ECE 341 Homework #1

P1. Problem 1.1 in Textbook:

**Problem 1.1** A 2-kHz sound wave traveling in the x-direction in air was observed to have a differential pressure \( p(x,t) = 10 \text{ N/m}^2 \) at \( x = 0 \) and \( t = 50 \mu s \). If the reference phase of \( p(x,t) \) is \( 36^\circ \), find a complete expression for \( p(x,t) \). The velocity of sound in air is 330 m/s.

P2. Problem 1.2:

**Problem 1.2** For the pressure wave described in Example 1-1, plot

(a) \( p(x,t) \) versus \( x \) at \( t = 0 \),
(b) \( p(x,t) \) versus \( t \) at \( x = 0 \).

Be sure to use appropriate scales for \( x \) and \( t \) so that each of your plots covers at least two cycles.

P3. Problem 1.3:

**Problem 1.3** A harmonic wave traveling along a string is generated by an oscillator that completes 180 vibrations per minute. If it is observed that a given crest, or maximum, travels 300 cm in 10 s, what is the wavelength?

P4. Problem 1.5:

Two waves, \( y_1(t) \) and \( y_2(t) \), have identical amplitudes and oscillate at the same frequency, but \( y_2(t) \) leads \( y_1(t) \) by a phase angle of \( 60^\circ \). If 

\[
y_1(t) = 4 \cos(2\pi \times 10^3 t),
\]

write down the expression appropriate for \( y_2(t) \) and plot both functions over the time span from 0 to 2 ms.

Note: We often call a sinusoidal function of time a "wave." This is not in a strict sense, as a wave is a function of both time and position. Better to say a "waveform" (as you can see with an oscilloscope) or a "signal."
P5. Problem 1.6:

The height of an ocean wave is described by the function

\[ y(x,t) = 1.5 \sin(0.5t - 0.6x) \text{ (m)}. \]

Determine the phase velocity and the wavelength and then sketch \( y(x,t) \) at \( t = 2 \text{ s} \) over the range from \( x = 0 \) to \( x = 2\lambda \).

P6. Problem 1.7:

A wave traveling along a string in the +x-direction is given by

\[ y_1(x,t) = A \cos(\omega t - \beta x), \]

where \( x = 0 \) is the end of the string, which is tied rigidly to a wall, as shown in Fig. 1-21 (P1.6). When wave \( y_1(x,t) \) arrives at the wall, a reflected wave \( y_2(x,t) \) is generated. Hence, at any location on the string, the vertical displacement \( y_s \) will be the sum of the incident and reflected waves: