(c) Calculate the sound intensity and sound intensity level in decibel for a sound wave travelling in air at 0°C and having a pressure amplitude of $0.656\ Pa$. (Ans: $5.04 \times 10^{-4}\ Wm^{-2}$, 87dB)

3. (a) i. Define the intensity of sound. Mention its unit & dimension.

ii. Prove that $I = \frac{1}{2}\ \rho\ v\ a^2\omega^2$ where the symbols have their usual meanings.

iii. Show that the intensity of sound for a given frequency is directly proportional to the square of amplitude of vibration.

(b) Why does an empty vessel produce more sound than a filled one?

(c) The ratio of intensities of two waves at a point is 25: 16. Calculate the ratio of amplitude of two waves.

(d) Explain, why is the roaring of a lion different than the sound of a mosquito?

(e) When a jet plane is flying on elevation of 1000m the sound level on the ground is 4.0 dB. What would be the intensity level on the ground when its elevation is as low as 100m? (Ans: 24 dB)

(f) At a point $20\ m$ from a small source of sound, the intensity is $0.5\ \mu Wm^{-2}$. Find a value for the rate of emission (power) from the source. $(25.1\ W)$

1. A sound has an intensity of $5 \times 10^{-7}\ Wm^{-2}$. What is decibel sound level? What is the bel level? [$57\ dB;\ 5.7\ bel$]
2. Find the amplitude of vibration of the particles of air through which a sound wave of intensity $2 \times 10^{-6} W/m^2$ and frequency $1\ KHz$ is passing. Density of air is $1.2\ kg/m^3$ and speed of sound in air is 330 m/s. [$1.6 \times 10^{-8}\ m$]
3. Intensity of sound from a point source is $10^{-8}\ Wm^{-2}$ at a distance of $5\ m$. What will be the intensity and intensity level of sound at a distance of $20\ m$ from the same source? [$6.25 \times 10^{-10} Wm^{-2};\ 27.95\ dB$]
4. The power output of a point source of sound is 1 Watt. It radiates sound energy uniformly in all directions. Calculate the intensity level at distances (i) 100 m and (ii) 500 m from the source. [$69\ dB\ ;\ 55\ dB$]
5. When a jet plane is flying at an elevation of 1000m, the sound level on the ground is 4 $dB$. What would be the intensity level on the ground when its elevation is as low as 50 m? [$30\ dB$]
6. The volume level of an outdoor public address system is adjusted to 55 $dB$ for people 5 m away. What will be its intensity level for people at distance 45 m? [$35.9\ dB$]
7. If the intensity of sound is doubled, by how many decibels does the sound level increase? [$3\ dB$]

## Doppler's effect:

1. A sound source is moving towards stationary listener with $(1/10)^{th}$ the speed of sound. The ratio of apparent to real frequency is

a. $\frac{11}{10}$ b. $\left(\frac{11}{10}\right)^2$ c. $\left(\frac{9}{10}\right)^2$ d. $\frac{10}{9}$

2. A moving source of sound passes a stationary observer with a velocity $v_s$. The velocity and frequency of sound is $v$ and $f$. If $v_s << v$, then the apparent decrease in frequency will be

a. $2\ v\ v_s\ f$ b. $2\ v_s f/v$ c. $v/2\ v_s f$ d. $2\ v\ f/v_s$

3. A source of sound and listener are moving along the same direction with same velocity. If the actual frequency of source is $f$, the frequency $f'$ heard by the observer will be

a. $f' = f$ b $f' > f$ c. $f' < f$ d. $f' \geq f$

4. Doppler shift in frequency is independent of

a. the frequency of waves produced b. the speed of source
c. the speed of observer d distance from source to observer

5. A source of sound and listener are moving with same velocity in opposite directions. If the actual frequency of source is $f$. The apparent frequency $f'$ heard by listener is

a. $f' = f$ b $f' > f$ c. $f' < f$ d. $f' \geq f$

6. An observer moves towards a stationary source of sound with a velocity one-fifth of the velocity of sound. The percentage change in the apparent frequency is

a. 5% b. 10% c. 20% d. zero

7. A moving source of sound passes a stationary observer with a velocity $v_s$. The velocity of sound is v and frequency of source is $f$. If $v_s << v$, then the apparent decrease in frequency will be

a. $\frac{2v}{v_s f}$ b. $\frac{2v_s f}{v}$ c. $\frac{2f}{v v_s}$ d. $\frac{v}{2f v_s}$

8. A source of sound producing wavelength 50 cm is moving away from a stationary observer with $(1/5)^{th}$ speed of sound. Then what is the wavelength of sound received by the observer?

a. 55 cm b. 40 cm c. 60 cm d. 70 cm

9. A policeman fires at a constant interval on a thief running way. If the velocity of policemen is twice the velocity of thief, then

a. The thief hears the sound at same interval
b. The thief hears the sound at quicker interval
c. The thief hears the sound at greater interval
d. The thief will not hear the sound of shots

10. A racing car moving towards a cliff, sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If $v$ is the velocity of sound, then the velocity of the car is

a. $\frac{v}{3}$ b. $\frac{v}{4}$ c. $\frac{v}{\sqrt{2}}$ d. $\frac{v}{2}$

11. A rocket is moving at a speed of $220\ ms^{-1}$ towards a stationary target, emiting a sound of frequency $1000Hz$. Some of the sound reaching the target gets reflected back to the rocket as an echo. The frequency of the echo as detected by the rocket is (Take velocity of sound = 330 ms$^1$)

a. $3000\ Hz$ b. $3500\ Hz$ c. $4000\ Hz$ d. 5000 Hz

12. A train approaching a railway platform with a speed of 20 ms$^{-1}$ starts blowing the whistle. Speed of sound in air is 340 ms$^{-1}$. If the frequency of the emitted sound from the whistle is 640 Hz, the frequency of sound as heard by person standing on the platform is

a. 600 Hz b. 640 Hz c. 680 Hz d. 720 Hz