Exercise 3

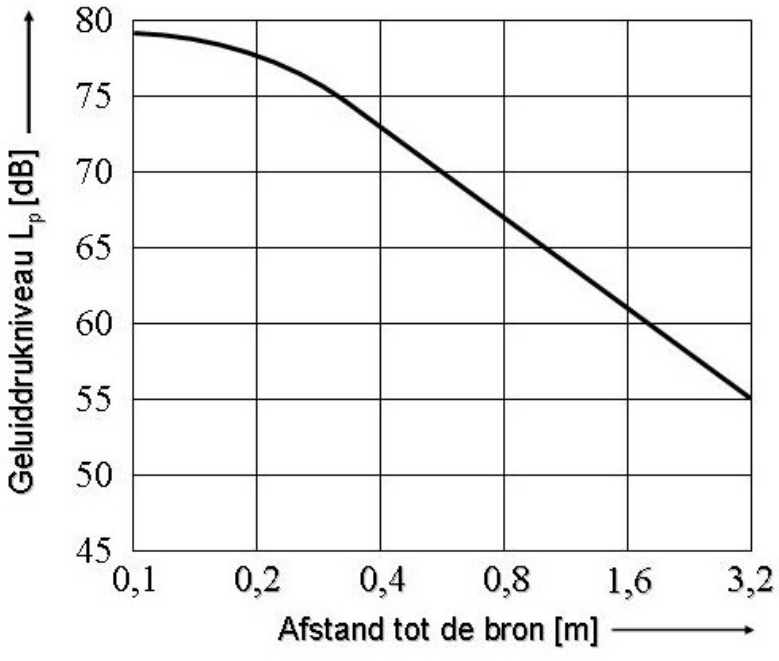
The speech intelligibility in a church is bad. The background noise (BGN) is not the reason. The problem is caused by the direct/diffuse field ratio. To improve the speech intelligibility in this church a sound system consisting of a microphone, an amplifier and a single driver loudspeaker box (box with one loudspeaker) is used. The first test of the new system shows no improvement of the speech intelligibility.

A: What is the reason that the use of the sound system is not the solution for the problem?
B: Mention 2 possible practical solutions to improve the speech intelligibility (increasing the 'direct/diffuse ratio') without using a sound system.
C: Mention a solution to improve the speech intelligibility (increasing the 'direct/diffuse ratio') using a sound system. (Describe the sound system!)

Exercise 4

The graph below is a result of a free field loudspeaker measurement in a large hall.

A: What is the sound power level Lw [dB] of the loudspeaker if the directivity factor Q is equal to 2?
B: At what distance is the sound power of the sound source equal to the sound pressure level?
C: Mention a reason why the line isn't straight for distances less than 40 cm?
D: What is the sound pressure level at the critical distance if the diffuse field sound pressure level is 50 dB? What is the critical distance value?



Geluidrukniveau = Sound pressure level
Afstand tot de bron = Source receiver distance

Exercise 5

The proud owner of a new set of loudspeakers claims that, according to him, one box can "produce 100 watts of sound energy". The boxes are in his living room. This room has a volume of 100 m^3 and a reverberation time is 0.5 s for all frequency bands. The presumed directivity factor Q = 1 (omnidirectional).

A: What is the sound pressure level at a distance of 5 m from that box if the sound power is really 100 watt,? Discuss the calculated result.
(sound power level $L_W = 10\lg(W/W_0)$ dB, $W_0 = 10^{-12}$ watt)

The just noticeable difference (JND = Just Noticeable Difference) between two sound pressure levels of noise-like sounds is 1 dB.

B: How many extra power do you need to produce 1 dB more sound at the same listener position?

In the same listening room another loudspeaker box of 40 watt produces the same sound level as the 100 watt box. Source position, listener position and level knob (amplifier) position are equal comparing the first situation.

C: Mention 2 reasons!

FORMULAS (without explanation and without dimension)

$$c = \lambda f = 340$$

$$L_p = 10 \lg \frac{p_{eff}^2}{p_0^2}$$

$$L_W = 10 \lg \frac{W}{W_0}$$

$$L_I = 10 \lg \frac{I}{I_0}$$

$$L_{pdir} = L_W + 10 \lg \left(\frac{Q}{4\pi r^2} \right)$$

$$L_{pdiff} = L_W + 10 \lg \left(\frac{4}{A} \right)$$

$$L_p = L_W + 10 \lg \left(\frac{Q}{4\pi r^2} + \frac{4}{A} \right)$$

$$A = \sum (\alpha \cdot Opp)$$

$$T = \frac{V}{6A + 4mV}$$

$$r_k = \sqrt{\frac{QA}{16\pi}}$$

ref. values:
$p_0 = 2 \times 10^{-5}$
$W_0 = 10^{-12}$
$I_0 = 10^{-12}$