SL & HL Answers to Index of hydrogen deficiency questions

1. C_6H_{12} fits the general formula for an alkene so it could be an alkene (an isomer of hexene) but it could also be cyclohexane as cycloalkanes also have an IHD of 1.

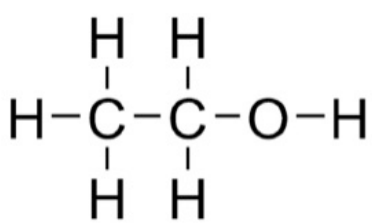
2. Number of C atoms = 6
Number of H atoms = 6
O does not affect the IHD
Therefore IHD = ½ ((2 x 6) +2 – 6) = 4

3. Both1,2-dichlorethane and ethane are non-cyclic and both have four single bonds around the two carbon atoms.

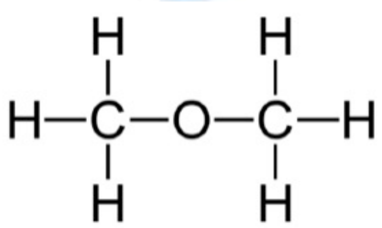
4. Ethylamine, $C_2H_5NH_2$ is non-cyclic and contains only single bonds so the IHD is zero.
To calculate this value using the formula: for nitrogen you need to add one to the number of carbon atoms and one to the number of hydrogen atoms so IHD = ½ ((2 x 3) +2 – 8) = 0

5. Number of carbon atoms in α-carotene = 40
Number of hydrogen atoms in α-carotene = 56
IHD = ½ ((2 x 40) +2 – 56) = 13
You can see this directly from the structure. There are two rings, each of which contributes 1 to the IHD, and eleven double bonds making a total IHD of 13.

6. (a)



and



(b) The IHD cannot be used to distinguish between the isomers as both have a value of zero. Spectroscopy can. For example, ethanol will have a broad absorption at about 3200 – 3600 cm^{-1} due to the –OH group in its IR spectrum which will be absent for dimethyl ether. Methoxymethane (dimethyl ether) will give one signal in its ^1H NMR spectrum whereas ethanol will give three. Ethanol will show a fragment with an *m/z* of 29 in its mass spectrum due to $C_2H_5^+$ whereas methoxymethane will show a fragment with an *m/z* of 31 due to CH_3O^+.

7. (a) To calculate this value using the formula: for nitrogen you need to add one to the number of carbon atoms and one to the number of hydrogen atoms so IHD = ½ ((2 x 18) + 2 – 20) = 9

(b) There are five rings and four double bonds each of which require one unit of H_2 to saturate making 9 in total.