"Mathcad_waves_lecture_3.xmcd"

Assign wave parameters: $\lambda := 5cm$ Wave velocity: $v := 1\frac{cm}{s}$ $k := \frac{2\pi}{\lambda}$ $\omega := \frac{2\pi \cdot v}{\lambda}$

For moving wave described by: $\sin(k \cdot x - \omega \cdot t)$

Trap this wave in a 1D box running from x = 0 to x = L with: $L := 5cm$

$$wave_{right\_1}(x,t) := \sin(k \cdot x - \omega \cdot t)$$

This reflects back to left at x = L forming:

$$wave_{left\_1}(x,t) := \sin[k \cdot (2L - x) - \omega \cdot t]$$

this properly matches waves R1 & L1 at x = L: sin(kL-ωt) = sin(k(2L-L)-ωt)

And then wave L1 reflects reaches left end of box (at x=0), it reflects back to right:

$$wave_{right\_2}(x,t) := \sin[k \cdot (2L + x) - \omega \cdot t]$$

properly matching waves L1 & R2 at x = 0: sin(k(2L-0)-ωt) = sin(k(2L+0)-ωt)

And then wave R3 when it reaches right end of box (at x=L), this wave reflects back to left:

$$wave_{left\_2}(x,t) := \sin[k \cdot (4L - x) - \omega \cdot t]$$

properly matching waves R2 & L2 at x = L: sin(k(2L+L)-ωt) = sin(k(4L-L) - ωt)

And then wave L2 when it reaches right end of box (at x=0), this wave relfecs back to right:

$$wave_{right\_3}(x,t) := \sin[k \cdot (4L + x) - \omega \cdot t]$$

properly matching waves L2 & R3 at x = 0: sin(k(4L-0)-ωt) = sin(k(4L+0) - ωt)

So, looking at series, sum of waves (through 2N terms):

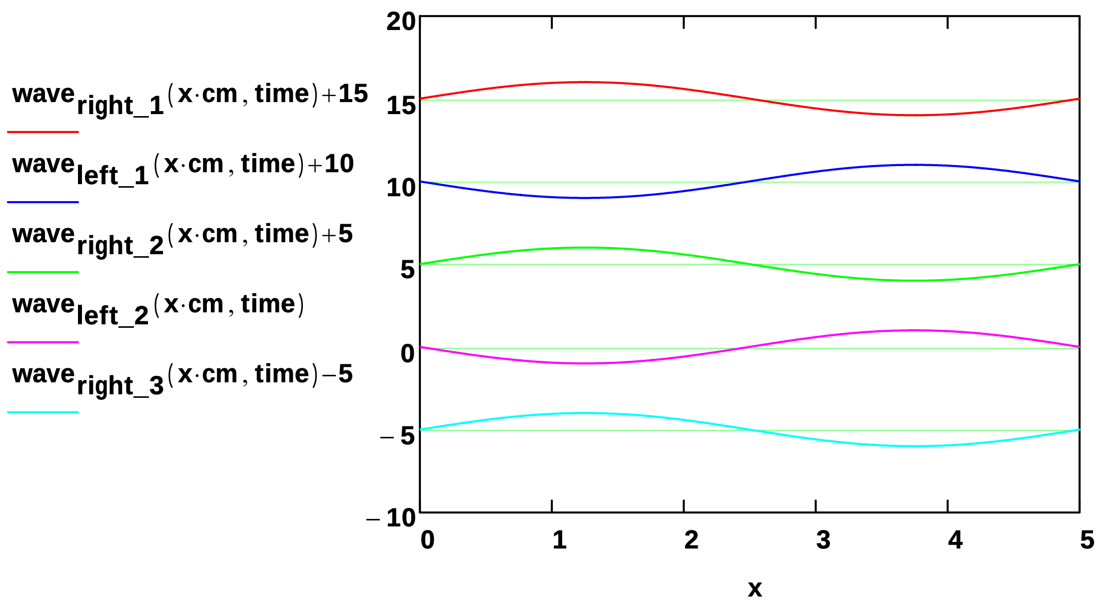
$$wave\_total(x,t,N) := \sum_{i=0}^{N} \sin[k \cdot (2 \cdot i \cdot L + x) - \omega \cdot t] + \sum_{i=1}^{N} \sin[k \cdot (2 \cdot i \cdot L - x) - \omega \cdot t]$$

Check by putting consecutive waves, offset from one another, in single animation.

Make sure as descend (from wave to its reflection) that waves are indeed mirrored at boundary:

$$time := 0.1 \cdot FRAME \cdot sec$$

YES, consecutive waves stay matched at edges



Add initial wave + 24 reflections. Animate versus time while slowly increasing the wavelength

$\lambda := (\text{FRAME} + 1)\cdot\frac{cm}{20}$ $\text{time} := \text{FRAME}$ $L := 5cm$

$v := 1\frac{cm}{s}$ $k := \frac{2\pi}{\lambda}$ $\omega := \frac{2\pi\cdot v}{\lambda}$

$$\text{wave\_total}(x, t, N) := \sum_{i=0}^{N} \sin[k\cdot(2\cdot i\cdot L + x) - \omega\cdot t] + \sum_{i=1}^{N} \sin[k\cdot(2\cdot i\cdot L - x) - \omega\cdot t]$$

$\text{FRAME} = 0$

$\lambda = 0.05\cdot cm$

$\text{wave\_total}(x\cdot cm, \text{time}\ sec, 25)$