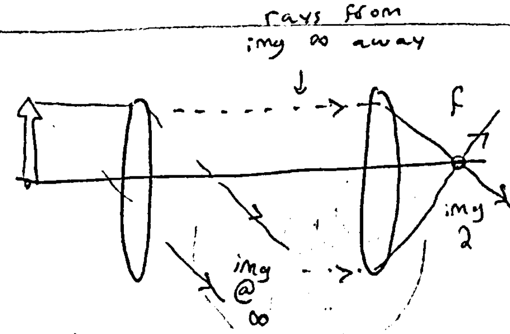
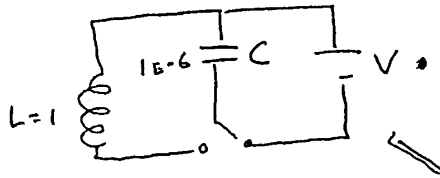
Py 202

Exam prep

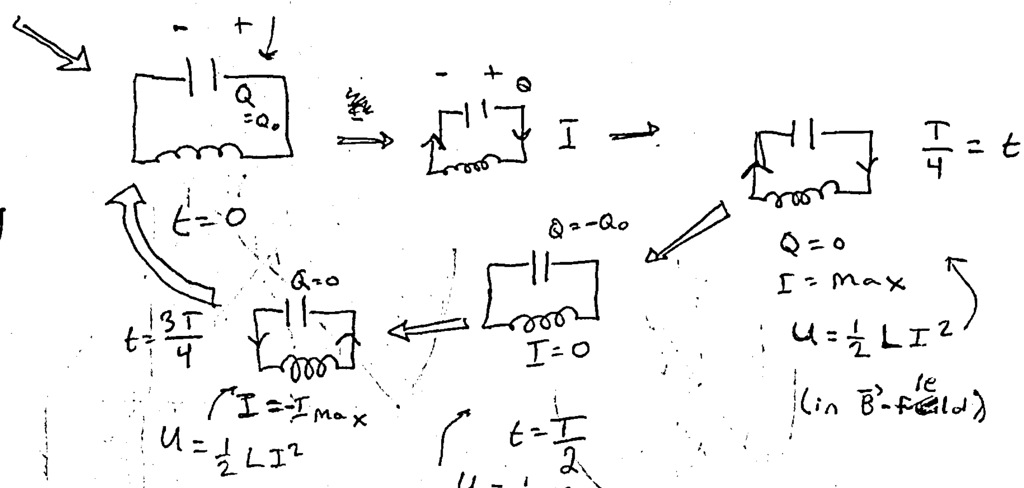
- Bring a ruler



ex)



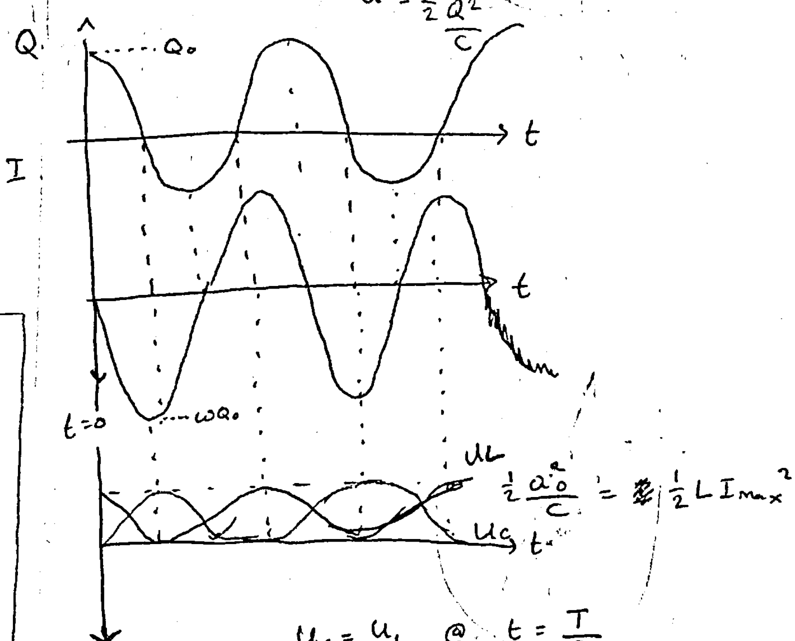
when is E density L = E density C ?



