Linear Waves

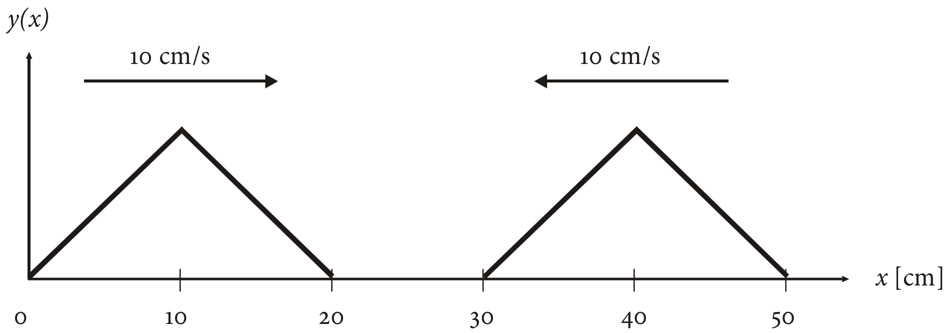
Basic Problems: Homework for Monday, 5 March 2007

Basic Problems

1. The shape of a wave travelling at 20 cm/s can be described by the function $f(x)$ with the following piecewise definition: $f(x) = x$ for x between 0 cm and 10 cm, $f(x) = 20\text{ cm} - x$ for x between 10 cm and 20 cm and $f(x) = 0$ everywhere else.

   Draw the displacement versus position diagram for the fixed time $t = 2$ s and the displacement versus time diagram for the fixed position $x = 30$ cm (t between 0 s and 5 s).

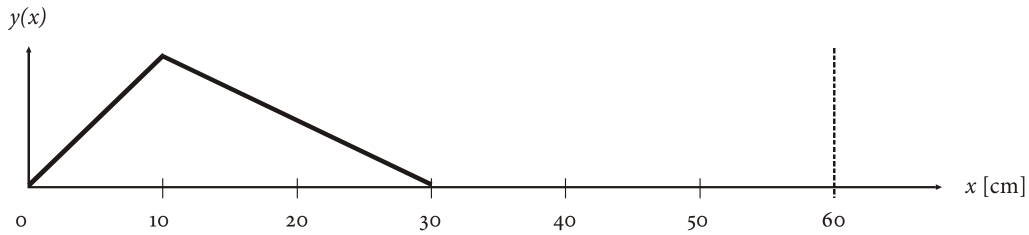
2. Two triangular wave crests on a rope move at 10 cm/s in opposite directions (see figure). Draw the shape of the rope after 1 s.



3. A wave on an 11 m long rope is produced by harmonically moving one end. After 3.4 s the first wave crest arrives at the other end. In the same time the first end has moved up and down twelve times. Calculate the wave's frequency, wavelength and speed.
4. A harmonic wave with wavelength 3.5 cm travels at 8.2 cm/s. Calculate its frequency.
5. The radio station DRS 3 broadcasts on 103.4 MHz. Calculate the radio wave's wavelength.

Additional Problems

6. A wave on a rope can be described by the function $y(x, t) = 3.5\text{ cm} \cdot \sin(3\text{ s}^{-1} \cdot t + 1.5\text{ m}^{-1} \cdot x + 0.5)$. Calculate its amplitude, frequency, wavelength and speed of the wave. At what time does the point at $x = 1$ m on the rope cross the equilibrium position for the first time?
7. The figure below shows a wave propagating at 20 cm/s to the right at the fixed time $t = 0$ s. It is reflected horizontally at $x = 60$ cm.
   a) Draw the form of the wave after 2 s.
   b) Draw the displacement vs time diagram for the fixed position $x = 50$ cm (t between 0 s and 4 s).



Solution to Basic Problems: 3. 3.5 Hz, 0.92 m, 3.2 m/s; 4. 2.3 Hz; 5. 2.9 m