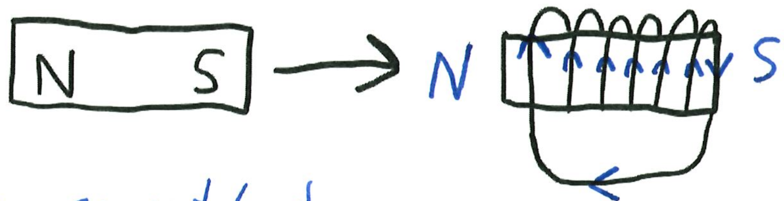
Induction Practice   Name:________________________

1. A magnet moved in the vicinity of a solenoid as shown. Draw the direction of conventional current generated.

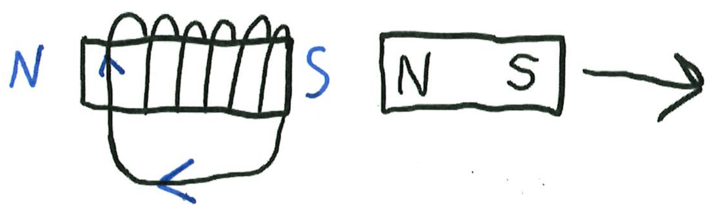
a.



Current is generated to oppose change, if left side is N it opposes, use to see direction of current

2nd RHR

b.

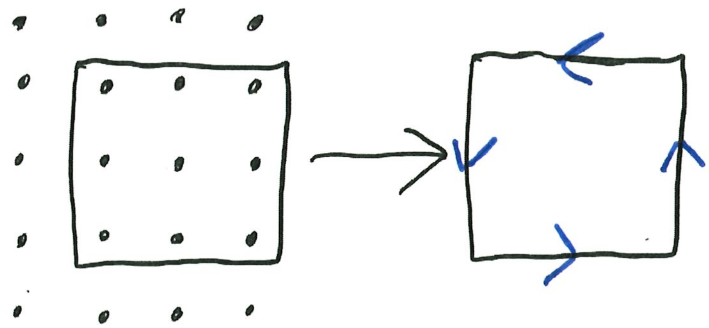


Induction Practice Name:______________________________

2. For each of the following:

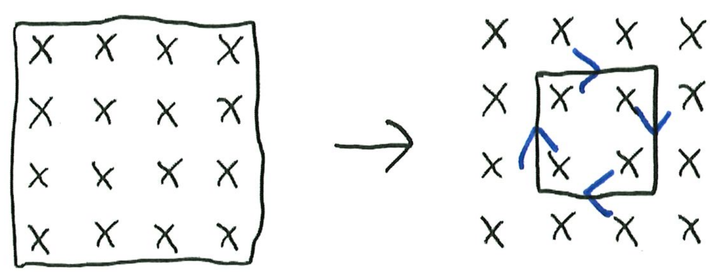
- Describe the change in magnetic flux (e.g. more into the page)
- Give the direction of the electric field that would oppose that change in flux
- Give the direction (clockwise or counter clockwise) that current would flow in the loop.

a.



Change: Less flux out of page
Oppose: More field out of page
and aHa, North end is out of page, so counter clockwise

b.

