15. HYDROCARBONS

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. The correct IUPAC name of $CH_3-CH_2-CH(CH_3)-CH_2-CH_3$ is

A) 3-Methylpentane B) 2-Ethylbutane
C) 2-Methylpentane D) 3-Ethylbutane

Answer:A

Solution:The longest chain has 5 carbons (pentane) and there's a methyl substituent on the middle carbon — carbon-3 — giving 3-methylpentane.

2. The IUPAC name of $CH_2=CH-CH(CH_3)-CH_2-CH_3$ is

(FA & SA- 5 Marks / 8 Marks)

A) 3-Methylpent-1-ene B) 2-Ethylbut-1-ene
C) 2-Vinylbutane D) 3-Methylpent-4-ene

Answer:A

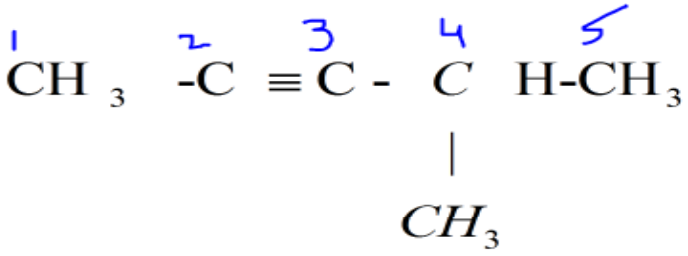
Solution:The longest chain that includes the double bond has 5 carbons, so the parent name is pentene.
Double bond starts at carbon 1, so → pent-1-ene
There is a methyl group (-CH_3) attached to carbon 3
IUPAC name:3-Methylpent-1-ene

3. The IUPAC name of $CH_3-C\equiv C-CH(CH_3)_2$ is

A) 4-Methylpent-2-yne B) 2-Isopropylprop-1-yne
C) 4,4-Dimethylbut-2-yne D) 2-Methylpent-3-yne

Answer:A

Solution:



From left: C1–C2≡C3–C4–C5 → triple bond at 2-3, methyl at C4 → 4-methylpent-2-yne.

4. The IUPAC name of $CH_3-CH_2-CH(OH)-CH(CH_3)-CH_3$ is

A) 3-Methylpentan-2-ol
B) 2-Ethylbutan-3-ol
C) 2-Methylpentan-3-ol
D) 2-Isopropylpropan-1-ol

Answer:C

Solution: $\overset{5}{CH_3}-\overset{4}{CH_2}-\overset{3}{CH}(OH)-\overset{2}{CH}(CH_3)-\overset{1}{CH_3}$

Numbering is chosen so –OH gets the lowest possible locant (both ends give OH at C-3), then choose direction giving the substituent the lower number → methyl at C-2.

5. The IUPAC name of $CH_3-CH_2-C(CH_3)=CH-CH(CH_3)-CH_3$ is

A) 3,4-Dimethylhex-2-ene
B) 2-Ethyl-3-methylpent-2-ene
C) 2,4-Dimethylhex-3-ene
D) 2,3-Diethylbut-2-ene

Answer:C

Solution: $\overset{6}{CH_3}-\overset{5}{CH_2}-\overset{4}{C}(CH_3)=\overset{3}{CH}-\overset{2}{CH}(CH_3)-\overset{1}{CH_3}$

Longest chain = 6 C (hexene). Numbering from the right gives substituent locants 2 and 4 (rather than 3 and 5), with the double bond at C-3
2,4-Dimethylhex-3-ene

6. The IUPAC name of $CH_2=CH-CH=CH-CH(CH_3)-CH_3$ is

A) 5-Methylhexa-1,3-diene
B) 2-Methylhexa-3,5-diene
C) 2-Vinylpenta-1,3-diene
D) 4-Methylhexa-2,4-diene

Answer:A

Solution:

$$\underset{1}{CH_2}=\underset{2}{CH}-\underset{3}{CH}=\underset{4}{CH}-\underset{5}{CH}(CH_3)-\underset{6}{CH_3}$$

