CHAPTER 8

ALIPHATIC HYDROCARBONS

MULTIPLE CHOICE QUESTIONS

1.	Pre	paration of vegetable gl	nee involves:	
	(a)	Halogenation	(b)	Hydrogenation
	(c)	Hydroxylation	(d)	Dehydrogenation
2.	Wh	ich type of reactions are	e given by all	kanes:
	(a)	Polymerization	(b)	Elimination
	(c)	Addition	(d)	Substitution
3.	The	most reactive hydrocar	rbon is:	
	(a)	Ethene	(b)	Acetylene
	(c)	Heptane	(d)	Ethane
4.	For	mula of chloroform is:		
	(a)	CH ₃ Cl	(b)	CCl ₄
	(c)	CH ₂ Cl ₂	(d)	CHCl ₃
5.	Cyc	loalkanes and Alkenes	contain whic	h general formula:
	(a)	C_nH_{2n+2}	(b)	C_nH_{2n}
	(c)	C_nH_{2n-2}	(d)	C_nH_n
6.	Wh	ich of the following is n	ot alicyclic:	
	(a)	Cyclohexene	(b)	Cyclobutane
	(c)	Toluene	(d)	Cyclopentene
7.	Uns	aturated nature of alke	ne can be de	tected by:
	(a)	Decolorization of red E	Br ₂ water in C	Cl ₄
	(b)	Decolorization of pink	colour of KM	InO ₄ solution
	(c)	Ozonolysis		
	(d)	All		

8.		addition of unsymmetrical ordance with the rule:	reage	nt to an unsymmetrical alkene is in
	(a)	Hund's rule	(b)	Mankownikov's rule
	(c)	Pauli's exclusion principle	(d)	Aufbau principle
9.	Vici	nal dihalides on treatment wit	th Zn-	dust give:
	(a)	Alkenes	(b)	Alkynes
	(c)	Alkanes	(d)	All of them
10.	For	mula of lindlers catalyst is:		
	(a)	Pb(BaSO ₄) / Quinoline	(b)	Ba(PbSO ₄) / Quinoline
	(c)	Pd(BaSO ₃) / Quinoline	(d)	Pd(BaSO ₄) / Quinoline
11.	Syn	thetic rubber is made by the p	olyme	erization of:
	(a)	Chloroform	(b)	Acetylene
	(c)	Divinyl acetylene	(d)	Chloroprene
12.	Am	monical solution of silver nitra	ite rea	acts with:
	(a)	2-pentyne	(b)	Ethene
	(c)	2-butyne	(d)	Ethyne
13.	Poly	merization of acetylene forms	s:	
	(a)	Propane	(b)	Butane
	(c)	Benzene	(d)	Napthalene
14.	The	number of xvlene isomers is:		
	(a)	2	(b)	3
	(c)	4	(d)	5
15.	Nun	nber of acidic hydrogens prese	ent in	1-butyne is:
	(a)	1	(b)	2
	(c)	3	(d)	4
16.	Che	mically Baeyer's reagent is:		
	(a)	1% alkaline KMnO ₄	(b)	1% acidic KMnO ₄
	(c)	15% alkaline KMnO ₄	(d)	2% alkaline KMnO ₄
17.	Whi	ich of the following gases is us	ed for	artificial ripening of fruits:
	(a)	Ethene	(b)	Ethyne
	(c)	Methane	(d)	Both (a) and (b)

18. Hydroxylation of alkene can be carried out b	18.	Hydroxylation	of alkene can	be carried	out by
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(a) Alkaline KMnO₄

(b) O₃

(c) H_2SO_4

(d) $K_2Cr_2O_7$

19. Acetylene has a characteristic smell resembling that of:

(a) Rotten egg

(b) Garlic

(c) Spicy like

(d) None of the above

20. When ethylene ozonide is treated with Zn-dust we get:

(a) Ethanal

(b) Methanal

(c) Methanol

(d) Ethanol

answers

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1.	(b)	2.	(d)	3.	(a)	4.	(d)	5.	(b)
6.	(c)	7.	(d)	8.	(b)	9.	(a)	10.	(d)
11.	(d)	12.	(d)	13.	(c)	14.	(b)	15.	(a)
16.	(a)	17.	(a, b)	18.	(a)	19.	(b)	20.	(b)



Q.1 Fill in the blanks:

- (i) Ozone reacts with ethene to form ———.
- (ii) Lindlar's catalyst is used for ———— of alkynes.
- (iii) Divinyl acetylene is a ——————————of acetylene.
- (iv) Vicinal dihalides have two halogens on ——————————————————carbon atoms.
- (vi) Halohydrins are formed due to addition of ———— in ethene.
- (vii) Ethylene glycol is produced when ———— reacts with cold alkaline KMnO₄ solution.
- (viii) Mustard gas is a highly boiling ———.
- (x) Ethyne is obtained by the reaction of with calcium carbide.

answers

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(i)	ozonide	(ii)	partial hydrogenation	(iii)	polymer
(iv)	adjacent	(v)	sp	(vi)	hypohalous acid HOX
(vii)	ethene	(viii)	liquid	(ix)	garlic
(x)	water				

Q.2 Indicate True or False:

- (i) Addition of HX to unsymmetrical alkanes takes place according to Markownikov's rule.
- (ii) Methane reacts with bromine water and its colour is discharged.
- (iii) Mustard gas is a blistering agent.
- (iv) Methane is also called marsh gas.

