PHYS1001B College Physics IB Homework 1 - Wave

Due Date: 20/9/2024

1. A water wave traveling in a straight line on a lake is described by the equation:

$$y(x,t) = (3.75 \text{ cm})\cos(0.450 \text{ cm}^{-1}x + 5.40 \text{ s}^{-1}t)$$

   where y is the displacement perpendicular to the undisturbed surface of the lake.
   (a) How much time does it take for one complete wave pattern to go past a fisherman in a boat at anchor, and what horizontal distance does the wave crest travel in that time?
   (b) What are the wave number and the number of waves per second that pass the fisherman?
   (c) How fast does a wave crest travel past the fisherman, and what is the maximum speed of his cork floater as the wave causes it to bob up and down?

2. A horizontal wire is stretched with a tension of 94.0 N, and the speed of transverse waves for the wire is 492 m/s. What must the amplitude of a traveling wave of frequency 69.0 Hz be in order for the average power carried by the wave to be 0.365 W?

3. Standing waves on a wire are described by
$$y(x,t) = (A_{SW}\sin ks)\sin\omega t$$

   with $A_{SW} = 2.50$ mm, $\omega = 942$ rad/s, and $k = 0.750\pi$ rad/m. The left end of the wire is at $x = 0$. At what distances from the left end are (a) the nodes of the standing wave and (b) the antinodes of the standing wave?

4. Consider a sound wave in air that has displacement amplitude of 0.0200 mm. Calculate the pressure amplitude for frequency of
   (a) 150 Hz;
   (b) 1500 Hz;
   (c) 15,000 Hz. In each case the result to the pain threshold, which is 30 Pa.

5. A sound wave in air at 20°C has a frequency of 150 Hz and a displacement amplitude of 5.00 x 10^{-3} mm. For this sound wave calculate the
   (a) pressure amplitude (in Pa);
   (b) intensity (in W/m^2);
   (c) sound intensity level (in decibels).

6. Two train whistles, A and B, each have a frequency of 392 Hz. A is stationary and B is moving toward the right (away from A) at a speed of 35.0 m/s. A listener is between the two whistles and is moving toward the right with a speed of 15.0 m/s. No wind is blowing.
   (a) What is the frequency from A as heard by the listener?
   (b) What is the frequency from B as heard by the listener?
   (c) What is the beat frequency detected by the listener?