Degrees of Unsaturation (DU):

1. The number of rings or pi bonds a given molecular formula can have. For a molecule with $C$ carbons, $H$ hydrogens, $X$ halogens, and $N$ nitrogens:

$$DU = C - \frac{1}{2}(H + X) + \frac{1}{2}(N) + 1$$

Consider a typical problem:

Compound $X$ has molecular formula $C_{13}H_{19}N$. When hydrogenated using excess hydrogen, it gives a new compound, $Z$, with molecular formula $C_{13}H_{23}N$. How many pi bonds and how many rings does compound $X$ have?

$$DU_X = 13 - \frac{1}{2}(19) + \frac{1}{2} + 1 = 5 \ [ \text{rings + pi bonds} ]$$

$$DU_Z = 13 - \frac{1}{2}(23) + \frac{1}{2} + 1 = 3 \ [ \text{rings} ]$$

$$(DU_X) - (DU_Z) = 5 \ [ \text{rings + pi bonds} ] - 3 \ [ \text{rings} ] = 2 \ [ \text{pi bonds} ]$$

So, the constitution of $X$ includes 3 rings and 2 pi bonds.