

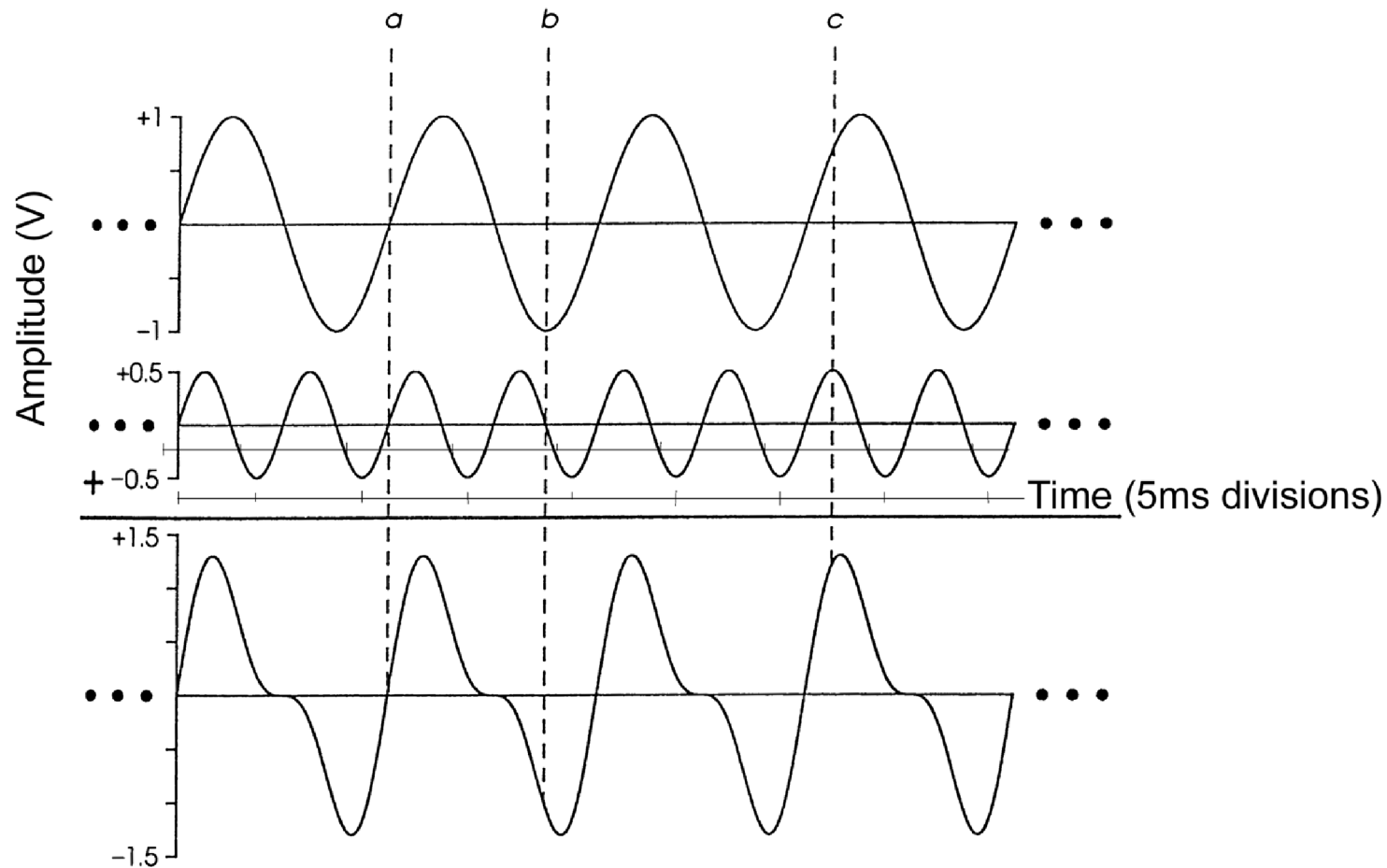
AUDL 4007

Auditory Perception

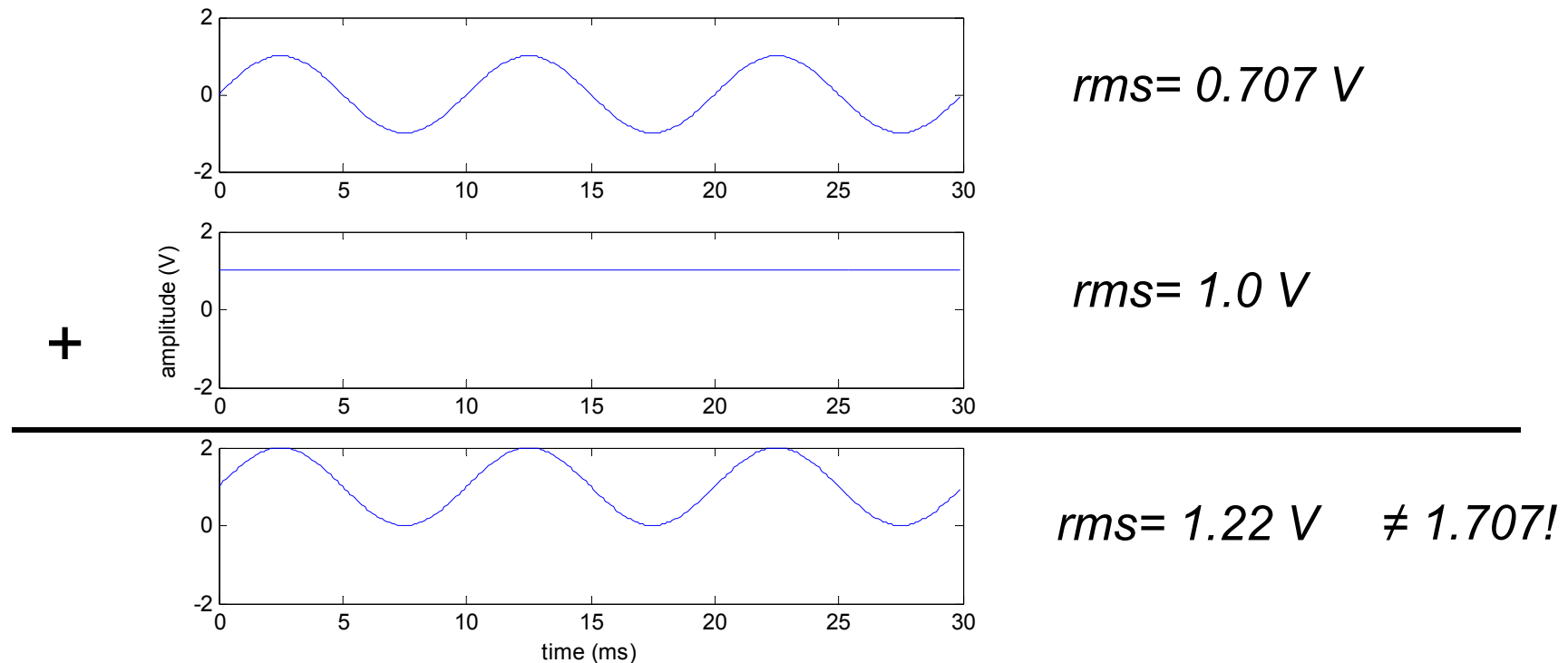
Week 1½

Technical preludes:
Adding up levels + SNRs

*You know about adding up waves, e.g.
from two loudspeakers*



But how do you get the total rms from the rms values of two signals that are added?