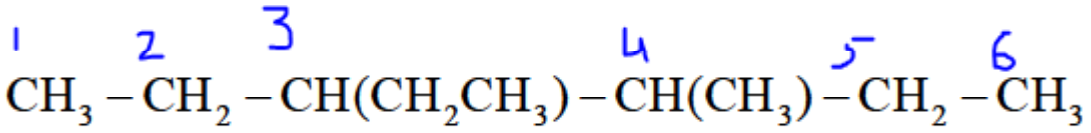
Longest chain containing both double bonds is 6 carbons → hexa-1,3-diene. Numbering from the left (nearest the first double bond) gives the lowest locants for the double bonds (1,3) and places the methyl substituent at C-5 →5-methylhexa-1,3-diene

7. The IUPAC name of $CH_3-CH_2-CH(CH_2CH_3)-CH(CH_3)-CH_2-CH_3$ is

A) 3-Ethyl-4-methylhexane
B) 2,3-Diethylpentane
C) 4-Methyl-3-ethylhexane
D) 2-Methyl-3-ethylhexane

Answer:A

Solution:Numbering chosen so ethyl gets the lower locant (alphabetical tie-breaker



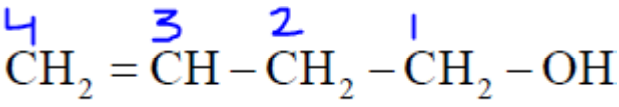
3-Ethyl-4-methylhexane

8. The IUPAC name of $CH_2=CH-CH_2-CH_2-OH$ is **(FA & SA- 2 Marks)**

A) But-3-en-1-ol B) But-1-en-4-ol C) Allyl alcohol D) 3-Hydroxyprop-1-ene

Answer:A

Solution:OH has priority, so number from the OH end → but-3-en-1-ol



9. The IUPAC name of $CH_3-CH=CH-C\equiv C-CH(CH_3)-CH_3$ is

(FA & SA- 3 Marks / 4 Marks)

A) 6-Methylhept-2-en-4-yne B) 2-Methylhept-5-en-3-yne

C) 3-Methylhept-2-en-4-yne D) 5-Methylhept-3-en-1-yne

Answer:A

Solution: 

Longest chain = 7; numbering from left gives double at C2 and triple at C4, methyl at C6 → 6-methylhept-2-en-4-yne.

10. The correct IUPAC name of the compound

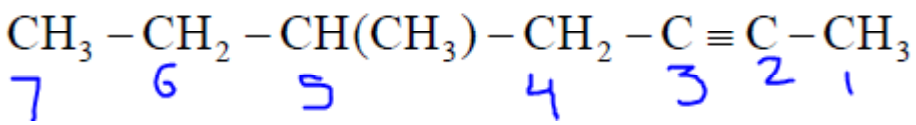
$CH_3-CH_2-CH(CH_3)-CH_2-C\equiv C-CH_3$ is

A) 5-Methylhept-2-yne B) 3-Methylhept-5-yne

C) 4-Methylhept-5-yne D) 2-Ethylhex-3-yne

Answer:A

Solution:Numbering chosen to give the triple bond the lowest possible locant ? triple at C2 and methyl at C5 → 5-methylhept-2-yne



JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

11. Which of the following statements about hydrocarbons are correct?
A)Alkenes are unsaturated hydrocarbons containing at least one carbon-carbon double bond.
B)The general formula for alkynes is C_nH_{2n-2}, where n = 2.
C)Cycloalkanes have the same general formula as alkenes: C_nH_{2n}.
D)Aromatic hydrocarbons always contain a benzene ring with alternating single and double bonds.