$$\boxed{\begin{aligned} \omega &= \frac{1}{\sqrt{LC}} \\ f &= \frac{1}{2\pi\sqrt{LC}} \\ T &= \frac{1}{f} = 2\pi\sqrt{LC} \end{aligned}}$$

$Q(t) = Q_0 \cos(\omega t)$

$I(t) = -\omega Q_0 \sin(\omega t)$



$\frac{1}{2}\frac{Q_0^2}{C} = \frac{1}{2}L I_{max}^2$

$U_C = U_L$ @ $t = \frac{T}{8}$

RMS

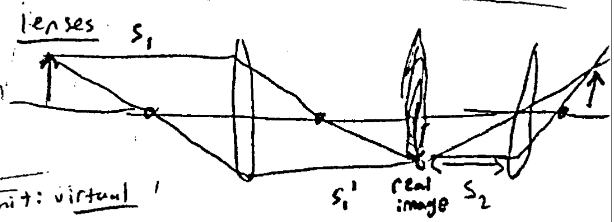
$A(t) = A_0 \cos(\omega t + \phi)$

$A_{RMS} = \frac{A_0}{\sqrt{2}}$

$\sqrt{\frac{1}{T}\int_0^T A(t)^2 \, dt}$

	mirrors		lenses
concave	$f > 0$	converging	$f > 0$
convex	$f < 0$	diverging	$f < 0$
obj on normal side	$s > 0$	obj on normal side	$s > 0$
image where light rays don't hit	$s' < 0$	obj on abnormal side	$s < 0$ light rays don't hit: virtual
if light rays hit image	$s' > 0$		$s' > 0$ light rays hit: real

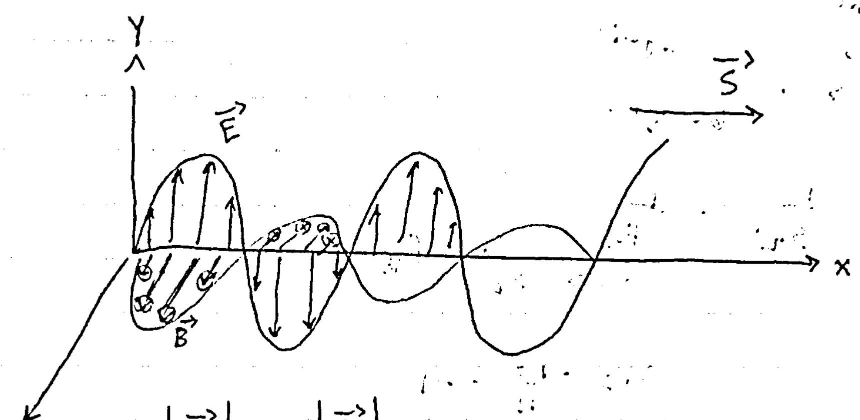
lenses



$M = M_1 \times M_2$

$= -\frac{s_1'}{s_1} \times -\frac{s_2'}{s_2}$

EM waves



$$|\vec{E}| = c|\vec{B}|$$

$$\vec{E}(x,t) = E_0 \cos(kx - \omega t)\,\hat{x}$$
$$= E_0 \cos(k(x - ct))\,\hat{x}$$

$$\vec{B}(x, t) = B_0 \cos(kx - \omega t)\,\hat{z}$$

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

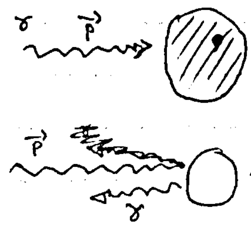
density of an EM wave

$$u = u_E + u_B$$
$$= \frac{1}{2}\varepsilon_0 E^2 + \frac{1}{2\mu_0} B^2$$
$$= \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = \frac{EB}{\mu_0 c}$$

Poynting vec

$$\vec{S} = \frac{\vec{E} \times \vec{B}}{\mu_0}$$ ← dir of wave ← intensity

ex|



$$\vec{p} = \frac{\text{Energy}}{c}$$

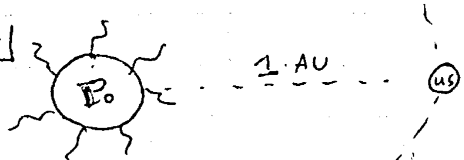
Intensity $I = |\vec{S}|$

$$[I] = \left[\frac{P}{A}\right] = \frac{W}{m^2}$$

Radiation Pressure

$$P_{rad} = \frac{I}{c}$$

ex|



$$I = \frac{P_0}{4\pi R_{e\text{-}s}^2} = 1350\ W/m^2$$

concave
$\frac{1}{s'} = \frac{1}{f} - \frac{1}{s}$ ← s' depends

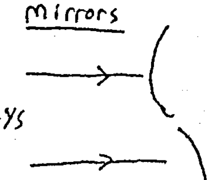
convex
$\frac{1}{s'} = -\left(\frac{1}{|f|} - \frac{1}{s'}\right)$ ← s' always (−)

