Method of Phasors

Question: How do you combine waves that overlap at some point in space?

Answer: Superposition - just add the oscillations!

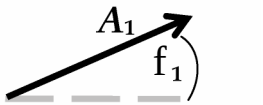
Question: How do you add two harmonic oscillations of the same frequency and type: $E_1 = A_1 \sin(\omega t + \phi_1)$ and $E_2 = A_2 \sin(\omega t + \phi_2)$?

Answer: Use the method of phasors!

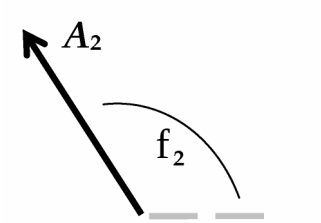
The method of phasors converts the addition of oscillations for different amplitudes and phases to the addition of phasors, which are just vectors.

The **amplitude** of the oscillation converts to the **magnitude** of the phasor.

The **phase** of the oscillation converts to the **direction** of the phasor.



$E_1 = A_1 \sin(\omega t + \phi_1)$

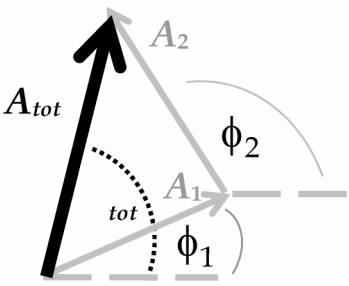


$E_2 = A_2 \sin(\omega t + \phi_2)$

So to combine E_1 and E_2, we **add the corresponding phasors like vectors**:

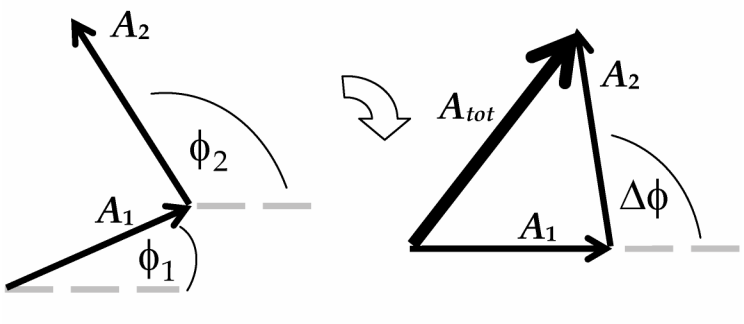
and convert back to oscillations. The amplitude of the combined oscillation is the magnitude of the resultant phasor; the phase of the combined oscillation is the direction of the resultant phasor

$$\Rightarrow E_{tot} = E_1 + E_2 = A_{tot} \sin(\omega t + \phi_{tot}).$$



$E_{tot} = A_{tot} \sin(\omega t + \phi_{tot})$

In most applications, we only care about the amplitude of the combined oscillation, even when more than two waves are combined. For that case, only the phase difference $\Delta\varphi$ matters. Draw the first phasor horizontal, turn the next phasor by $\Delta\varphi$ and add head to tail:



To add the vectors, use our standard method of components, and finish with

$$A_{tot} = \sqrt{A_{tot,x}^2 + A_{tot,y}^2}.$$

See **http://www.eg.bucknell.edu/physics/212E/class/phasors.ppt**
or go to **Calendar entry for Friday February 24 for link**
for more description and a worked out example.