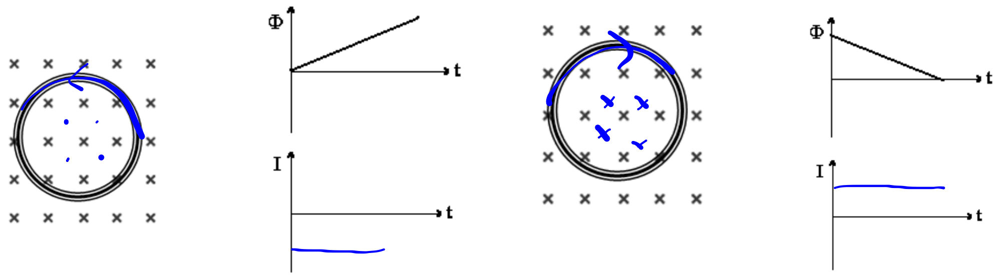
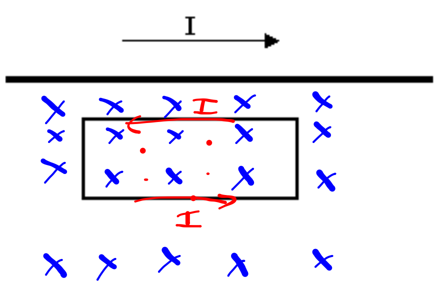
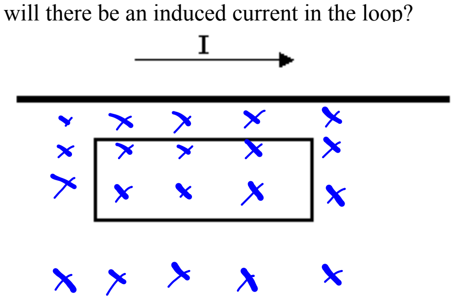
1. The diagrams show a conducting ring that is placed in a uniform magnetic field that is changing at a constant rate, as shown by the graph. Deduce the nature and direction of the induced current in each case.



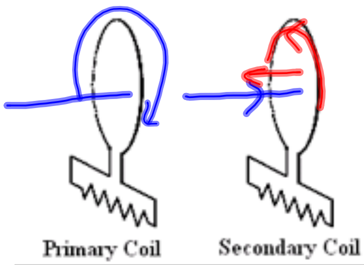
2. If the current in the wire is increasing, in which direction will there be an induced current in the rectangular wire loop?



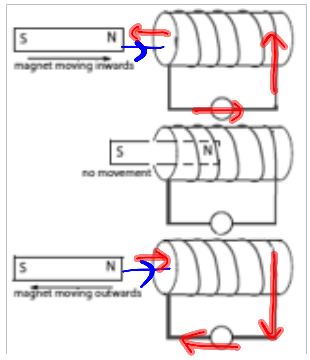
3. If the wire loop moves away from a steady current in the straight wire, in which direction will there be an induced current in the loop?



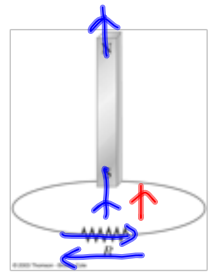
4. If a clockwise current through the primary coil is increasing with time, what effect will this have on the secondary coil?



5. Determine the direction of the current in the solenoid in each case.



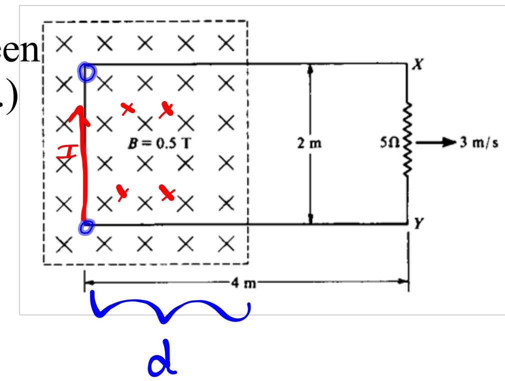
6. Determine the direction(s) of the induced current as the magnet falls through the loop.



