CONCEPT: SOUND INTENSITY LEVEL (DECIBELS)

● Humans hear over a huge range of intensities, so we use a _____ scale for **sound intensity** rather than $\frac{W}{m^2}$.

β = _____ Units: Decibels [___]

- I = Intensity of the sound source
- I_0 = Lower threshold of human hearing = $1\times10^{-12}\ \frac{\mathrm{W}}{\mathrm{m}^2}$

INTENSITIES OF COMMON SOUNDS		
Rustling of leaves	$\rightarrow 1\times10^{-11}\ \frac{\mathrm{W}}{\mathrm{m}^2}$	→ 10dB
Normal Conversation	$\rightarrow 1\times10^{-6}\ \frac{\mathrm{W}}{\mathrm{m}^2}$	→ 60dB
Jet Engine	$\rightarrow 1\times10^{1}\ \frac{\mathrm{W}}{\mathrm{m}^2}$	→ 130dB

WAVE/SOUND INTENSITY
$I = \frac{P}{4\pi r^2}$

EXAMPLE: A siren with a power of 9mW continuously produces a sound wave in all directions. **a)** Calculate the sound level in decibels at a distance of 3m?

PROBLEM: A sound wave from a police siren has an intensity of 0.01 W/m^2 at a certain distance. A second sound wave from an ambulance has a sound intensity level 8 dB greater than the police siren, when measured at the same distance. What is the sound intensity level (in dB) of the sound wave due to the ambulance?

A) 8.01 dB
B) 108 dB
C) 0.063 dB

WAVE/SOUND INTENSITY
$I = \frac{P}{A} = \frac{P}{4\pi r^2}$
$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$
$\beta = 10 \log_{10}\left(\frac{I}{I_0}\right)$
$I_0 = 1 \times 10^{-12}$ W/m^2

PROBLEM: A sound source emits sound at constant power equally in all directions. If you move twice the distance away from the source, by how many decibels does the sound intensity level decrease?

WAVE/SOUND INTENSITY
$I = \frac{P}{A} = \frac{P}{4\pi r^2}$
$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$
$\beta = 10 \log_{10}\left(\frac{I}{I_0}\right)$
$\log(a) - \log(b) = \log\left(\frac{a}{b}\right)$

● Whenever the distance from an inverse-square law power source doubles, the sound intensity level ***decreases*** by __ dB.