*Conclusion: you don't add them!
(the squaring for rms is non-linear)*

Powers & intensities *do* add

power/intensity \sim voltage²/pressure²

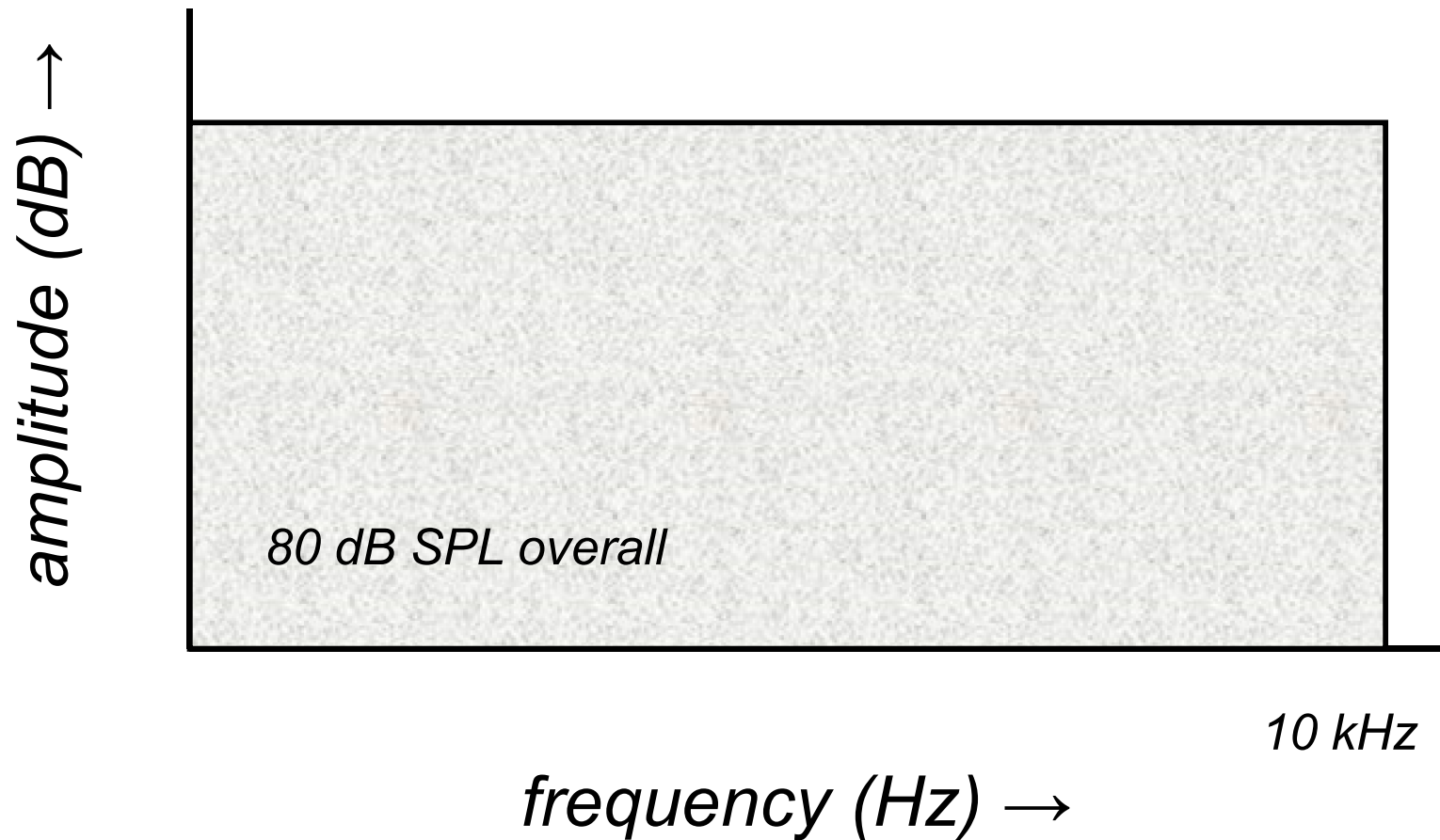
no need to worry about constant of proportionality

