PHY 4324 December 4, 2013

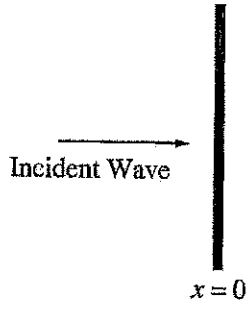
Final Quiz

In some sort of crude sense which no vulgarity, no humour, no overstatement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose.
J. Robert Oppenheimer

(1) An electromagnetic plane wave, propagating in vacuum, has an electric field given by $E = E_0 \cos(kx - \omega t)$ and is normally incident on a perfect conductor at $x = 0$, as shown in the figure below. Immediately to the left of the conductor, the total electric field E and the total magnetic field B are given by which of the following? **(21 points)**

#61 on 2001 Exam

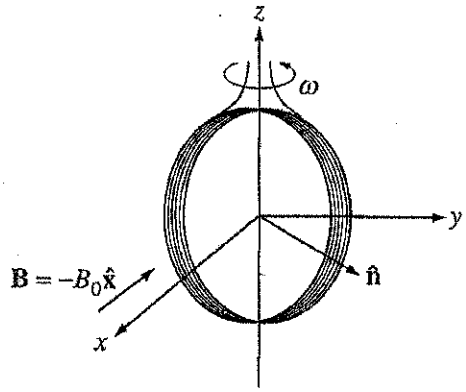
(A) $E = 0$, $B = 0$
(B) $E = 2E_0 \cos(\omega t)$, $B = 0$
(C) $E = 0$, $B = (2E_0/c)\cos(\omega t)$
(D) $E = 2E_0 \cos(\omega t)$, $B = (2E_0/c)\cos(\omega t)$
(E) $E = 2E_0 \cos(\omega t)$, $B = (2E_0/c)\sin(\omega t)$



(2) A coil of 15 turns, each of radius 1 centimeter, is rotating at a constant angular velocity $\omega = 300$ radians per second in a uniform magnetic field of 0.5 tesla, as shown in the figure below. Assume at time $t = 0$ that the normal $\hat{\mathbf{n}}$ to the coil plane is along the y-direction and that the self-inductance of the coil can be neglected. If the coil resistance is 9 ohms, what will be the magnitude of the induced current in milliamperes? **(21 points)**

#86 on 2001 Exam

(A) $225\pi \sin(\omega t)$
(B) $250\pi \sin(\omega t)$
(C) $0.08\pi \cos(\omega t)$
(D) $1.7\pi \cos(\omega t)$
(E) $25\pi \cos(\omega t)$



(3) A uniformly charged sphere of total charge Q expands and contracts between radii R_1 and R_2 at a frequency f. The total power radiated by the sphere is **(21 points)**

#96 on 2001 Exam

(A) proportional to Q
(B) proportional to f^2
(C) proportional to f^4
(D) proportional to (R_2/R_1)
(E) zero