- (v) Ethyne is a saturated compound.
- (vi) Bayer's reagent is used to locate a double bond in an alkene.
- (vii) Alkanes usually undergo substitution reactions.
- (viii) Benzene is a polymer of ethene.
- (ix) Acrylonitrile can be obtained from ethyne.
- (x) Ethyne is more reactive towards electrophilic reagents than ethene.

answers

(i)	False	(ii)	False	(iii)	True	(iv)	True	(v)	False
(vi)	True	(vii)	True	(viii)	False	(ix)	True	(x)	False

- Q.3 Multiple choice questions. Encircle the correct answer
- (i) Preparation of vegetable ghee involves:
 - (a) Halogenation

(b) Hydrogenation

(c) Hydroxylation

- (d) Dehydrogenation
- (ii) Formula of chloroform is:
 - (a) CH₃Cl

(b) CCl₄

(c) CH₂Cl₂

- (d) CHCl₃
- (iii) The presence of a double bond in a compound is the sign of:
 - (a) Saturation

(b) Unsaturation

(c) Substitution

- (d) None
- (iv) Vinyl acetylene combines with HCl to form:
 - (a) Polyacetyiene

(b) Benzene

(c) Chloroprene

- (d) Divinylacetylene
- (v) The addition of unsymmetrical reagent to an unsymmetrical alkene is in accordance with the rule:
 - (a) Hund's rule

- **(b)** Markownikov's rule
- (c) Pauli's exclusion principle
- (d) Aufbau principle
- (vi) Synthetic rubber is made by polymerization of:

- Chloroform Acetylene **(b)** (a) (c) Divinylacetylene (d) Chloroprene β - β '-dichloroethyl sulphide is commonly known as: (vii) Mustard gas Laughing gas (a) (b)
- When methane reacts with Cl2 in the presence of diffused light the products (viii) obtained are:

(d)

Bio-gas

Chloroform only (a)

Phosgene gas

- Carbon tetrachloride only (b)
- Chloromethane and dichloromethane (c)
- (d) Mixture of (a), (b), (c)
- Which one of the following gases is used for artificial ripening of fruits: (ix)
 - Ethene (a)

(c)

(b) Ethyne

Methane (c)

Both (a) and (b) (d)

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(i)	(b)	(ii)	(d)	(iii)	(b)	(iv)	(c)	(v)	(b)
(vi)	(d)	(vii)	(a)	(viii)	(d)	(ix)	(d)		

- Q.4 Write the structural formula for each of the following compounds:
 - 2-methylpropane **(i)**
- (ii) Neopentane
- (iii) 3-ethylpentane
- (iv) 4-ethyl-3, 4-dimethylheptane
- (v) 2, 2, 3, 4-tetramethylpentane (vi) 2, 2, 3, 4-tetramethylpentane
- (vii) 2, 2-dimethylbutane (viii) 2, 2-dimethylpropane



Compound Name Structural Formula CH_3 **(i)** 2-methylpropane $CH_3 - CH - CH_3$ CH_3 (ii) Neopentane

$$\begin{array}{c} CH_3-C-CH_3\\ |\\ CH_3 \end{array}$$

(iii) 3-ethylpentane

$$CH_3 - CH_2 - CH - CH_2 - CH_3$$

 C_2H_5

(iv) 4-ethyl-3, 4-dimethylheptane

$$CH_3 - CH_2 - CH - C - CH_2 - CH_2 - CH_3$$
 CH_3

CH₃ C₂H₅

(v) 2, 2, 3, 4-tetramethylpentane

(vi) 4-iso-propylheptane

$$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$$

 $CH_3 - CH - CH_3$

(vii) 2, 2-dimthyl butane

(viii) 2, 2-dimethylpropane

Q.5 Write down names of the following compounds according to IUPAC system:

(ii) $(CH_3)_3C - CH_2 - C(CH_3)_3$



- (v) CH₃CH₂C(CH₃)₂ CH(CH₂CH₃)CH₃
- (vi) (CH₃CH₂)₃CH
- (vii) $CH_3C(CH_3)_2(CH_2)_2CH_3$

Ans. Detailed question. See text book.

(viii) (C₆H₅)₃CH

Ans.

	Compound	IUPAC Name
(i)	H ₃ C — CH ₂ — CH — CH ₂ CH ₃	3-methylpentane
(ii)	$(CH_3)_3C - CH_2 - C(CH_3)_3$	2, 2, 4, 4-tetramethylpentane
	HETTITI GI	2, 4-dimethylpentane
(iv)	(CH ₃) ₂ CH – CH – CH(CH ₃) ₂ CH ₃	2, 3, 4-trimethylpentane
(v)	CH ₃ CH ₂ C(CH ₃) ₂ CH(CH ₂ CH ₃)CH ₃	3, 3, 4-trimethylhexane
(vi)	(CH ₃ CH ₂) ₃ CH	3-ethylpentane
(vii)	$CH_3C(CH_3)_2(CH_2)_2CH_3$	2, 2-dimethylpentane
(viii)	$(C_6H_5)_3CH$	triphenylmethane
Q.6	What are the rules for naming alkanes?	Explain with suitable examples.

- Q.7 (a) Write down the structural formulas for all the isomeric hexanes and name them according to IUPAC system.
 - (b) The following names are incorrect. Give the correct IUPAC names:
 - (i) 4-methylpentane
- (ii) 3, 5, 5-trimethylhexane
- (iii) 2-methy-3-ethylbutane

Ans.

