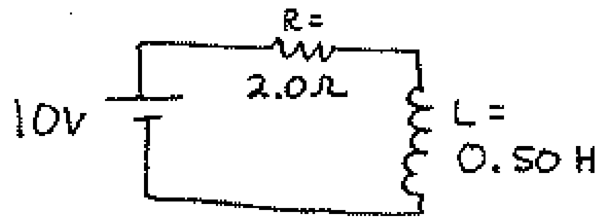
Remember, I have asked questions directly from your homeworks in the past.

Short Answer ↔ Multiple Choice

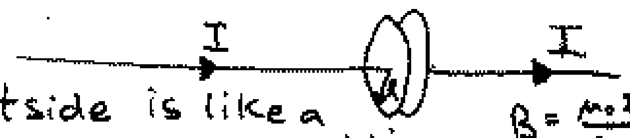
a) The inductive time constant for this circuit is:



I) 1.0s
II) 4.0s
III) 0.25s
IV) 1.0/s
V) 4.0/s

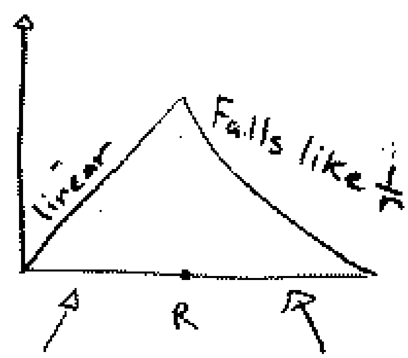
$$\tau = L/R = \frac{0.50\,H}{2.0\,\Omega} = \frac{0.50\,\Omega s}{2.0\,\Omega} = 0.25\,s$$

b) Sketch the magnetic field as a function of r for the space inside a cylindrical capacitor charging up with current I.



Outside is like a wire $B = \frac{\mu_0 I_{enc}}{2\pi r}$ B

inside, we are capturing flux



$$B \cdot 2\pi r = \pi r^2 \frac{dE}{dt}$$

$$B \propto \frac{\pi r^2}{2\pi r} \frac{dE}{dt}$$

$B \propto r$ inside B inside the capacitor

B outside the capacitor

c) To trasport electrical power to your home, the power company uses ____ voltage over long distances and ____ voltage in your home.

Lower, Higher

Higher, Lower

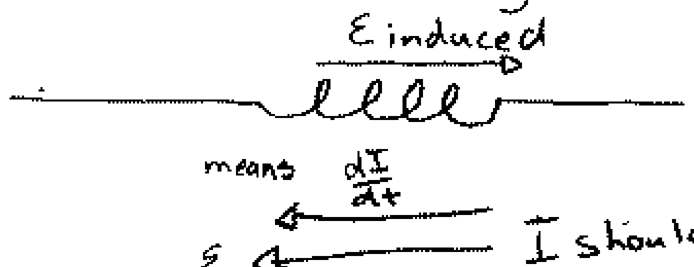
d) The induced Emf in this inductor is to the right. Which is most correct?

I) The current is constant and to the right

II) The current is constant and to the left

III) The current is increasing and to the right

IV) The current is increasing and to the left



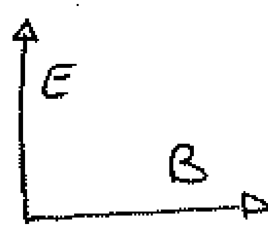
$I = ?$

means $\frac{dI}{dt}$

I should be this way since increasing

e) Which direction is this E-M wave going?

$\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$



out of the page

into the page

(make sure you look at page 717 of your book (Solar Energy & Poynting Vector for a wire)

f) In which of these substances does light, in general, travel faster?

air

water

g) The critical angle for total internal reflection for diamond in air is about 24°. What is the index of refraction of diamond?

