# 10th Physics (New Book)

National Book Foundation (Federal Board)

(Fazal Academy) Unit # 11 (chapter 2)

## Numerical Problems 1 :

1. In a busy street, traffic noise has intensity of $10^{-5}\ Wm^{-2}$. Find the intensity level in decibel.

Data:

$I = 10^{-5}\ Wm^{-2}$ — I = High Sound Intensity

$I_o = 10^{-12}\ Wm^{-2}$ — $I_o$ = Faintest Sound Intensity (low)

Intensity level = ? (dB)

Solution:

$$\text{Intensity level} = 10 \log \frac{I}{I_o}\ dB$$

$$= 10 \log \frac{10^{-5}}{10^{-12}}\ dB$$

$$= 10 \log 10^{-5+12}\ dB$$

$$= 10 \log 10^{7}\ dB$$

$$= 10 \times (7 \log 10)\ dB$$

$$= 10\ (7\ (1))\ dB$$

$$= 10\ (7)\ dB$$

**Intensity level = 70 dB**

Book Page 34
Figure 11.16
Car city traffic ← Intensity level

www.FazalAcademy.com

2. Mosquito buzzing has intensity level of 40 dB, Calculate the intensity of this buzzing Sound.

Data:

Intensity level = 40 dB

$I = ?$

$I_0 = 10^{-12}\ Wm^{-2}$

Solution:

$$\text{Intensity level} = 10 \log \frac{I}{I_0}\ dB$$

$$40\ dB = 10 \log \frac{I}{10^{-12}}\ dB$$

$$40 = 10 \log \frac{I}{10^{-12}}$$

$$\frac{40^{4}}{10} = \log \frac{I}{10^{-12}}$$

$\because \log \frac{A}{B} = \log A - \log B$

$$4 = \log I - \log 10^{-12}$$

$$4 = \log I - (-12) \log 10$$

$\because \log x^2 = 2 \log x$

$$4 = \log I + 12\,(1)$$

$$4 = \log I + 12$$

$$4 - 12 = \log I$$

$$-8 = \log I$$

www.FazalAcademy.com

$$\log I = -8$$

Taking Antilog on b/s

$$I = \text{Antilog}(-8)$$

$$\boxed{I = 1 \times 10^{-8}\ Wm^{-2}}$$

3. What is intensity level of threshold of hearing and threshold of pain?

## Threshold of Hearing :

→ The threshold of hearing is assigned a sound level of 0 decibels (0 dB).

→ This sound corresponds to an intensity of $10^{-12}\ Wm^{-2}$.

## Threshold of Pain :

The intensity level of a loud sound which gives pain to the ear, usually between 115 and 140 dB.

www.FazalAcademy.com

4. Speed of Sound waves in water at 25°c is $1480\ ms^{-1}$. If their wavelength is 70 cm, find the frequency of these Sound waves?

Data:

$$V = 1480\ ms^{-1}$$

$$\lambda = 70cm = \frac{70}{100} = 0.7m$$

$$f = ?$$

Solution:

$$V = f\lambda$$

$$\frac{V}{\lambda} = f$$

$$\Rightarrow f = \frac{V}{\lambda}$$

$$= \frac{1480}{0.7}$$

$$\boxed{f = 2114.2\ Hz}$$

www.FazalAcademy.com

5. What is speed of Sound at 15°c in air if speed of Sound is 332 m/s at 0°c?

Data:

$V_t = ?$ (speed of Sound at given temperature)

$T_2 = 15°c = 15+273 = 288K$

$V_0 = 332 ms^{-1}$

$T_1 = 0°c = 0+273 = 273K$

$t = T_2 - T_1 = 288 - 273 = 15K$

Solution:

$V_t = V_0 + 0.61t$

$V_t = 332 + 0.61(15)$

$= 332 + 9.15$

$\boxed{V_t = 341.15 ms^{-1}}$

Speed of Sound at 15°c in air is $341.15 ms^{-1}$ if speed of Sound is $332 ms^{-1}$ at 0°c.

www.FazalAcademy.com

6. Find the range of wavelengths for audible sounds if the minimum frequency is 20Hz and maximum frequency is 20KHz.

Data:

$\lambda_{min} = ?$

$\lambda_{max} = ?$

$f_{min} = 20\,Hz$

$f_{max} = 20kHz = 20 \times 1000 = 20,000\,Hz$

Solution:

$$V = f\lambda$$

$\lambda_{min} = ?$

$$\frac{V}{f} = \lambda$$

$$\Rightarrow \lambda_{min} = \frac{V}{f_{min}}$$

$$= \frac{332}{20}$$ ← Speed of Sound in air is $332\,ms^{-1}$.

$$\boxed{\lambda_{min} = 16.6\,m}$$

www.FazalAcademy.com

$\lambda_{max} = ?$

$$\lambda_{max} = \frac{V}{f_{max}}$$

$$= \frac{332}{20,000}$$

$$\boxed{\lambda_{max} = 0.017\ m}$$

www.FazalAcademy.com

7. During thunderstorm, thunder sound is heard after 3 seconds of lightning flash. Find the distance of clouds from ground. (speed of sound $= 340 ms^{-1}$).

Data:

$$t = 3s$$

$$S = ?$$

$$V = 340 ms^{-1}$$

Solution:

$$S = vt$$

$$= (340)(3)$$

$$\boxed{S = 1020m}$$

www.FazalAcademy.com

8. SONAR (Sound navigation and ranging System) Sends ultraSound Signal towards Sea bed. It is received back after 5.3s. If speed of Sound in Sea water is 1550 m/s. Find the depth of Sea bed.

Data:

$t = 5.3\,s$

$V = 1550\,m/s$

$S = ?$

5.3

2.65 ↓ ↑ 2.65

Solution:

$S = vt$

$= (1550)(5.3)$

$S = 8215\,m$

8215

( ↓↑ )

$$\text{Depth} = \frac{8215}{2}$$

$$\boxed{\text{Depth} = 4107.5\,m}$$

www.FazalAcademy.com