(a) The isomeric forms of hexanes and their IUPAC names are as follows:

$$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$$
 Hexane

 CH_3

$$CH_3-CH_2-CH_2-CH-CH_3\\$$

2-methylpentane

$$CH_3-CH_2-CH-CH_2-CH_3\\ |\\CH_3$$

3-methylpentane

$$CH_3$$
 | $CH_3 - CH_2 - C - CH_3$ | CH_3

2, 2-dimethylbutane

$$\begin{array}{ccc} CH_3-&CH_3-CH-CH-CH_3\\ & | & |\\ & H_3C & CH_3 \end{array}$$

2, 3-dimethylbutane

(b) Correct names:

Given Name	Structure	Correct Name
	$\mathrm{CH_3} - \mathrm{CH} - \mathrm{CH_2} - \mathrm{CH_2} - \mathrm{CH}$	3
4-methylpentane		2-methyl pentane
	CH_3	
	СН	
3, 5, 5-trimethylhexane	$CH_3 - CH_2 - CH - CH_2 - C -$	CH ₃ 2, 2, 4-trimethyl hexane
	CH ₃ CH	3

2, 3-dimethyl pentane

- Q.8 (a) Explain why alkanes are less reactive than alkenes? What is the effect of branching on the melting point of alkanes?
 - (b) Three different alkanes yield 2-methylbutane when they are hydrogenated in the presence of a metal catalyst. Give their structures and write equations for the reactions involved.

Ans.

- (a) Descriptive question. Consult text book for details.
- (b) (i) 2-methyl-1-butene:

$$\begin{array}{cccc} CH_3-CH_2-C=&CH_2+H_2&\xrightarrow{&Pt/Pd&\\&&&&\\|&&&&\\|&&&&\\CH_3&&&&&CH_3-CH_2-CH-CH_3\\&&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\|&&&&\\$$

(ii) 2-methyl-2-butene:

(iii) 3-methyl-1-butene:

$$\begin{array}{c} CH_3-CH-CH=CH_2+\overline{H_2} \stackrel{\overline{P}t/Pd}{\longrightarrow} CH_3-CH_2-CH-CH_3\\ |\\ CH_3 \end{array}$$

- Q.9 (a) Out line the methods available for the preparation of alkanes.
 - (b) How will you bring about the following conversions?
 - (i) Methane to ethane
- (ii) Ethane to methane
- (iii) Acetic acid to ethane
- (iv) Methane to nitromethane

Ans.

- (a) Descriptive question. Consult text book for details.
- (b) (i) Methane into ethane:

$$CH_4 + Cl_2 \xrightarrow{hv} CH_3Cl + HCl$$

$$2CH_3Cl + 2Na \longrightarrow CH_3 - CH_3 + 2NaCl$$

(ii) Ethane into methane:

$$\begin{array}{c} CH_3-CH_3+Cl_2 & \xrightarrow{hv} & CH_3-CH_2Cl+HCl \\ CH_3-CH_2Cl+KOH_{(aq)} & \longrightarrow & CH_3-CH_2-OH+KCl \\ \hline\\ CH_3-CH_2-OH+[O] & \xrightarrow{K_2Cr_2O_7} & CH_3-C-H+H_2O \\ \hline\\ O & & & & & & & \\ CH_3-C-H+[O] & \xrightarrow{K_2Cr_2O_7} & CH_3-C-OH \\ \hline\\ O & & & & & & \\ CH_3-C-OH+NaOH & \longrightarrow & CH_3-C-ONa+H_2O \\ \hline\\ O & & & & & \\ CH_3-C-ONa+NaOH & \xrightarrow{CaO} & CH_4+Na_2CO_3 \\ \hline\\ \end{array}$$

(iii) Acetic acid to ethane:

$$CH_3COOH + 6HI \xrightarrow{P} CH_3 - CH_3 + 3I_2 + 2H_2O$$

(iv) Methane to nitromethane:

$$CH_4 + HNO_3 \xrightarrow{450^{\circ}C} CH_3 - NO_2 + H_2O$$

- Q.10 (a) What is meant by octane number? Why does a high octane fuel has a less tendency to knock in an automobile engine?
 - (b) Explain tree radical mechanism for the reaction of chlorine with methane in the presence of sunlight.

Ans.

- (a) (i) Octane Number: It is defined as; the percentage of branched chain hydrocarbon, iso-octane, in gasoline fraction of petroleum is known as octane number.
 - (ii) Less Tendency to Knock: High octane fuel has less tendency to knock because it contains 100% isooctane.
- (b) Descriptive question. Consult text book for details.

Q.11 (a) Write structural formulas for each of the following compounds:

- (i) Isobutylene
- (ii) 2, 3, 4, 4-tetramethyl-2-pentene
- (iii) 2, 5-heptadiene
- (iv) 4, 5-dimethyl-2-hexene
- (v) Vinylacetylene
- (vi) 1, 3-pentadiene
- (vii) 1-butyne
- (viii) 3-n-propyl-1, 4-pentadiene
- (ix) Vinyl bromide
- (x) But-1-en-3yne
- (xi) 4-methyl-2-pentyne
- (xii) Iso-pentane
- (b) Name the following compounds by IUPAC system:
 - (i) $H_3C CH = CH(CH_2)_2CH_3$
 - (ii) $(CH_3)_2C = CH_2$

(iii)
$$CH_3 - CH_2 - CH_2 - C = CH_2$$

 $|$
 $CH(CH_3)_2$

- (iv) $CH_2 = CH CH = CH_2$
- (v) $CH_2 = C CH_2CH_2CH_3$ | C_2H_5
- (vi) $CH \equiv C CH_3$
- (vii) $CH_3 C \equiv C CH_3$
- (viii) $CH_2 = CH C \equiv C CH = CH_2$
- (ix) $CH \equiv C CH = CH C \equiv CH$
- (x) $CH_2 = CH C = CH$