Answer:A,B,C,D

Solution:A) Alkenes are unsaturated hydrocarbons containing at least one carbon–carbon double bond. $\rightarrow$ True
B) The general formula for alkynes is C_nH_{2n-2}, where n = 2. $\rightarrow$ True (for n = 2, C_2H_2)
C) Cycloalkanes have the same general formula as alkenes: C_nH_{2n} $\rightarrow$ True
D) Aromatic hydrocarbons always contain a benzene ring with alternating single and double bonds. $\rightarrow$ True

12. Which of the following statements about functional groups and IUPAC nomenclature are correct?
A)The suffix "-ol" is used for alcohols, and when naming an alcohol, the parent chain must include the carbon bearing the -OH group.
B)In aldehydes, the carbonyl carbon is always numbered as C1 in the parent chain, and the suffix "-al" replaces the "-e" of the alkane name.
C)For ketones, the suffix "-one" is used, and the chain is numbered to give the carbonyl carbon the lowest possible number.
D)If a molecule contains both a double bond and an -OH group, the alcohol (OH) gets priority in numbering over the double bond.

Answer:A,B,C,D

Solution:A) The suffix "-ol" is used for alcohols, and the parent chain must include the carbon bearing the -OH group. $\rightarrow$ True.
B) In aldehydes, the carbonyl carbon is always numbered as C1, and the suffix "-al" replaces "-e" of the alkane. $\rightarrow$ True.
C) For ketones, suffix "-one" is used, and chain is numbered to give carbonyl carbon the lowest possible number. $\rightarrow$ True, unless a higher priority group (like carboxylic acid, aldehyde) is present.
D) If a molecule contains both a double bond and an -OH group, the alcohol (OH) gets priority in numbering over the double bond. $\rightarrow$ True: Alcohol has higher priority than alkene in numbering (according to IUPAC, OH > C=C).

Assertion and Reason Type:

A) Both A) and (R) are true and (R) is the correct explanation of (1)
B) Both A) and (R) are true and (R) is not the correct explanation of (1)
C) A) is true but (R) is false

D) A) is false but (R) is true

13. **Assertion :** The correct IUPAC name of CH_3-CH_2-$CH(CH_3)$-CH_2-CH_3 is 3-methylpentane.
Reason : The parent chain is selected as the longest continuous carbon chain, and numbering is done to give the substituent the lowest possible number.

Answer:A

Solution:Assertion is true CH_3-CH_2-$CH(CH_3)$-CH_2-CH_3 is 3-methylpentane).
Reason is true (parent chain = longest continuous chain; numbering chosen to give substituent the lowest possible locant).
The reason correctly explains the assertion.

14. **Assertion :** The compound with formula C_4H_8 must be named as a cycloalkane if it forms a ring structure.
Reason : Cycloalkanes have the general formula C_nH_{2n}, which is different from alkanes (C_nH_{2n+2}), and ring formation reduces the number of hydrogen atoms by two.

Answer:A

Solution:Assertion is true (if a C_4H_8 molecule forms a ring, it is named as a cycloalkane — e.g., cyclobutane).
Reason is true (cycloalkanes follow C_nH_{2n}; forming a ring removes two H atoms vs. the corresponding alkane).
The reason correctly explains the assertion.

Comprehension Type:

Alkyl group :

The group formed by the removal of one hydrogen atom from all alkane molecule is called an alkyl group. Example of alkyl group are methyl group (CH_3—) and ethyl group (C_2H_5—). Methyl group (CH_3—) is formed by the removal of one H atom from methane (CH_4); and ethyl group (C_2H_5—) is formed by the removal of one H atom from ethane (C_2H_6).

15. What is an alkyl group?
A) A group formed by removing a carbon atom from an alkane
B) A group formed by removing one hydrogen atom from an alkane
C) A hydrocarbon with a double bond
D) A cyclic hydrocarbon

Answer:B

Solution:An alkyl group is formed by removing one hydrogen atom from an alkane.

16. Which of the following represents an ethyl group?
A) CH_3– B) C_2H_5– C) CH_2=CH– D) C_6H_5–

Answer:B

Solution:Ethyl group = C_2H_5–

17. How is a methyl group represented?
A) CH_3– B) CH_4– C) C_2H_5– D) CH_2–

Answer:A

Solution:Methyl group = CH_3–

Integer Type:

18. Number of 2° hydrogen atoms in n-pentane (CH_3–CH_2–CH_2–CH_2–CH_3) is _____

Answer:6

Solution:Structure:CH_3–CH_2–CH_2–CH_2–CH_3

A 2° hydrogen is attached to a 2° carbon (a carbon bonded to two other carbons).

