Answer on Question #50908, Physics, Electromagnetism

a) A time varying magnetic field $B(t) = B_o \cos \omega t$ pointing out of the page fills the region enclosed by a circle of radius R shown in the figure below. Determine the induced electric field.

Solution

According to Maxwell–Faraday equation $\oint_L \vec{E} \cdot d\vec{l} = -\frac{d}{dt} \iint_S \vec{B} \cdot d\vec{S}$

$$E 2\pi R = -\frac{d}{dt} B_0 \pi R^2 \cos \omega t \Rightarrow E = \frac{B_0 R \omega}{2} \sin \omega t$$

Answer: $E = \frac{B_0 R \omega}{2} \sin \omega t$

b) Do the following fields satisfy all four Maxwell's equations?

$E(t) = E_0 \sin x \cdot \sin t$

$B(t) = B_0 \cos x \cdot \cos t$

Solution

According to Gauss's law for magnetism $\nabla \cdot \vec{B} = -\vec{B}_0 \sin x \cos t \neq 0$ for all $x \in \mathbb{R}$.

Answer:

So, the following fields don't satisfy all four Maxwell's equations.