(a)

Name	Structural Formulas	
T 1 1	CH_3	
Isobutylene	$CH_3 - C = CH_2$	

CH_3 $CH_3 - CH = C - C - CH_3$
$H_3C - CH = CH - CH_2 - CH = CH - CH_3$
$CH_3 - CH = CH - CH - CH - CH_3$
$CH_2 = CH - C \equiv CH$
$CH_2 = CH - CH = CH - CH_3$
$CH \equiv C - CH_2 - CH_3$
$CH_2 = CH - CH - CH = CH_2$ $ $ $CH_2 - CH_2 - CH_3$
$CH_2 = CH - Br$
$HC \equiv C - CH \equiv CH_2$
$CH_3 - C \equiv C - CH - CH_3$ $ $ CH_3
CH ₃ – CH ₂ – CH – CH ₃ CH ₃

(b)

Compounds	IUPAC Name
$CH_3 - CH = CH(CH_2)_2CH_3$	2-hexene
$(CH_3)_2C = CH_2$	2-methyl-1-propene
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HC CH	2-isopropyl-1-pentene
$CH_2 = CH - CH = CH_2$	1, 4-butadiene

$$CH_2 = C - CH_2 - CH_2 - CH_3 \\ | \\ C_2H_5$$
 2-ethyl-1-pentene

$$HC \equiv C - CH_3$$
 Propyne

$$CH_3 - C \equiv C - CH_3$$
 2-butyne

$$CH_2 = CH - C \equiv C - CH = CH_2$$
 1, 5-hexadiene-3-yne

$$HC \equiv C - CH = CH - C \equiv CH$$
 3-hexene-1, 5-diyne

$$H_2C = CH - C \equiv CH$$
 1-butene-3-yne

- Q.12 (a) Describe different methods for the preparation of alkenes. How would you establish that ethylene contains a double bond?
 - (b) Give structure formulas of the alkenes expected to form by the dehydrohalogenation of the following compounds with a strong base:
 - (i) 1-chloropentane
- (ii) 2-chloro-3-methylbutane
- (iii) 1-chloro-2, 2-dimethyl propa

Ans.

(a) Descriptive question. Consult text book.

"Ethylene contains double bond" it can be established by following reactions:

- (i) Baeyer's test
- (ii) Ozonolysis
- (i) Baeyer's Tests: Reaction with Baeyer's reagent i.e., 1% alkaline solution of KMnO₄

$$CH_2 \longrightarrow CH_2$$

 $3H_2C = CH_2 + 2KMnO_4 + 4H_2O \longrightarrow 3 \mid + 2MnO_2 + 2KOH$
 $OH OH$

Result: Discharging of the colour of KMnO₄ confirms the presence of double bond.

(ii) Ozonolysis:

$$CH_{2} = CH_{2} + O_{3} \longrightarrow H \xrightarrow{C} C \xrightarrow{C} H \xrightarrow{i. H_{2}O} 2H - C - H + ZnO$$

$$O \longrightarrow H \xrightarrow{O} O \longrightarrow O$$

(b)

(i) 1-Chloropentane:

$$CH_3-CH_2-CH_2-CH_2-CH_2+KOH \longrightarrow CH_3-CH_2-CH_2-CH=CH_2+KCl+H_2O$$

$$| (alc) 1-pentene$$

$$Cl$$

(ii) 2-chloro-3-methyl butane:

2 methyl-2-butene

(iii) 1-chloro-2, 2-dimethyl propane:

Q.13 (a) Write down chemical equations for the preparation of propene from the following compounds:

(i)
$$CH_3 - CH_2 - CH_2 - OH$$

(ii)
$$CH_3 - C \equiv CH$$

- (iii) Iso-propyl chloride
- (b) Write skeleton formula showing only the arrangement of carbon atoms for all the possible alkenes of the molecular formula C₅H₁₀.

Ans.

(a) (i)
$$CH_3 - CH_2 - CH_2 - OH \xrightarrow{75\% H_2SO_4} CH_3 - CH = CH_2 + H_2O$$

(ii)
$$CH_3 - C \equiv CH + H_2 \xrightarrow{Pd(BaSO_4)} CH_3 - CH = CH_2$$

(iii)
$$CH_3 - CH - CH_3 + KOH \xrightarrow{alcohol} CH_3 - CH = CH_2 + KCl + H_2O$$

 Cl

(b) Possible structures of alkenes having molecular formula C_5H_{10} are as following:

(i)
$$CH_3 - CH_2 - CH_2 - CH = CH_2$$
 1-pentene

(ii)
$$CH_3 - CH_2 - CH = CH - CH_3$$
 2-pentene

(iii)
$$CH_3 - CH_2 - C = CH_2$$
 2-methyl-1-butene CH_3

(iv)
$$CH_3 - CH - CH = CH_2$$
 3-methyl-1-butene CH_3

(v)
$$CH_3 - CH = C - CH_3$$
 2-methyl-2-butene CH_3

- Q.14 (a) How may ethene be converted into ethyl alcohol?
 - (b) Starting from ethene, outline the reactions for the preparation of following compounds:
 - (i) 1, 2-ethyldibromide (ii) Ethyne
 - (iii) Ethane (iv) Ethylene glycol
 - (c) How will you bring about the following conversions:
 - (i) 1-butene to 1-butyne (ii) 1-propanol to CH₃—CH—CH₂Cl

Ans.

