isomerism.

$$\begin{array}{ccc} H-C-CH_{3} & H-C-CH_{3} \\ \parallel & \parallel \\ H-C-CH_{3} & CH_{3}-C-H_{1} \\ \text{cis-Butene -2} & \text{trans-Butene -2} \end{array}$$

**35.** (d) Sidechain chlorination and bromination is favoured by high temperature, light and in absence of halogen carrier.



$$Cl_2$$
  $Cl_2$ 





- (b)  $C_2H_4 + CO + H_2O \xrightarrow{\text{Ligh temp.}} C_2H_5 COOH$ 36. Propionic acid Ethv lene
- (b) Cyclohexane  $C_6H_{12}$  is alicyclic compound. 37.

**38.** (c) 
$$CH_2 = CH_2 \xrightarrow{HBr} CH_3 - CH_2 \xrightarrow{Hydrolysis} Br$$

$$\begin{array}{c} CH_{3} - CH_{2} \xrightarrow{Na_{2}CO_{3}} CHI_{3} \\ | \\ OH \end{array} \xrightarrow{I_{2} \text{ excess}} CHI_{3} \\ \begin{array}{c} CHI_{3} \\ Vellowpt \\ (Iodoform) \end{array}$$

(d) On oxidation, with  $KMnO_4$ , they give different 39. alcohols

$$CH_{3}CH_{2}CH_{2}CH_{2}CH_{3} \xrightarrow{KMnO_{4}} [O]$$

$$CH_{3}CH_{2}CH_{2}CH_{2}CH_{2}CHOH_{2}$$

$$I^{\circ} \text{ alcohol}$$

$$CH_{3}CH_{2} - CH - CH_{3} \xrightarrow{KMnO_{4}} CH_{3}CH_{2} - \begin{bmatrix}OH\\-CH_{3}\end{bmatrix}$$

$$CH_{3}CH_{2} - CH_{3}CH_{2} - \begin{bmatrix}CH-CH_{3}\\-CH_{3}\end{bmatrix}$$

$$CH_{3}CH_{2} - CH_{3}CH_{3}$$

$$CH_{3}$$

$$C$$

(b)  $CH \equiv CH + HBr \rightarrow CH_2 = CHBr$ Acetylene Vinyl bromide 40. Vinyl bromide

#### Assertion & Reason

(a) This reaction is followed by against of 1. Markownikoff rule

In this reaction anti Markownikoff's addition is explained on the basis of the fact that in the presence of peroxide the addition takes place Via a free radical mechanism rather than the ionic mechanism.

2. (a) 
$$CH_3 - CH_2 - CH = CH_2 + Br_2 \rightarrow 1$$
 Butene

$$H$$

$$CH_2 - CH_2 - C^{\bullet} - CH_2Br$$

$$Br$$
1,2 dibrom obut ane

- (a) Pyrrole is a heterocyclic compound having five 4. membered ring. It has  $6\pi$  electrons. As  $4\pi$ electrons in the ring and  $2\pi$  electrons donated by nitrogen atom present in the ring.
- (b) The assertion that chlorination of  $CH_4$  does 5٠ not take place in dark is correct because it is a free radical reaction and free radicals are obtained in presence of sun light.
- (b) The alkyl benzene is not prepared by Friedel 6. Craft's alkylation of benzene because the monoalkyl product formed undergo alkylation to produce polyalkylated benzene.

The reason that alkyl halides are less reactive than acyl halides is also correct but this is not the correct explanation of assertion.

(d) 2-bromobutane on reaction with sodium 7. ethoxide in ethanol gives 2-butene as a major product. EtO<sup>-</sup>

$$\begin{array}{c} H-CH-CH(CH_3)-Br \rightarrow \\ | \\ CH_3 \end{array}$$

$$EtOH + CH = CH + Br^{-}$$
  
|  
 $CH_{2}$ 

This is according to saytzeff's rule i.e. the Predominant product is the most substituted alkene, i.e. are carrying the largest number of alkyl substituents of hydrogen is eliminated preferentially from the carbon atom joined to the least number of hydrogen atoms.

