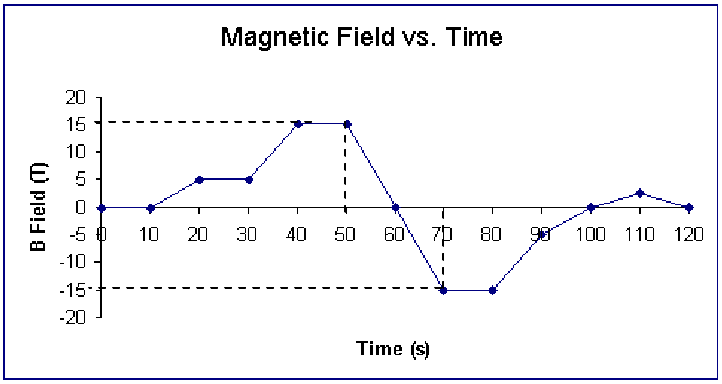
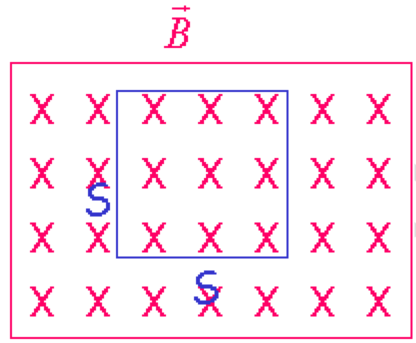
Q- A square conducting loop with sides length a = 0.5 m is placed in a magnetic field. The magnetic field varies in time according to the graph. If the area vector of the coil is in the same direction as magnetic field, what is the **magnitude** of the induced EMF in the coil at t = 25 s, 35 s and 60 s?





(1) As the graph from 20s to 30s is a straight line parallel to the time axis, there is no change in the magnetic field from 20 s to 30 s is constant. Thus the rate of change of magnetic field is zero and hence the induced EMF in the coil at 25 s is zero.

(2) As the graph from 30s to 40s is a straight line, the change in the magnetic field from 30 s to 40 s is at a uniform rate and given by

$$\frac{dB}{dt} = \frac{15 - 5}{40 - 30} = 1 \text{ T/ss}$$

And hence the induced EMF in the coil at 35 s is given by using Faraday's law

$$\varepsilon = -\frac{d\varphi_B}{dt} = -A * \frac{dB}{dt} = -(0.5)^2 * 1 = -0.25\, V$$

The negative sign shows the direction of the field as per Lenz law. Magnitude of the field is 0.25 V

(3) As the graph from 50s to 70s is a straight line, the change in the magnetic field from 50 s to 70 s is at a uniform rate and given by

$$\frac{dB}{dt} = \frac{(-15) - (15)}{70 - 50} = -1.5 \text{ T/s}$$

And hence the induced EMF in the coil at 60 s is given by using Faraday's law

$$\varepsilon = -\frac{d\varphi_B}{dt} = -A * \frac{dB}{dt} = -(0.5)^2 * (-1.5) = 0.375\, V.$$