CHAPTER

3

Degree of Carbon & Hydrogen, Alcohol & Amine

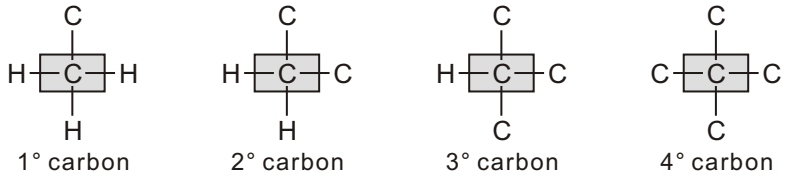
DEGREE OF CARBON AND HYDROGEN IN HYDROCARBON

DEGREE OF CARBON

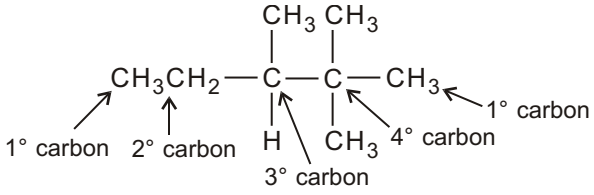
Carbon atoms in alkanes and other organic compounds are classified by the number of other carbons directly bonded to them.

1º or Primary	2º or Secondary
3º or Tertiary	4º or Quaternary

CLASSIFICATION OF CARBON ATOMS

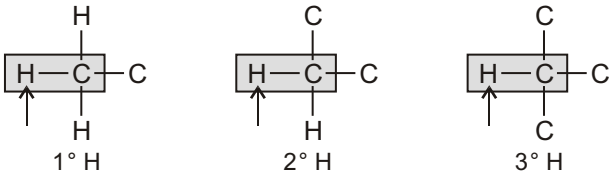


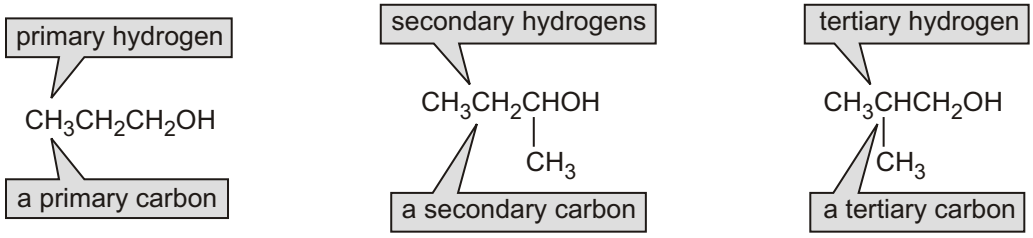
Solved Example



CLASSIFICATION OF HYDROGEN ATOMS

Like the carbons, the hydrogens in a molecule are also referred to as primary, secondary, and tertiary. **Primary hydrogens** are attached to a primary carbon, **secondary hydrogens** are attached to a secondary carbon, and **tertiary hydrogens** are attached to a tertiary carbon.

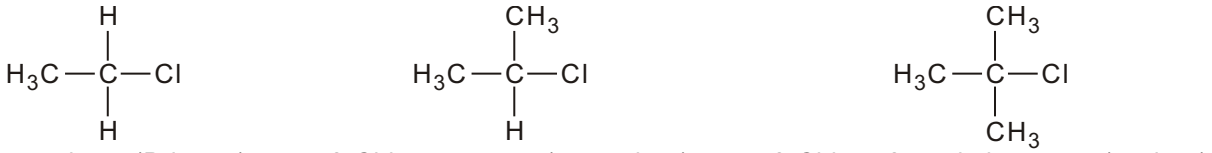




DEGREE OF CARBON IN ALKYLHALIDE

Alkyl halides are classified as primary, secondary and tertiary alkyl halides depending on whether the halogen atom is attached to a primary, secondary or tertiary carbon atom respectively.

