The formal charge on an atom in a covalent species is the net charge the atom would bear if the electrons in all the bonds to the atom were equally shared. Alternatively the formal charge on an atom in a covalent species is the net charge the atom would bear if all bonds to the atom were nonpolar covalent bonds. To determine the formal charge on a given atom in a covalent species, use the following formula:

\[
\text{formal charge} = \text{atomic} \times \left( \frac{\# \text{ of electrons in the inner shells} + 2 \times \# \text{ of lone pairs} + \frac{\# \text{ of electrons in bonds}}{2}}{\text{atomic number}} \right)
\]

**eg. 1: Carbon Atom in CH}_4**

\[
\begin{align*}
\text{atomic number of carbon} &= 6 \\
\text{number of inner shells in the carbon atom in CH}_4 &= 1 \text{ (shell K)} \\
\text{number of electrons in the inner shell of the carbon atom in CH}_4 &= 2 \\
\text{number of lone pairs on the carbon in CH}_4 &= 0 \\
\text{number of electrons in the bonds to the carbon atom in CH}_4 &= 2 \times 4 = 8
\end{align*}
\]

\[
\text{formal charge on the carbon atom in CH}_4 = 6 \times \left( \frac{2 + 2 \times 0 + \frac{8}{2}}{6} \right) = 0
\]

**eg. 2: Carbon Atom in CH}_3**

\[
\begin{align*}
\text{atomic number of carbon} &= 6 \\
\text{number of inner shells in the carbon atom in CH}_3 &= 1 \text{ (shell K)} \\
\text{number of electrons in the inner shell of the carbon atom in CH}_3 &= 2 \\
\text{number of lone pairs on the carbon in CH}_3 &= 0 \\
\text{number of electrons in the bonds to the carbon atom in CH}_3 &= 2 \times 3 = 6
\end{align*}
\]

\[
\text{formal charge on the carbon atom in CH}_3 = 6 \times \left( \frac{2 + 2 \times 0 + \frac{6}{2}}{6} \right) = +1
\]

**eg. 3: Carbon Atom in :CH}_3**
atomic number of carbon = 6
number of inner shells in the carbon atom in $\text{CH}_3$ = 1 (shell K)
number of electrons in the inner shell of the carbon atom in $\text{CH}_3$ = 2
number of lone pairs on the carbon in $\text{CH}_3$ = 1
number of electrons in the bonds to the carbon atom in $\text{CH}_3$ = 2 x 3 = 6
formal charge on the carbon atom in $\text{CH}_3$ = 6 $-\left[2 + 2 \times 1 + \frac{6}{2}\right] = -1$

see also coordination number, oxidation number

Contributors

- Gamini Gunawardena from the OChemPal site (Utah Valley University)