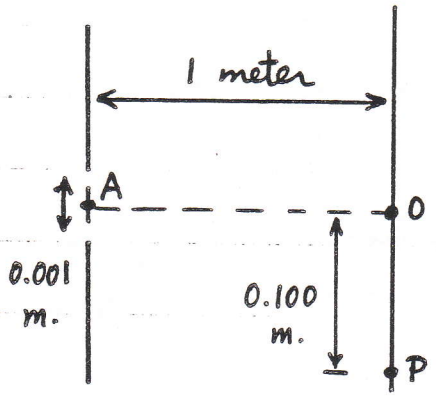
Physics 8B (Sec 2) Second Midterm Exam Nov. 12, 1986

You may use the memory aids agreed upon, but no other papers, and no books. The questions are arranged in estimated order of increasing difficulty, and the exam totals 100 points; $c = 3 \times 10^8$ m/s.

(25) (1) The electric field vector of a certain electromagnetic wave in vacuum has the equation $\vec{E}(z,t) = \vec{E}_0 \sin(kz - \omega t)$, where the amplitude vector $\vec{E}_0 \equiv E_0 \hat{y}$. The magnitude $E_0 = 1000$ volts/meter, + the wave number of the wave is 1 (meter)$^{-1}$. (a) Calculate the circular frequency ω of the wave; (b) Calculate the magnitude $|\vec{E}|$ of the electric field of the wave at the point $z = 4$ meters when the time $t = 10^{-8}$ sec.; (c) In what direction is the electric field $\vec{E}$ at $z = 4$ meters when $t = 10^{-8}$ sec? Justify your answer.; (d) Is the EM wave described above linearly polarized? Justify your answer with a reason.; (e) In what direction(s) is the magnetic field $\vec{B}(z,t)$ associated with this wave? Justify your answer with a reason. [Each part = 5 points.]

(30) (2) Given the thin diverging lens shown on the sheet. The magnitude of the focal length is 3 inches. An object 1 inch high is located 4 inches from the center of the lens. (a) Calculate and describe in words the location of the image; (b) Is the image real or virtual? Justify your answer; (c) Calculate the height of the image; (d) On the sheet supplied, locate the image by tracing two (2) rays. For each ray, give the reason it takes the path that you show. [Parts (a), (b), (c) = 5 points each; part (d) = 15 points.]

(25) (3) A double slit experiment consists of two slits located 10^{-3} meters apart and illuminated with green light of wavelength 6000 Å. A screen is located 1 meter from the slits. A certain point P is located 0.100 meter from the point O on the screen perpendicularly opposite the point A midway between the slits, as shown in the drawing. Waves from the two slits start with zero phase difference between them. Calculate the phase difference Φ (in radians) between the two waves when they arrive at point P.



(20) (4) Given a circular loop of wire of radius R and self-inductance L. A magnetic field B passes through the loop and varies with time with a rate (dB/dt). If I is the current induced in the loop, derive an expression for (dI/dt) in terms of (dB/dt), L, and R. (Assume that $\vec{B}$ is normal to the plane of the loop.)

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NAME _____ DISCUSSION SECTION _____

SCALE 1 inch