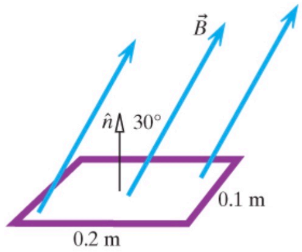
A uniform magnetic field of 1.6 tesla points 30° away from the perpendicular to the plane of a rectangular loop of wire 0.1 m by 0.2 m (see the figure). What is the magnetic flux on this loop?

[ ] T·m²




$$\Phi_{mag} = \vec{B} \cdot \hat{n} A$$

$$= |\vec{B}| \cos(\theta) A$$

$$= 0.0277 \ Tm^2$$

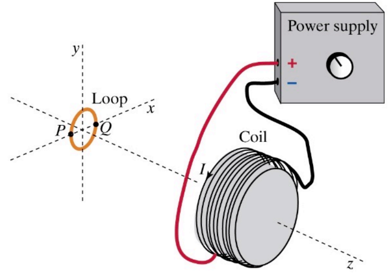
On a circular path of radius 7 cm in air around a solenoid with increasing magnetic field, the emf is 30 volts. A wire with resistance 4 ohms is placed along the path. What is the current in the wire?

[ ] A

$$I = \frac{V}{R}$$

$$= \frac{emf}{R}$$

$$= \frac{30}{4} A$$




A conventional current $I$ runs through a coil in the direction shown in the diagram. Initially the current in the coil is constant. A single loop of copper wire is near the coil. Both loop and coil are stationary.

In this initial state (constant current in coil), what is the direction of the magnetic field at the center of the copper loop, due to the current in the coil?

+z

In this initial state, what is the direction of the electric field at location $P$ inside the copper loop?

E = 0

What is the direction of the electric field at location $Q$ inside the copper loop?

E = 0

Now the power supply is adjusted so the current in the coil **increases** with time.

Now, at the center of the copper loop, what is the direction of $d\vec{B}/dt$?

+z

At the center of the copper loop, what is the direction of $-d\vec{B}/dt$?

-z

What is the direction of the electric field at location $P$ inside the copper wire?

+y

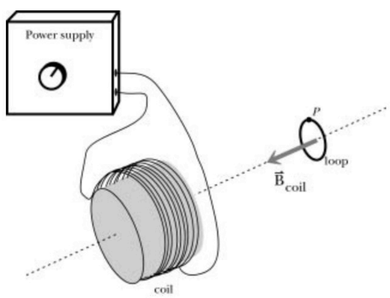
What is the direction of the electric field at location $Q$ inside the copper wire?

-y

Is the magnitude of the magnetic flux inside the copper loop changing at this moment?

- The magnitude of the magnetic flux inside the loop is decreasing.
- (selected) The magnitude of the magnetic flux inside the loop is increasing.
- The magnetic flux inside the loop is constant.

A coil of wire is connected to a power supply, and a current runs in the coil. A single loop of wire is located near the coil, with its axis on the same line as the axis of the coil. The radius of the loop is 4 cm.




At time $t_1$ the magnetic field at the center of the loop, due to the coil, is 0.5 T, in the direction shown in the diagram; the current in the coil is constant.

(a) What is the absolute value of the magnetic flux through the loop at time $t_1$?

$\Phi_{mag}$ = ______ T m$^2$ (b) What approximations or assumptions did you make in calculating your answer to part (a)? Check all that apply.

- [x] The magnetic field due to the coil is uniform in direction over the area of the loop.
- [ ] The magnetic field outside the loop is zero.
- [x] The magnitude of the magnetic field due to the coil is uniform over the area of the loop.

(c) What is the direction of the "curly" electric field inside the wire of the loop at time $t_1$? (Remember that at this time the current in the coil is constant.) ---Select---

At a later time $t_2$, the current in the coil begins to decrease.

(d) Now what is the direction of the "curly" electric field in the loop? ---Select---

At time $t_2$ the rate of change of the magnetic field at the center of the loop, due to the coil, is -0.25 T/s.

(e) At this time, what is the absolute value of the rate of change of the magnetic flux through the loop?

$|d\Phi_{mag}/dt|$ = ______ T m$^2$/s

(f) At this time, what is the absolute value of the emf in the loop?

$|\text{emf}|$ = ______ V

(g) What is the magnitude of the electric field at location $P$, which is inside the wire?

$|\vec{E}|$ = ______ V/m

(h) Now the wire loop is removed. Everything else remains as it was at time $t_2$; the magnetic field is still changing at the same rate. What is the magnitude of the electric field at location $P$?

$|\vec{E}|$ = ______ V/m

## Part One

$$\Phi_{mag} = \vec{B} \cdot \hat{n} A$$

$$= |\vec{B}| \cos(\theta) A$$

$$= BA$$

$$= \pi r^2 B$$

$$= 2.513e{-3}\ Tm^2$$

## Part Three

$$E = 0$$

## Part Four

Counter Clockwise

## Part Five

$$\frac{d\Phi}{dt} = \frac{d}{dt}(\pi r^2 B(t))$$

$$= \pi r^2 \frac{dB(t)}{dt}$$

$$= -0.25\ \pi r^2$$

$$= -1.256e{-3}\ T\,\frac{m^2}{s}$$

$$\left|\frac{d\Phi}{dt}\right| = 1.256e{-3}\ T\,\frac{m^2}{s}$$

## Part Six

$$|emf| = \left|\frac{d\Phi}{dt}\right|$$

$$= 1.256e{-3}\ T\,\frac{m^2}{s}$$

## Part Seven and Eight

$$emf = \oint \vec{E}_{NC} \cdot d\vec{r}$$

$$emf = E_{NC} \oint 1 \cdot d\vec{r}$$

$$emf = E_{NC}\, 2\pi r$$

$$E_{NC} = \frac{emf}{2\pi r}$$

$$= 4.999e{-3}\ V/m$$