## Answer on Question\#49417-Physics - Acoustics

A person, with his ear to the ground, see a huge stone strike the concrete payment. A moment later two sounds are heard from the impact. One travels in the air and the other in the concrete, and they are $\Delta t=1.1 \mathrm{~s}$ apart. How far away did the impact occur?

## Solution:



The difference in time $\Delta t$ is caused by the different speed of sound in the air ( $c_{a}$ ) and in the concrete $\left(c_{c}\right)$. The time needed for the sound to overcome the distance $L$ :

$$
t=\frac{L}{c}
$$

So, the difference in time $\Delta t$ can be defined as

$$
\Delta t=\frac{L}{c_{a}}-\frac{L}{c_{c}}=\frac{\left(c_{c}-c_{a}\right)}{c_{c} c_{a}} L
$$

And for the distance $L$ between the man and the impact we obtain the following formula

$$
L=\frac{c_{c} c_{a}}{c_{c}-c_{a}} \Delta t
$$

Since the speed of sound in the concrete is $c_{c}=3400 \frac{\mathrm{~m}}{\mathrm{~s}}$ and in the air $c_{a}=343 \frac{\mathrm{~m}}{\mathrm{~s}}$, we can now calculate this distance

$$
L=\frac{c_{c} c_{a}}{c_{c}-c_{a}} \Delta t=\frac{3400 \frac{\mathrm{~m}}{\mathrm{~s}} \cdot 343 \frac{\mathrm{~m}}{\mathrm{~s}}}{3400 \frac{\mathrm{~m}}{\mathrm{~s}}-343 \frac{\mathrm{~m}}{\mathrm{~s}}} 1.1 \mathrm{~s}=381.5 \mathrm{~m}
$$

Answer: $L=\frac{c_{c} c_{a}}{c_{c}-c_{a}} \Delta t=381.5 \mathrm{~m}$.

