A time varying magnetic field B(t) = B0 coswt
r r
pointing out of the page fills the region enclosed by a circle of radius a shown in the figure below. Determine the induced electric field.

Solution.

We are going to calculate the electric field straight on the edge of the circle with radius r. We right down the Faraday's law:

$$\oint \vec{E}\cdot\vec{l} = \frac{d}{dt}\int \vec{B}\cdot d\vec{A}$$

Now we evaluate the path integral, which is rather simple due to the radial symmetry:

$$\oint \vec{E}\cdot\vec{l} = 2\pi E r$$

The change of the flux:

$$\frac{d}{dt}\int \vec{B}\cdot d\vec{A} = |dB/dt|\pi r^2$$

We combine E and B and obtain

$$E = |\frac{dB(t)}{dt}|\cdot\frac{r}{2} = B_0\omega|\sin(\omega t)|\cdot\frac{r}{2}$$

Answer.

$$E = B_0\omega|\sin(\omega t)|\cdot\frac{r}{2}$$