

Answer on Question # 71329, Physics / Mechanics | Relativity

Question

By rocking a boat, a child produces surface water waves on a previously quiet lake. It is observed that the boat performs 12 oscillations in 30 s and also that a given wave crest reaches shore 15 m away in 5.0 s. Find (a) the frequency, (b) the speed, and (c) the wavelength of the waves.

Solution

(a) The frequency, f , of a wave is the number of oscillations at a point in a certain time. Normally use a time of one second, so this gives frequency in units of hertz (Hz). One hertz is equal to one oscillation per second.

Since in 30 seconds the boat performs 12 oscillations then in order to get the frequency of wave (the number of oscillations per second), we need the number of oscillations 12 in 30 seconds divide by 30

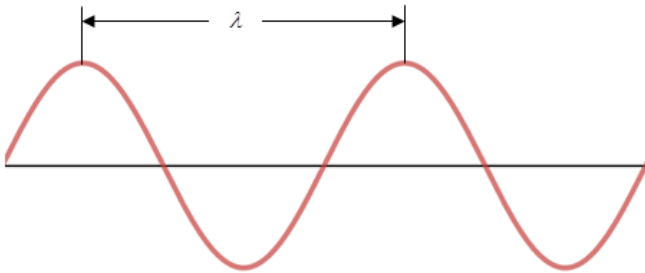
$$f = \frac{12}{30} = \frac{2}{5} = 0.4 \text{ Hz}$$

(b) The speed of a wave, v , is the distance which the wave travels in a certain time. Usually one second is used, and the wave speed is measured in meters per second (m/s).

Since a given wave crest reaches shore 15 m away in 5.0 s, then to obtain the speed of the wave we need divide distance 15 meters by time 5 seconds

$$v = \frac{15}{5} = 3 \text{ m/s}$$

(c) The wavelength, λ , of a wave is the distance from any point on one wave to the same point on the next wave along.



The wavelength corresponds to the distance that a point with a constant phase "passes" over a time interval equal to the period T , therefore we can find wavelength by

$$\lambda = vT$$

However $T = 1/f$ so

$$\lambda = \frac{v}{f} = \frac{3 \text{ m/s}}{0.4 \text{ Hz}} = 7.5 \text{ m}$$

Answer: the frequency of the waves is $f = 0.4 \text{ Hz}$, the speed of the waves is $v = 3 \text{ m/s}$, the wavelength is $\lambda = 7.5 \text{ m}$