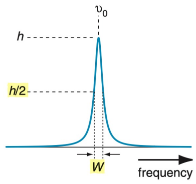
2/2 Well done!

Jigsaw 13

Keeler Section 2.2. Linewidths, lineshapes and i

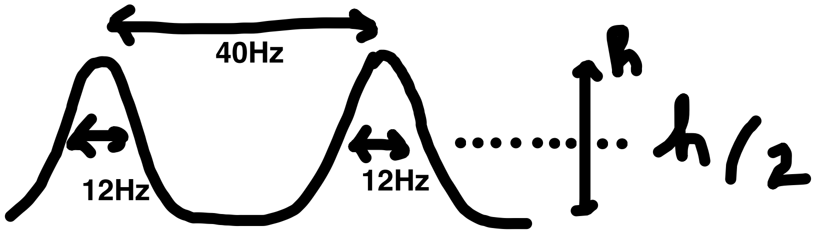
1. Explain how the linewidth of an absorption



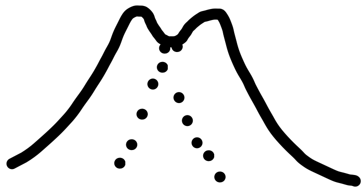
The linewidth W is the width at half the height h/2 of the maximum. First one needs to determine the frequency on either side of v_0 where the signal intensity equals h/2, and then the difference between these two frequencies is the linewidth W = v_2 - v_1, in Hz.

2. Draw schematically the ^{1}H doublet ... 12 Hz ... linewidth of ... cases where the separation between the two

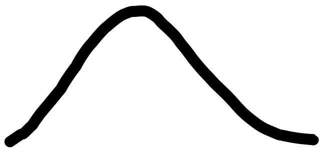
a. 40 Hz



b. 12 Hz



c. 6 Hz



d. What happens to the signal in (c)?

The two peaks are so close that they merge into one broader line -> the merged signal looks like a single peak of about the same total area (same total intensity) but lower height

3. If you have a peak ^{1}H ... increasing ... what is th... intensity of the peak? What is the linewidth in

The integral (area) under the peak corresponds to the number of contributing nuclei -> so it stays constant for a given proton

here linewidth increases, hence the same area is spread over a wider frequency range -> the peak height has to decrease for the area to stay the same (the line becomes shorter and broader)

the signal-to-noise ratio (S/N) worsens, because lower height makes the peak harder to distinguish from the noise

2/2 Good job!

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Jigsaw 1B

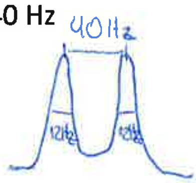
Keeler Section 2.2. Linewidths, lineshapes and integrals

1. Explain how the linewidth of an absorption mode lineshape is measured.

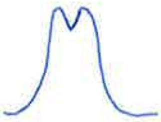
It is measured as the frequency difference between the two points on either side of the resonance peak where the intensity is half the maximum.

2. Draw schematically the signal expected from a ^1H doublet with a 12 Hz linewidth, for cases where the separation between the two peaks in the doublet is:

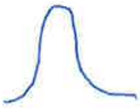
a. 40 Hz



b. 12 Hz



c. 6 Hz



d. What happens to the signal in (c)?

The two components merge into ~~a~~ singlet-like line. The apparent line is broader than 12Hz

3. If you have a peak corresponding to a single ^1H in a molecule, what happens to the intensity of the peak as the linewidth increases? Why?

As the linewidth increases, the peak intensity decreases, but the total intergrated area remains constant, because the same signal is distributed over a broader frequency range.

2/2 Nice work!

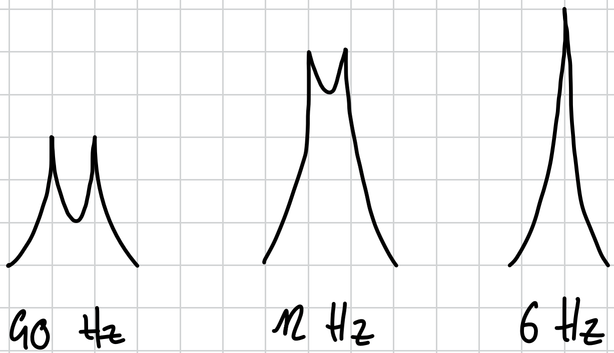
Jigsaw 1B

Exo 1

The lineshape is entirely positive and symmetrical about the maximum. Therefore, the linewidth is measured at half-height.

Exo 2

40 Hz peaks should have little/no overlap



The signal at 6 Hz is half of the linewidth, therefore the two peaks are no longer visually distinct and only one peak is seen.

Exo 3

As the linewidth increases, the intensity of the peak will decrease, since the area under the peak (the integral) should remain the same.

2/2 Good work!

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Jigsaw 1B

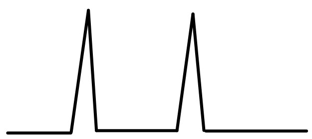
Keeler Section 2.2. Linewidths, lineshapes and integrals

1. Explain how the linewidth of an absorption mode lineshape is measured.

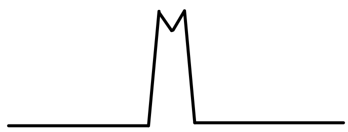
   The linewidth is measured at half-height maximum

2. Draw schematically the signal expected from a ^{1}H doublet with a 12 Hz linewidth, for cases where the separation between the two peaks in the doublet is:

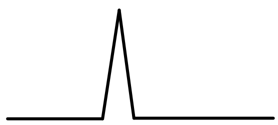
   a. 40 Hz

   b. 12 Hz

   c. 6 Hz

   d. What happens to the signal in (c)?

   The coupling constant line is thiner than the line width of the peak thus it doesn't appear anymore

3. If you have a peak corresponding to a single ^{1}H in a molecule, what happens to the intensity of the peak as the linewidth increases? Why?

   the intensity will decrease because the integral for 1H has to stay identical