## CONCEPT: CALCULATING PROPERTIES OF STANDING WAVES USING WAVEFUNCTIONS

- In some problems, you'll be given the wavefunction for a standing wave and have to calculate some of its properties.
  - The wavefunction for the Standing Wave is a special combination of the original & reflected waves that make it up:

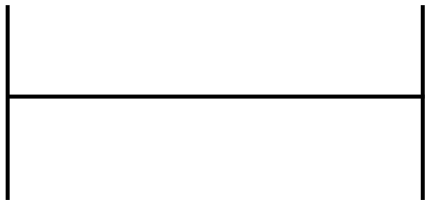
$y_n(x,t)$ = _____ **(FOR STANDING WAVES *ONLY*)**

  - where $A_{SW}$ is _____ the amplitude **A** of the original & reflected waves.

EXAMPLE: A thin string under tension, tied at both ends, vibrates in its 3rd harmonic. The wavefunction describing this wave is given by $y(x,t) = (5\text{cm})sin\left[0.034\left(\frac{\text{rad}}{\text{cm}}\right)x\right] sin\left[50\left(\frac{\text{rad}}{\text{s}}\right)t\right]$.

| WAVES |
| --- |
| $v = \lambda f$ |
| $v = \sqrt{\frac{F_T}{\mu}}$ (for *strings only*) |
| $y(x,t) = A\,sin(kx \pm \omega t)$ |
| $y(x,t) = A\,cos(kx \pm \omega t)$ |
| $k = \frac{2\pi}{\lambda}$ |
| $\omega = \frac{2\pi}{T} = 2\pi f$ |
| $f_n = \frac{nv}{2L}$ |
| $\lambda_n = \frac{2L}{n}$ |

**a)** Draw a sketch of this standing wave.

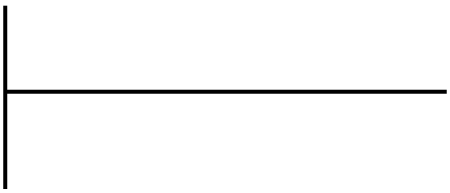


**b)** Calculate the amplitude of the waves that make up this standing wave.

**c)** Calculate the length of the string.

**d)** Calculate the period of oscillation.

PROBLEM: A standing wave on a wire is described by the wavefunction $\boldsymbol{y(x,t)=[0.0025sin(0.75\pi x)]sin[942\,t]}$. The left end of the wire is at x = 0. Derive an expression for the distances of the nodes and anti-nodes.



**STANDING WAVES**

$\boldsymbol{v} = \sqrt{\frac{F_T}{\mu}}$ (for *strings only*)

$\boldsymbol{f_1} = \frac{v}{2L}$

$\boldsymbol{f_n} = \boldsymbol{nf_1} = \frac{nv}{2L}$

$\boldsymbol{\lambda_n} = \frac{2L}{n}$

*$n^{th}$ Overtone = $(n+1)^{th}$ Harmonic*