2-butene is more stable than 1-butene due to presence of large number of hyperconjugating structures in 2-butene.

8. (b) HBr adds to the double bond of the styrene forming 1-bromo-1-phenylethane.



This is an example of elimination-addition reaction.

Note : Here given assertion is wrong.

(b) Alkanes with odd carbon atoms have their and 9. carbon atom on the same side of the molecule

and in even carbon atom alkane, the end carbon atom on opposite side. Thus alkanes with even carbon atoms are packed closely in crystal lattice to permit greater intermolecular attractions and hence higher melting point.

10. (b) Iodination is reversible since formed *HI* is a strong reducing agent and reduces the alkyl iodide back to alkane.

$$CH_4 + I_2 \Rightarrow CH_3I + HI$$

(b) Normally oxidising agents have no effect on alkanes. However, alkanes containing a tertiary hydrogen atom can be oxidised by oxidising agents such as *KMnO*<sub>4</sub> to the corresponding alcohols. For example,

$$CH_{3} \xrightarrow[]{} CH_{3} \xrightarrow[]{} CH_$$

- (e) Halogenation of alkanes is catalysed by radical initiators like benzoyl peroxide.
- 13. (c) Neopentane has four identical methyl groups attached on 4° carbon atom and thus only one product is possible during monosubstitution.
- 14. (b) Neopentane is more symmetric than *n*-pentane and it is expected to show more stable crystal lattice than that of *n*-pentane and thus have high melting point.
- 15. (b) Knocking involves the production of metallic sound due to irregular burning of the fuel. This irregular burning lowers the efficiency of the engine.
- **16.** (b)  $Ag^+$  coordinates with the alkene by  $p\pi d\pi$  bonding giving an ion and the solubility increases.



17. (a) In the dehydration of secondary and tertiary alcohols. When there is a possibility of formation of two isomers. The hydrogen atom is preferentially eliminated from the adjacent carbon atom with the fewer number of hydrogen atoms. This is Saytzeff's rule.

$$CH_{3} - CH_{2} - CH_{2} - CH_{3} - CH_{3} \xrightarrow{60\%H_{2}SO_{4}} (CH_{3} - CH_{3} - CH$$

**18.** (c) The addition of  $Br_2$  follows ionic mechanism

$$H_{2}C = CH_{2} \xrightarrow{\overset{\delta^{+}}{H_{P_{2}}(Br-Br)}}_{NaCl \to Na^{+}+Cl^{-}} H_{2}\overset{+}{C} = \overset{-}{C}H_{2} \xrightarrow{\overset{+}{H_{P_{2}}}}_{+Br} \xrightarrow{\overset{+}{H_{P_{2}}}}_{H_{2}} H_{2}\overset{+}{C} = \overset{-}{C}H_{2} \xrightarrow{\overset{+}{H_{P_{2}}}}_{H_{2}} H_{2}\overset{+}{C} = \overset{-}{C}H_{2}Br \xrightarrow{\overset{+}{H_{P_{2}}}}_{1, 2} \xrightarrow{H_{P_{2}}}_{L^{2}} H_{2}\overset{+}{C} \xrightarrow{\overset{+}{C}}_{L^{2}} \xrightarrow{Cl CH_{2} - CH_{2} Br}_{L^{2}}$$

- 19. (b) Straight chain alkanes have very low octane number because as the length of the chain increases, octane number further decreases.
- 21. (d) The two hydrogen atoms on first carbon and the two *H*-atoms on the third carbon atom lie in perpendicular planes. The central carbon atom is *sp*-hybridized while terminal carbon atoms are  $sp^2$ -hybridized.
- 22. (d) Propene reacts with *HBr* in presence of benzoyl peroxide to give 1-bromopropane. In presence of peroxide, the addition of *HBr* to propane occurs by free radical mechanism.
- **24.** (b) Arylhalide shows resonance stabilization and thus resistant to substitution reaction.
- **25.** (e) During alkylation of bromobenzene, if benzene is used as solvent, alkylation of benzene will take place because benzene is more reactive for  $S_E$  reactions than bromo benzene, benzene is not used as a solvent for this reaction.

