VS203B: Waves and Superposition Problem Solutions

1. Consider the following two wave equations:

$$E_1 = 3\cdot\sin\left(12{,}566{,}370\cdot x-\left(3.77\times10^{15}\right)\cdot t+\frac{\pi}{2}\right)$$

$$E_2 = 2\cdot\sin\left(12{,}566{,}370\cdot x-\left(3.77\times10^{15}\right)\cdot t+\pi\right)$$

a) $k = 12{,}566{,}370 = \dfrac{2\pi}{\lambda}$

$\Rightarrow$ λ=500 nm for both waves

b) $\omega = 3.77\times10^{15} = 2\pi f$

$\Rightarrow$ $f = 6\times10^{14}$cycles/sec. for both waves

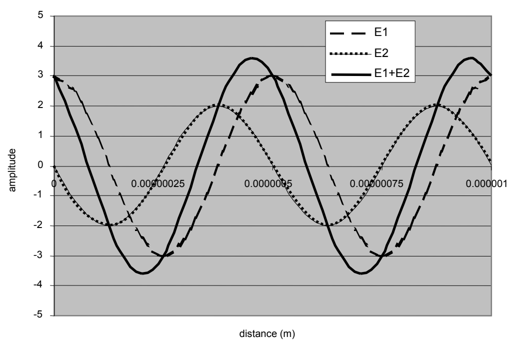
c) $V = \lambda f = 3\times10^{8}$ $\Leftarrow$ speed of light in a vacuum!

d) ω is positive, $\therefore$ waves are travelling to the right

e) Initial phases are $\frac{\pi}{2}$ and π respectively

f),g)

For this problem, you can simply input distances in meters along the axis to find the amplitude. Be sure to compute the sin function in radians and not degrees.



h) $I_1 = A^2 = 9$

$I_2 = A^2 = 4$

$$sum = \left(E_1^2+E_2^2\right) = A_1^2 + A_2^2 + 2A_1A_2\cos\left(\frac{\pi}{2}\right) = 13$$

i) for waves that are in phase $\alpha_1-\alpha_2 = 0$, and $I = 13+12 = 25$

j) for mutually INCOHERENT waves, the phase term is dropped, and the intensity would be:

$$I = E_1^2 + E_2^2 = 9+4 = 13$$

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2. $k = \dfrac{2\pi}{\lambda}$, for $\lambda = 600\times10^{-9}$

$$k = \frac{2\pi}{600\times10^{-9}} = 10{,}471{,}976$$

$$\omega = k\times c = 3.1416\times10^{15}$$

$$E_1 = A_1\sin\left(10{,}471{,}976x - 3.1416\times10^{15}t\right)$$

$$E_1 = A_1\sin\left(10{,}471{,}976x - 3.1416\times10^{15}t+\pi\right)$$

180° out of phase

traveling to the right