Chapter K - Problems

Blinn College - Physics 2425 - Terry Honan

Problem K.1

Consider a pulse that in SI units has the shape

$$u = f(x) = \frac{8}{x^2+4}.$$

Write this as a function $u(x, t)$ that describes this pulse moving in the positive x direction with a speed of $3\ m/s$.

Problem K.2

What are the speed and direction of a pulse on a string that (in SI units) has the form:

$$y(x, t) = 0.04\, e^{-\left(\frac{x+0.03\,t}{0.06}\right)^2}.$$

Problem K.3

A sinusoidal pulse on a string has the mathematical form $y(x, t) = (0.80\text{ m})\sin\left[\frac{2\pi}{10}(x - 4\,t)\right]$. Plot the y vs. x graph at $t = 0$ s. By the time $t = 0.6$ s how much has the pulse shifted. On the same graph plot y vs. x at $t = 0.6$ s.

Problem K.4

A string with a linear density of $\mu = 4\times10^{-3}$ kg/m is given a tension of 360 N. What is the speed of waves on this string?

Problem K.5

The elastic limit for steel is $S_{\max} = 2.7\times10^{9}\ \text{N}/\text{m}^2$; this is the maximum stress (force per area) that steel under tension can withstand. $S_{\max}$ is the largest value that T/A, the tension per area, can have without a wire breaking. If the density of steel is $7860\ \text{kg}/m^3$ then what is the largest speed a wave can travel down a steel wire?

Problem K.6

A 30 m long copper wire with a 1.2 mm diameter is stretched to a tension of 200 N. How long does it take for a pulse to travel the length of the wire? The density of copper is $\rho = 8.92 \times 10^3 \text{ kg}/\text{m}^3$.

Problem K.7

A sinusoidal wave on a string has the form

$$y(x) = (15 \text{ cm}) \cos\left[\left(\frac{\pi}{20} \text{ cm}^{-1}\right) x - \left(16\,\pi \text{ s}^{-1}\right) t\right].$$

(a) Plot the motion of the positon $x = 0$ as a function of time and find its period and frequency.
(b) What is the maximum speed of this point ($x = 0$) on the string?
(c) What are the wavelength and speed of this wave?

Problem K.8

As a sinusoidal wave passes, a point on a string makes 50 complete vibrations is 20 s. In the same time a crest (maximun) of the wave moves a distance of 4 m. What is the frequency, speed and wavelength of this wave?

Problem K.9

A 15 m length of rope has a mass of 0.6 kg and is given a tension of 500 N. What power is required to put a wave with an amplitude of 20 cm and a frequency of 3 Hz?

Problem K.10

A wave of the form

$$y(x, t) = (0.12 \text{ m}) \sin\left[\left(0.8 \text{ m}^{-1}\right) x + \left(40 \text{ s}^{-1}\right) t\right]$$

travels down a string with a linear density of 8 g/m.

(a) What is the speed of the wave and in what direction is it moving?
(b) What are the wavelength and frequency of this wave?
(c) What is the tension in the string?
(d) What is the power transmitted by this wave?