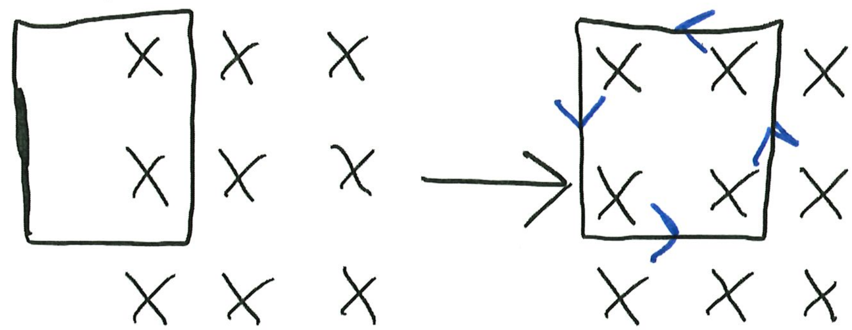


Change: Less flux into page
Oppose: More field into pag

Clockwise

Induction Practice Name:________________________________

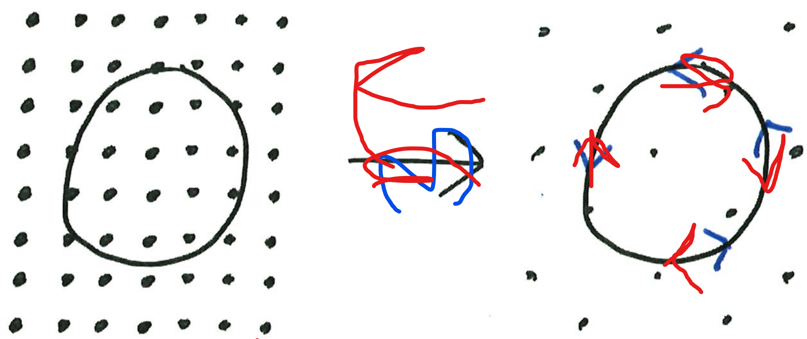
c.



Change: More flux into page
Oppose: More field out of page

Counter clockwise

d.



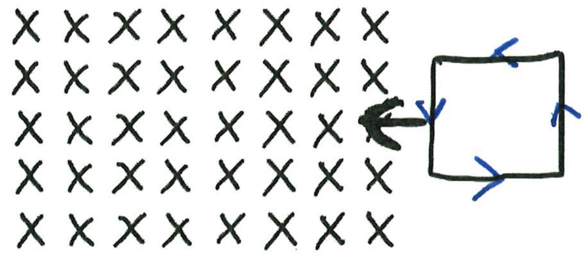
Change: ~~Less~~ More flux out of page
Oppose: ~~More~~ Less flux out of page

~~Counter~~ clockwise

Induction Practice Name:______________________________

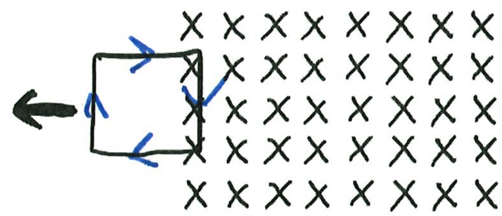
3. A loop of wire is moved as shown over a fixed permanent magnet which generates a magnetic field pointed into the page.

a. Draw the direction of conventional current generated as the loop enters the magnetic field.



Flux into page increases
To oppose a field out of the page should be generated
Counterclockwise

b. Draw the direction of conventional current generated as the loop leaves the magnetic field.



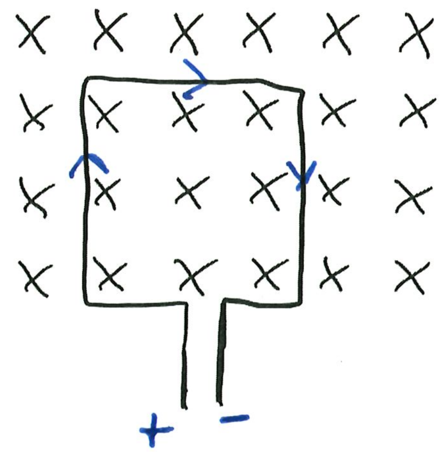
Flux into page decreases
To oppose a field into the page should be generated
Clockwise

c. While the loop is moving through the uniform magnetic field is any current generated?

No, there is no change in flux

Induction Practice Name:______________________

4. A coil of wire initially perpendicular to a magnetic field as shown is rotated to being parallel to the field and so the flux drops to zero.



   a. As it is rotating which direction will conventional current flow in the wire.

Flux into page decreases, to oppose field into page generated

Clockwise

   b. Label the two ends of the wire as positive and negative.

