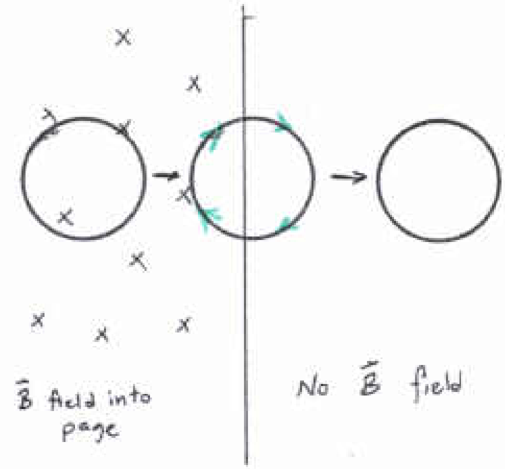
Name ____________ Units? Units?

Phys 2020

Quiz #4 — Fall 2002

1. A loop (in the plane of the page; see figure) is moving from a region where there is a uniform magnetic field directed into the page to one where there is no magnetic field.

While the loop is moving between the two regions, there is an induced current. Give me the direction of this induced current and *give the reasoning* that led to this choice.

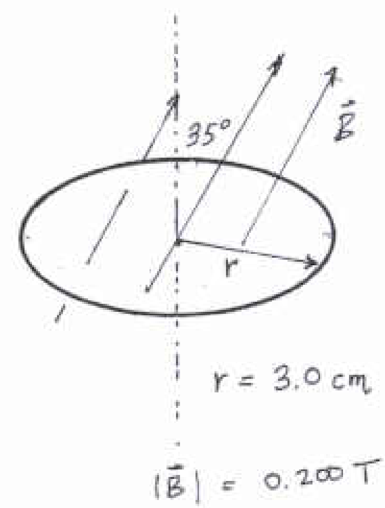


The magnetic field goes "into the page", so that while the loop is leaving the region the flux is "into the page" and decreasing. To oppose this change we need to create a flux into the page.

Using RHR-2 we see that this will come about when the current flows clockwise (as we view the ring). The induced current goes in the direction indicated.

2. A circular loop or radius 3.0 cm is placed in a region where there is a uniform magnetic field of magnitude 0.200 T, directed at an angle of 35.0° from the normal to the plane of the loop.

What is the magnetic flux through the loop?



Using $\Phi = BA\cos\phi$, where $\phi = 35°$ here (angle between $\vec{B}$ and normal to plane of loop) and also $A_{loop} = \pi r^2$, we get:

$$\Phi = (0.200\,T)\,\pi\,(0.030\,m)^2\cos 35°$$

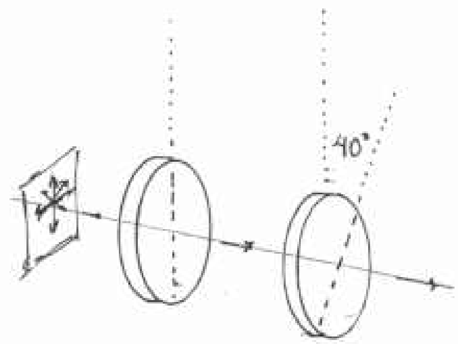
$$= \boxed{4.6\times10^{-4}\ \underbrace{Wb}_{=\,T\cdot m^2}}$$

3. What is the frequency of microwaves (a type of EM waves) which have a wavelength of 12.5 cm ?

Relation between λ, f and c is: $\lambda f = c$. Then $f = c/\lambda$ and using $\lambda = 0.125\ m$,

$$f = \frac{c}{\lambda} = \frac{(2.998 \times 10^{8}\ \mathrm{m/s})}{(0.125\ \mathrm{m})} = \boxed{2.4 \times 10^{9}\ \mathrm{s^{-1}}}$$

$$= \boxed{2.4 \times 10^{9}\ \mathrm{Hz} = 2.4\ \mathrm{GHz}}$$



4. Unpolarized light of intensity 10.0 W/m^2 is incident on a polarizer with its axis aligned vertically. The light then passes through an analyzer with its axis tilted at 40.0° from the vertical.

What is the intensity of the light which passes through both polaroids?

With $\overline{S}_0 = (10.0\ \mathrm{W/m^2})$, the first polaroid reduces the intensity by $\times \frac{1}{2}$ and passes light polarized vertically.

The next polaroid passes the light reduced by a further factor of $\cos^2 40°$ (since its axis is tilted at 40° from pol. of incoming light) The light that emerges is pol'd at 40° from the vertical and its intensity is

$$\overline{S} = \overline{S}_0 \cdot \tfrac{1}{2} \cdot \cos^2 40° = (10.0\ \mathrm{W/m^2})\tfrac{1}{2}\cos^2 40° = \boxed{2.93\ \mathrm{W/m^2}}$$

You must show all your work and include the right units with your answers!

$$A = \tfrac{1}{2}bh \qquad A = \pi r^2 \qquad \Phi = BA\cos\phi \qquad \mathcal{E} = -\frac{\Delta\Phi}{\Delta t} \qquad \mathcal{E} = -L\frac{\Delta I}{\Delta t}$$

$$c = 2.998 \times 10^{8}\,\mathrm{\tfrac{m}{s}} \qquad \lambda f = c \qquad \overline{S}_{\mathrm{pol}} = \tfrac{1}{2}\overline{S}_{\mathrm{unpol}} \qquad \overline{S} = \cos^2\theta\,\overline{S}_0$$