

Phys102 (Sec # 42) Quiz # 1 (Ch.16)

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1- A transverse sinusoidal wave traveling in the negative x direction has an amplitude of 20 cm, a wavelength of 30 cm, and a frequency of 10 Hz. Write the expression for y as a function of x (in meters) and t (in seconds) if $y(0,0) = 20$ cm.

$$y = y_m \sin(kx + \omega t + \phi)$$

$$y_m = 20 \text{ cm}$$

$$\lambda = 30 \text{ cm} = 0.3 \text{ m} \Rightarrow k = \frac{2\pi}{\lambda} = 21 \text{ m}^{-1}$$

$$f = 10 \text{ Hz} \Rightarrow \omega = 2\pi f = 62.8 \text{ rad/s}$$

$$y(0,0) = 20 \text{ cm} = 20 \text{ cm} \sin(\phi) \Rightarrow \phi = \sin^{-1}(1) = \pi/2$$

$$\Rightarrow y = 20 \text{ cm} \sin\left(21x + 62.8t + \frac{\pi}{2}\right)$$

2- The equation for a standing wave is given by:

$$y = 5 * 10^{-3} \sin(4.18 x) \cos(50 t) \text{ (SI units).}$$

What is the distance between two consecutive nodes?

$$\downarrow (= \frac{\lambda}{2})$$

$$\text{we find } \lambda = \frac{2\pi}{k} = \frac{2\pi}{4.18} = 1.5 \text{ m}$$

$$\Rightarrow \text{distance requested} = \frac{\lambda}{2} = \frac{1.5}{2} = 0.75 \text{ m}$$

3- Two identical waves moving in the same direction along a stretched string interfere with each other. The amplitude of each wave is 20 mm and the phase difference between them is 35 degrees. What is the amplitude of the resultant wave?

$$y' = 2y_m \cos\left(\frac{\phi}{2}\right) \sin(kx - \omega t + \phi/2)$$

$$\text{amplitude} = y'_m = 2y_m \cos\left(\frac{\phi}{2}\right) = 2(20 \text{ mm}) \cos\left(\frac{35^\circ}{2}\right) = 38 \text{ mm}$$