- (a) Ethene may be converted into ethyl alcohol by two steps:
- (i) Addition of H₂SO₄:

$$CH_2 = CH_2 + H - O - SO_3H$$
 \longrightarrow $CH_3 - CH_2 - O - SO_3H$

(ii) Hydration:

$$CH_3 - CH_2 - O - SO_3H + H - OH \xrightarrow{100^{\circ}C} CH_3 - CH_2 - OH + H_2SO_4$$

(b) (i) Ethylene dibromide:

$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} Br - CH_2 - CH_2 - Br$$

(ii) Ethyne:

(a)
$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} Br - CH_2 - CH_2 - Br$$

(b) Br - CH₂ - CH₂ - Br + 2KOH
$$\xrightarrow{80^{\circ}\text{C}}$$
 CH = CH + 2KBr + 2H₂O (alc)

(iii) Ethane:

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

(iv) Ethylene glycol:

$$3H_2C = CH_2 + 2KMnO_4 + 4H_2O \xrightarrow{\overline{O}H} 3CH_2 - OH + 2MnO_2 + 2KOH$$

$$| CH_2 - OH$$

(c) (i) 1-butene to 1-butyne:

Steps involved:

1. Bromination:

$$CH_3 - CH_2 - CH = CH_2 + Br_2 \xrightarrow{CCl_4} CH_3 - CH_2 - CH - CH_2$$

$$| | |$$

$$Br Br$$

2. Dehydrohlogenation:

$$CH_3-CH_2-CH-CH_2+2KOH \xrightarrow{100^{\circ}C} CH_3-CH_2-C \equiv CH+2KBr+2H_2O$$

$$| | (alc)$$

$$Br Br$$

(ii) 1-propanol to CH₃ – CH – CH₂

Steps involved:

1. Dehydration:

$$CH_3 - CH_2 - CH_2 - OH \xrightarrow{H_2SO_4} CH_3 - CH = CH_2 + H_2O$$

2. Addition of hypochlorus acid:

Q.15 Show by means of chemical equations how the following cycle of changes may be affected:





First Step:

Ethane — Ethene

(i) Halogenation in the presence of sunlight:

$$CH_3 - CH_3 + Cl - Cl \xrightarrow{hv} CH_3 - CH_2 - Cl + HCl$$

(ii) Dehydrohalogenation:

$$CH_3 - CH_2 - Cl + KOH \xrightarrow{100^{\circ}C} CH_2 = CH_2 + KCl + H_2O$$
(alc)

Second Step:

(i) Addition of halogen:

$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} Br - CH_2 - CH_2 - Br$$

(ii) Dehydrohalogenation:

$$Br - CH_2 - CH_2 - Br + 2KOH \xrightarrow{-HBr} CH \equiv CH + 2KBr + 2H_2O$$
(alc)

Third Step:

(i)
$$CH = CH + H_2 \xrightarrow{Pd / BaSO_4} CH_2 = CH_2$$

(ii)
$$CH_2 = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_3$$

- Q.16 Write down structural formulas for the products that are formed when 1-butene will react with the following reagents:
 - (i) H_2 , Pt

- (ii) Br₃ in CCl₄
- (iii) Cold dil. KMnO₄\OH
- (iv) HBr
- (v) O_2 in the presence of Ag
- (vi) HOCl

(vii) dil. H₂SO₄

Ans.

(i)
$$CH_2 = CH - CH_2 - CH_3 + H_2 \xrightarrow{Pt} CH_3 - CH_2 - CH_2 - CH_3$$

n-butane

(iii)
$$3CH_2 = CH - CH_2 - CH_3 + 2KMnO_4 + 4H_2O \longrightarrow 3CH_2 - CH - CH_2 - CH_3$$

$$| | | OH OH$$

$$+ 2MnO_2 + 2KOH$$

(iv)
$$CH_2 = CH - CH_2 - CH_3 + HBr \longrightarrow CH_3 - CH - CH_2 - CH_3$$

$$| 2-bromobutane$$
Br

(v)
$$CH_3 - CH_2 - CH = CH_2 + \frac{1}{2}O_2 \xrightarrow{Ag} CH_3 - CH_2 - CH - CH_2$$
Butylene oxide O

(vi)
$$CH_3 - CH_2 - CH = CH_2 + HOCl \longrightarrow CH_3 - CH_2 - CH - CH_2$$

1-chloro-2-butanol | OH Cl

(vii)
$$CH_3 - CH_2 - CH = CH_2 + H_2SO_4 \longrightarrow CH_3 - CH_2 - CH - CH_3$$

$$| O - SO_3H$$

Q.17 In the following reactions, identify each lettered product:

(i) Ethyl alcohol
$$\xrightarrow{\text{Conc. H}_2\text{SO}_4}$$
 A $\xrightarrow{\text{Br}_2}$ B $\xrightarrow{\text{alcoholic}}$ C

(ii) Propene
$$\xrightarrow{Br_2}$$
 D $\xrightarrow{alcoholic}$ E \xrightarrow{HCN} F

Ans.

