

Q1

A - Prove this equation (interference)

$$y = 2A \cos\left(\frac{\phi}{2}\right) \sin\left(kx - \omega t + \frac{\phi}{2}\right)$$

And determine when the wave has maximum amplitude and minimum amplitude

assume we have two waves

$$y_1 = A \sin(kx - \omega t)$$

$$y_2 = A \sin(kx - \omega t + \phi)$$

$$y = y_1 + y_2 = A \sin(kx - \omega t) + A \sin(kx - \omega t + \phi)$$

$$= A \left(2 \cos\left(\frac{\phi}{2}\right) \sin\left(kx - \omega t + \frac{\phi}{2}\right) \right)$$

$$= 2A \cos\left(\frac{\phi}{2}\right) \sin\left(kx - \omega t + \frac{\phi}{2}\right)$$

$$\frac{\phi}{2} = \cos^{-1}(1) \Rightarrow \phi = 0, 2\pi, 4\pi, \dots$$

$$\frac{\phi}{2} = \cos^{-1}(0) \Rightarrow \phi = \pi, 3\pi, 5\pi, \dots$$

$$\sin a + \sin b = 2 \cos\left(\frac{a-b}{2}\right) \sin\left(\frac{a+b}{2}\right)$$

$$\rightarrow \text{Max when } \cos\left(\frac{\phi}{2}\right) = \pm 1$$

$$\rightarrow \text{minimum when } \cos\left(\frac{\phi}{2}\right) = 0$$

B - Prove this equation (Standing waves)

$$y = (2A \sin kx) \cos \omega t$$

And determine when the wave has nodes and antinodes

$$y_1 = A \sin(kx - \omega t), \quad y_2 = A \sin(kx + \omega t)$$

$$y = A \sin(kx - \omega t) + A \sin(kx + \omega t) = A (\sin(kx - \omega t) + \sin(kx + \omega t))$$

$$= A \left(2 \sin\left(\frac{2kx}{2}\right) \cos\left(\frac{2\omega t}{2}\right) \right)$$

$$y = 2A \sin(kx) \cdot \cos(\omega t)$$

$$\text{nodes} \rightarrow 2A \sin(kx) = 0, \quad \sin kx = 0, \quad kx = \sin^{-1}(0)$$

$$\frac{2\pi}{\lambda} \cdot x = n\pi, \quad n = 1, 2, 3$$

$$\frac{2\pi}{\lambda} \cdot x = \pi, 2\pi, 3\pi$$

$$\text{when } x = \frac{n\lambda}{2}, \quad n = 1, 2, 3, \dots$$

$$\text{Anti nodes} \rightarrow 2A \sin(kx) = 2A \rightarrow \sin(kx) = 1$$

$$kx = \sin^{-1}(1) = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}$$

$$\frac{2\pi}{\lambda} \cdot x = \frac{n\pi}{2}, \quad n = 1, 3, 5, \dots$$

$$x = \frac{n\lambda}{4}, \quad n = 1, 3, 5, \dots$$

1- The wave is said to be transverse wave when :

a- the elements of the medium at the right angle of the direction of propagation



3- The wave length :

- A - two nodes
- B- two antinodes
- C - either of them
- D) none of them

4- Two waves in a superposition, what happens to the velocity ?

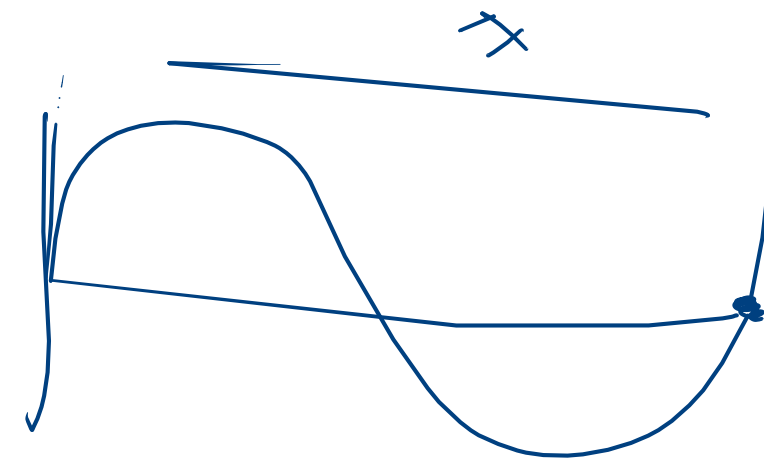
- A- increase
- B- decrease
- C) remains unchanged
- D- zero

$$v = \lambda f$$

$$y = y_1 + y_2$$

5- The displacement covered by wave in one period ?

- A- frequency
- B) wavelength
- C- time period
- D- wave number



6- Two identical waves in the same direction. What happens when they meet?

- A- interference
- B- Standing waves



7- Two identical waves in the opposite direction. What happens when they meet?

- A- interference
- B- Standing waves



12- the maximum distance of the wave from its equilibrium?

- A- Amplitude

13- the reflection of the standing waves is inverted because :

- A - Free end
- B- Fixed end

