SUMMARY

Hydrocarbons are the compounds of carbon and hydrogen only. Hydrocarbons are mainly obtained from coal and petroleum, which are the major **sources of energy**. **Petrochemicals** are the prominent starting materials used for the manufacture of a large number of commercially important products. LPG (liquefied petroleum gas) and CNG (compressed natural gas), the main sources of energy for domestic fuels and the automobile industry, are obtained from petroleum. Hydrocarbons are classified as **open chain saturated** (alkanes) and **unsaturated** (alkenes and alkynes), **cyclic** (alicyclic) and **aromatic**, according to their structure.

The important reactions of alkanes are **free radical substitution**, **combustion**, **oxidation** and **aromatization**. Alkenes and alkynes undergo addition reactions, which are mainly **electrophilic additions**. Aromatic hydrocarbons, despite having unsaturation, undergo mainly **electrophilic substitution** reactions. These undergo addition reactions only under special conditions.

Alkanes show conformational isomerism due to free rotation along the C–C sigma bonds. Out of **staggered** and the **eclipsed** conformations of ethane, staggered conformation is more stable as hydrogen atoms are farthest apart. Alkenes exhibit **geometrical (*cis-trans*) isomerism** due to restricted rotation around the carbon–carbon double bond.

Benzene and **benzenoid** compounds show aromatic character. Aromaticity, the property of being aromatic is possessed by compounds having specific electronic structure characterised by Hückel $(4n+2)\pi$ electron rule. The nature of groups or substituents attached to benzene ring is responsible for activation or deactivation of the benzene ring towards further electrophilic substitution and also for orientation of the incoming group. Some of the polynuclear hydrocarbons having fused benzene ring system have carcinogenic property.

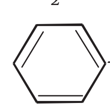
EXERCISES

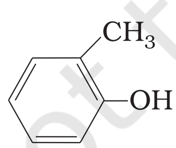
13.1 How do you account for the formation of ethane during chlorination of methane ?

13.2 Write IUPAC names of the following compounds :

(a) $CH_3CH=C(CH_3)_2$ (b) $CH_2=CH\text{-}C\equiv C\text{-}CH_3$

(c) 

(d)  $–CH_2–CH_2–CH=CH_2$

(e) 

(f) $CH_3(CH_2)_4\ CH(CH_2)_3CH_3$
$\qquad\qquad\qquad |$
$\qquad\qquad CH_2–CH(CH_3)_2$

(g) $CH_3 – CH = CH – CH_2 – CH = CH – CH – CH_2 – CH = CH_2$
$\qquad\qquad\qquad\qquad\qquad\qquad |$
$\qquad\qquad\qquad\qquad\qquad\quad C_2H_5$

13.3 For the following compounds, write structural formulas and IUPAC names for all possible isomers having the number of double or triple bond as indicated :

(a) C_4H_8 (one double bond) (b) C_5H_8 (one triple bond)

13.4 Write IUPAC names of the products obtained by the ozonolysis of the following compounds :

(i) Pent-2-ene (ii) 3,4-Dimethylhept-3-ene

(iii) 2-Ethylbut-1-ene (iv) 1-Phenylbut-1-ene

13.5 An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write structure and IUPAC name of 'A'.

13.6 An alkene 'A' contains three C – C, eight C – H σ bonds and one C – C π bond. 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44 u. Write IUPAC name of 'A'.

13.7 Propanal and pentan-3-one are the ozonolysis products of an alkene? What is the structural formula of the alkene?

13.8 Write chemical equations for combustion reaction of the following hydrocarbons:

(i) Butane (ii) Pentene

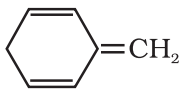
(iii) Hexyne (iv) Toluene

13.9 Draw the *cis* and *trans* structures of hex-2-ene. Which isomer will have higher b.p. and why?

13.10 Why is benzene extra ordinarily stable though it contains three double bonds?

13.11 What are the necessary conditions for any system to be aromatic?

13.12 Explain why the following systems are not aromatic?

(i)  (ii)  (iii) 

13.13 How will you convert benzene into

(i) *p*-nitrobromobenzene (ii) *m*- nitrochlorobenzene

(iii) *p* - nitrotoluene (iv) acetophenone?

13.14 In the alkane $H_3C-CH_2-C(CH_3)_2-CH_2-CH(CH_3)_2$, identify 1°,2°,3° carbon atoms and give the number of H atoms bonded to each one of these.

13.15 What effect does branching of an alkane chain has on its boiling point?

13.16 Addition of HBr to propene yields 2-bromopropane, while in the presence of benzoyl peroxide, the same reaction yields 1-bromopropane. Explain and give mechanism.

13.17 Write down the products of ozonolysis of 1,2-dimethylbenzene (*o*-xylene). How does the result support Kekulé structure for benzene?

13.18 Arrange benzene, *n*-hexane and ethyne in decreasing order of acidic behaviour. Also give reason for this behaviour.

13.19 Why does benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions with difficulty?

13.20 How would you convert the following compounds into benzene?

(i) Ethyne (ii) Ethene (iii) Hexane

13.21 Write structures of all the alkenes which on hydrogenation give 2-methylbutane.

13.22 Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E^+

(a) Chlorobenzene, 2,4-dinitrochlorobenzene, *p*-nitrochlorobenzene

(b) Toluene, $p\text{-}H_3C-C_6H_4-NO_2$, $p\text{-}O_2N-C_6H_4-NO_2$.

13.23 Out of benzene, *m*–dinitrobenzene and toluene which will undergo nitration most easily and why?

13.24 Suggest the name of a Lewis acid other than anhydrous aluminium chloride which can be used during ethylation of benzene.

13.25 Why is Wurtz reaction not preferred for the preparation of alkanes containing odd number of carbon atoms? Illustrate your answer by taking one example.