26. (b) Benzene is a polar solvent Butter is composed of organic compounds of low polarity. So it gets dissolved in benzene.  $CH_{2}$ 

**27.** (a)

In toluene 🔾

, the  $-CH_3$  group is electron

Pushing. It is an activating group. By its+I effect,  $-CH_3$  group activates the benzene ring at ortho and para position relative to it. Due to increased activity towards electrophilitic substitution toluene can be more easily nitrated than benzene.

28. (e) With fuming  $H_2SO_4$ or oleum (conc.  $H_2SO_4 + SO_3$ ) at high temperature benzene forms *m*-benzene disulphonic acid.



*m*-Benzene disulphonic

- (c) Like halogens, the nitroso group (-N = O) is 29. also deactivating but o, p-directing. It is deactivating because 0 is more electronegative than N and hence No group as whole withdraws electrons from the benzene ring.
- (e) Completely conjugated polyenes containing 31. even number of carbon atoms is known as annulenes.
- (c)  $(4n+2)\pi$  electrons and planar structure are 32. the essential conditions for aromaticity.
- **33.** (a)



Due to severe non-bonded interactions between the internal hydrogen (as shown in figure), the ring assumes non-planar geometry.

## Hydrocarbon

1. Which one of the following alkenes will react fastest with  $H_2$  under catalytic hydro-genation condition

[IIT-JEE (Screening) 2000; CBSE PMT 2005]



- 2. On cracking petrol, we get [CPMT 1980] (a)  $CH_4$ 
  - (b)  $C_3 H_6$
  - (c) Both (a) and (b)
  - (d)  $CH_3 + CH_4 + C_2H_6$  + alcohols
- **3.** Cetane is a compound which has very good ignition property. Chemically it is
  - (a)  $CH_3(CH_2)_{14}CH_3$
  - (b)  $(CH_3)_3 C(CH_2)_{11} CH_3$
  - (c)  $C_{17}H_{34}$
  - (d) None of these
- 4. Which one of these is not compatible with arenes
  [CBSE PMT 1998]
  - (a) Greater stability
  - (b) Delocalisation of  $\pi$  electrons
  - (c) Electrophilic additions
  - (d) Resonance
- 5. Which of the following is an electrophile[BHU 1998]

(a) 
$$H_2O$$
 (b) *NH*

(c) 
$$AlCl_3$$
 (d)  $C_2H_5NH_2$ 

6. The reaction,

$$H_2C = CH_2 + H_2O \xrightarrow{H_3PO_4} C_2H_5OH_2$$
  
Ethylene water  $300^{\circ}C/60$  atm. Ethylalcoho

is called :	[Pb. CET 2001]
(a) Hydration	(b) Sublimation
(c) Dehydration	(d) Substitution
- ,·	

7. In reaction

 $C_{6}H_{5}CH_{3} \xrightarrow{\text{Oxidation}} A \xrightarrow{\text{NaOH}} B \xrightarrow{\text{Sodalime}} C$ Then C is [MP PET 2004] (a)  $C_{6}H_{6}$  (b)  $C_{6}H_{5}OH$  (c)  $C_6H_5COON a^+$  (d)  $C_6H_5ONa$ 

Self Evaluation Test - 24

**8.** Which one of the following is a free-radical substitution reaction [CBSE PMT 2003] (a)  $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$ 



**9.** The most unlikely representation of resonance structures of *p*-nitrophenoxide ion is [**IIT-JEE 1999**]



 Which one of the following on ozonolysis followed by oxidation will give adipic acid [AMU 2002]



**11.** Which of the following structures correspond to the product expected, when excess of  $C_6H_6$  reacts with  $CH_2Cl_2$  in presence of anhydrous  $AlCl_3$  [CBSE PMT 198



(c) 
$$Cl$$
  
 $C$  (d)  $CH_2$ 

Which of the following will be easily nitrated[DCE 2001] 12.  $CH_3$ 17.



