Solve

1) The displacement of the particle of a string carrying a travelling wave is given by,

$$y = 10\sin[(\pi/4)x - 3\pi t]$$

where y and x is in centimeter and t is in seconds. Find the amplitude, wavelength, frequency and speed of the wave.

2) A progressive wave is represented by the equation, $y = 0.3\sin[1.57\,x - 314\,t]$, where y is in metre, x is in centimeter and t in seconds. Find the amplitude, wavelength, frequency and speed of the wave.

3) A transverse wave represented by $y = 0.25\sin(4\pi t - 0.2\pi x)$, where x and y are in centimeters and t is in seconds. Find the velocity of the particle at $t = 0.5s$ and $x = 10cm$ from one end of the thread. What is the displacement of the particle at the instant? Also find the phase difference at the point.

4) A wave is described by the equation, $y = (1\,mm)\sin\left[\pi\left(\frac{x}{2\,cm} - \frac{t}{0.01\,s}\right)\right]$. Find the time period and wavelength. What are the speed of the particles at $x = 3cm$, $5cm$ and $7cm$ at $t = 0.01s$?

5) A string vibrates according to the equation $y = 5\sin\left(\frac{\pi x}{3}\right)\cos(40\pi t)$, where x and y are in centimeters and t is in seconds.
   a) What are the amplitude and velocity of the component waves whose superposition gives rise to above vibration?
   b) Write down the equations of the component waves.
   c) What is the distance between the nodes?
   d) What is the velocity of a particle of the string at the position $x = 1.5\,cm$ at $t = \frac{9}{8}s$.

6) The vibrations of a string of length $60\,cm$ fixed at both ends are represented by $y = 4\sin\left(\frac{\pi x}{15}\right)\cos(96\pi t)$, where x and y are in centimeters and t is in seconds.
   a) What is the maximum displacement of a point at $x = 5cm$?
   b) Where are the nodes located along the string?
   c) What is the velocity of a particle of the string at the position $x = 7.5\,cm$ at $t = 0.25s$.
   d) Write down the equations of the component waves.

7) A rope weighing $0.05\,kg/m$ is stretched by a force of $245\,N$ between two points $35\,m$ apart. What would be the speed of wave passing through it?

8) A transverse wave described by $y = (0.02m)\sin[(1m^{-1})x + (30s^{-1})t]$ propagates on a stretched string having a linear mass density of $1.2 \times 10^{-4}\,kg/m$. Find the tension in the string.

9) A transverse sinusoidal wave is generated at one end of a long horizontal wire. The motion is continuous and is repeated regularly twice each second. If the string has linear density of $8\,g/cm$ and is kept under a tension of $10\,g\,wt$, find the speed and wavelength of the waves produced.

10) A travelling wave is produced on a long horizontal string. The amplitude of vibration is $1\,cm$ and the displacement becomes zero 200 times per second. The linear mass density of the string is $0.1\,kg/m$ and it is subjugated to a tension of $90\,N$. Find the speed and wavelength of the wave. Find velocity of the wave at $x = 10cm$ at time $t = 10s$.

11) Find the change in volume of 1 litre kerosene when it is subjected to an extra pressure of $2 \times 10^5 N/m^2$. Density of kerosene is $800\,kg/m^3$ and speed of sound in kerosene is $1330\,m/s$.

12) The velocities of sound in air and in sea water are $340\ m/s$ and $1435\ m/s$ respectively. Signals are sent from ship A to ship B through air and water. If the time interval between the two signals is $5\ s$, then find the distance between the ships.

13) Two men A and B stand in a line perpendicular to a cliff, A being nearer to it and B $251.5\ m$ from A. A fires a gun and hears the echo after $1\ sec$ and when B fires a gun, A hears the echo after $1.75\ secs$. Find the velocity of sound and the distance of B from the cliff.

14) Find the fundamental, first overtone and second overtone frequencies of an open organ pipe of length $20\ cm$. Speed of sound in air is $340\ m/s$. Also find the same for a closed organ pipe of same length.

14) The separation between the node and the next antinode of a vibrating air column is $25\ cm$. If the speed of sound is $340\ m/s$, find the frequency of vibration of the air column.

15) The water level in a vertical tube $1\ m$ long can be adjusted to any position of the tube. A tuning fork vibrating at $660\ Hz$ is held just over the open top end of the tube. At what positions of the water level will there be resonance? Velocity of sound in air = $330\ m/s$.

16) The pitch of the fundamental note of an open organ pipe $100\ cm$ long is the same as that of a sonometer wire $200\ cm$ long with mass $1\ g/cm$. Find the tension of the wire. Velocity of sound in air = $330\ m/s$.

17) The length of an open organ pipe is twice the length of a closed organ pipe. If the fundamental frequency of the open pipe is $100\ Hz$, what is the frequency of the third harmonic of the closed pipe?

18) How many beats per second will be heard if the following sound waves are superposed,
$y_1 = 11\cos(400\pi t - \pi x)$ and $y_2 = 9\cos(410\pi t - 1.02\pi x)$.

19) Two tuning forks A and B produce 5 beats when sounded together. A is in unison with $40\ cm$ length of a sonometer under a constant tension. B is in unison with $40.5\ cm$ length of the same wire under the same tension. Find the frequencies of the tuning forks.

20) A tuning fork of frequency $200\ Hz$ is in unison with a sonometer wire. If the tension of the wire is increased by 1%, how many beats will be heard?