I) $n = 0.407$

II) $n = 2.45$

III) $n = 0.914$

IV) $n = 1.09$

$n_{Diamond} \sin\theta_c = n_{Air} \sin 90°$

$n_{Diamond} = \frac{1}{\sin\theta_c} = 2.46$ (closest is II)

#2) For this solenoid, each turn takes up πd (diameter of pipe) of wire and adds 1mm to the length of the solenoid

$$N = \left(\frac{\text{total length of wire}}{\pi d}\right) = \#\text{turns}$$

Likewise, the length of the solenoid = # turns × 1.00mm = N (1.00mm)

$$\left(\text{this means } n = \frac{N}{\ell} = \frac{N}{N(1.00\,mm)} = \frac{1}{0.001\,m}\right)$$

From the equation sheet we see that for a solenoid

$$L = \underset{H/m}{\mu_0} n^2 A \ell = \left(4\pi\times10^{-7}\frac{Tm}{A}\right)\left(\frac{1}{0.001m}\right)^{\cancel{2}} \underbrace{\cancel{\pi}\left(\frac{0.05m}{2}\right)^2}_{\text{Area of pipe}} \left(\frac{30.0m}{\underset{\text{cancels out one on top}}{\cancel{\pi}\,0.05m}}\right)\left(\cancel{0.001m}\right)$$

$$= \left(4\pi\times10^{-7}\frac{Tm}{A}\right)\left(\frac{30.0m}{0.001m}\right)\frac{0.05m}{2^2} = 4.7\times10^{-4}H$$

(note that this makes $L \propto$ diameter of the pipe here)

from the 1st part, we know

$$L = \mu_0\left(\frac{\text{total length of wire}}{\text{diameter of wire}}\right)\frac{\text{diameter of pipe}}{4}$$

so, if we increase just the diameter of the pipe, inductance must increase

$$L_{new} = L_{old}\,\frac{(\text{new diameter})}{(\text{old diameter})} = 4.7\times10^{-4}\,H\left(\frac{.06}{.05}\right)$$

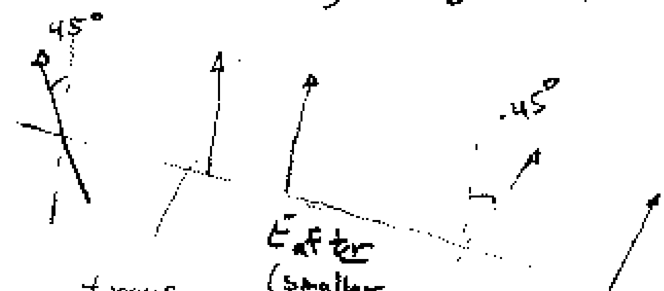
$$= 5.7\times10^{-4}\,H$$

#3) know

$$I_{\substack{\text{After}\\ \text{polarizer}}} = I_0 \cos^2\theta$$

angle between the direction of E and the transmission axis of polarizer

E direction after polarizer is in the direction of the transmission axis the light just passed through. Expect



E_{after} (smaller and along trans axis)

$E_1 = E_0 \cos 45°$

$I_1 = I_0 \cos^2 45°$

E After 2nd polarizer (smaller & along transmission axis)

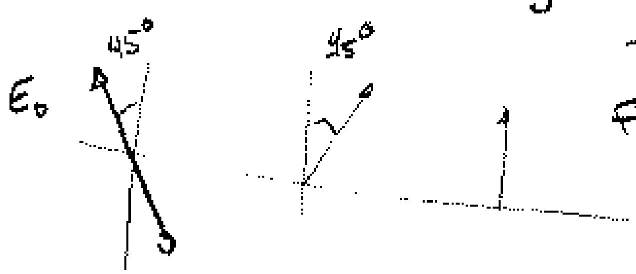
$E_2 = E_1 \cos 45°$

$I_2 = I_1 \cos^2 45°$

$$I_2 = I_0 \cos^2 45° \cos^2 45°$$

$$= \left(1.00\,\frac{W}{m^2}\right)\left(\cos^4 45°\right) = 0.25\,\frac{W}{m^2}$$