Ċl



(c)  $CH_3NO_2$ (d)  $C_6 H_5 NO_2$ 

Chlorination of benzene is not possible in the 13. following reaction [UPSEAT 2004]

(a) 
$$C_6H_6 + Cl_2 \xrightarrow{FeCl_3}$$

(b) 
$$C_6H_6 + HOCl - H^2$$

(c) 
$$C_6H_6 + I - Cl \xrightarrow{ZnCl_2}$$

(d) 
$$C_6H_6 + Cl_2 \xrightarrow{AlCl_3}$$

14. 
$$Ph - C \equiv C - CH_3 \xrightarrow{Hg^{2+}/H^+} A$$
. A is

[IIT-JEE Screening 2002]



In order to complete the reaction 15. 1 - Pentyne  $\xrightarrow{a}$  4 - Octyne  $\xrightarrow{b}$  cis 4Octene a and b will be a b

(1)	$NaNH_2$ ; $CH_3 CH_2Br$	: $H_2$ , (one mole) $Pd$ or $Ni$
(2)	$NaNH_2$ ; $CH_3CH_2CH_2Br$	$H_2$ (two moles) <i>Pd</i> or <i>Ni</i>
(3)	$NaNH_2$ ; $CH_3CH_2CH_2Br$	$H_2$ , (one mole) $Pd$ or $Ni$
(4)	NaNH <sub>2</sub> ;CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> Br	$H_3, H_2O_2, OH^-$
		[MP PET 1994]
(a)	1	(b) 2

(c) 3

(d) 4 The number of secondary hydrogens in 2, 2-16. dimethyl butane is [UPSEAT 2004]

- An alkane (molecular weight 72) forms only one monochlorinated product. Its formula is[BHU 1981] (a)  $(CH_3)_4 C$

(b) 
$$CH_3(CH_2)_3CH_3$$

(c) 
$$(CH_3)_2 CHCH_2 CH_3$$

(d) 
$$H_2C$$
  $CH_2$   
 $H_2C$   $CH_2$   
 $H_2C$   $CH_2$ 

18. The poisonous gas that comes out with petrol burning in a car is [CPMT 1997] (a) *CH*<sub>4</sub> (b)  $C_2H_6$ 

(c) 
$$CO_2$$
 (d)  $CO$ 

The reagent X in t  $(CH_3)_3 CCH = CH_2 \xrightarrow{X}_{THF} Y \xrightarrow{NaBH_4}_{NaOH}$ 19. The the reactions

$$(CH_3)_3 - C - CH - CH_3$$
  
 $\stackrel{|}{OH}$ 

[Roorkee 2000]

(a) 
$$H_3O^+$$

(b) 
$$Hg(CH_3COO)_2$$

(c) *OH*<sup>-</sup>

(d) HCOOH

$$20. \quad CH_2 = CH_2 \xrightarrow{Br_2 / H_2 O} A,$$

In the above reaction the compound A is [DPMT 2004] (a) Ethylene bromohydrin

(b) 1, 2-dibromo ethane

(c) Ethanol

(d) None of these

# S Answers and Solutions

1. (a) According to saytzeff rule order of stability is R > C = C < R > R > R > C = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R = C < R =

$$R \xrightarrow{R} C = C \stackrel{H}{\longleftrightarrow} H \xrightarrow{R} H \xrightarrow{R} C = C \stackrel{R}{\longleftrightarrow} H$$

