Ch 19 #9

$$y = 6.0 \sin(0.020\pi x + 4.0\pi t)$$

a) the amplitude is 6.0 cm

b) the wavelength can be found from $k = \frac{2\pi}{\lambda} = 0.020\pi$ here

$$\Rightarrow \frac{1}{\lambda} = 0.01$$

$$\Rightarrow \lambda = 100 \text{ cm}$$

c) the frequency can be found from $\omega = 2\pi\nu = 4.0\pi$ here

$$\Rightarrow \nu = 2.0 \text{ Hz}$$

d) the (phase) speed can be found from $\lambda\nu = v$

$$v = (100 \text{ cm})(2.0 \text{ Hz})$$
$$= 2.0 \text{ m/s}$$

e) the form $kx + \omega t$ suggests a wave traveling in the $-ve$ x direction

f) the transverse speed is given by $\frac{dy}{dt}$

$$\frac{dy}{dt} = (4.0\pi)(6.0)\cos(0.020\pi x + 4.0\pi t)$$

which has a maximum value when $\cos(\ ) = 1$

$$\frac{dy}{dt}_{max} = 24\pi \text{ cm/s}$$

Ch 19 #15

a) the amplitude is 5 cm according to the graph

b) the wavelength is 40 cm " " " "

c) the wave speed can be found from $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{3.6\,N}{25\times10^{-3}\,kg/m}}$

$= 12\,m/s$

d) the period is the time for a point of constant phase to travel one λ $\therefore$ $v = \frac{\lambda}{T} \Rightarrow T = \frac{\lambda}{v} = \frac{0.40\,m}{12\,m/s}$

$= 0.033\,s$

e) the maximum transverse velocity is $y_m\,\omega = (0.05m)\frac{2\pi}{T}$

$= 3\pi\,m/s$

f) $k = \frac{2\pi}{\lambda} = 5\pi\ rad/m$

$\omega = \frac{2\pi}{T} = 60\pi\ rad/s = 190\ rad/s$

$\phi = ?$ at $t=0, x=0$ $y = 4 = y_m \sin\phi$

$= 5\sin\phi$

$\phi = \sin^{-1}\frac{4}{5}$

$= 53°$ or 0.93 rad

$y = y_m \sin(kx + \omega t + \phi)$

$= 0.05m\,\sin(5\pi x + 60\pi t + 0.93)$

(with x in meters)

Ch 19 # 25

$$\bar{P} = \frac{1}{2} y_m^2 \mu v \omega^2$$

where $\mu = \frac{m}{L} = \frac{263\,g}{2.72\,m} = 0.097\ kg/m$

$$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{36.1\,N}{0.097\,kg/m}} = 19.3\ m/s$$

$y_m = 7.70 \times 10^{-3}\ m$ given

$$\omega^2 = \frac{2\bar{P}}{y_m^2 \mu v}$$

$$\omega = \left[\frac{(2)(85.5\,W)}{(7.70\times10^{-3}\,m)^2(0.097\,kg/m)(19.3\,m/s)}\right]^{1/2}$$

$$= 1241\ rad/s$$

$$\omega = 2\pi\nu \Rightarrow \nu = \frac{\omega}{2\pi} = 198\ Hz$$

Ch 19 # 32

$$y = y_1 + y_2$$

$$= 3.2 \sin(kx - \omega t) + 4.19 \sin(kx - \omega t + \pi/2)$$

$$y = y_m' \sin(kx - \omega t + \phi')$$

$$y_m' = \sqrt{y_1^2 + y_2^2 + 2y_1 y_2 \cos\Delta\phi}$$

$$\cos \pi/2 = 0$$

$$y_m' = \sqrt{y_1^2 + y_2^2}$$

$$= 5.27\ cm$$

Ch 19 # 41

$$y = 0.15 \sin(0.79x - 13t)$$

a) $y(x = 2.3m, t = 0.16s)$

$$= 0.15 \sin[(0.79)(2.3) - (13)(0.16)]$$

$$= -0.039 \text{ m}$$

b) $y = 0.15 \sin(0.79x + 13t)$

c) $y' = 0.30 \sin(0.79x)\cos(13t)$

$y'(x = 2.3m, t = 0.16s)$

$$= 0.30 \sin[(0.79)(2.3)] \cos[(13)(0.16)]$$

$$= -0.14 \text{ m}$$

Ch 20 # 1

a) $\lambda \nu = v$

$$\lambda = \frac{v}{\nu} = \frac{343 \text{ m/s}}{4.5 \times 10^6 \text{ Hz}} = 7.6 \times 10^{-5} \text{ m}$$

b) $$\lambda = \frac{v}{\nu} = \frac{1500 \text{ m/s}}{4.5 \times 10^6 \text{ Hz}} = 3.3 \times 10^{-4} \text{ m}$$

Ch 20 # 8

the time for the P waves to reach the seismograph is t
" " " " S waves " " " " " $t + \Delta t$

the distance traveled by the P waves is $V_p t$
" " " " " S waves is $V_s(t + \Delta t)$

these distances are equal $\quad V_p t = V_s t + V_s \Delta t$

$$t = \frac{V_s \Delta t}{(V_p - V_s)}$$

$$= 219 \text{ s}$$

$$d = V_p t = 1795 \text{ km}$$