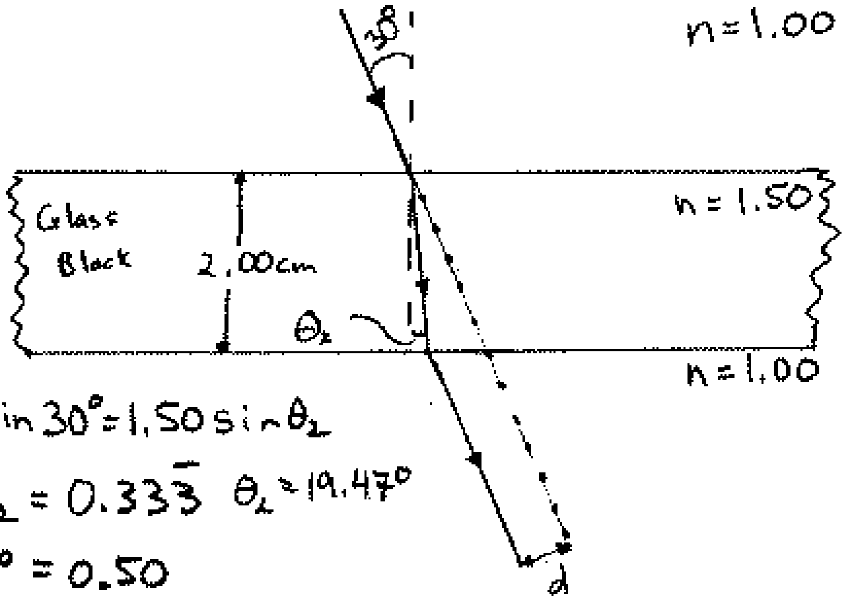
Now is we change the order of the polarizers



The angle between the E_0 and the first polarizer becomes 90°

$$E_1 = E_0 \cos 90° = 0$$

no light is transmitted!



$\sin 30° = 1.50 \sin\theta_2$

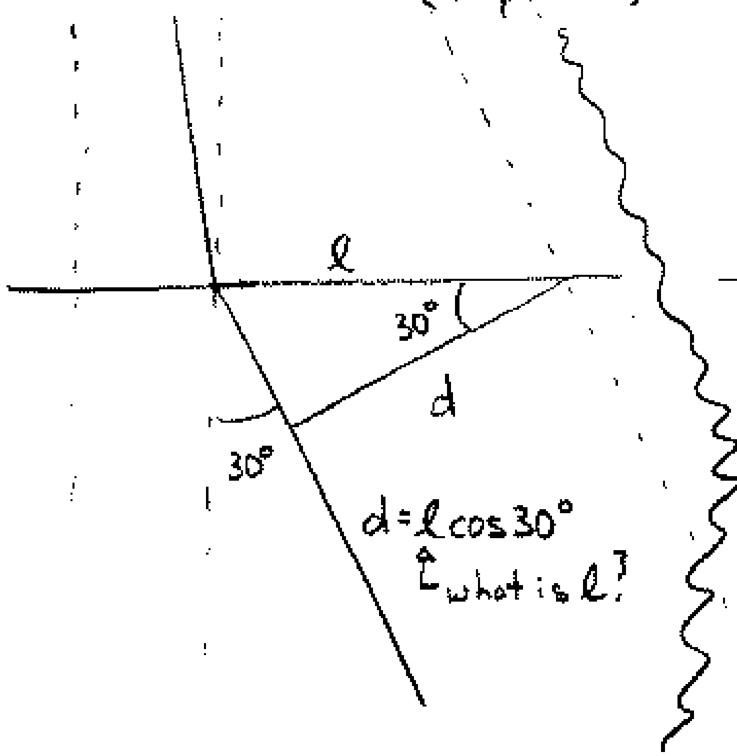
$\sin\theta_2 = 0.33\bar{3}$ $\theta_2 = 19.47°$

$\sin 30° = 0.50$

When the light passes through the glass block it is shifted laterally by the distance d. What is d?

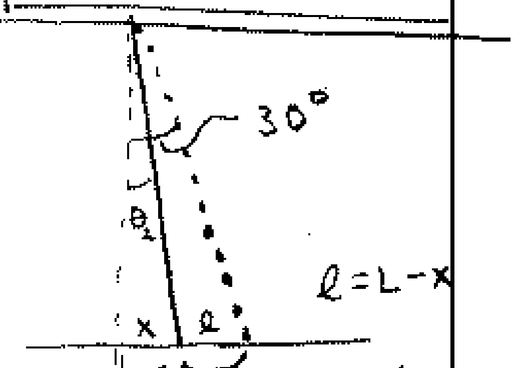
$d =$

I think I would do this problem by noticing that at the second interface (expanded)



$d = \ell\cos 30°$

↑ what is ℓ?



$\ell = L - x$

$L = (2.00\text{cm})\tan 30°$

$x = (2.00\text{cm})\tan\theta_2$

$\ell = (2.00\text{cm})(\tan 30° - \tan 19.47°)$

$= (2.00\text{cm})(.2193)\ 0.4386$

$d = \ell\cos 30° = 0.4386\text{cm}\cos 30°$

$= 0.380\text{ cm}$