3.5 Example using total phase

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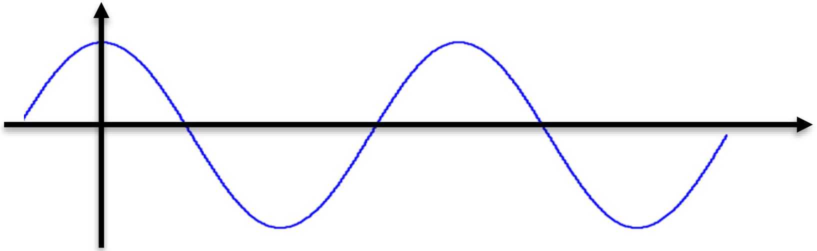

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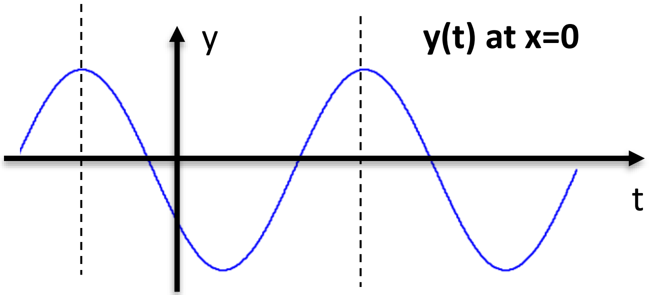
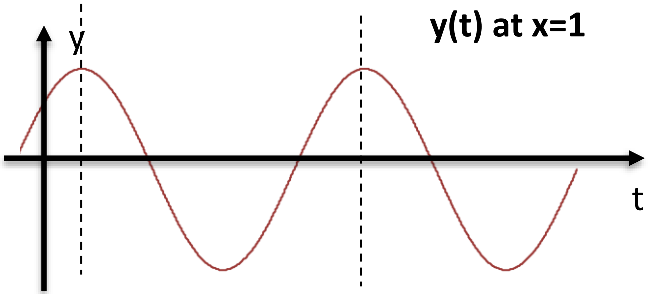
Total phase





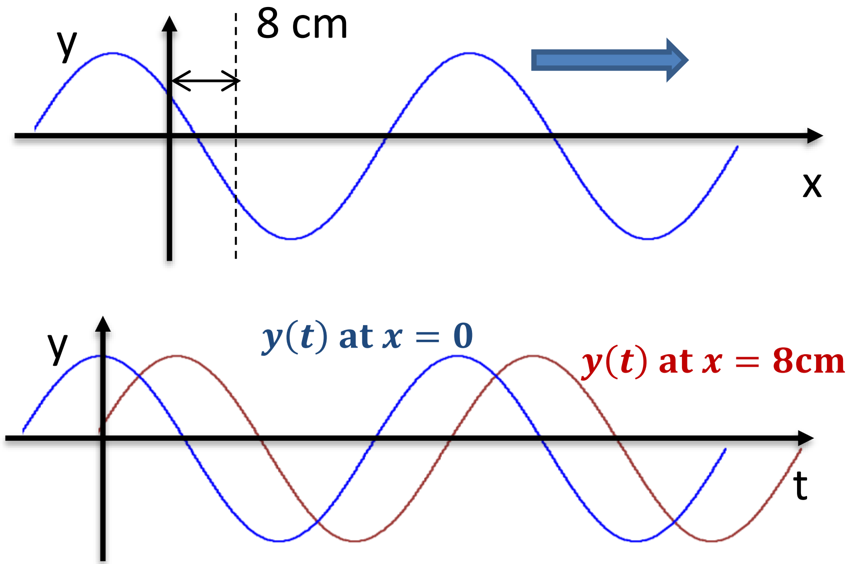
$$y(x,t) = A\cos(kx - \omega t + \phi_0)$$

- The quantity $kx - \omega t + \phi_0$ is the (total) wave phase
  - Argument to sin/cos
  - ϕ_0 is the initial phase at t=0,x=0
- As x changes, the total wave phase changes by 2π per wavelength
- As t changes, the total wave phase changes by 2π per period

A wave with speed v=344 m/s has a frequency of 1000 Hz. The displacement at $x = 0$ is

$$y(t, x = 0) = A\cos(\omega t)$$

If the wave is travelling to the right, what is $y(t)$ at $x = +8$ cm?



Write an arbitrary wave going to the right as

$$y = A\cos(kx - \omega t + \phi_0)$$
$$= A\cos(\omega t - kx - \phi_0)$$

At x=0,

$$y = A\cos(\omega t - 0 - \phi_0) = A\cos(\omega t)$$

So that $\phi_0 = 0$. Using $k = \frac{\omega}{v} = \frac{2\pi f}{v}$ =18.2651 m^{-1}, the displacement at x=8 cm is:

$$y(t, \mathrm{x} = 8\mathrm{cm}) = A\cos(\omega t - kx + \phi_0)$$
$$y(t, \mathrm{x} = 8\mathrm{cm}) = A\cos(\omega t - 18.3 * 0.08 + 0)$$
$$y(t, \mathrm{x} = 8\mathrm{cm}) = \mathrm{A}\cos(\omega t - 1.46)$$

→ When position changes by x, the total phase changes by $-kx$ (for a wave moving to the right)

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