KING FAHD UNIVERSITY OF PERTOLEUM & MINERALS
PHYSICS DEPARTMENT
QUIZ #1- CHAPTER 16

NAME: Key ID# SECTION#

Two identical sinusoidal waves travel simultaneously in the same direction along the same string. Each wave has an amplitude of y_m = 10 cm.

(a) If the amplitude of the resultant wave is $y_m/4$, what is the phase difference between the two waves in degrees, radian and wavelenght?

$$y'_m = 2y_m \cos\frac{\phi}{2} = \frac{y_m}{4} \Rightarrow \cos\frac{\phi}{2} = \frac{1}{8}$$

$$\frac{\phi}{2} = \cos^{-1}\left(\frac{1}{8}\right) = 82.8^\circ \Rightarrow \boxed{\phi = 165.6^\circ}$$

$$\frac{165.6 \times \pi}{180} = \boxed{0.92\pi \text{ rad}}$$

$$\Delta x = \frac{\lambda}{2\pi} \times 0.92\pi = 0.46\lambda = \boxed{0.46\lambda}$$

(b) Write the equation of the resultant wave if the interfering waves are moving to the right, their wavelength is 20 cm and their frequency is 100 Hz and.

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

$$\phi = 0.92\pi \text{ rad}$$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{0.2} = 10\pi \text{ rad/m}$$

$$\omega = 2\pi f = 200\pi \text{ rad/s}$$

$$\boxed{y'(x,t) = (0.2\text{ m}) \cos(0.46\pi) \sin(10\pi x - 200\pi t + 0.46\pi)}$$

$$= (0.025\text{ m}) \sin(10\pi x - 200\pi t + 0.46\pi)$$

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A transverse sinusoidal wave with an amplitude of 2.5 cm is traveling on a stretched string. The speed of the wave on the string is 35 cm/s, and the maximum transverse speed of a particle on the sting is 7.5 cm/s.

(a) What is the wavelength of the wave?

$\lambda = \frac{v}{f} = \frac{\omega}{k}$

$u_{max} = \omega y_m$

$\omega = \frac{u_{max}}{y_m}$

$\omega = \frac{0.075}{0.025} = 3 \text{ rad/s}$

$\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi}$

$f = 0.5 \text{ Hz}$

$\lambda = \frac{0.35}{0.5} = \boxed{0.7 \text{m}}$

(b) What is the average rate of energy carried by the wave if the string has a mass of 20 g and a length of 50 cm?

$P = \frac{1}{2} \mu v \omega^2 y_m^2$

$\mu = \frac{0.02}{0.5} = 0.04 \text{ kg/m}$

$v = 0.35 \text{ m/s}$

$\omega = 3 \text{ rad/s}$

$y_m = 0.025$

$P = \frac{1}{2}(0.04)(0.35)(3)^2(0.025)^2 =$

$\boxed{P = 3.9 \times 10^{-5} \text{ W}}$

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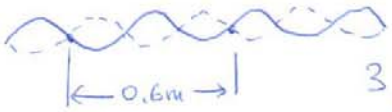
Standing waves are produced by two traveling sinusoidal waves, each of frequency 100 Hz. The distance between the second node and the fifth node is 60 cm.

(a) What is the wavelength of each of the two interfering waves?



$3\frac{\lambda}{2} = 0.6 \Rightarrow \lambda = \frac{1.2}{3} = \boxed{0.4\ m}$

(b) What is the speed of each of the two interfering waves?

$v = \lambda f = 0.4 \times 100 = \boxed{40\ m/s}$

(c) Write the equation of the resultant wave if the amplitude of each of the two waves is 0.2 m.

$y'(x,t) = 2y_m \sin kx \cos \omega t$

$k = \frac{2\pi}{\lambda} = \frac{2\pi}{0.4} = 5\pi\ rad/s$

$\omega = 2\pi f = 200\pi\ rad/s$

$$\boxed{y'(x,t) = 0.4 \sin(5\pi x) \cos(200\pi t)}$$