PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

INTENSITY AND PITCH OF MUSICAL NOTES

Examples

1. The disc of a siren revolves 600 times in on eminute and it is in unison with a tuning fork of frequency 480 Hz. Calculaate the number of holes in the disc.

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2. Calculate the intensiyt of the wave $y = 0.002 \sin(4000t - 10x)$. Density of medium $= 1.29 kgm^{-3}$

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3. A smoked plate falls vertically under gravity and a tuning fork traaces waves on it. It was found from the trace that there 10 waves are spaced over 4.2 cm. Calculate the frequecny of the tuming fork.

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4. At a distance $r_0 = 20m$ form an isotropic point source of sound the loudness level is $L_0 = 30dB$. Neglicting the damping of the

sound wave, find : (a) the loudness level at a distacne $r = 10m$ form the source, (b) the distance form the source at which sound is not heard.

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Exercise

1. A siren with 20 holes in its disc given 5 beats per second with a closed pipe sounding its fundamental note when the disc makes 2400

revolution per minute. What is the effective length of the pipe? (velocity of sound in air $= 360ms^{-1}$)

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2. A siren wth a ring of 200 holes is making 132 revolutions per mintue and is found to emit a note which is an octave higher than of a tuning fork. Find the frequency of the latter.

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3. A note of frequency 300 Hz has an intensity of 1 microwatt per square metre. What is the amplitude of the air vibrations caused by this sound ? (Density of air $= 1.293 kgm^{-3}$ and velocity of sound in air $= 332 ms^{-1}$)

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4. The disc of a siren has 100 holes and rotates at the rate of 1000 revolutions per mintue. Find the frequency and wavelength of the

note emitted by the siren. (Velocity of sound in air $= 350 m / s$)

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5. A smoked plate falls vertically under gravity. A tuning fork traces wave on it. It is found that the lengths of two conscutive grounps of 10 waves are 5.143 and 6.64 cm respectively. What is the frequecny of the fork ?

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6. A pointer attached to a vibrating fork presses a smoked cylinder lightly. The cylinder is suddenly rotated through one complete revolution in 0.75 seconds. The pointer traces 192 waves on the cylinder. Calculate the frequency of the tuning fork.

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7. The minimum intensity of audibility of a source is $01^{-12}\text{watt}/m^2$. If the frequency of the note is 1000 Hz, calculate the amplitude of

vibrations of air particles. Density of air $= 1.293 kgm^{-3}$ and velocity of sound $= 340 ms^{-1}$

$$\left[\text{Hint} \quad a = \sqrt{\frac{I}{2\pi^2 n^2 \rho C}}\right]$$

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8. Calculate the intensity of a note of frequency 1000 Hz if the amplitude of vibration is $10^{-9} cm$. Density of air $= 1.3 kgm^{-3}$ and velocity of sound $= 340 ms^{-1}$

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9. Calculate the amplitude of vibrations of air particles when a wavee of intensity $10^{-3}\text{watt}/m^2$ is produced by a tuning fork of frequency 540 Hz. Velocity of sound in air $= 340ms^{-1}$ and density of air $= 1.3kgm^{-3}$

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10. S_1 and S_2 are two loudspeakers with the same frequency of 165 Hz and acoustic output 1.2×10^{-3} and 1.8×10^{-3} watt respectively. They vibrate in the same phase. P is a point at a distance 4 m from S_1 and 3 m from S_2.

(a) How are the phases of the two waves arriving at P related ?

(b) What is the intensity of P if S_1 is turned off $(S_2 \quad \text{on})$?

(c) What is the intensity of sound at P if S_2 is turmed off ?

(d) What is the intensity at P with S_1 and S_2

on ?

[Hint : For phase relationship see example 6 of chapter 1. Intensity is inversely proportional to square of the distance]

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11. The intensity of a sound wave 20 m away from the sound source is $3nW/m^2$. Find the intensity of the wave 32 m away from the source, if the half -thickness for sound of this frequency is 120 m.

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12. Calculate the interval between two sound waves of frequencies 1000 Hz and 400 Hz. Express the interval on logarithmic scale and in centioctaves.

[Hint absolute interval $= n_1 / n_2$ interval on log scale log n_1 / n_2, interval in centioctaves $= \frac{\log n_1 / n_2}{\log 2} \times 100.$]

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13. At a distance $r = 100m$ from a isotropic point sources of sound 200 Hz the loudness level is $L = 50dB$. The standard intensity level, i.e., intensity level just audible to human ear is $I_0 = 0.1nW/m^2$. Find the sonic power of the source.

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14. A plane sound wave propagates along the x-axis. At the point $x = 0$, the loudness level is

$L_0 = 60dB$. Find : (a) the loudness level at $x = 50m$, (b) the co-ordinates x at which the sound is not heard any more (μ, the absorption coefficient of the medium $= 0.04m^{-1}$ Audible level of sound = 1 dB)

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