Physics 201 Exam 3: Tuesday Evening Review

EM Waves:

Is $E(x,t) = Ae^{kx-\omega t}$ a solution to $c^2\frac{d^2E}{dx^2} = \frac{d^2E}{dt^2}$? If so what is c in terms of the constants: A k ω

If not, why not?

$$\frac{dE}{dx} = Ae^{kx-\omega t} \cdot \underbrace{\frac{d}{dx}(kx-\omega t)}_{k} = Ake^{kx-\omega t}$$

$$\frac{d^2E}{dx^2} = Ak^2e^{kx-\omega t}$$

$$\frac{dE}{dt} = A(-\omega)e^{kx-\omega t}$$

$$\frac{d^2E}{dt^2} = A\omega^2e^{kx-\omega t}$$

$$c^2\frac{d^2E}{dx^2} \overset{?}{=} \frac{d^2E}{dt^2}$$

$$c^2Ak^2e^{kx-\omega t} \overset{?}{=} A\omega^2e^{kx-\omega t}$$

$$c^2k^2 \overset{?}{=} \omega^2$$

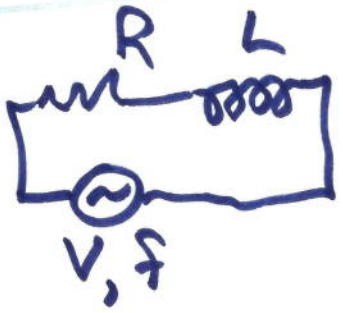
$$\boxed{c = \frac{\omega}{k}}$$ if this is to "work".

What about

$$E(x,t) = A \sin(kx + \omega t)$$

$$\frac{dE}{dx} = A \cos(kx + \omega t)\, k$$

$$\frac{d^2E}{dx^2} = -A \sin(kx + \omega t)\, k^2$$



$V = 1.11\ V$

$f = 1024\ Hz$

$R = 333\ \Omega$

$L = 0.54\ H$

$\omega = 2\pi f$

Find I and V across each element. (rms values). $V = ZI$ $V = XI$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$X_L = \omega \cdot L$$

$$X_C = \frac{1}{\omega \cdot C}$$

solution:

$\omega = 2\pi f = 6434\ \frac{1}{s}$

$X_L = \omega L = 3470\ \frac{\Omega}{H/s}$

$$Z = \sqrt{333^2 + (3470 - 0)^2}$$

No C thus $X_C = 0$.
Do not set $C = 0$.

$$Z = 3490\,\Omega$$

$$V = ZI \qquad I = \frac{1.111\,V}{3490\,\Omega} = \boxed{3.18 \times 10^{-4}\,A}$$

I flows through all elements.

$$V_R = RI = X_R \cdot I = 333\,\Omega \times 3.18 \times 10^{-4}\,A$$

across R only. R

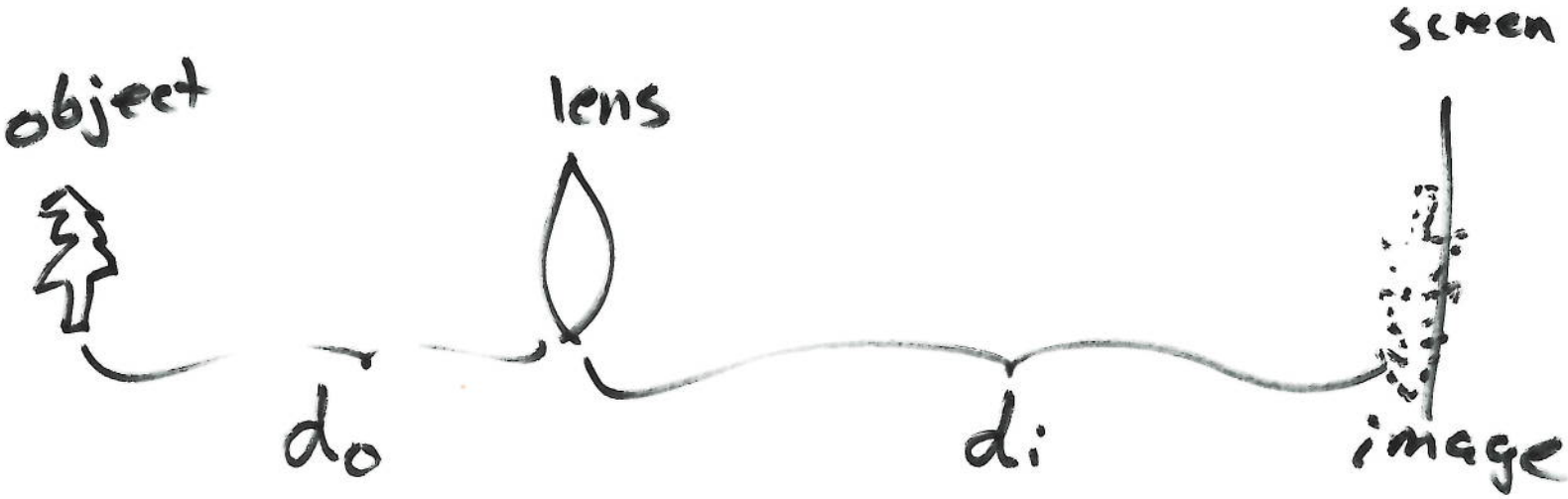
$$\boxed{V_R = 0.106\,V}$$

$$V_L = X_L \cdot I = 3470\,\Omega \times 3.18 \times 10^{-4}\,A$$

$$\boxed{V_L = 1.10\,V}$$

lenses

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \qquad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$



If $d_o = 30\text{cm}$ $d_i = 71\text{cm}$, find f.

If $h_o = 5.1\text{cm}$, find: h_i is image upright or inverted?

$$\frac{1}{f} = \frac{1}{30} + \frac{1}{71} \rightarrow \boxed{f = 21.1\text{cm}}$$

$$h_i = -\frac{d_i}{d_o} \times h_o = -\frac{71\text{cm}}{30\text{cm}} \times 5.1\text{cm}$$

$$h_i = -12.1\text{cm}$$

↑ means image is inverted.

Find λ of laser.

double slit bright

$d\sin\theta = n\lambda$ $\quad n = 0, \pm1, \pm2, \ldots$

single slit darks

$a\sin\theta = p\lambda$ $\quad p = \pm1, \pm2, \ldots$

slit width = 0.10 mm

slit separation = 0.50 mm

$d\sin\theta = n\lambda$

$\sin\theta = \frac{opp}{hyp} = \frac{5.1\,cm}{321\,cm}$

$0.5\,mm \cdot \frac{5.1}{321} = 5\cdot\lambda$

$1.59\times10^{-6}\,m = \lambda$