Questions

1. Suppose you have two sounds from two different sources that have sound pressure levels (SPL) of 20 dB and 40 dB. Suppose you play the sounds simultenously. What is the sound pressure level of the result?

   Hint: Here you need to make some assumptions about the physics, namely that the squared sound pressure I^2 of the resulting sound is the sum $I_1^2 + I_2^2$ of the squared sound pressures of the individual sounds (since energy of the sound is proportional to the pressure squared).

2. If you triple a sound pressure $I(X, Y, Z, t)$, then what is the increase in loudness (dB) ?

Solutions

1. $$10 \log_{10} \frac{I_1^2}{I_0^2} = 20 \qquad 10 \log_{10} \frac{I_2^2}{I_0^2} = 40$$

   So,

   $$\log_{10} \frac{I_1^2}{I_0^2} = 2 \qquad \log_{10} \frac{I_2^2}{I_0^2} = 4$$

   and so

   $$\frac{I_1^2}{I_0^2} = 10^2 \qquad \frac{I_2^2}{I_0^2} = 10^4$$

   and, by the assumption in the question, the loudness of the resulting soune will be

   $$10 \log_{10} \frac{I_1^2 + I_2^2}{I_0^2} \;=\; 10 \log_{10} 10100 \;\approx 40.04.$$

   which is just slightly over 40. So the 20 dB sound has almost no effect.

2. The change in dB when you triple the pressure will be

   $$20 \log_{10} \frac{3I}{I_0} - 20 \log_{10} \frac{I}{I_0} = 20 \log_{10} 3 \;\approx\; 20 * .477 \;\approx\; 9.54$$