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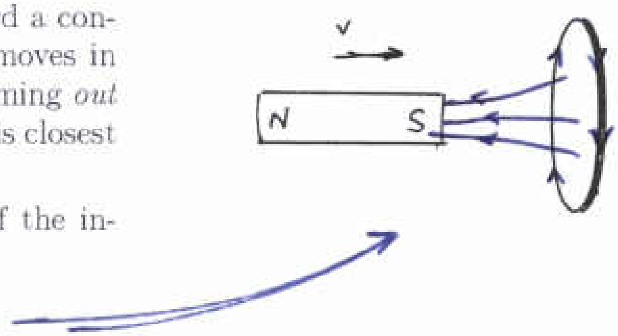
Phys 122 — Section 1
Quiz #4

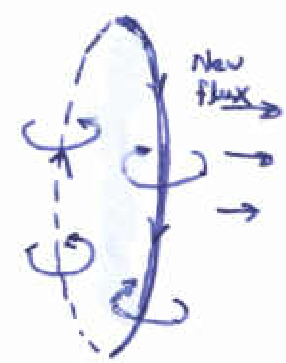
1. A permanent bar magnet is moving toward a conducting loop as shown here. (The magnet moves in the plane of the page; the loop is oriented coming *out of* the page.) The South pole of the magnet is closest to the loop.

a) On the drawing, indicate the direction of the induced current in the loop.



b) Carefully explain why you made your choice in part (a).

Since $\vec{B}$ field lines go into the S pole of the magnet, the flux thru the loop in the leftward direction is increasing. To counteract this change a current will be set up so as to give a magnetic flux in the rightward direction. By the RHR-2 this will come about if the current goes as shown, since the give a mag. field inside the loop pointing to the right.



2. a) The radiation in a microwave oven has a frequency of 2.45×10^9 Hz. Find the wavelength of this radiation.

$= 2.45 \times 10^9$ Hz

Use: $\lambda f = c$ Then $\lambda = \frac{c}{f} = \frac{(2.998 \times 10^8 \text{ m/s})}{(2.45 \times 10^9 \text{ 1/s})} = \boxed{0.122 \text{ m}}$

$= 12.2$ cm

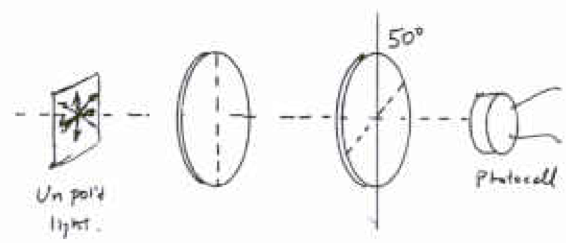
b) At its closest approach to the Earth, the comet Hale-Bopp will be at a distance of 1.95×10^{11} m. How long does it take for the light from the comet to reach the Earth?

Lite travels at const. speed: $d = ct$ Here, $d = 1.95 \times 10^{11}$ m, so

$$t = \frac{d}{c} = \frac{1.95 \times 10^{11}\,\text{m}}{2.998 \times 10^{8}\,\frac{\text{m}}{\text{s}}} = \boxed{650.\ \text{s}} = 10.8\ \text{min}$$

3. A beam of unpolarized light of intensity $700\,\frac{\text{W}}{\text{m}^2}$ is incident on a polarizer with its axis at 0.0° from the vertical. It then passes through another polarizer with its axis at 50.0° from the vertical. It is then measured by a photocell.

Find the intensity of the light which reaches the photocell.



After going thru the first polarizer the light is polarized vertically and has intensity $\frac{1}{2}(700\,\frac{\text{W}}{\text{m}^2}) = 350\,\frac{\text{W}}{\text{m}^2}$ (because it was initially unpolarized).

After going thru the second polarizer the light is polarized at 50° away from the vertical and its intensity is now

$$(350\,\tfrac{\text{W}}{\text{m}^2})(\cos^2 50°) = \boxed{145\,\tfrac{\text{W}}{\text{m}^2}}$$

You must show all your work!

$$\epsilon_0 = 8.895 \times 10^{-12}\,\frac{\text{C}^2}{\text{N}\cdot\text{m}^2} \qquad \mu_0 = 4\pi \times 10^{-7}\,\frac{\text{T}\cdot\text{m}}{\text{A}} \qquad c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} = 2.998 \times 10^{8}\,\frac{\text{m}}{\text{s}}$$

Polarity of an induced emf is such that the induced current produces an induced magnetic field that opposes the change in flux causing the emf.

$$V = IR \qquad P = IV \qquad N_2\Phi_2 = MI_1 \qquad N\Phi = LI \qquad \text{Energy} = \tfrac{1}{2}LI^2$$

RHR–2: Point thumb in direction of current, fingers "wrap" in direction of **B** field.

$$\lambda f = c \qquad \overline{u} = \epsilon_0 E_{\text{rms}}^2 = \frac{1}{\mu_0} B_{\text{rms}}^2 \qquad \overline{S} = c\epsilon_0 E_{\text{rms}}^2 = \frac{c}{\mu_0} B_{\text{rms}}^2 \qquad \overline{S} = \overline{S}_0 \cos^2\theta$$

Some EM units: Coulomb, Volt, Farad, Ampere, Ohm, Tesla, Weber, Henry