

21. (a) Let I_1 be the original intensity and I_2 be the final intensity. The original sound level is $\beta_1 = (10 \text{ dB}) \log(I_1/I_0)$ and the final sound level is $\beta_2 = (10 \text{ dB}) \log(I_2/I_0)$, where I_0 is the reference intensity. Since $\beta_2 = \beta_1 + 30 \text{ dB}$, $(10 \text{ dB}) \log(I_2/I_0) = (10 \text{ dB}) \log(I_1/I_0) + 30 \text{ dB}$, or $(10 \text{ dB}) \log(I_2/I_0) - (10 \text{ dB}) \log(I_1/I_0) = 30 \text{ dB}$. Divide by 10 dB and use $\log(I_2/I_0) - \log(I_1/I_0) = \log(I_2/I_1)$ to obtain $\log(I_2/I_1) = 3$. Now use each side as an exponent of 10 and recognize that $10^{\log(I_2/I_1)} = I_2/I_1$. The result is $I_2/I_1 = 10^3$. The intensity is increased by a factor of 1000 .
- (b) The pressure amplitude is proportional to the square root of the intensity so it is increased by a factor of $\sqrt{1000} = 32$.