Conventional current goes from (+) to (−)

   c. If the magnetic field strength is 0.023 T, the area of the coil is 0.025 m^2 and it takes 0.015 seconds to rotate from perpendicular to parallel what will the EMF induced by each loop be?

$$\mathcal{E} = \left|\frac{\Delta \Phi}{t}\right| = \frac{(0 - BA)}{t} = \frac{0.023 \times 0.025}{0.015}$$

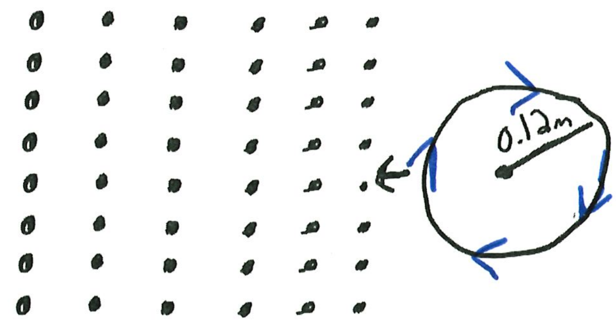
$$= 0.038\ V$$

   d. What will the total EMF induced be if there are 250 loops of wire in the coil?

$0.038333 \times 250 = 9.6\ V$

Induction Practice Name:______________________________

5. A circular loop of wire of radius 0.12m enters a 0.026 T magnetic field directed out of the page as shown.



   a. What is the area of the loop?

$A = \pi r^2$

$= \pi (0.12m)^2 = 0.04524m^2$

   b. What is the flux of the loop when it is fully in the magnetic field?

$\Phi = BA = (0.026)(0.04524)$

$= 0.001176\ T\cdot m^2$

   c. What is the induced EMF in the loop if it takes 0.23 seconds for the loop to move from fully out of to fully in the magnetic field?

$\varepsilon = \frac{\Delta\Phi}{t} = \frac{0.001176}{0.23}$

$= 0.0051V$

   d. Draw the direction current will flow in the loop.

change is more flux out of page

oppose by more field into page

Clockwise

Induction Practice Name:________________________________

6. A coil of 35 loops of wire with area of 0.25 square metres is perpendicular to a 0.085 T magnetic field and is rotated so that it is parallel to the field in 0.017 seconds.

↑when parallel flux will be zero

a. During that time what is the EMF generated?

$$\frac{\Delta\Phi}{t} = \frac{(35)(0.085)(0.25)}{0.017} = 43.75V$$

b. If the wire is connected to a lightbulb that has resistance of 15 Ω, how much current will flow through the wire (Remember $V = IR$)

$$\frac{V}{R} = I \rightarrow \frac{43.75}{15} = 2.9A$$

7. A coil of 250 loops of circular wire with radius of 0.26 metres is perpendicular to a magnetic field of strength 0.52 T, the magnetic field strength is slowly decreased to 0.23 T in 15.0 seconds.

a. During that time what is the EMF generated?

$A = \pi r^2 = 0.2124 m^2$

$$\Delta\Phi = \Phi_f - \Phi_i = 0.2124 \times 0.23 - 0.2124 \times 0.52 = -0.06158$$

$$\mathcal{E} = |N \frac{\Phi}{t}| = 1.03V$$

b. If the wire is connected to a lightbulb that has resistance of 8.0 Ω, how much current will flow through the wire?

$$\frac{V}{R} = I \rightarrow I = 0.128A$$

c. How much power is the lightbulb drawing? (Remember $P = VI$)

$$P = 1.03 \times 0.128 = 0.1321 W$$

d. How much electrical energy is generated in those 15 seconds? $\left(P = \frac{W}{t}\right)$

$$W = Pt = 0.1321 W \times 15 sec$$

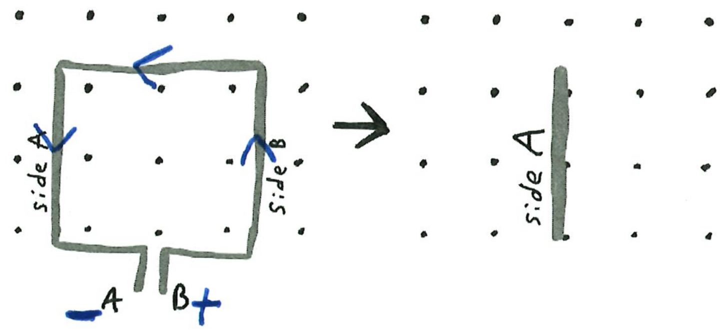
$$= 1.98 J$$

Induction Practice Name:________________________

8. A coil of wire of area 0.152 square metres is initially perpendicular to a magnetic field of strength 0.272 T directed out of the page.

   a. It rotates so that side A lifts out of the page and side B rotates into the page until the coil is parallel to the field and the flux becomes zero.