In n-pentane:

The three middle carbons are 2° carbons.

Each 2° carbon has 2 hydrogens.

So total 2° hydrogens =3 carbons × 2 hydrogens each = 6

19. Number of 1° carbon atoms in iso-butane (CH_3–$CH(CH_3)$–CH_3) is _____

Answer:3

Solution:A 1° carbon is attached to only one carbon.

Here, the three CH_3 groups are 1° carbons.

Matrix Matching Type:

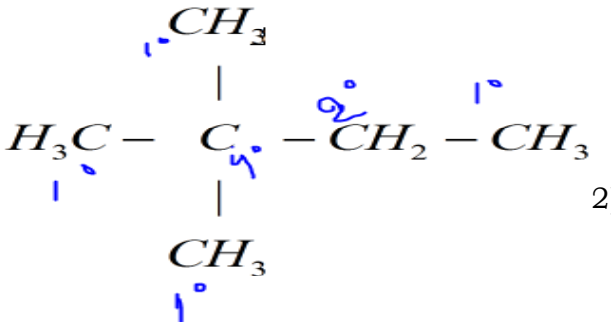
20.

LIST - 1 (compound)	LIST - 2 (type of carbons)
A) 2,2-Dimethylbutane	1)1°, 2°, 3°
B) 2,3-Dimethylbutane	2)1°, 2°, 4°
C) 3-Ethylpentane	3)Only 2° carbons
D) Cycloheptane	4)1°, 3°
	5)1°, 2°

Answer:A-2, B-4, C-1, D-3.

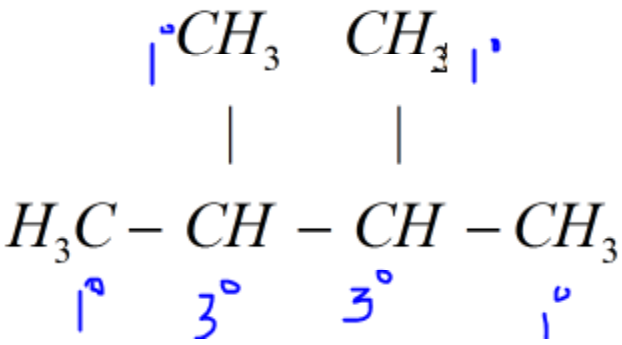
Solution:

A) 2,2-Dimethylbutane



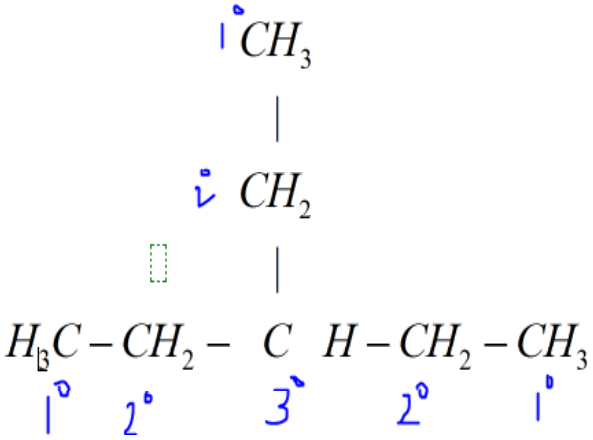
2)1°, 2°, 4°

B) 2,3-Dimethylbutane



4)1°, 3°

C) 3-Ethylpentane



1)1°, 2°, 3°

D) Cycloheptane 3)Only 2° carbons

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1. The hydrocarbon residue derived by removing a hydrogen atom from an alkyne is called:
   A)Alkenyl group B)Alkyl group C)Alkynyl group D)Aryl group

Answer:C

Solution:Removing H from alkyne → alkynyl group

2. The unsaturated hydrocarbons with C=C are called _____.
   A)Alkanes B)Alkenes C)Alkynes D)None

Answer:B

Solution:The unsaturated hydrocarbons with C=C are called Alkenes.

