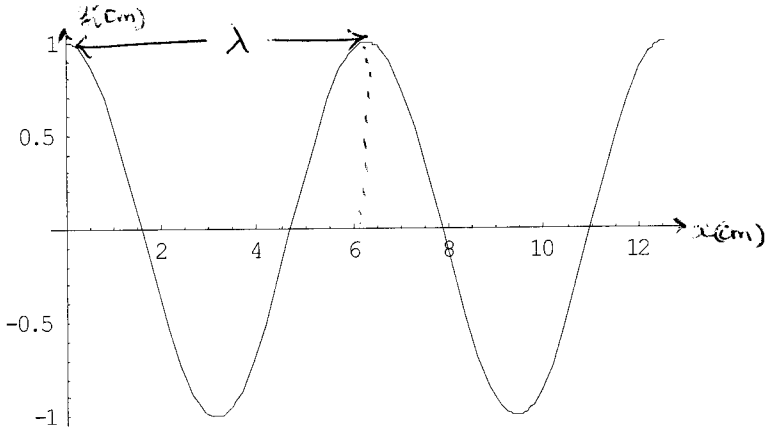
**Physics 102.13**
**Quiz#1**
**Chapter 16**

Instructor: Dr. A. Mekki

Name: Key Id:

A sinusoidal wave traveling to the left is shown in the figure. If the speed of this wave is 20 m/s, find the following:




(a) The wavelength of this wave

From the figure

$\boxed{\lambda = 6 \text{ cm}}$

(b) The maximum displacement

From the figure

$\boxed{y_m = 1 \text{ cm}}$

(c) The angular frequency of this wave

$$v = \frac{\omega}{k} = \frac{\omega}{\frac{2\pi}{\lambda}} = \frac{\lambda\omega}{2\pi} \Rightarrow \omega = \frac{2\pi v}{\lambda} = \frac{2\pi * 20}{0.06\text{m}}$$

$$\boxed{\omega = 666.7\pi \text{ rad/s}}$$

(d) The phase constant

From the figure

$y(0,0) = 1$ cm and in general: $y(x,t) = y_m \sin(kx + \omega t + \phi)$

$$y(0,0) = y_m \sin(\phi) = (1\text{ cm}) \sin\phi = 1\text{ cm}$$

$$\Rightarrow \sin\phi = 1 \Rightarrow \boxed{\phi = \frac{\pi}{2}}$$

(e) Write the expression for the displacement as a function of position and time

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{0.06} = 33.3\pi \text{ rad/m}$$

$$\Rightarrow \boxed{y(x,t) = (0.01\text{ m}) \sin\left(33.3\pi x + 666.7\pi t + \frac{\pi}{2}\right)}$$

**Physics 102.14**
**Quiz#1**
**Chapter 16**

Instructor: Dr. A. Mekki

Name: Key Id:

The expression of a traveling wave is given by $y(x,t) = (0.2m)\cos\pi(2x - 50t + \frac{1}{4})$, where x is in meters and t in seconds.

Find the following including the correct units:

(a) The wavelength of this wave

$$\lambda = \frac{2\pi}{k} = \frac{2\pi}{2\pi} = \boxed{1\ m}$$

(b) The speed of the wave

$$v = \frac{\omega}{k} = \frac{50\pi}{2\pi} = \boxed{25\ m/s}$$

(c) The maximum transverse speed

$$u_{max} = \omega y_m = 50\pi * 0.2 = \boxed{10\pi\ rad/s}$$

(d) The displacement of the particle at x = 0.2 m and t = 1 s.

$$y(0.2, 1) = 0.2 \cos\pi(2*0.2 - 50*1 + \tfrac{1}{4})$$

$$= \boxed{-0.09\ m}$$

**Physics 102.15**
**Quiz#1**
**Chapters 16**

Instructor: Dr. A. Mekki

Name: Key Id: Sect:

1. A stretched string of mass 30 g and length 1.0 m vibrates in its second harmonic when driven by an oscillator of frequency f = 120 Hz. What is the tension in the string?

$$f_2 = 2\frac{v}{2L} = 120 \Rightarrow v = 120 * L = 120 * 1 = 120\ m/s$$

$$v = \sqrt{\frac{\tau}{\mu}} \Rightarrow \tau = v^2 \mu$$

$$\mu = \frac{m}{L} = \frac{30\times10^{-3}}{1} = 30\times10^{-3}\ kg/m$$

$$\Rightarrow \tau = (120)^2 * 30 * 10^{-3} = \boxed{432\ N}$$

2. The resultant wave of two equal waves moving in the same direction is given by:

$y(x,t) = (0.5\text{m})\sin[\pi(2x - 200t + \frac{1}{6})]$

Write the displacement wave for the two orignal waves.

In general: $y = 2y_m \cos\frac{\phi}{2} \sin\left(kx - \omega t + \frac{\phi}{2}\right)$

$$\Rightarrow \frac{\phi}{2} = \frac{\pi}{6} \Rightarrow \phi = \frac{\pi}{3}\ rad$$

$$2y_m \cos\frac{\phi}{2} = 0.5 = 2y_m \cos\frac{\pi}{6} \Rightarrow y_m = \frac{0.5}{1.73}$$

$$\Rightarrow y_m = 0.29\ m$$

$$\Rightarrow \boxed{\begin{aligned} y_1 &= (0.29\text{m})\sin[\pi(2x - 200t)] \\ y_2 &= (0.29\text{m})\sin[\pi(2x - 200t + \tfrac{\pi}{3})] \end{aligned}}$$