$$\sqrt{0.7072^2 + 1^2} = \sqrt{0.5+1.0} = \sqrt{1.5} = 1.22$$

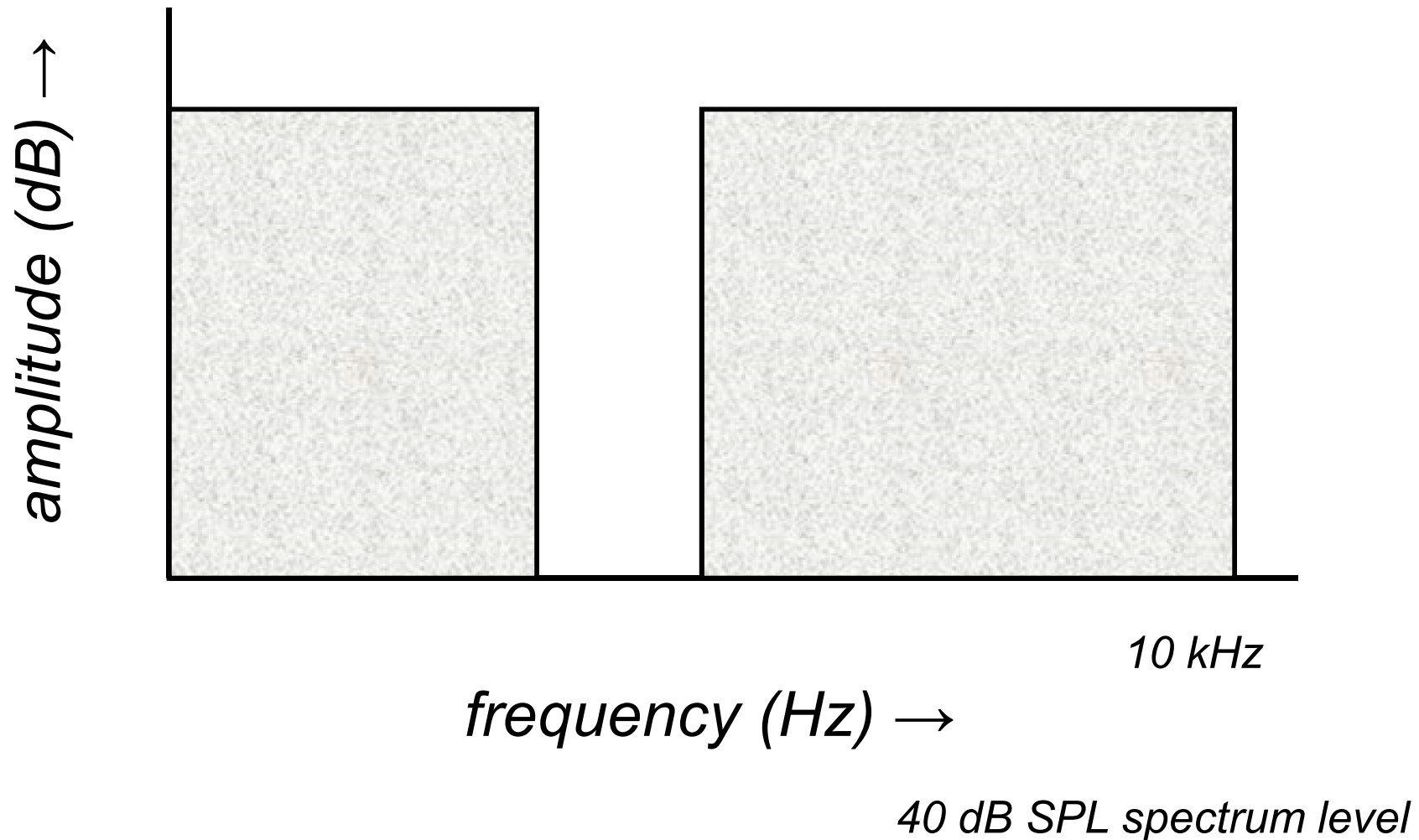
This holds true as long as the two signals
do not overlap in spectrum

What can happen when you add a 1-V 1-kHz sine wave to another 1-V 1-kHz sinusoid?

Specifying levels for noises: signals with *continuous* spectra



Specifying levels for noises: signals with *continuous* spectra



Specifying levels for noises signals with *continuous* spectra

- spectrum level
 - measured within a 1 Hz band
- overall level
 - summed over the whole spectrum
- converting between measures has to be done in terms of *power*, not amplitude.

Converting between measures

- Suppose the spectrum level of noise was 40 dB SPL
 - measured within a 1 Hz band
- What would be the overall level of a noise ranging from 100 - 1100 Hz?
- Convert 40 dB SPL to intensity, then add together 1000 times (multiply by 1000)
- $\text{overall} = \text{spectrum level} + 10 \log(\text{BW})$
 - here, $40 + 10 \log(1000) = ?$
- $\text{spectrum level} = \text{overall} - 10 \log(\text{BW})$

Signal-to-Noise Ratio (SNR)

- Literally ...
 - rms level of signal/rms level of noise
- usually expressed in dB
 - $20 \log_{10}(\text{signal/noise})$
- Nothing implied about the form of the signal or noise
 - the signal is what you are interested in (*e.g.*, a tone, a band of noise, a word, a sentence)
 - the noise is everything else (*e.g.*, a tone, car noise, speech from other people)

Various SNRs for a sentence in speech-shaped noise

SNR of +40 dB?



SNR of -40 dB?



SNR of 0 dB?



Intelligibility for a particular SNR depends on many factors

*SNR of -10 dB for
speech-shaped noise*



*SNR of -10 dB for a
single male talker in
the background*