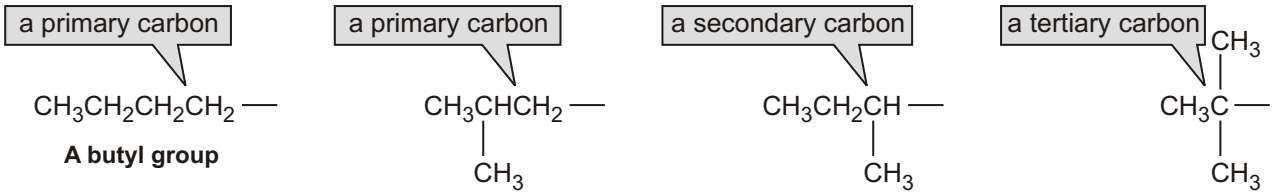
For example



Chloro ethane (Primary) | 2-Chloro propane (secondary) | 2-Chloro-2-methyl propane (tertiary)

Aromatic halogen compounds or halo arenes are the halogen compounds which contain atleast one aromatic ring.

There are four alkyl groups that have four carbons. Two of them, the butyl and isobutyl groups, have a hydrogen removed from a primary carbon. A *sec* -butyl group has a hydrogen removed from a secondary carbon (*sec*- , sometimes abbreviated *s*- , stands for secondary), and a *tert* -butyl group has a hydrogen removed from a tertiary carbon (*tert*-, often abbreviated *t*- , stands for tertiary). **A tertiary carbon** is a carbon that is bonded to three other carbons. Notice that the isobutyl group is the only one with an iso structural unit.

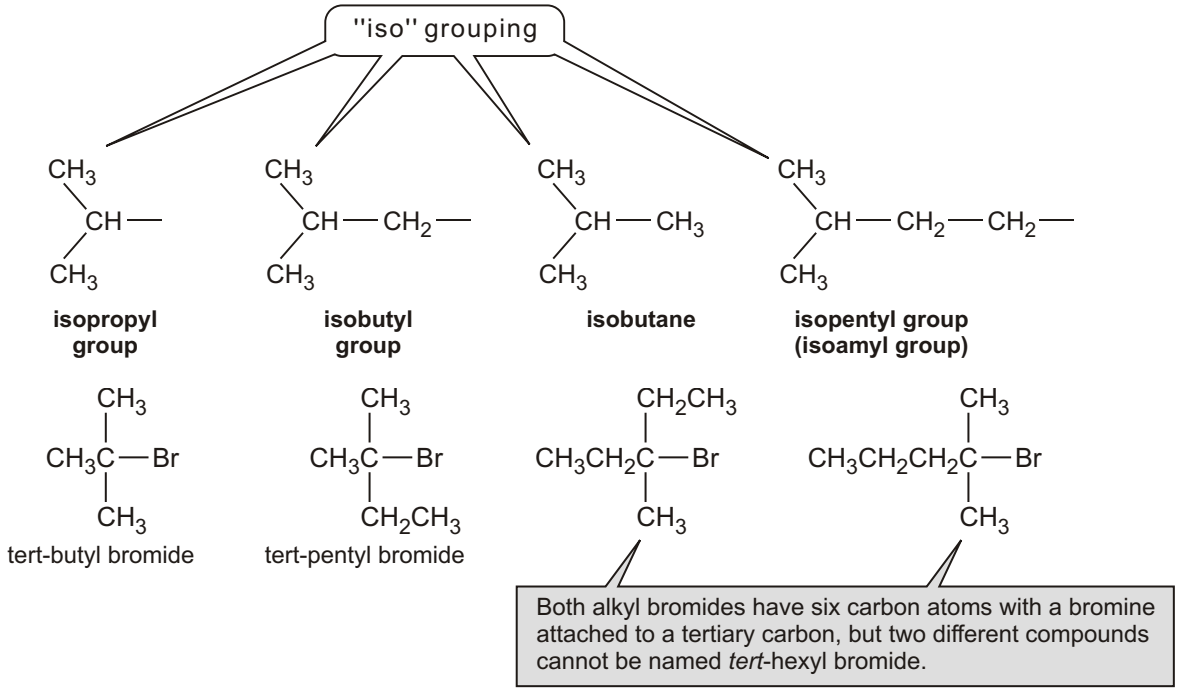


A chemical name must specify one compound only. The prefix "*sec*, " therefore, can be used only for *sec* -butyl compounds. **The name "*sec*-pentyl" cannot be used because pentane has two different secondary carbons.** Thus, removing a hydrogen from a secondary carbon of pentane produces one of two different alkyl groups, depending on which hydrogen is removed. As a result, *sec*-pentyl chloride would specify two different alkyl chlorides, so it is *not* a correct name.

