University of California, Berkeley
Physics H7A Fall 1998 (*Strovink*)

**PROBLEM SET 10**

**1.** French problem 5-6.

**2.** French problem 5-10.

**3.** French problem 5-14.

**4.** A transverse wave on a string has:

- at $x$=0, a time variation of the form $\cos\omega t + \sin\omega t$ with a period of $10^{-2}$ sec.
- a wavespeed of 10 m/sec.
- the appearance of propagating to the left (toward smaller $x$).
- an amplitude of 0.01 m.

Suppose that the string is described by

$$y(x,t) = \Re(\mathcal{A}_+ \exp i(\omega t - kx) + \mathcal{A}_- \exp i(\omega t + kx))$$

where $\mathcal{A}_\pm$ are complex constants.

**a.** Substitute numbers in place of all the variables (except $x$ and $t$) in the above equation.

**b.** Compute the maximum transverse speed and the maximum slope of the string.

**5.** If surface tension is included, the phase velocity of a surface wave on a liquid of mass density $\rho$ and surface tension $T$ is

$$v_{\rm ph} = \sqrt{\frac{2\pi T}{\lambda\rho} + \frac{g\lambda}{2\pi}}$$

where $\lambda$ is the wavelength and $g$ is the acceleration due to earth's gravity.

**a.** Find the wavelength, frequency, and phase velocity of ripples on water which advance with *minimum* speed.

**b.** Find the group velocity of such a wave.

**6.** A non-dispersive string ($\omega/k$ = constant), initially at rest, has length $L$ ($0 \le x \le L$), and mass per unit length $\mu$. At $t$=0, its shape is

$$y(x) = 3\sin\frac{\pi x}{L} + \sin\frac{3\pi x}{L}$$

and it is under tension $S$.

**a.** What is its period of oscillation $T$?

**b.** At $t = T/2$, what is its shape?

**7.** A guitar string tuned to middle C (256 Hz) is "plucked" at exact center by giving it nonzero transverse velocity in a very small region. What tones (in Hz) will be heard in addition to 256 Hz?