Index of hydrogen deficiency (IHD)

A saturated hydrocarbon with no rings would have the maximum number of H atoms, i.e., $C_nH_{(2n+2)}$. If any of the bonds are replaced with double or triple bonds, or if rings are involved, there would be a “deficiency” of H atoms. By calculating the index of hydrogen deficiency (IHD), we can tell from the molecular formula whether and how many multiple bonds and rings are involved. This will help cut down the possibilities of possible isomers of a given formula. Here is a summary of how the index of hydrogen deficiency (IHD) works.
A double bond and ring each counts as one IHD. A triple bond counts as two IHD.

Compound (CxHy): \[ \text{IHD} = \frac{2x + 2 - y}{2} \]
(where x and y stand for # of C and H respectively.)

Compounds Containing Elements Other than C and H:
O and S atoms do not affect the IHD.
Halogens (F, Cl, Br, I) are treated like H atoms. (CH₂Cl₂ has the same IHD as CH₄.)
For each N, add one to the number of C and one to the number H.
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(CH₅N is treated as C₂H₆. CH₄N₂O is treated as C₃H₆ by adding 2 to # of C and 2 to # of H.) Do not forget that when double bonds and rings are involved, geometric isomers are possible.

Practice problems: Calculate the IHD for each of the following and see whether it corresponds to the structure shown. (Obviously it should!) Don’t peek until you’ve worked it out yourself, but answers are provided at the bottom.

a) CH₃CH=CHCH₂CH=CH₂

b) CH₃OCOCH₂Cl

c) CH₃C≡CCOCH₃

Answers:

a) IHD = 2

b) IHD = 1

c) IHD = 3