Both alkyl halides have five carbon atoms with a chlorine attached to a secondary carbon, but two compounds cannot be named *sec*-pentyl chloride.

PROBLEM-SOLVING HINT

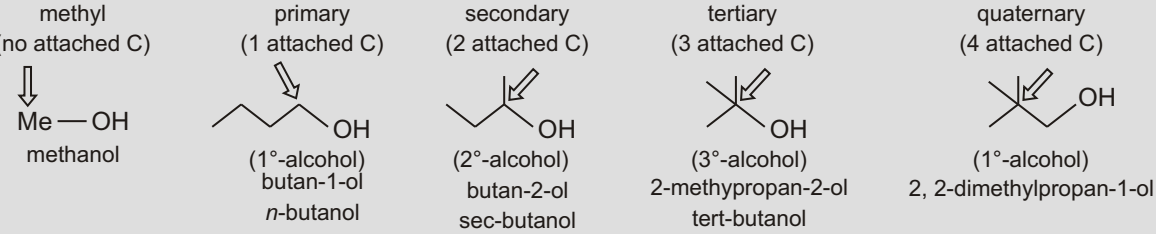
When looking for the longest continuous chain (to give the base name), look to find all the different chains of that length, Often, the longest chain with the most substituents is not obvious.



DEGREE OF ALCOHOL

- **Primary, secondary, and tertiary**

  The prefixes *sec* and *tert* are really short for secondary and tertiary, terms that refer to the carbon atom that attaches these groups to the rest of the molecular structure.

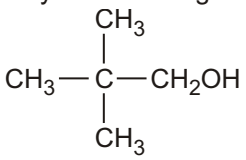


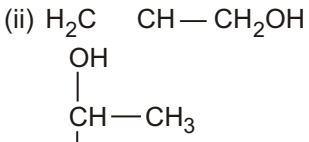
  A primary carbon atom is attached to only one other C atom, a secondary to two other C atoms, and so on. This means there are five types of carbon atom.

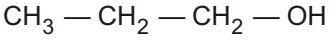
  These names for bits of hydrocarbon framework are more than just useful ways of writing or talking about chemistry. They tell us something fundamental about the molecule and we shall use them when we describe reactions.

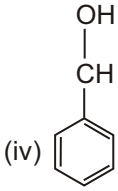
Solved Example

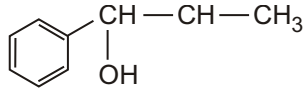
- Classify the following as primary, secondary and tertiary alcohols :

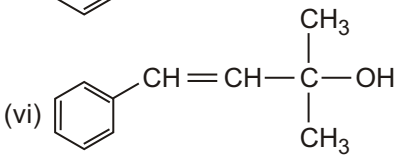
(i) 

(ii) 

(iii) 

(iv) 

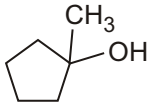
(v) 

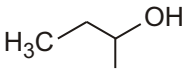
(vi) 

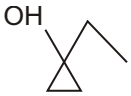
Ans. Primary alcohol (i), (ii) and (iii), Secondary alcohol (iv) and (v), Tertiary alcohol (vi)

Solved Example

- Classify the following into primary, secondary and tertiary alcohols :

(a) 

(b) 

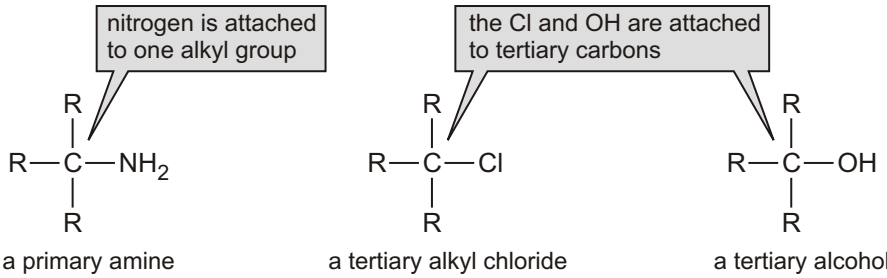
(c) 

