TA: Tomoyuki Nakayama Monday, December 6, 2010

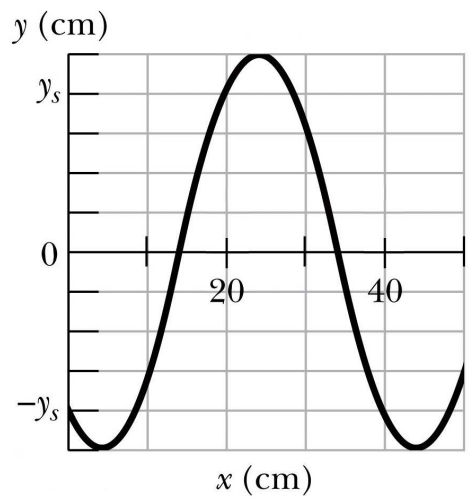
PHY 2048: Physic 1, Discussion Section7193
Quiz 12 (Homework Set #14)

Name: **UFID:**

Formula sheets are not allowed. Calculators are allowed. Do not store equations in your calculator. You need to show all of your work for full credit.

A sinusoidal transverse wave is traveling along a string in the negative direction of an x axis. The wave equation is of the form $y(x\ t) = y_m \sin(kx - \omega t + \varphi)$. The figure below right shows a plot of the displacement as a function of position at time $t = 0$; the y intercept is -8.0 cm. The string tension is 40 N, and its linear density is 50 g/m.

a) What is the maximum transverse speed of a particle in the string?



According to the graph, the maximum displacement y_m is 10 cm and the wavelength λ is 40 cm. The speed of the wave is
$v = \sqrt{(F/\mu)} = 28.3$ *m/s.*
The angular frequency is
$\omega = vk = v(2\pi/\lambda) = 445$ *rad/s*
The transverse velocity is the time derivative of the displacement. We get
$vt(x,t) = dy/dt = \omega y_m \cos(kx - \omega t + \varphi)$
Cosine function changes from -1 to 1. Therefore, the maximum transverse velocity is
$v_{t,max} = \omega y_m = 44.5$ *m/s*

b) Find the phase constant φ.

The graph shows the displacement at t = 0. The wave equation at t = 0 is
$y(x,0) = y_m \sin(kx + \varphi)$.
At x = 0, the displacement is $-y_s$. Therefore, the phase constant is
$y(0,0) - = y_m \sin(\varphi) = -y_s \Rightarrow \varphi = \sin^{-1}(y_s/y_m) = 233^o$ *or* 307°
Now we need to choose one of them. At x = 0, the slope of the graph is negative. This leads to
$dy/dx\ (0,0) = k\, y_m \cos(\varphi) < 0 \Rightarrow 90^o < \varphi < 270^o$
The phase constant is 233º.