(i) Reactions Involved:

$$CH_3-CH_2-OH \xrightarrow[170^{\circ}C,\ -H_2O]{COnc.\ H_2SO_4} CH_2=CH_2\xrightarrow[CCl_4]{Br_2} CH_2-CH_2\xrightarrow[-HBr]{2KOH\ (alc)} HC\equiv CH+2KBr+2H_2O$$

Products:

A = Ethene

B = 1, 2 dibromoethane

C = Ethyne

$$CH_3 - C \equiv CH + HCN \longrightarrow CH_3 - C = CH_2$$

$$\mid CN$$

- Q.18 After an ozonolysis experiment, the only product obtained was acetaldehyde, CH₃CHO. Can you guess the structural formula of this compound.
- Ans. The only product of acetaldehyde can be obtained by the ozonolysis of 2-butene.

Structural formula: $CH_3 - CH = CH - CH_3$

- Q.19 (a) The addition of sulphuric acid to an alkene obeys Markownikov's rule. Predict the structures of the alochols obtained by the addition of the acid to the following compounds:
 - (i) Propene
- (ii) 1-butene
- (iii) 2-butene
- (b) Predict the most likely product of the addition of hydrogen chloride to 2-methyl 2-butene. Explain the formation of this product.

Ans.

(a) (i) Propene:

$$CH_3 - CH = CH_2 + H - O - SO_3H \longrightarrow CH_3 - CH - CH_3$$

$$\begin{array}{c} O-SO_3H\\ \mid\\ CH_3-CH-CH_3+\overset{\delta+}{H}-\overset{\delta-}{OH} \xrightarrow{100^{\circ}C} CH_3-CH-CH_3+H_2SO_4\\ \mid\\ iso-propyl \ alcohol\\ OH \end{array}$$

(ii) 1-butene:

$$\begin{array}{c} CH_3-CH-CH_2-CH_3+\overset{\delta+}{H}-\overset{\delta-}{OH} \xrightarrow{100^{\circ}C} & CH_3-CH-CH_2-CH_3+H_2SO_4\\ |\\ O-SO_3H & OH \end{array}$$

2-butanol

(iii) 2-butene:

$$CH_3 - CH = CH - CH_3 + H - O - SO_3H \longrightarrow CH_3 - CH - CH_2 - CH_3$$

$$\begin{vmatrix} & & & & & & & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & \\ & & & \\ & & \\ & & \\ & & & \\$$

$$\begin{array}{c} CH_3-CH-CH_2-CH_3+\overset{\delta+}{H}-\overset{\delta-}{OH} & \xrightarrow{100^{\circ}C} & CH_3-CH-CH_2-CH_3+H_2SO_4\\ | & | & | \\ O-SO_3H & OH \end{array}$$

2-butanol

(b)
$$CH_3 - C = CH - CH_3 + H C1 \longrightarrow CH_3 - C - CH_2CH_3$$

$$CH_3 - C = CH - CH_3 + H C1 \longrightarrow CH_3 - C - CH_2CH_3$$

$$CH_3 - C - CH_3 + CH_3 - CH_3$$

As 2-methyl-2-butene is an unsymmetrical compound and H-Cl is an unsymmetrical reagent so, the addition will be according to Markownikov's rule and the product will be 2-chloro-2 methyl butane.

Q.20 Why are some hydrocarbons called saturated and others unsaturated? What type of reactions are characteristics of them?

Saturated Hydrocarbons: If all the valencies of the carbon atoms in a molecule are fully satisfied and these cannot further take up any more hydrogen or other atom then this compound is named as saturated hydrocarbon.

Type of Reactions: Saturated hydrocarbons give substitution reactions. e.g.,

$$CH_4 + HNO_3 \xrightarrow{450^{\circ}C} CH_3 - NO_2 + H_2O$$
substitutional product

Unsaturated Hydrocarbons: If in the compounds of carbon and hydrogen all the four valencies of carbon atom are not fully utilized and they contain either a double or a triple bond then these are called as unsaturated hydrocarbons.

Types of Reactions: Unsaturated hydrocarbons give addition reactions. e.g.,

$$CH_2 = CH_2 + HC1 \longrightarrow CH_3 - CH_2 - C1$$

addition product

- Q.21 (a) Describe methods for the preparation of ethyne.
 - (b) How does ethyne react with:
 - (i) Hydrogen
- (ii) Halogen acid
- (iii) Alkaline KMnO₄
- (iv) 10% H₂SO₄ in the presence of HgSO₄
- (v) Ammonical cuprous chloride
- (c) Mention some important uses of methane, ethene and ethyne.

Ans.

- (a) Preparation of Ethyne:
- (i) Hydrolysis of calcium carbide (industrial method):

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$

(ii) Dehydrohalogenation of vicinal dihalides:

$$H_2C \longrightarrow HC \equiv CH + 2KBr + 2H_2O$$
| (alc)
Br Br

(iii) Dehalogenation of Tetrahalides:

(iv) Kolbe's Method:

(b) (i)
$$HC \equiv CH + H_2 \xrightarrow{Ni} CH_2 = CH_2$$

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



(iii)
$$HC \equiv CH + 2H_2O + 2[O] \xrightarrow{KMnO_4} CH - CH$$
$$OH OH$$
$$OH OH$$

$$\begin{array}{c|cccc} OH & OH \\ & & | & & CH = O \\ CH - CH & \longrightarrow & | & (Glyoxal) \\ & & | & & CH = O \\ OH & OH & & \end{array}$$

$$CH = O$$

$$| HO - C - C - OH$$

$$CH = O$$

$$| HO - C - C - OH$$

Oxalic acid

(iv)
$$\begin{array}{c} CH \\ \parallel + H_2O \xrightarrow{10\% \text{ } H_2SO_4} & CH_2 \\ \hline CH & HgSO_4 & CH-OH \end{array}$$

$$\begin{array}{c} CH_2 \\ \parallel \\ CH-OH \end{array} \longrightarrow \begin{array}{c} CH_3-C-H \\ \end{array}$$