3. The IUPAC name of ethylene is:
   A) Ethane B) Ethene C) Ethyne D) Ethyl

Answer:B

Solution:Ethylene = common name for $H_2C=CH_2$ → IUPAC name = ethene.

4. A compound with the molecular formula C_3H_4 must contain:
   A) All single bonds B) One double bond
   C) One triple bond D) Two double bonds

Answer:C

Solution:General formula: C_nH_{2n-2} → alkyne or diene
C_3H_4 fits alkyne formula.

5. The general formula of alkene is:
   A) C_nH_n B) C_nH_{2n+2} C) C_nH_{2n} D) C_nH_{2n-2}

Answer:C

Solution:The general formula of alkene is C_nH_{2n} for one double bond.

6. Alkenes have in their molecule:
   A) Two hydrogen atoms less than in a molecule of corresponding alkane
   B) Two hydrogen atoms more than in a molecule of corresponding alkyne
   C) Four hydrogen atoms less than in a molecule of corresponding alkane
   D) The same number of hydrogen atoms as alkynes

Answer:A,B

Solution:
A) Two hydrogen atoms less than in a molecule of corresponding alkane → True (C_nH_{2n} vs C_nH_{2n+2}).
B) Two hydrogen atoms more than in a molecule of corresponding alkyne →True (C_nH_{2n} vs C_nH_{2n-2} → difference of 2 H).
C) Four hydrogen atoms less than in a molecule of corresponding alkane → False (that's alkyne vs alkane).
D) The same number of hydrogen atoms as alkynes → False.

7. The primary suffix for saturated hydrocarbons is:
   A)-ane B) -ene C) -yne D)-yl

Answer:A

Solution:The primary suffix for saturated hydrocarbons is –ane.

8. Which of the following statements is correct?
   A)Alkynes are more unsaturated than alkenes
   B)Alkenes are more saturated than alkanes
   C)Alkanes can undergo addition reactions
   D)Alkynes have the same general formula as alkenes

Answer:A

Solution:A) Alkynes are more unsaturated than alkenes → True (triple bond vs double bond).
B) Alkenes are more saturated than alkanes → False.
C) Alkanes can undergo addition reactions → False (they undergo substitution).
D) Alkynes have same general formula as alkenes → False (alkynes C_nH_{2n-2}).

9. Which of the following is a saturated hydrocarbon?
A) CH_4 B) $CH_2=CH_2$ C) C_2H_2 D) C_6H_6

Answer:A

Solution:Saturated = only single bonds $\rightarrow$ CH_4.

10. Which of the following contains a double bond?
A) CH_4 B) C_2H_6 C) C_2H_4 D) C_2H_2

Answer:C

Solution:C_2H_4= ethene has C=C double bond.

JEE MAINS LEVEL QUESTIONS

1. Which of the following compounds is an alkyne?
A) $CH_3CH_2CH_3$ B) $CH_3CH=CH_2$
C) $CH=CCH_3$ D) C_6H_6

Answer:C

Solution:$CH=CCH_3 \rightarrow C_3H_4 \rightarrow C_nH_{2n-6} \rightarrow$alkyne

2. The IUPAC name of $CH_3CH(CH_3)CH_2CH_3$ is: **(FA & SA- 5 Marks / 8 Marks)**
A) 2-Methylbutane B) 3-Methylbutane
C) 2,2-Dimethylbutane D) 3,3-Dimethylbutane

Answer:A

Solution:Longest chain: 4 carbons (butane)
Methyl on C2 $\rightarrow$ 2-methylbutane

