Organic Chemistry

Determining Degrees of Unsaturation

Degrees of Unsaturation from Structure
- A degree of unsaturation corresponds to a deficiency of 2H from a molecule.
- Double Bond = 1 Unsaturation
- Ring = 1 Unsaturation
- Triple Bond = 2 Unsaturations

Degrees of Unsaturation from Structure
- 1) Formula containing carbon and hydrogen only.
  \[
  \text{# Unsaturations} = \frac{\text{Saturated # of H} - \text{Unsaturated # of H}}{2}
  \]
- Ex: \( \text{C}_8\text{H}_{10} \)

Degrees of Unsaturation from Formula
- 1) Formula containing carbon and hydrogen only.
- Ex: \( \text{C}_8\text{H}_{10} \)
Degrees of Unsaturation from Formula

2) Formula containing halogens.
   • Add 1H for each halogen present

   Ex: $C_6H_{10}Cl_2$

$$\text{# Unsaturations} = \frac{\text{Saturated # of H} - \text{Unsaturated # of H}}{2}$$

Degrees of Unsaturation from Formula

3) Formula containing nitrogen.
   • Subtract 1H for each nitrogen present

   Ex: $C_5H_{11}N$

$$\text{# Unsaturations} = \frac{\text{Saturated # of H} - \text{Unsaturated # of H}}{2}$$

Degrees of Unsaturation from Formula

4) Formula containing oxygen.
   • Just ignore the oxygen

   Ex: $C_{10}H_{18}O_2$

$$\text{# Unsaturations} = \frac{\text{Saturated # of H} - \text{Unsaturated # of H}}{2}$$

Combined Example

Ex: $C_8H_7NOBr_2$
Summary

**Determining Unsaturations from a Structure**
- Double Bond = 1 Unsaturation
- Ring = 1 Unsaturation
- Triple Bond = 2 Unsaturations

**Determining Unsaturations from a Formula**
Use the general formula:

\[
\text{# Unsaturations} = \frac{\text{Saturated # of H} - \text{Unsaturated # of H}}{2}
\]

Determine the number of saturated H using:

- **Halogen**: add 1H to formula for each halogen.
- **Nitrogen**: subtract 1H from formula for each nitrogen.
- **Oxygen**: just ignore any oxygen in the formula.

**Saturated # of H**: \( C_nH_{2n+2} \)