(c) Important Uses:

Uses of Methane:

- (i) For the preparation of chloroform and carbon tetrachloride.
- (ii) Methane is important constituent of natural gas.
- (iii) For the industrial preparation of CH₃OH, HCHO, HCOOH.
- (iv) Methane is used in the preparation of carbon-black used in paints, automobile tyres and printing inks.
- (v) By cracking of methane, H₂ is produced which is used in fertilizers and for the hydrogenation of vegetable oil

Uses of Ethene:

- (i) Artificial ripening of fruits.
- (ii) As an anaesthetic.
- (iii) In the preparation of mustard gas.
- (iv) In the preparation of polyethylene

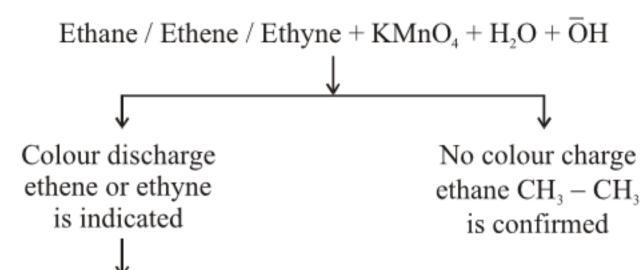
Uses of Ethyne:

- (i) Oxy-acetylene flame (2800 3000°C) is used for welding.
- (ii) For artificial ripening of fruits.
- (iii) For the preparation of acetaldehyde, ethanol and acetic acid.
- (iv) It is used in the preparation of PVC, Neoprene rubber, Orlon.
- It is used in the preparation of C₂H₂Cl₄ which is used in varnishes, resins, rubber

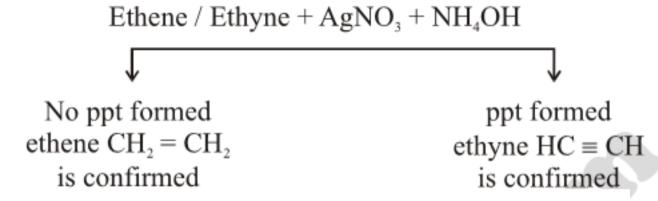
Q.22 Describe how you could distinguish ethane, ethene and ethyne from one another by means of chemical reactions.

Ans. We can distinguish between saturated and unsaturated hydrocarbons by means of a chemical test called as Baeyer's test.

BAEYER'S TEST



To differentiate between ethene and ethyne



- Q.23 (a) How will you synthesize the following compounds starting from ethyne:
 - (i) Acetaldehyde
- (ii) Benzene
- (iii) Chloroprene
- (iv) Glyoxai
- (v) Oxalic acid
- (vi) Acrylonitrile

(vii) Ethane

- (viii) Methyl nitrile
- (b) Write a note on the acidity of etnyne.

Ans.

(a) (i) Acetaldehyde

$$\begin{array}{c} \text{CH} & \xrightarrow{\quad \text{CH}_2 \\ \parallel \quad + \text{HOH}} \xrightarrow{\quad \text{HgSO}_4 \quad \text{CHOH}} & \xrightarrow{\quad \text{CH}_3 - \text{C} - \text{H}} \\ \end{array}$$

(ii) Benzene:

$$3HC \equiv CH \xrightarrow{\text{Cu-tube}} \bigcirc$$

(iii) Chlorperene:

$$2HC \equiv CH \xrightarrow{Cu_2Cl_2} CH_2 = CH - C \equiv C - H$$

$$CH_2 = CH - C \equiv CH + HC1 \longrightarrow H_2C = CH - C = CH_2$$

$$|$$

$$C1$$

(iv) Glyoxal:

$$HC \equiv CH + 2H_2O + 2[O] \xrightarrow{\begin{subarray}{c} OH & OH \\ & | & | \\ & CH - CH \\ & | & | \\ OH & OH \end{subarray}$$

$$\begin{array}{c|cccc} OH & OH \\ | & | & \\ CH - CH & \xrightarrow{-2H_2O} & CH = O \\ | & | & CH = O \\ OH & OH \end{array}$$

(v) Acrylonitrile:

$$\begin{array}{c} CH \\ \parallel + HCN \xrightarrow{Cu_2Cl_2} CH_2 = CH - CN \\ CH \end{array}$$

(vi) Ethane:

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

(vii) Methyl Nitrile:

$$HC \equiv CH + NH_3 \xrightarrow{Al_2O_3} CH_2 - C \equiv N + H_2$$

- **(b)** Consult the text book.
- Q.24 (a) Compare the reactivity of ethane, ethene and ethyne.
 - (b) Compare the physical properties of alkanes, alkenes and alkynes.

Ans.

(a) The general decreasing reactivity order of ethane, ethene and ethyne is as follow:

Ethene > Ethyne > Ethane

Reasons: A π -bond in **ethene** is not only weak but its electrons are more exposed to an attack by an electrophilic reagent. Both these facts make the ethene a very reactive compound. **Ethyne** although contain 2π -bonds but it is less reactive than ethene towards electrophilic reagents. This is because the bond distance between the two triple bonded carbon atoms is very short and hence π -electrons are not easily available to be attacked by electrophilic reagents. Ethyne is, however more reactive than ethene towards nucleophilic reagents. **Ethane** have no π -electrons so, it is much less reactive than ethene or ethyne.