3. The compound $CH_3C\equiv CCH_3$ is named as: **(FA & SA- 2 Marks)**
A) Butyne B) 2-Butyne C) 1-Butyne D) 3-Butyne

Answer:B

Solution:4 carbons, triple bond between C2 and C3 $\rightarrow$ 2-butyne

4. The number of primary (1°) carbon atoms in neopentane ($C(CH_3)_4$) is:
A) 1 B) 3 C) 4 D) 5

Answer:C

Solution:Neopentane C(CH3)4 has four methyl carbons; each methyl carbon is primary $\rightarrow$ 4 primary C's

5. Which of the following represents a vinyl group?
A) CH_3– B) $CH_2=CH$– C) C=CH D) C_6H_5–

Answer:B

Solution:Vinyl group: $CH_2=CH$–

6. The IUPAC name of $CH_2=CH–CH(CH_3)_2$ is:
A)2-Methylpropene B) 3-Methyl-1-butene
C) 2-Methyl-1-butene D) 3-Methylbutane

Answer:B

Solution:Interpreting $CH_2=CH–CH(CH_3)–CH_3$ (one methyl on the 3rd C of a 4-C chain) $\rightarrow$ 3-methyl-1-butene

7. A compound with molecular formula C_4H_6 could be:
A) Butyne B) Butadiene C) Cyclobutene D) All of the above

Answer:D

Solution:C_4H_6 formula fits butyne, butadiene, or a cycloalkene (e.g. cyclobutene).

8. Which of the following statements is true?
A) Alkanes are unsaturated hydrocarbons
B) Alkenes can undergo addition reactions
C) Alkynes have the same general formula as alkanes
D) Aromatic compounds always contain triple bond

Answer:B

Solution:A) False — alkanes are saturated
B) True — alkenes undergo addition
C) False — alkynes formula C_nH_{2n-2}, alkanes C_nH_{2n+2}
D) False — aromatic have benzene rings, not triple bonds

9. The hybridization of carbon atoms in propyne ($CH_3–C\equiv CH$) is:

(FA & SA- 3 Marks / 4 Marks)

A) sp^3, sp^3, sp^3 B) sp^3, sp, sp C) sp^2, sp^2, sp^2 D) sp^3, sp^2, sp

Answer:B

Solution:C in CH_3: sp^3
C in $C\equiv$: sp
C in $\equiv CH$: sp

10. The IUPAC name of $CH_3–CH_2–C\equiv C–CH_3$ is:
A) 2-Pentyne B) 3-Pentyne C) 1-Pentyne D) 2-Methylbutyne

Answer:A

Solution:Reason: $CH_3–CH_2–C\equiv C–CH_3$ is a five-carbon chain; numbering from the nearer end gives the triple bond at C-2 $\rightarrow$ pent-2-yne (2-pentyne)

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

11. Which of the following statements is/are correct?
A)Alkanes are saturated hydrocarbons with only single bonds
B)Alkenes contain at least one carbon-carbon double bond
C)Ethylene is the trivial name for ethene
D)Acetylene is the trivial name for ethyne

Answer:A,B,C,D

Solution:A) Alkanes are saturated hydrocarbons with only single bonds $\rightarrow$ True.
B) Alkenes contain at least one carbon-carbon double bond $\rightarrow$ True.
C) Ethylene is the trivial name for ethene $\rightarrow$ True.
D) Acetylene is the trivial name for ethyne $\rightarrow$ True.

12. Which of the following statements about hydrocarbon classification is/are correct?
A)Cycloalkanes have the general formula C_nH_{2n} and are saturated cyclic

compounds

B)Aromatic compounds like benzene follow Hückel's rule (4n+2 p electrons)

C)The common name for propyne is methylacetylene

D)Isopentane has the IUPAC name 2-methylbutane

Answer:A,B,C,D

Solution:A) True (though small rings have strain, but yes saturated).

B) True at a basic organic chemistry level, though this question is at an introductory stage; they might accept it as correct.

C) True ($CH_3–C\equiv CH$).

D) Isopentane has the IUPAC name 2-methylbutane $\rightarrow$ True.

