NCERT-Analog-11.15-6

EE22BTECH11004 - Allu lohith

1) A bat emits ultrasonic sound of frequency $1000kHz$ in air. If the sound meets a water surface, what is the wavelength of
(t)he reflected sound
(b) the transmitted sound?
Speed of sound in air is $340ms^{-1}$ and in water is $1486ms^{-1}$.

Parameter	Description	Value	Formulae
f	Frequency of sound	$1000KHz$	
v_a	Speed of sound in air	$340ms^{-1}$	
v_w	Speed of sound in water	$1486ms^{-1}$	
λ_a	Wavelength of sound wave in air	-	v_a/f
λ_w	Wavelength of sound wave in water	-	v_w/f
K_a	Wavenumber of sound wave in air	-	$\lambda_a/2\pi$
K_w	Wavenumber of sound wave in water	-	$\lambda_w/2\pi$

TABLE 1
Parameters

Soln: The frequency of sound does not change with medium. And,

$$\lambda \cdot \text{f} = \text{v} \tag{1}$$

So,

$$\lambda_w = v_w/\text{f} \tag{2}$$
$$\lambda_w = 1486/1000KHz \tag{3}$$
$$\lambda_w = 1.486mm \tag{4}$$
$$\lambda_a = v_a/\text{f} \tag{5}$$
$$\lambda_a = 340/1000KHz \tag{6}$$
$$\lambda_a = 0.34mm \tag{7}$$

The general equation of a sound wave is

$$y(t) = A\sin(2\pi \text{f}t - kx) \tag{8}$$

Parameter	Description
f	Frequency of sound
A	Amplitude of the wave
t	Time
x	Position
$y(t)$	Position of particle as a function of time

$$K_a = \left(\frac{0.34 \times 10^{-3}}{2 \times 3.14}\right) \tag{9}$$
$$K_a = 54 \times 10^{-6}\ m^{-1} \tag{10}$$

$$K_w = \left(\frac{1.486 \times 10^{-3}}{2 \times 3.14}\right) \tag{11}$$
$$K_w = 236 \times 10^{-6}\ m^{-1} \tag{12}$$

$$y(t)_{Air} = A\sin(6.28 \times 10^6 t - 54 \times 10^{-6} x) \tag{13}$$

$$y(t)_{Water} = A\sin(6.28^6 t - 236 \times 10^{-6} x) \tag{14}$$

Parameter	Description	Formula	value
λ_a	Wave length of the reflected sound	v_a/f	$0.34mm$
λ_w	Wave length of the reflected sound	v_w/f	$1.486mm$
K_w	Wavenumber of sound wave in air	$\lambda_a/2\pi$	$54 \times 10^{-6} m^{-1}$
K_a	Wavenumber of sound wave in water	$\lambda_w/2\pi$	$236 \times 10^{-6} m^{-1}$

TABLE 1
Results

Parameter	Description	Formula	Variables	Variables Description
V	Speed of sound	$\sqrt{\frac{\gamma \cdot P}{\rho}}$	γ	adiabatic index
			V	Speed of sound
			P	Pressure of Medium
			ρ	Density of medium

TABLE 1
GENERAL EQUATION OF SPEED OF SOUND

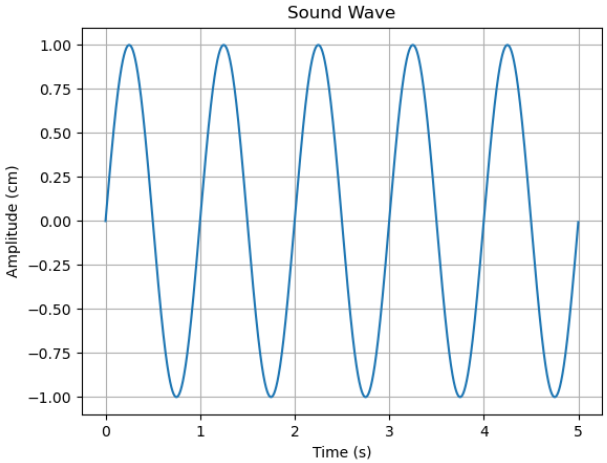

Fig. 1. A Sound wave