15 - WAVES

1) Two wires placed to each other are vibrating in their first harmonic. The sound produced by the two wires produce 5 beats per second. If the longer wire is 25 cm long and the velocity of waves in wire is 50 m / s, then find length of the smaller wire. [March, 2003]
(Ans: 23.8 cm)

2) A propagating harmonic wave expression is $y = 0.05 \sin (628t - 1.8x)$ meter. Find the values of (a) the wave-length, (b) the frequency and (c) the velocity of the wave. [April, 2002, October, 1990]
(Ans: (a) 3.49 m, (b) 100 Hz, (c) 349 m / s)

3) Two sound waves of wavelengths 140 cm and 140.4 cm, propagating in a gas, produce 8 beats per second. Find the velocity of the sound wave in M. K. S. system. [March, 1998]
(Ans: 3931 m /s)

4) For a wave in a wire, the velocity is 10 m / s and wavelength is 4 cm. Calculate the angular frequency and the wave-vector. [October, 1997]
(Ans: 500π rad /s, 157 rad /m)

5) A source producing a sound of the frequency 660 Hz moves with the velocity 10 m / s. The velocity of sound is 340 m / s. Compute the frequency of sound, listened by a stationary listener, for the under mentioned cases:
(1) The source is moving towards stationary listener.
(2) The source is moving away from the stationary listener. [October, 1996]
(Ans: (1) 680 Hz, (2) 642 Hz)

6) $y = 10 \sin \pi (5t - 2x)$ is the equation of a wave propagating in the positive direction of the x-axis, x and y are in m. Find velocity of a particle at a distance of 2 m from source of the wave at the end of one second. [March, 1996]
(Ans: –157 m / s)

7) Two simple harmonic waves are given by the equations $y = 0.30 \sin (314t - 1.57x)$ and $y = 0.10 \sin (314t - 1.57x + 1.57)$. Find the phase difference between them in degrees. Also find the ratio of their intensities. [March, 1995]
(Ans: 90^0, 9)

8) The equation of a progressive wave is $y = 5 \sin (10 \pi / 3) (t - x / 40)$, where x and y are in metre and t is in second. Calculate for this wave (i) frequency, (ii) wavelength, and (iii) the phase difference between two particles separated by a distance of 6 m.
(Ans: (i) 1.67 seconds, (ii) 24 m, (iii) $\pi / 2$ radian) [October, 1994]

9) The amplitude of a transverse wave is 4 cm. If its frequency is 4 Hz and wavelength 4 cm, find the displacement of a particle 1 cm away from the origin at time t = 0.25 sec. Also give the name of this position of the particle. [March, 1993]
(Ans: 4 cm, crest)

10) If the frequency of the radio waves is 850 KHz and velocity in air is 3×10^8 m / s, calculate the wavelength and wave-vector of the radio waves. [March, 1990]
(Ans: 353 m, 1.78×10^{-2} m^{-1})

11) Amplitude of a progressive wave is 10 cm. Its frequency and wavelength are 2 Hz and 20 cm respectively. Compute the displacement of a particle involved in wave motion which is at 10 cm from the origin after 0.5 second. [March, 1989]
(Ans: zero)

12) An equation of a wave is given by $y = 5 \sin 0.5\pi (2t - x / 2)$. Find the velocity of a particle of the medium at a point, 2 cm away from the origin of the wave, after 2 sec. (Ans: zero) [March, 1988]

13) Find the frequency of a fork which gives 4 beats per second when sounded with a fork of frequency 256 and gives 2 beats per second when one of its prongs is loaded with a small piece of wax. (Ans: 260 Hz)

14) A set of 28 tuning forks is arranged in a series of decreasing frequencies. Each fork gives 3 beats with succeeding one. The first fork is the octave of the last. Calculate the frequency of the first and the 15^{th} tuning fork. (Ans: 162 Hz, 120 Hz)

15) If forks A and B produce 3 beats per second and forks B and C produce 4 beats per second, then find the number of beats per second produced by forks A and C. (Ans: 1 or 7 beats per second)

16) Wavelengths of two forks in air are 90 / 175 m and 90 / 173 m. Each note produces 4 beats / s with the third note of a fixed frequency. Calculate the velocity of sound in air. (Ans: 360 m / s)

17) In a string of 165 cm length, the frequencies of two consecutive harmonics are 300 Hz and 400 Hz. What will be the wave velocity ? (Ans: 330 m / s)

18) If the displacement and velocity of a particle at a distance 1 m from one end of a stationary wave are 8 m and 6 m / s at a given instant and its time period is 2π sec, then find its wavelength. (Ans: 4 m)

19) A train is passing a railway station with a speed of 60 km/hr and blowing continuously its whistle of frequency 320 Hz. What will be the apparent frequencies noted by a person waiting on the platform when the train is (a) approaching and (b) departing ? (Ans: (a) 337 Hz, (b) 305 Hz)

20) A whistle is whirled in a circle of 100 cm radius and traverses the circular path twice per second. An observer is situated outside the circle but is in its plane. What will be the musical interval between the highest and lowest pitch observed if the velocity of sound is 332 m / s ? (Ans: 1.079)

21) Two sources give out identical notes of 1360 Hz. An observer halfway between them moving from one to the other hears 4 beats / second. At what speed is he moving ? (Ans: 1.8 km / hr)

22) Two trains move towards each other at speeds of 72 km / hr. The first train whistles emitting a sound with a frequency of 800 Hz. Find the frequency of the sound which can be heard by a passenger in the second train: (a) before the trains meet, (b) after the trains meet. (velocity of sound is 340 m / s). (Ans: (a) 887.5 Hz, (b) 722.2 Hz)

23) A source of sound and a listener are moving towards a wall with listener between the source of sound and the wall. Velocity of the source of sound is 10 m / s and that of the listener is 4 m / s. If the frequency of sound is 320 Hz and velocity of sound is 330 m / s, find the number of beats per second heard by the listener. (Ans: 8 beats per second)