Table of sign conventions: for mirrors and lenses

all u have to work with is $\boxed{\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}}$

$\boxed{R = 2f}$ $\boxed{m = -\frac{s'}{s}}$

mirrors



$\boxed{\text{Convex } f<0}$

$\boxed{\text{Concave } f>0}$

$\boxed{\text{Memorize the table}}$

$U \quad O$

1st lens: obj @ ∞ for second lens $\hookrightarrow$ $s = f$ again bc $s' =$

2nd lens: $\frac{1}{\infty} + \frac{1}{s_2'} = \frac{1}{f_2}$

$\hookrightarrow s_2' = f_2$:)

$$M = -\frac{15}{15} = -1$$

Maxwell's Equations

Gauss E ① $\int \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\varepsilon_0}$ finding $\vec{E}$-fields of symm. things

Gauss B ② $\int \vec{B} \cdot d\vec{A} = 0$ bc no magnetic monopole

③ $\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt} = -\frac{d}{dt}\int \vec{B} \cdot d\vec{A}$

$$\oint \vec{E} \cdot d\vec{l} = \underbrace{-}_{\text{Lenz's Law}} \int \frac{d\vec{B}}{dt} \cdot d\vec{A}$$

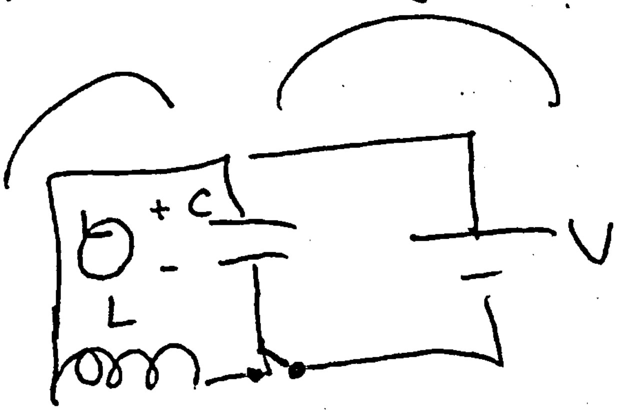
④ $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc} + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$

$$\oint \vec{B} \cdot d\vec{l} = \underbrace{\mu_0 I_{enc}}_{\text{no "}\vec{B}\text{ current"}} + \underbrace{\mu_0 \varepsilon_0}_{1/c^2} \int \frac{d\vec{E}}{dt} \cdot d\vec{A}$$

Charges capacitor

(tells you Q_0, U_0)

$\sum_{loop} \Delta V = 0$

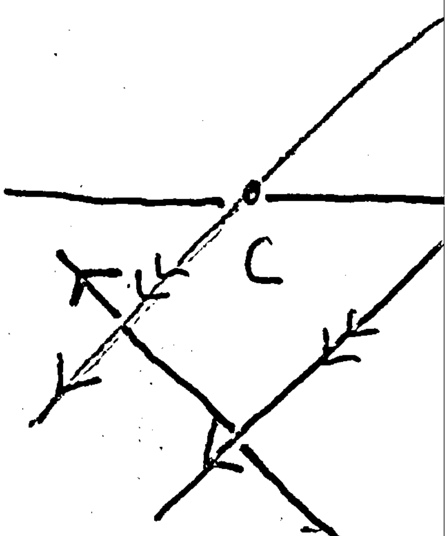


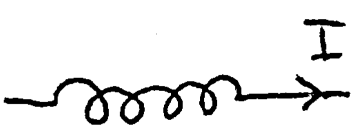
$\sum_{loop} \Delta V = 0$

no i

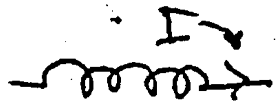
$V_c(t) = \frac{Q(t)}{C}$

$V_L(t) = -L \frac{\partial I(t)}{\partial t}$

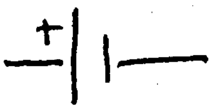




$\frac{\partial I}{\partial t} > 0$



$\frac{\partial I}{\partial t} < 0$

$\approx$ 

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