

Restoring =  $mg \sin \theta$   
 $\theta \approx \sin \theta$

$F = mg \theta$  ←  $\theta = \frac{x}{L}$

$F = \frac{mgx}{L}$   
 $F = kx$

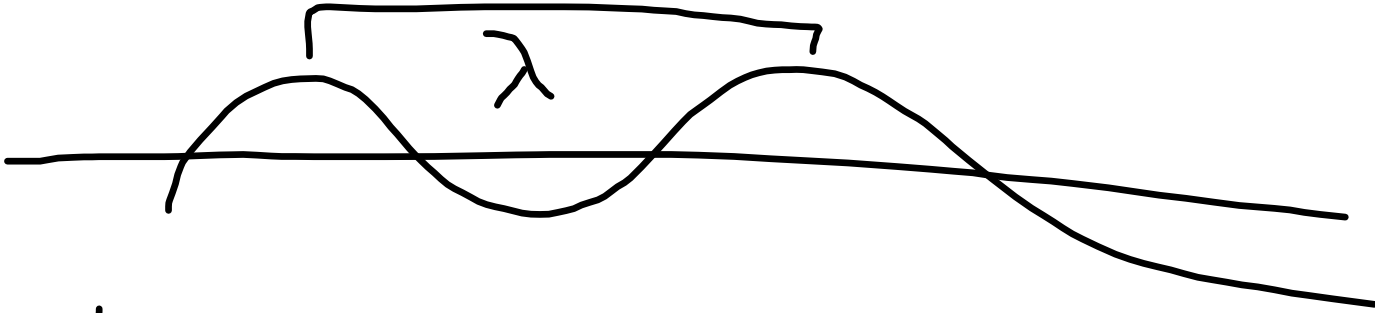
$kx = \frac{mgx}{L}$

∴  $k = \frac{mg}{L}$

$T = 2\pi \sqrt{\frac{m}{k}}$

$T = 2\pi \sqrt{\frac{m}{\frac{mg}{L}}}$

$T = 2\pi \sqrt{\frac{L}{g}}$



frequency = waves/sec  
 $s^{-1}$  (Hz)

$$v = f \lambda$$

$$v = \frac{\lambda}{T}$$

Every wave has a "set" velocity in a particular substance!

solid

$$v = \sqrt{\frac{E}{\rho}}$$

fluid

$$v = \sqrt{\frac{\beta}{\rho}}$$

wave

$$v = \sqrt{\frac{F_T}{\mu}} = \sqrt{\frac{F_T}{m/L}}$$

$\mu$  = "mass per unit of length"

H<sub>2</sub>O sound

$$v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{2.0 \times 10^9 \text{ N/m}^2}{1000 \text{ kg/m}^3}}$$

$$v = 1400 \text{ m/s}$$

in air

$$v = \sqrt{\frac{1.01 \times 10^5 \text{ N/m}^2}{1.29 \text{ kg/m}^3}}$$

$$v = 280 \text{ m/s}$$

in steel

$$v = \sqrt{\frac{E}{\rho}} = \sqrt{\frac{200 \times 10^9 \text{ N/m}^2}{7800 \text{ kg/m}^3}}$$

$$v = 5100 \text{ m/s}$$

$$v = f \lambda$$

sound

$$v_s = 343 \text{ m/s}$$

$$\text{if } \lambda = 1.0 \text{ m}$$

$$f = ?$$

$$v = f \lambda$$

$$f = \frac{v}{\lambda} = \frac{343 \text{ m/s}}{1 \text{ m}}$$

$$f = 343 \text{ Hz}$$

light

$$v_l = 3.0 \times 10^8 \text{ m/s}$$

$$\lambda = 7 \times 10^{-7} \text{ m} \quad v = f \lambda$$

$$f = ?$$

$$f = \frac{v}{\lambda}$$

$$f_r = \frac{3.0 \times 10^8 \text{ m/s}}{7 \times 10^{-7} \text{ m}}$$

$$f_r = 4.3 \times 10^{14} \text{ Hz}$$