Carbocations — NEET Chemistry Notes

1. Definition

A carbocation is an organic ion in which a carbon atom carries a positive charge.

Example:

$$CH_3^+$$

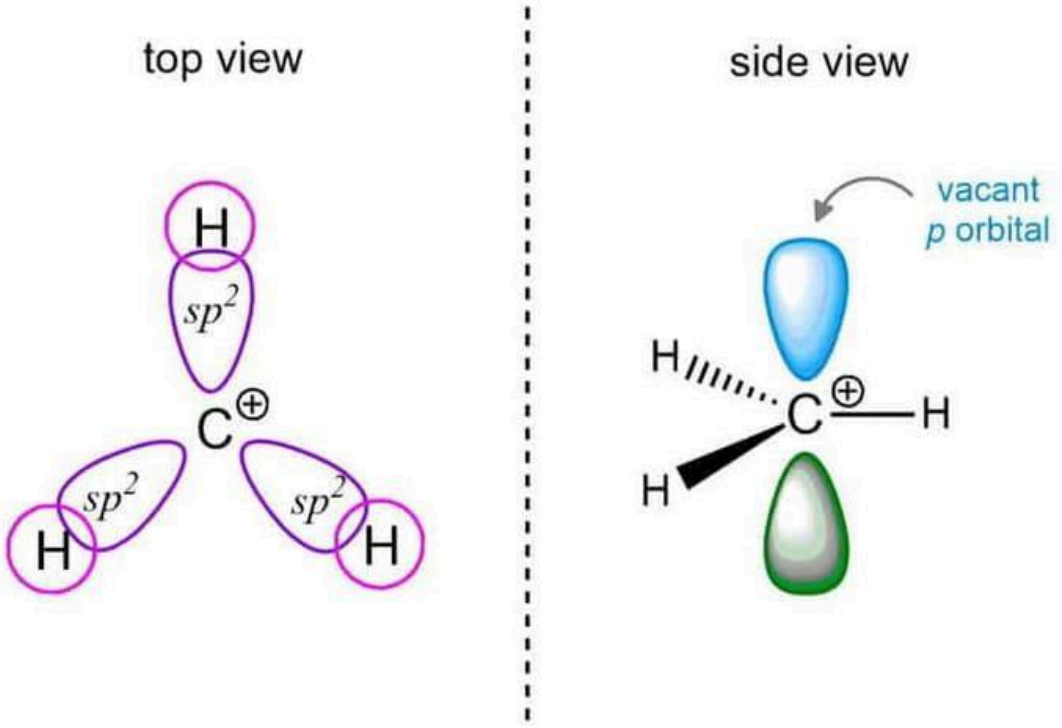
The methyl carbocation has only six electrons in its valence shell and is therefore electron-deficient.

2. Formation of carbocations

Carbocations may form by heterolytic bond fission, when both bonding electrons go to the other atom.

\[\mathrm{(CH_3)_3C-Cl \longrightarrow (CH_3)_3C^+ + Cl^-} \]

Structure of a carbocation



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- The positively charged carbon is usually sp² hybridised.
- Geometry is approximately trigonal planar.
- Bond angle is approximately 120°.
- It has an empty unhybridised p orbital.

3. Types of carbocations

Type	General structure	Example
Methyl	CH_3^+	Methyl carbocation
Primary (1°)	$R - CH_2^+$	$CH_3CH_2^+$
Secondary (2°)	R_2CH^+	$(CH_3)_2CH^+$

Tertiary (3°)	R_3C^+	$(CH_3)_3C^+$

4. Stability order of carbocations

For simple alkyl carbocations:

\[\boxed{3^\circ > 2^\circ > 1^\circ > CH_3^+} \]

Why? Two major factors stabilise carbocations:

- +I effect: Alkyl groups release electron density toward the positively charged carbon.
- Hyperconjugation: Adjacent C–H or C–C sigma bonds help delocalise the electron deficiency.

More alkyl groups generally provide greater stabilisation.

Resonance-stabilised carbocations

Resonance can make a carbocation especially stable.

Allyl carbocation

$$CH_2 = CH - CH_2^+ \leftrightarrow {}^+CH_2 - CH = CH_2$$

The positive charge is delocalised over the two terminal carbon atoms.

Benzyl carbocation

$$C_6H_5 - CH_2^+$$

The positive charge can be delocalised into the aromatic ring through resonance.

For NEET, remember that resonance stabilisation can outweigh the usual primary–secondary–tertiary comparison. Allylic and benzylic carbocations are particularly important examples.

5. Carbocation rearrangement

Carbocations may rearrange to form a more stable carbocation through:

- 1,2-hydride shift: migration of a hydrogen atom with its bonding electron pair.
- 1,2-alkyl shift: migration of an alkyl group with its bonding electron pair.

Rearrangement commonly occurs when it produces a more stable carbocation, such as converting a secondary carbocation into a tertiary one.

6. Carbocation vs free radical

Feature	Carbocation	Free radical
Charge	Positive	Usually neutral
Electron condition	Electron-deficient; typically six electrons around carbon	One unpaired electron
Formation	Often heterolytic fission	Often homolytic fission
Example	CH_3^+	$CH_3^\bullet$

NEET practice

1. What is the usual geometry of a simple carbocation?

Tetrahedral
Trigonal planar
Linear
Trigonal pyramidal

2. Which is the most stable among these simple alkyl carbocations?

CH_3^+
$CH_3CH_2^+$
$(CH_3)_2CH^+$
$(CH_3)_3C^+$

3. Which effect stabilises an allyl carbocation?

Resonance
Only steric effect
Only hydrogen bonding
Electrostatic repulsion
Reset answers