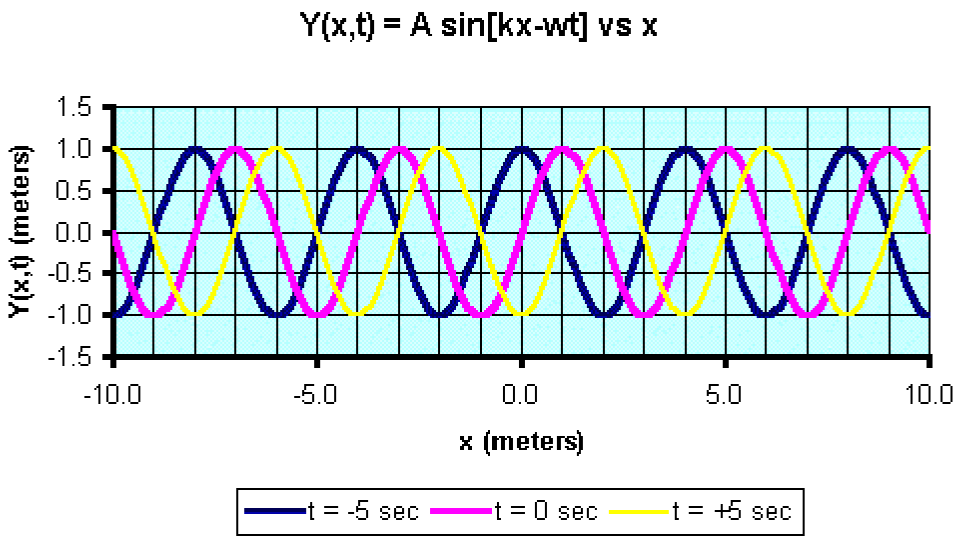
Snapshots of the transverse displacement, $y(x,t)$ *vs*. position, x for a right-moving sine-type harmonic traveling wave are shown in the figure below, for $t = -5$, 0 and +5 seconds. The transverse displacement, $y(x, t) = A \sin(kx-\omega t) = A \sin[2\pi(x/\lambda - ft)]$, with amplitude, $A = 1.0$ *m*, wavelength, $\lambda = 4.0$ *m*, longitudinal velocity $v_x = +1.0$ *m*/*sec* and thus $f = |v_x|/\lambda = 1/4 = 0.25$ *Hz*.



The three sinusoidal curves in this figure may seem a bit confusing at first glance. Consider the crest at x ($t = -5$ *sec*) $= -8.0$ *m* associated with the snapshot of the dark blue sinusoidal traveling wave at $t = -5$ *sec*. Five seconds later, this crest (along with the rest of the sinusoidal traveling wave) has propagated to the *right*, a distance of $\Delta x = |v_x|\Delta t =$ 1 *m*/*sec**5 *sec* = 5.0 *m*. Thus, this same crest is now located at x ($t = 0$ *sec*) $= -8.0 + 5.0$ *m* $= -3.0$ *m*. This is the crest located at $x(t = 0$ *sec*$) = -3.0$ *m* on the magenta curve. Five seconds after this, at $t = +5.0$ *sec*, this same crest has propagated to the *right* another distance of $\Delta x = |v_x|\Delta t = 1$ *m*/*sec**5 *sec* = 5.0 m. This crest is now at $x(t = +5$ *sec*$) = -3.0 +$ 5.0 *m* = +2.0 *m*, *i.e*. the crest located at $x(t = +5.0$ *sec*$) = +2.0$ *m* on the yellow curve.

The transverse *velocity*, $u_y(x,t)$ of a sine-type harmonic traveling wave can be obtained from the transverse *displacement*, $y(x, t)$. Since velocity (units = *m*/*sec*) is the *change* of position per unit *change* in time, the transverse velocity, $u_y(x,t)$ is the *derivative*, d/dt of position with respect to time. Then $u_y(x,t) = d/dt\,(y(x,t)) = dy(x, t)/dt = d/dt(A\,sin[kx-\omega t])$ $= -\omega A\,cos[kx-\omega t]$, since the derivative, d/dt of the $sin(u(t))$ function is $d/dt(\sin u(t)) =$ $d(sin(u(t))/dt = cos\,u * du(t)/dt$, by the *chain-rule of differentiation*, where $u(t) = [kx-\omega t]$, thus $du(t)/dt = -\omega$. Snapshots of the transverse velocity, $u_y(x, t)$ as a function of position, x, for $t = -5$, 0 and +5 seconds are shown in the figure below. Again, for the crest of $u_y(x = -7.0\ m, t = -5\ sec)$ at $x(t = -5\ sec)$ associated with the snapshot of the dark blue sinusoidal traveling wave at $t = -5$ sec, after 5 seconds, at $t = 0$ sec, this crest associated with the dark blue $u_y(x,t)$ curve has also propagated to the right a distance $\Delta x = |v_x|\Delta t = 1$ *m*/*sec**5 *sec* = 5.0 *m*. Thus, the velocity crest is now at $x(t = 0\ sec) = -7.0 + 5.0 = -2.0$ *m*, on the magenta curve; and another $\Delta t = 5$ seconds later, this velocity crest is at +3.0 *m* on the yellow curve.