CHAPTER XVI

WAVES-I

PROBLEM SET

1) A transverse wave on a wire is given by $D(x,t) = 0.015 \sin(25x - 1200t)$ where D and x are in meters and t is in seconds. (*a*) Write an expression for a wave with the same amplitude, wavelength, and frequency but traveling in the opposite direction. (*b*) What is the speed of either wave?

[Answer: a) $D(x,t) = 0.015 \sin(25x + 1200t)$, b) 48 m/s]

2) *** A transverse traveling wave on a cord is represented by $D = 0.22 \sin(5.6x + 34t)$ where D and x are in meters and t is in seconds. For this wave determine (*a*) the wavelength, (*b*) frequency, (*c*) velocity (magnitude and direction), (*d*) amplitude, and (*e*) maximum and minimum speeds of particles of the cord.

[Answer: a) 1.1 m, b) 5.4 Hz, c) 6.1 m/s, -x direction, d) 0.22 m, e) $v_{max} = 7.5\ m/s$, $v_{min} = 0$]

3) *** A transverse wave on a cord is given by $D(x, t) = 0.12 \sin(3.0x - 15.0t)$, where D and x are in m and t is in s. At $t = 0.20$ s, what are the displacement and velocity of the point on the cord where $x = 0.60$ m?

[Answer: displacement= -0.11 m, velocity $= -0.65$ m/s]

4) *** A 524-Hz longitudinal wave in air has a speed of 345 m/s. (*a*) What is the wavelength? (*b*) How much time is required for the phase to change by 90° at a given point in space? (*c*) At a particular instant, what is the phase difference (in degrees) between two points 4.4 cm apart?

[Answer: a)0.658 m, b) 4.77×10^{-4} s, c) 24.1^0]

5) Write the equation for the wave in Problem 28 traveling to the right, if its amplitude is 0.020 cm, and $D = -0.020\ cm$ at $t = 0$ and $x = 0$. [Answer: expression below]

$$D(x,t) = (0.020\,\text{cm})\cos\left[(9.54\,\text{m}^{-1})x - (3290\,\text{rad/s})t + \pi\right], x \text{ in m}, t \text{ in s}$$