

20.55. Model: This is a sinusoidal wave.

Solve: (a) The displacement of a wave traveling in the positive x -direction with wave speed v must be of the form $D(x, t) = D(x - vt)$. Since the variables x and t in the given wave equation appear together as $x + vt$, the wave is traveling toward the left, that is, in the $-x$ direction.

(b) The speed of the wave is

$$v = \frac{\omega}{k} = \frac{2\pi/0.20 \text{ s}}{2\pi \text{ rad}/2.4 \text{ m}} = 12.0 \text{ m/s}$$

The frequency is

$$f = \frac{\omega}{2\pi} = \frac{2\pi \text{ rad}/0.20 \text{ s}}{2\pi} = 5.0 \text{ Hz}$$

The wave number is

$$k = \frac{2\pi \text{ rad}}{2.4 \text{ m}} = 2.62 \text{ rad/m}$$

(c) The displacement is

$$D(0.20 \text{ m}, 0.50 \text{ s}) = (3.0 \text{ cm}) \sin \left[2\pi \left(\frac{0.20 \text{ m}}{2.4 \text{ m}} + \frac{0.50 \text{ s}}{0.20 \text{ s}} + 1 \right) \right] = -1.50 \text{ cm}$$