

State Examination Commission – Physics Higher Level, 2007

Question 12b

Define sound intensity.

(6)

The sound intensity at a point is the rate of flow of sound energy, normally, through unit area at that point. It is measured in W m^{-2}

A loudspeaker has a power rating of 25 mW. What is the sound intensity at a distance of 3 m from the loudspeaker? (9)

At a distance of 3 m from the loudspeaker, 25 J of sound energy is passing each second through a total area A of

$$\begin{aligned} A &= 4\pi r^2 && \text{(surface area of sphere)} \\ &= 4\pi(3)^2 \\ &= 113 \text{ m}^2 \\ \Rightarrow \text{sound energy per sec through unit area} &= (2.5 \times 10^{-4})/113 &= 2.21 \times 10^{-4} \text{ W m}^{-2} \\ \text{i.e., sound intensity} &= 2.21 \times 10^{-4} \text{ W m}^{-2} \end{aligned}$$

The loudspeaker is replaced by a speaker with a power rating of 50 mW.

What is the change:

(i) in the sound intensity?

It doubles

(ii) in the sound intensity level?

(9)

It increase by 3 dB

The human ear is more sensitive to certain frequencies of sound. How is this taken into account when measuring sound intensity levels? (4)

A scale is used that is adapted to those frequencies (2000 – 4000 Hz) humans are most sensitive to. It is referred to as the dBA scale.