(b) (i) Physical State:

Alkanes: Alkanes containing upto 4 carbon atoms are gases while pentane to heptadecane (C_5 to C_{17}) are liquids. The higher members from C_{18} to onwards are waxy solids.

Alkenes: First 3 members of alkenes are gases while C₅ to C₁₅ are liquids and higher members are solids.

Alkynes: The first 3 members of alkynes are gases. Next 8 members C_5 to C_{12} are liquid and higher members are solids.

(ii) Characteristics:

Alkanes: All alkanes are colourless and odourless.

Alkenes: They have characteristic smell.

Alkynes: They are colourless, odourless, except acetylene which has garlic like odour.

(iii) Polarity and Solubility:

Alkanes: They are non-polar or very weakly polar and are insoluble in polar solvents like water but soluble in non-polar solvents like benzene etc.

Alkenes: They show weakly polar properties because of sp² hybridization. They are insoluble in H₂O but soluble in alcohol.

Alkynes: They are non-polar and dissolve readily in non-polar solvents like ether, benzene, etc.

(iv) Physical Constants:

Alkane: In alkanes, boiling points, melting points and density increases with the increase in number of carbon atoms, whereas solubility decreases with increase in molecular mass.

Alkenes and Alkynes: In case of physical constants, similar trend for alkenes and alkynes as that for alkanes.

- Q.25 How does propyne react with the following reagents:
 - (a) AgNO₃/NH₄OH
- (b) Cu₂Cl₂/NH₄OH
- (c) $H_2O/H_2SO_4HgSO_4$

Ans.

(a) (i)
$$H - C \equiv C - CH_3 + AgNO_3 + NH_4OH \longrightarrow Ag - C \equiv C - CH_3 + NH_4NO_3 + H_2O$$

(Silver-propylide)

(ii)
$$H - C \equiv C - CH_3 + Cu_2Cl_2 + NH_4OH \longrightarrow 2Cu - C \equiv C - CH_3 + 2NH_4Cl + 2H_2O$$

(iii)
$$H - C \equiv C - CH_3 + \overset{+}{HOH} \xrightarrow{10\% H_2SO_4} CH_2 = C - CH_3$$

 $| OH | OH$

$$CH_2 = C - CH_3$$

$$CH_3 - C - CH_3$$

$$OH$$

$$OH$$

$$CH_3 - C - CH_3$$

$$Acetone$$

Q.26 A compound has a molecular formula C₄H₆, when it is treated with excess hydrogen in the presence of Ni-catalyst, a new compound C₄H₁₀ is formed. When C₄H₆ is treated with ammoniacal silver nitrate a white precipitate is formed. What is the structural formula of the given compound?

Ans. Reactions Involved:

$$CH_3 - CH_2 - C \equiv CH + 2H_2 \xrightarrow{Ni} CH_3 - CH_2 - CH_2 - CH_3$$

$$1\text{-butyne} \qquad \qquad \text{n-butane}$$

$$CH_3 - CH_2 - C \equiv CH + AgNO_3 + NH_4OH \longrightarrow CH_3 - CH_2 - C \equiv CAg + NH_4NO_3 + H_2O$$

Ammonical silver nitrate gives white ppt. with alkynes containing acidic hydrogen. The compound with molecular formula C₄H₆ can be 1-butyne or 2-butyne.

The compound 1-butyne has acidic hydrogen and can be replaced by metal forming alkynides. 2-butyne has no acidic hydrogen and do not form white ppt. So, only 1-butyne can give white ppt. with ammonical silver nitrate.

The possible structure is:

$$CH_3 - CH_2 - C \equiv CH$$
 (1-butyne)

Q.27 (a) Identify A and B:

$$CH_3CH_2CH_2OH \xrightarrow{PCl_5} A \xrightarrow{Na/Ether} B$$

(b) Give the general mechanism of electrophilic addition reactions of alkenes.

Ans.

(a)
$$CH_3CH_2CH_2OH + PCl_5 \longrightarrow CH_3 - CH_2 - CH_2 - Cl + POCl_3 + HCl_2$$

 $2CH_3 - CH_2 - CH_2Cl + 2Na \longrightarrow CH_3(-CH_2)_4 - CH_3 + 2NaCl_2$
(n-hexane)

$$A = CH_3 - CH_2 - CH_2 - CI$$
 (1-chloropropane)

$$B = CH_3 - CH_2 - CH_2 - CH_2 - CH_3$$
 (n-hexane)

(b) Descriptive question. Consult text book for details.

DO YOU KNOW?

- 1. Alkanes are also called paraffins.
- **2.** Alkenes are also called olefines.
- 3. $C_{20}H_{42}$ is called eicosane.
- 4. $C_{11}H_{24}$ is called undecane.
- 5. $C_{12}H_{26}$ is called dodecane.
- **6.** $C_{16}H_{34}$ is called hexadecane.
- 7. $C_{100}H_{202}$ is called hectane.
- **8.** Wurtz's reaction is used for lengthening the carbon chain.
- 9. The boiling point of branched chain alkanes are less than straight chain hydrocarbons.
- 10. Kolbe's method is used for the preparation of alkanes, alkenes, alkynes.
- 11. Raney Nickel has high surface area and is more reactive.
- 12. Bayer's test is used for the identification of double bond.
- 13. Mustard gas is highly boiling liquid. It is used as vesicant (blistering agent).
- 14. 1-butyne reacts with ammonical AgNO₃ but 2-butyne does not react.
- 15. Acetylene was prepared accidentally by an American Chemist named Willson.
- **16.** Ethyne has garlic like odour.
- 17. Methane is also called marsh gas.