- (c) On cracking petrol gives smaller hydrocarbons like CH<sub>4</sub>, C<sub>3</sub>H<sub>6</sub>.
- 3. (a) Cetane is chemically hexadecane i.e,  $CH_3(CH_2)_{14}CH_3$ .
- 4. (c) In arenes electrophillic substitution reaction takes place and it does not gives electrophillic addition reactions. We also know that benzene is a resonance hybrid of two structure's and greater stability of benzene is due to delocalization of  $\pi$  electron.
- **5.** (c)  $AlCl_3$  is an electron deficient compound. Hence, act as an electrophile.
- **6.** (a) Alkenes react with water in the presence of acid and form alcohols. This reaction is called as hydration.

7. (a) 
$$C_6H_5COONa \xrightarrow{[A]}{(B]} C_6H_5COOH \xrightarrow{[A]}{(C_6H_6} C_6H_6$$

**8.** (b) Halogenation of alkyl group proceed via free radical mechanism.



as *N* containing 5 valence electrons should not carry positive charge.

10. (b)   

$$(B_{1}) = (B_{1}) + CH_{2}CH_{2} + CH_{2} + CH_{2} + CH_{2} + CH_{2} + CH_{2} + CH_{2}CH_{2} + CH_{$$



12. (a) The presence of an electron-releasing groups (+I group) e.g., -CH<sub>3</sub>,-OH,-NH<sub>2</sub> etc makes th★★★ process of nitration easier. So C<sub>6</sub>H<sub>3</sub>CH<sub>3</sub> will be easily nitrated.

(SET -24)

**13.** (b) Reaction is called Gattermann-Koch synthesis, which is carried by catalyst *AlCl*<sub>3</sub>.

(a)

$$C_6H_5 - C \equiv C - CH_3 \xrightarrow{H_gSO_4} C_6H_5 - \stackrel{O}{C} - CH_2 - CH_3$$

15. (c) 
$$CH_3 - CH_2 - CH_2 - C \equiv CH \xrightarrow{NaNH_2}$$
  
 $CH_3 - CH_2 - CH_2 - C \equiv C - Na \xrightarrow{CH_3CH_2CH_2Br}$   
 $CH_3 - CH_2 - CH_2 - C \equiv C - CH_2 - CH_2 - CH_3 \xrightarrow{H_2}$   
 $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{H_2}$   
 $CH_2 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{CH_2}$   
 $CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{CH_2}$   
 $CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{CH_2}$   
 $CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{CH_2}$ 

**16.** (d) 
$$H_3C - C - C - C - CH_3$$
  
 $H_3C + CH_3$   
 $H_3C + CH_3$   
 $H_3C + CH_3$   
 $H_3C + CH_3$   
 $H_3C + CH_3$ 

- 17. (a) The alkane forms only one mono substituted product, it must have only one type of hydrogen atoms. there fore the alkane is 2, 2-dimethyl propane.
- 18. (d) On petrol burning CO comes out which is so much poisonous gas.
- 19. (b) Oxy mereuration-demercuration : with mercuricacetate (in THF) followed by reduction with *NaBH*<sub>4</sub> / *NaOH* is an example of hydration of alkene according to markowni koff's rule.

 $(CH_3)_3 C - CH = CH_2 \xrightarrow{(CH_3COO)_2 H_g} (CH_3)_3 C - CH - CH_2 - HgOOCCH_3$   $OOCCH_3$   $(CH_3)_3 C - CH - CH_3 \leftarrow OOCCH_3$   $(CH_3)_3 C - CH - CH_3 \leftarrow OOCCH_3$   $OH_3, 3 - Dimethyl - 2 - butanol$ 20. (a)  $CH_2 = CH_2 \xrightarrow{Br_2, H_2O} CH_2 - CH_2$  Br OHEthylenebromohydr in

Hence compound *A* is Ethylene bromohydrin.