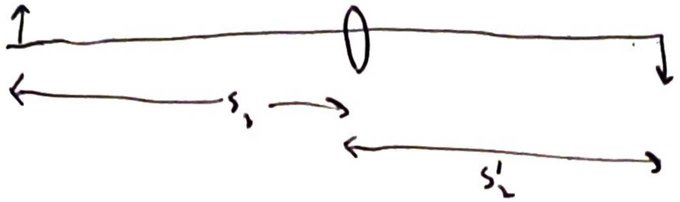
Week 4 pt 3

Bessels method:



Thinking about reversibility, we can write $s_1 = s_2'$ (even tho it doesn't look like that in the picture)

also $s_1 + s_2' = L - d = 2s_1$

$s_1 + s_1' = L \qquad s_1' = L - s_1 = L - \frac{1}{2}(L-d)$

$$\frac{1}{s_1} + \frac{1}{s_1'} = \frac{1}{f} \Rightarrow \frac{2}{L-d} + \frac{2}{L+d} = \frac{1}{f} \Rightarrow f = \frac{L^2 - d^2}{4L}$$

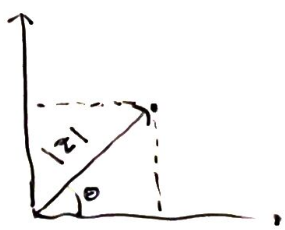
Chapter 4 - Complex #'s

Chapt. 5 - Superposition

Chpt. 6 - Lasers

Chapt 7 - Physical optics

Complex numbers



$a = |z|\cos\theta$

$z = a + bi$

$|z|^2 = a^2 + b^2 = z\bar{z}$

$e^{i\theta} = \cos\theta + i\sin\theta$

$z = |z|e^{i\theta}$

$\cos\theta = Re(e^{i\theta})$

If I wanted to write down an oscillation

$y = A\cos(\omega t + \phi) \qquad y = Re(A e^{i(\omega t + \phi)})$ or just $y = Ae^{i(\omega t + \phi)}$

$y_1 = A_1 e^{i(\omega t+\phi_1)} = \tilde{A}_1 e^{i\omega t}$

$y_2 = A_1 e^{i(\omega t+\phi_2)} = \tilde{A}_2 e^{i\omega t}$ $\quad y = y_1 + y_2 = A e^{i(\omega t+\phi)} = \tilde{A} e^{i\omega t}$

when $\tilde{A}_1 = A_1 e^{i\phi_1}$ $\tilde{A}_2 = A_2 e^{i\phi_2}$ $\quad$ when $\tilde{A} = A e^{i\phi}$

so $\tilde{A} = \tilde{A}_1 + \tilde{A}_2$ $\quad \tilde{A}^2 = \tilde{A}\tilde{A}^* = A^2$

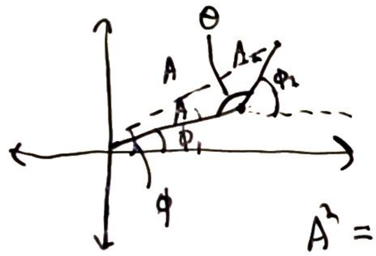
$$A^2 = (\tilde{A}_1 + \tilde{A}_2)(\tilde{A}_1 + \tilde{A}_2)^* = A_1^2 + A_2^2 + \tilde{A}_1\tilde{A}_2^* + \tilde{A}_2\tilde{A}_1^*$$

$$A^2 = A_1^2 + A_2^2 + A_1A_2 e^{i(\phi_1-\phi_2)} + A_1A_2 e^{i(\phi_2-\phi_1)}$$

$$= A_1^2 + A_2^2 + 2A_1A_2\cos(\phi_1-\phi_2)$$

$$\tan\phi = \frac{\sin\phi}{\cos\phi} = \frac{\mathrm{Im}(\tilde{A})}{\mathrm{Re}(\tilde{A})} = \frac{\mathrm{Im}(\tilde{A}_1+\tilde{A}_2)}{\mathrm{Re}(\tilde{A}_1+\tilde{A}_2)} = \frac{A_1\sin\phi_1 + A_2\sin\phi_2}{A_1\cos\phi_1 + A_2\cos\phi_2}$$

<u>phaser representation</u>



$$A^2 = A_1^2 + A_2^2 - 2A_1A_2\cos\theta$$

$180 = \theta + \phi_2 - \phi_1$ $\quad \theta = 180 + (\phi_1 - \phi_2)$

so $A^2 = A_1^2 + A_2^2 + 2A_1A_2\cos(\phi_1-\phi_2)$

$$\tan\phi = \frac{A_1\sin\phi_1 + A_2\sin\phi_2}{A_1\cos\phi_1 + A_2\cos\phi_2}$$

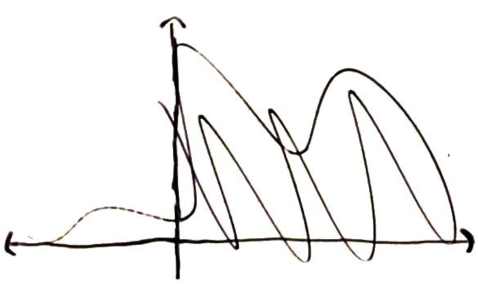
<u>Waves:</u>

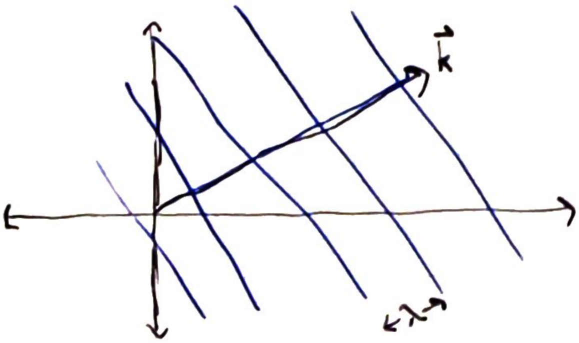
$y(x,t) = A\cos(kx - \omega t + \phi)$

$y = Ae^{i(kx-\omega t+\phi)}$ $\quad k = \frac{2\pi}{\lambda}$ $\quad \omega = 2\pi f$

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

waves in 2D





$|\vec{k}| = \frac{2\pi}{\lambda}$

and points normal to wavefronts