



# ! Answers: "Acoustic Knowledge" - English 1

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1. What is the difference in the propagation of sound waves and electromagnetic waves?

Sound waves are bound to a propagation medium (air), electromagnetic waves require no propagation medium.

2. What does the speed of sound depend on?

The sound velocity depends only on the temperature and the propagation medium.

3. What is the speed of sound  $c$  in the medium air at 20°C and at 0°C?

At 20°C, the speed of sound  $c_{20} = 343$  m/s and at 0°C the speed is lower with  $c_0 = 331$  m/s.

4. How many centimeters path length does the sound change in a second when the temperature increases 1 degree?

At 1°C increase of temperature the path length of sound increases by 60 cm. ( $c = 331 + 0,6 \cdot \vartheta$  Temperatur  $\vartheta$  in °C).

5. What is the speed of propagation of electromagnetic waves and of light waves in vacuum?

Both types of waves have the same size:  $c = 299,792,458$  m/s (constant), that is about 300,000 km/s.

6. What is meant by sound pressure?

The sound pressure  $p$  is the alternating pressure variation superimposed to the atmospheric static pressure of the air.

7. What sound pressure receivers do you know?

That are omnidirectional microphones and even our human ears.

8. What is meant by sound velocity?

The sound velocity or the particle velocity is the change rate of the medium such as air particles around their rest position. It is perpendicular to the propagation of the speed of sound.  $v = p / Z_0$  und  $Z_0 = \rho \cdot c$

9. Microphone developers are familiar with the term "pressure gradient". What does this term mean?

It is the "pressure difference between front and rear of the microphone diaphragm." The sound pressure falls from a certain direction on the microphone and the microphone membrane itself forms the pressure gradient.

10. What are the various sound levels and their reference sizes? Name four of them.

Sound level	Reference quantity (field quantity as rms value)
1. Sound pressure level $L_p$	$p_0 = 2 \cdot 10^{-5} \text{ N / m}^2 = 2 \cdot 10^{-5} \text{ Pa}$
2. Sound velocity $L_v$	$v_0 = 5 \cdot 10^{-8} \text{ m / s}$
3. Sound power level $L_w$	$P_0 = 10^{-12} \text{ W}$
4. Sound intensity level $L_J$	$J_0 = 10^{-12} \text{ W / m}^2$

11. A sound pressure of  $p = 0.5 \text{ N/m}^2 = 0.5 \text{ Pa}$  is measured by a microphone. How much is the sound pressure level  $L_p$ ?

$L_p = 20 \cdot \log(0,5 / 2 \cdot 10^{-5}) = 88 \text{ dB}$ . or  $1 \text{ Pa} = 94 \text{ dB}$ . And  $94 \text{ dB}$  minus  $6 \text{ dB} = 88 \text{ dB}$ .

12. How can the sound propagation be affected?

By sound reflection, sound absorption and sound insulation.

13. What is meant by the word "level or a measure", and what use is the introduction of these calculation sizes?

Level and measures are logarithmic ratios of quantities of the same unit and with very different sizes. The handling of these variables is improved significantly by this logarithmic ratio.

14. How do the curves of equal loudness level differ from the rating curves like dBA?

Curves of equal loudness level curves show the loudness impression in phone. Rating curves are mirror-image approximations of certain curves of equal loudness. Used are sound level meters with different rating curves such as dBA or CCIR 468 (DIN 45405).

15. What level of compensation does the A-weighting require according to IEC 651 (DIN 45 633) with a sound at 100 Hz?

At 100 Hz, the A rating filter shows a level of attenuation of approximately (-) 20 dB (19.1 dB).