Q- A coil consists of 200 turns. Each turn is a square of wire of side 18cm. A magnetic field produced by an electro-magnet and directed perpendicular to the plane of the coil is switched on. If the field changes linearly from 0 to 0.5T in 0.8s:

(a) What is the induced emf in the coil while the field is changing?

According to the Faraday's law, the induced EMF in a coil is given by the rate of change of magnetic field through the loop and hence

$$e = -\frac{d\phi_B}{dt} = -\frac{d}{dt}\left(n * B * A * \cos\theta\right) = -n * A * \cos\theta\left(\frac{dB}{dt}\right)$$

Now the area of the coil A = $(0.18\ m)^2$ = $0.0324\ m^2$.

The rate of change of the field through the coil is

(dB/dt) = (0.5 - 0)/0.8 = 0.625 T/s

And here $\theta = 0^0$

Hence substituting the values in above equation we have the induced EMF in the coil as

$$e = -\ 200 * 0.0324 * 1 * 0.625 = 4.05\,V$$

(Negative is showing the direction according to Lenz's law.)

(b) What is the magnitude of the induced current in the coil while the field is changing if the coil is connected to an external circuit of total resistance 2 Ω.?

The current induced in the loop is given by

I = e/R = 4.05/2 = 2.025 A.