Ans. (a) Tertiary (b) Secondary (c) Tertiary

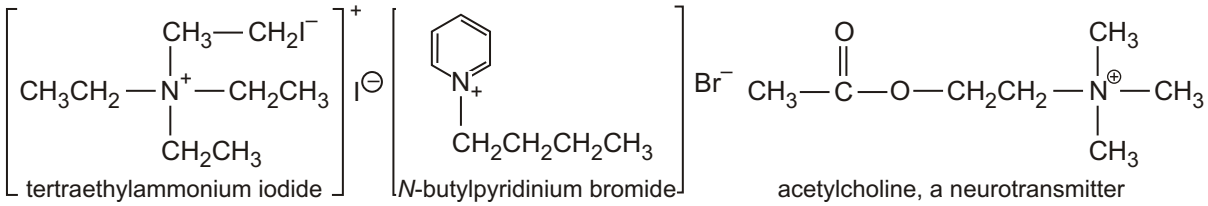
DEGREE OF AMINE

An amine is a compound in which one or more hydrogens of ammonia have been replaced by alkyl groups. Amines are classified as **primary**, **secondary**, and **tertiary**, depending on how many alkyl groups are attached to the nitrogen. Primary amines have one alkyl group attached to the nitrogen, secondary amines have two, and tertiary amines have three.

Be sure to note that the number of alkyl groups attached to the nitrogen determines whether an amine is primary, secondary,

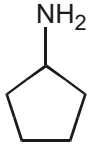


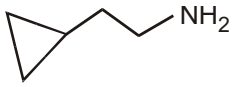
Quaternary ammonium salts have four alkyl or aryl bonds to a nitrogen atom. The nitrogen atom bears a positive charge, just as it does in simple ammonium salts such as ammonium chloride. The following are examples of quaternary (4°) ammonium salts:

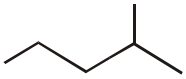


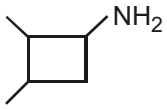
Solved Example

- Which among the following compound(s) is a primary amine with the molecular formula $C_5H_{11}N$?

(A) 

(B) 

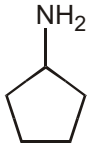
(C) 

(D) 

Ans. (A, B)

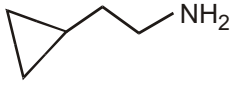
Sol. $C_5H_{11}N$; D.B.E. (5 1) $\frac{(11\ 1)}{2}$ 1

Thus, amine either be a cyclic or having double bond



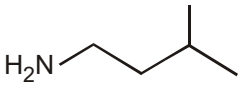
$C_5H_{11}N$

✓



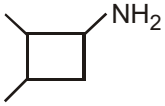
$C_5H_{11}N$

✓



$C_5H_{13}N$

×



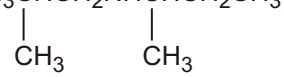
$C_6H_{13}N$

×

Solved Example

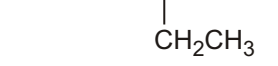
- Give a systematic name and a common name (if it has one) for each of the following amines and indicate whether each is a primary, secondary, or tertiary amine :

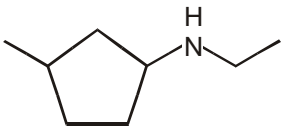
(a) $CH_3CH_2CH_2CH_2CH_2CH_2NH_2$

(b) 

(c) $(CH_3CH_2)_2NCH_3$

(d) $CH_3CH_2CH_2NHCH_2CH_2CH_2CH_3$

(e) 

(f) 

Sol. (a) Hexan-1-amine (1)

(b) N-(2-methylpropyl)butan-2-amine (2)

(c) N-ethyl-N-methylethan-1-amine (3)

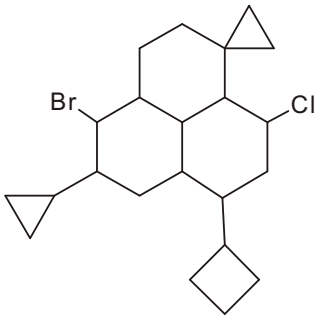
(d) N-propylbutanamine (2)

