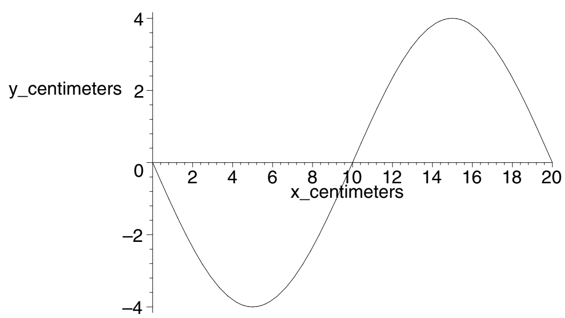
8. (a) The figure in the book makes it clear that the period is $T = 10$ s and the amplitude is $y_m = 4.0$ cm. The phase constant ϕ is more subtly determined by that figure: what is shown is $4 \sin \omega t$, yet what follows from Eq. 17-2 (without the phase constant) should be $4 \sin(-\omega t)$ at $x = 0$. Thus, we need the phase constant $\phi = \pi$ since $4 \sin(-\omega t + \pi) = 4 \sin(\omega t)$). Therefore, we use Eq. 17-2 (modified by the inclusion of ϕ) with $k = 2\pi/\lambda = \pi/10$ (in inverse centimeters) and $\omega = 2\pi/T = \pi/5$ (in inverse seconds). In the graph below we plot the equation for $t = 0$ over the range $0 \le x \le 20$ cm, making sure our calculator is in radians mode.



(b) Since the frequency is $f = 1/T = 0.10$ s, the speed of the wave is $v = f\lambda = 2.0$ cm/s.

(c) Using the observations made in part (a), Eq. 17-2 becomes

$$y = 4.0 \sin\left(\frac{\pi x}{10} - \frac{\pi t}{5} + \pi\right) = -4.0 \sin\left(\frac{\pi x}{10} - \frac{\pi t}{5}\right)$$

where y and x are in centimeters and t is in seconds.

(d) Taking the derivative of y with respect to t, we find

$$u = \frac{\partial y}{\partial t} = 4.0 \left(\frac{\pi}{t}\right) \cos\left(\frac{\pi x}{10} - \frac{\pi t}{5}\right)$$

which (evaluated at $(x, t) = (0, 5.0)$, making sure our calculator is in radians mode) yields $u = -2.5$ cm/s.