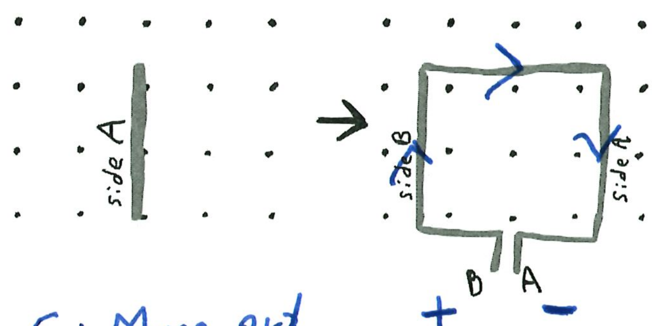
      Label the direction current is flowing in the wire and label the A and B ends of the wire as being either positive or negative during this rotation.



C: Less out
O: More out
counter clockwise

   b. After the coil is parallel to the field it continues to rotate until it is perpendicular to the magnetic field again.

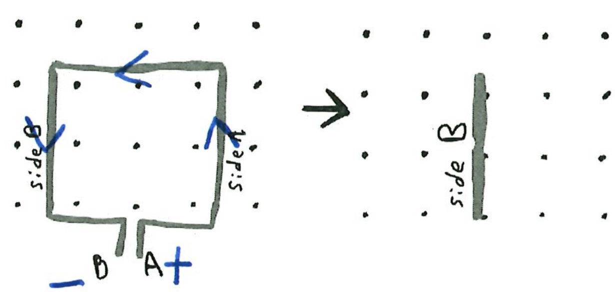
      Label the direction current is flowing in the wire and label the A and B ends of the wire as being either positive or negative during this rotation.



C: More out
O: More in
clockwise

   c. The coil continues its rotation until it is parallel with the field with side B on top.

      Label the direction current is flowing in the wire and label the A and B ends of the wire as being either positive or negative during this rotation.



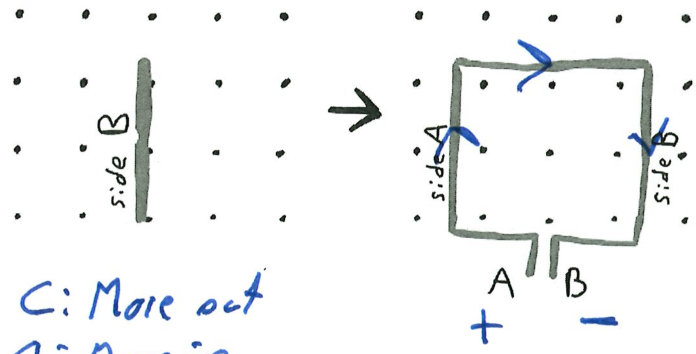
C: Less out
O: More out
counter clockwise

Induction Practice

Name:______________________________

d. The coil rotates until it is back to its original position.

Label the direction current is flowing in the wire and label the A and B ends of the wire as being either positive or negative during this rotation.



C: More out
O: More in
clockwise

e. As the coil spins describe how direction of the electric current charges throughout the rotation.

For first half it goes one way and for second half it goes the other

f. If the coil spins at 30 rotations per second how many times does the direction of the current change per second?

Switches twice per rotation

so $30 \times 2 = 60$

g. If the coil spins at 30 rotations per second what is the average EMF during each quarter rotation?

$t = \frac{1}{30} \div 4 = \frac{1}{120}$

$\mathcal{E} = \frac{\Phi}{t} = \frac{(0.152)(0.272)}{1/120} = 4.96\text{ V}$

h. If the wires are connected to a 12 Ω lightbulb what will the average current flowing through the wires be?

$\frac{V}{R} = I \rightarrow \frac{4.96}{12} = 0.41\text{ A}$