Assertion and Reason Type:

A) Both A) and (R) are true and (R) is the correct explanation of (1)

B) Both A) and (R) are true and (R) is not the correct explanation of (1)

C) A) is true but (R) is false

D) A) is false but (R) is true

13. **Assertion** : IUPAC name of CH_3-$CH(CH_3)$-CH_2-CH_3 is 2-methylbutane but not 3-methylbutane.

Reason : The parent chain is numbered to give the substituent the lowest possible number.

Answer:A

Solution:2-methylbutane gives substituent the lowest possible locant 2 vs 3.

14. **Assertion** : The IUPAC name of CH_3-CH_2-$CH(CH_3)$-CH_2-$CH(CH_3)$-CH_3 is 2,4-dimethylhexane but not 3,5-dimethylhexane.

Reason : When numbering the parent chain, the sum of the locants of the substituents should be the lowest possible.

Answer:A

Solution:Numbering from the other end gives 2,4 (sum 6) which is preferred over 3,5 (sum 8)

Comprehension Type:

a) Carbon atoms can be of four types,

A carbon atom, which is attached to one or no carbon atoms is called primary (1^0) carbon atom.

A carbon atom attached two carbon atoms is called secondary (2^0) carbon atom.

A carbon atom attached to three carbon atoms is called tertiary (3^0) carbon atom.

A carbon atom attached to four carbon atoms is called quaternary (4^0) carbon atom.

b) The hydrogens attached to 1^0, 2^0 and 3^0 carbon atoms are called 1^0, 2^0 and 3^0 hydrogen atoms respectively.

1^0, 2^0 and 3^0 and 4^0 carbon atoms

15. A carbon atom that is directly bonded to three other carbon atoms is classified as:

A) Primary carbon B) Secondary carbon

C) Tertiary carbon D) Quaternary carbon

Answer:C

Solution:A carbon atom bonded to three other carbon atoms is a tertiary carbon.

16. Hydrogen atoms attached to a secondary carbon atom are called:
    A) Primary hydrogen atoms B) Secondary hydrogen atoms
    C) Tertiary hydrogen atoms D) Quaternary hydrogen atoms

Answer:B

Solution:Hydrogen atoms attached to a secondary carbon are called secondary hydrogen atoms.

Integer Type:

17. Number of carbons in the root word "Pent" is _____

Answer:5

Solution:The root word "Pent" represents 5 carbon atoms.

18. Number of hydrogen atoms in an alkane with root word "Hept" is _____

Answer:16

Solution:For an alkane with root word "Hept", the number of carbons = 7.

General formula of alkane = C_nH_{2n+2}

So for n = 7:

H = 2(7) + 2 = 16

Matrix Matching Type:

19.

LIST-I (Compound)	LIST-II (Hydrocarbon Type)
i) $CH_3–CH_2–CH_3$	p) Alkane
ii) $CH_3–CH=CH_2$	q) Alkene
iii) $CH\equiv CH$	r) Alkyne
iv) C_6H_6	s) Aromatic

Answer:i-p,ii-q,iii-r,iv-s

Solution:

i) $CH_3–CH_2–CH_3$	p) Alkane
ii) $CH_3–CH=CH_2$	q) Alkene
iii) $CH\equiv CH$	r) Alkyne
iv) C_6H_6	s) Aromatic

KEY

				TEACHING TASK					
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
A	A	A	C	C	A	A	A	A	A
			JEE ADVANCED LEVEL QUESTIONS						
11	12	13	14	15	16	17	18	19	
A,B,C,D	A,B,C,D	A	A	B	B	A	6	3	
20-A-2, B-4, C-1, D-3.									
				LEARNERS TASK					
			CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)						
1	2	3	4	5	6	7	8	9	10
C	B	B	C	C	A,B	A	A	A	C
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
C	A	B	C	B	B	D	B	B	A
			JEE ADVANCED LEVEL QUESTIONS						
11	12	13	14	15	16	17	18	19	
A,B,C,D	A,B,C,D	A	A	C	B	5	16	i-p,ii-q,iii-r,iv-s	