

MATH 5 WORKSHEET : Intensity & dB

4/20/07  
Barnett

A sound engineer doubles the amplitude of a signal (eg. at a rock concert)

By what factor does the intensity change?

How does the dB change?

[Hint: argue by ratios, or choose a certain  $I$  eg  $1 \text{ W/m}^2$  and compute using  $\text{Hek.}$ ]

What change in amplitude results from a 10 dB increase in intensity?

20

a 20 dB increase?

$1 \text{ W}$  is radiated in all directions. What intensity in dB do you record  $1 \text{ m}$  from the source?

$10 \text{ m}$  from the source?

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## ~ SOLUTIONS ~

A sound engineer doubles the amplitude of a signal (eg. at a rock concert)

$I \propto A$  so doubling  $A$  is multiplying  $I$  by 4.

By what factor does the intensity change? // factor of 4.

How does the dB change?

say  $I_1 = 1 \text{ W/m}^2 \rightarrow \text{dB}_1 = 10 \log_{10} \frac{1}{10^{-12}} = 120 \text{ dB}$   
 $I_2 = 4 \text{ W/m}^2 \rightarrow \text{dB}_2 = 10 \log_{10} \frac{4}{10^{-12}} = 126 \text{ dB}$

[Hint: argue by ratios, or choose a certain  $I$  eg.  $1 \text{ W/m}^2$  and compute using Hint.]

so increase is by +6 dB

Or use ratio formula  $\text{dB increase} = 10 \log_{10} \frac{4}{1} = 6 \text{ dB}$ .

What change in amplitude results from a 10 dB increase in intensity?

10 dB increase means  $\log_{10} \left( \frac{I_2}{I_1} \right) = 1$  so  $\frac{I_2}{I_1} = 10^1$  so  $\frac{A_2}{A_1} = \sqrt{10}$   
 a 20 dB increase? ampl. ratio.

$\log_{10} \left( \frac{I_2}{I_1} \right) = 2$  so  $\frac{I_2}{I_1} = 10^2$  so  $\frac{A_2}{A_1} = \sqrt{10^2} = 10$

1W is radiated in all directions. What intensity in dB do

you record  $\rightarrow$  1m from the source?  $I = \frac{P}{4\pi r^2} = \frac{1}{4\pi} \text{ W/m}^2$

$r = 1\text{m}$   $\text{dB} = 10 \log_{10} \frac{I}{I_r} = 10 \log_{10} \frac{0.08}{10^{-12}} = 109 \text{ dB}$

10m from the source?

$I = \frac{P}{4\pi r^2} = \frac{1}{4\pi \cdot 10^2} \approx 7.95 \times 10^{-4} \text{ W/m}^2$

$\text{dB} = 10 \log_{10} \frac{7.95 \times 10^{-4}}{10^{-12}} = 89 \text{ dB}$

down by 20 dB from before.