QUESTION:

Q1.If the sound **r_1=10 meters** from the stage at a rock concert is at the **L_1=120dB** what is the intensity level **L_2 r_2=100 meters** away

SOLUTION:

Intensity level 10 meters from the stage is

$$L_1 = 10\lg \frac{I_1}{I_0}$$

$$\frac{L_1}{10} = \lg \frac{I_1}{I_0}$$

$$10^{\frac{L_1}{10}} = \frac{I_1}{I_0}$$

$$I_1 = I_0 10^{\frac{L_1}{10}}$$

On the other hand sound intensity is sound power **P_{acc}** per unit area *A*:

$$I_1 = \frac{P_{acc}}{4\pi r_1^2}$$

$$P_{acc} = 4\pi r_1^2 I_1$$

$$P_{acc} = 4\pi r_1^2 \cdot I_0 10^{\frac{L_1}{10}}$$

And

$$I_2 = \frac{P_{acc}}{4\pi r_2^2}$$

$$I_2 = \frac{4\pi r_1^2 \cdot I_0 10^{\frac{L_1}{10}}}{4\pi r_2^2} = \left(\frac{r_1}{r_2}\right)^2 \cdot I_0 10^{\frac{L_1}{10}}$$

Hence intensity level 100 m away is

$$L_2 = 10\lg \frac{I_2}{I_0} = 10\lg\left(\frac{\left(\frac{r_1}{r_2}\right)^2 \cdot I_0 10^{\frac{L_1}{10}}}{I_0}\right) = 10\lg\left((\frac{r_1}{r_2})^2 10^{\frac{L_1}{10}}\right) = 10(\lg 10^{\frac{L_1}{10}} + \lg(\frac{r_1}{r_2})^2) =$$

$$= 10(\frac{L_1}{10} - 2\lg \frac{r_2}{r_1}) = L_1 - 20\lg \frac{r_2}{r_1}$$

$$L_2 = 98.4 \ \text{dB}$$

ANSWER:

$$L_2 = 98.4 \ \text{dB}$$