(e) N,N-diethylpropan-1-amine (3)

(f) N-ethyl-3-methylcyclopentanamine (2)

Solved Example

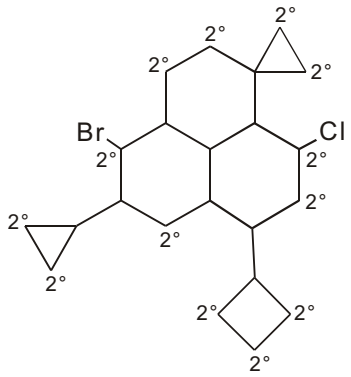
- Total number of 2° carbon present in given compound is , so the value of



is :

Ans. 13

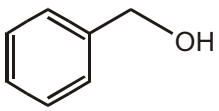
Sol.

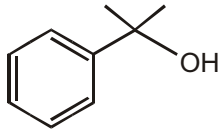


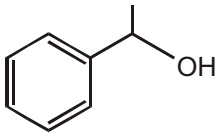
2º carbons are present = 13

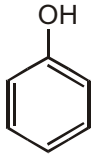
Solved Example

- Which of the following compounds is a secondary alcohol?

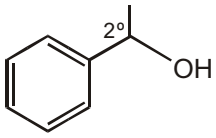
(A) 

(B) 

(C) 

(D) 

Ans. (C)

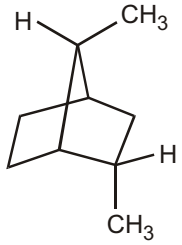
Sol. 

❑ **NOTE:** (Phenol is not alcohol).

Solved Example

- How many secondary hydrogens are present in the hydrocarbon below?

(A) 2 (B) 6
(C) 7 (D) 8
(E) 16

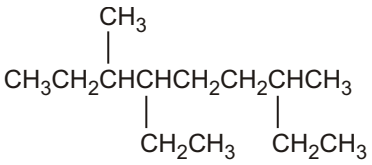
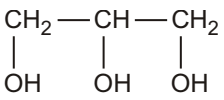
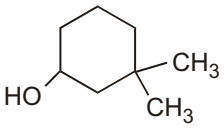
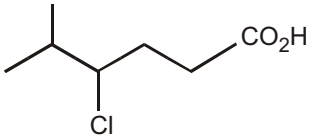
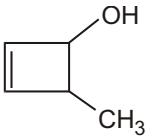
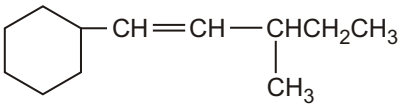
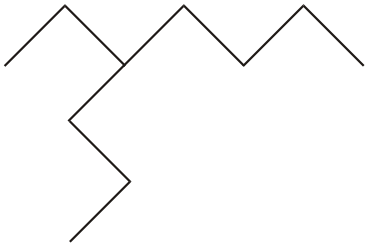
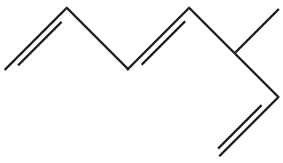
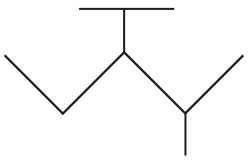


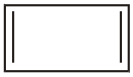
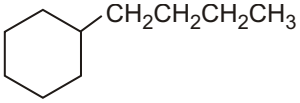
Ans. (B)

EXERCISE

WORK SHEET - 1

Count the number of primary, secondary, tertiary, quarternary carbon as well as hydrogen in given compound :

S.No.	Compound	1 C	2 C	3 C	4 C	1 H	2 H	3 H
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								

10.								
11.								

Answers

Work Sheet-1

S.No.	1 C	2 C	3 C	4 C	1 H	2 H	3 H
1.	5	5	3	0	15	10	3
2.	2	1	0	0	4	1	0
3.	2	5	0	1	6	9	0
4.	3	3	1	0	6	5	1
5.	1	3	1	0	3	3	1
6.	2	8	2	0	6	14	2
7.	3	6	1	0	9	12	1
8.	3	4	1	0	7	4	1
9.	5	1	3	0	15	2	3
10.	0	4	0	0	0	4	0
11.	1	8	1	0	3	16	1

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