

## Rak-43.3415 Building physical design 2 - Acoustical design

Autumn 2015

Exercise 1. Assignments.

1.

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- Sound pressure of normal speech at 1 m distance is 0,02 Pa. Calculate sound pressure level.
- What is the sound pressure corresponding to threshold of pain?
- Calculate the corresponding sound power when the acoustical power of a loudspeaker is 0,8 W.
- What is the intensity level of the loudspeaker at a 3 m<sup>2</sup> surface? What about when the surface area is 1 m<sup>2</sup>?

2.

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Calculate the total sound level caused by sound sources having the following sound levels:

- 50 dB, 50 dB
- 59 dB, 61 dB ja 72 dB
- 0 dB, 0 dB
- 1 dB, -10 dB

3.

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What is the total sound power (linear and A-weighted) of a video projector when the linear sound power level in octave bands is as follows?

Taajuus [Hz]	125	250	500	1000	2000	4000
Lineaarinen äänitehotaso $L_w$ [dB]	35	39	41	43	42	39

Linear sound power level

4.

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- Calculate the sound pressure level of the loudspeaker in assignment 1 at 5 m distance outside at ground surface. Do the calculation in octave bands 125-4000 Hz and also calculate the total sound level. Show how much the SPL decreases when distance doubles. Assume that the loudspeaker is a point source and that the sound power level is equal at all frequency bands.
- What is the A-weighted SPL of projector in assignment 3 in octaves 125-4000 Hz and the total SPL in an auditorium 4 m from the source. What about 8 m from the source? Assume that the projector acts as a point source, absorption area of the auditorium is 10 m<sup>2</sup>-Sab at all frequencies.

5.

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Manufacturer states that the noise level caused by its mechanical input and extract ventilation unit (LTO-kone) is  $L_{p,A,10m^2} = 29$  dB. To which space can the unit be positioned in an apartment so that the noise level regulations are satisfied? Use the permitted noise levels given in RakMK D2-2010 (Finnish Building Code Section D2, see [www.ymparisto.fi](http://www.ymparisto.fi)). Absorption areas are given in brackets.

- makuuhuone / bed room (10 m<sup>2</sup>)
- kylpyhuone / bath room (1 m<sup>2</sup>)
- kodinhoitohuone / utility room (4 m<sup>2</sup>)
- keittiö / kitchen (4 m<sup>2</sup>)
- olohuoneeseen aukeava avokeittiö / kitchen opening to living room (4 m<sup>2</sup>)

6.

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Your assignment as an acoustician is to choose the most silent compressor of three models when you are given the following acoustic data from the manufacturers:

Compressor A: "Sound power level is 95 dB."

Compressor B: "Sound level measured at a distance of 10 m from the source is 80 dB. Measurement conducted outside."

Compressor C: "Sound level is 80 dB. Measurement conducted in a 250 m<sup>3</sup> room with a reverberation time of 1,6 s."

Which compressor would you choose?

The frequency distribution of all compressors is reported to be as follows:

Frequency [Hz]	125	250	500	1000	2000	4000
Correction in octave bands [dB]	-2	-4	-6	-8	-10	-20