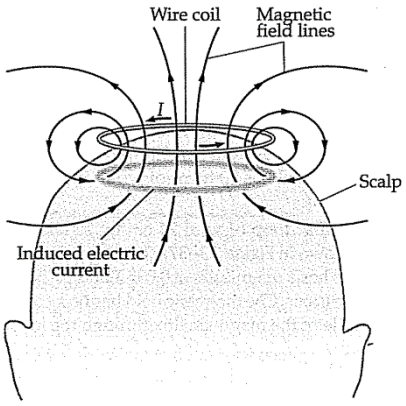
Week 10 Challenge Homework Solutions

Question 1

Transcranial magnetic stimulation (TMS) is a noninvasive method for studying brain function, and possibly for treatment as well. In this technique, a conducting loop is changed rapidly, the magnetic field it creates can change at the rate of 3.00 x 104 T/s. This rapidly changing magnetic field induces an electric current in a restricted region of the brain that can cause a figure to twitch, a bright spot to appear in the visual field, or a feeling of complete happiness to overwhelm a person. If the magnetic field changes at the previously mentioned rate over an area of 1.13 x 10-2 m2, what is the induced emf?



$$|\mathcal{E}| = \left| -\frac{\Delta \Phi_B}{\Delta t} \right|$$

$$= \frac{\Delta(BA\cos 0^\circ)}{\Delta t} = \frac{\Delta B}{\Delta t} A$$

$$= \left(3 \times 10^4 \frac{T}{s}\right)\left(1.13 \times 10^{-2}\ m^2\right)$$

$$= 3.39 \times 10^2 \frac{T\,m^2}{s}$$

$$\boxed{|\mathcal{E}| = 339\ V}$$