Q-1(S)

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Equation of a progressive wave.

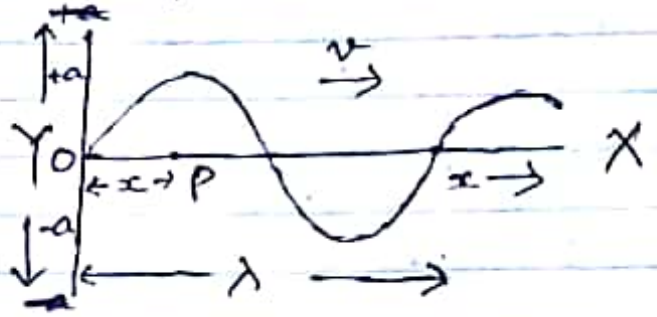
When a particle of material medium is displaced slightly from its position of rest and then released, it begins to oscillate due to its inertial and elastic properties. In course of vibration this particle disturbs other particles. Thus the displacements of any particle will produce a disturbance which is handed over from particle to particle till all of them have suffered more or less displacement. This disturbance is termed as progressive wave. Thus progressive wave is a kind of disturbance which propagates in the medium with certain velocity without changing its form.

When a plane progressive wave propagates in a medium then, at any instant, all the particles of the medium oscillate in the same way but the phase of oscillation changes from particle to particle. The wave motion in any medium is produced due to S.H.M. of the constituent particles of the medium.

Let us suppose that the source of S.H. disturbance necessary to produce a

wave is situated at the origin O and the wave is progressing in the positive direction of X-axis. In fig the displacement (y) of the particles is plotted against their positions (x) from the origin at a particular instant.

Let the time be measured from the instant when the particle at O is passing through its equilibrium position.



fig

Then, the displacement of this particle at any instant t is given by

$$y = a \sin \omega t \quad \text{---} (1)$$

where a is the amplitude of motion and $\omega/2\pi$ is the frequency n. If the wave velocity is v, when the disturbance produced at O will reach a point P, distant x from O, in x/v second. So, the displacement of the particle at P at any instant t will be the same as the displacement at O at the instant x/v second earlier, i.e $(t - x/v)$.