NOTE: An emf induced by a force moving a conductor in a magnetic field (motional emf) and an emf induced by a time-changing flux (Faraday's law) are really the same phenomena explained in two different ways.

7. A wire loop as shown is pulled to the right at a constant speed of 3 m/s

a) Determine the induced emf between points X and Y. (Use motional emf.)



$\mathcal{E} = B\ell v$

$(.5T)(2m)(3m/s)$

b) Determine the induced emf between points X and Y. (Use Faraday's law.)

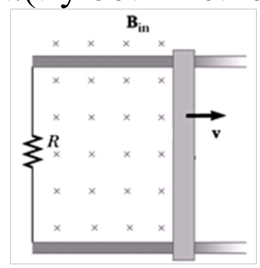
$\mathcal{E} = -N\Delta\phi/\Delta t = -NB\frac{\Delta A}{\Delta t} = -NB\ell\left(\frac{d}{t}\right) = -1 \cdot .5T \cdot 2m\,\frac{3m}{s}$

c) Determine the magnitude of the induced current.

d) Determine the direction of the induced current. (Try both methods.)

8. A conducting bar is moved to the right at a constant speed by an external force, as shown.

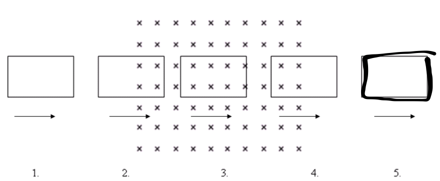
a) Determine the direction of the induced current.(try both methods)

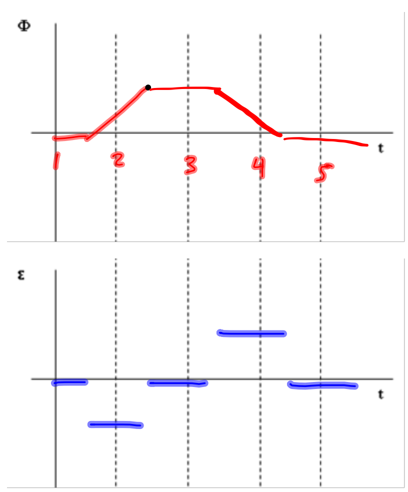


b) Explain why work must be done to move the bar. What becomes of the mechanical energy supplied to do this work?

An opposing magnetic force (BIL) resists the applied force – work must be done to overcome this resistive force – mechanical energy is transformed into electrical energy (the induced current) and then into thermal energy due to resistive heating (Joule heating) - conservation of energy

9. A conducting loop moves at a constant speed into and through a uniform magnetic field as shown in the diagram.





a) Determine the direction of the induced current in each section. (Try both methods.)

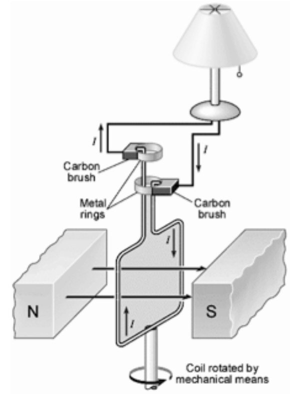
b) Graph the flux through the loop and the induced emf as a function of time.

Alternating Current Generators

IB 12

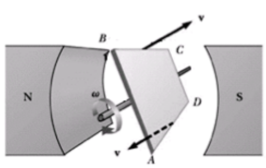
Basic Operation:

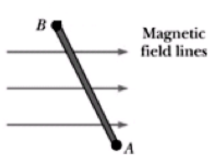
1. coil of wire is turned by mechanical means in an external magnetic field
2. emf and current are induced in coil as coil cut flux lines
3. current varies in magnitude and direction as flux linkage changes – current and emf variations are sinusoidal
4. brushes and rings maintain contact with external circuit without getting tangled



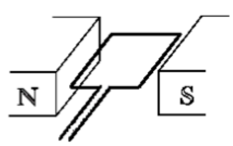
Rotation of a Coil in a Uniform Magnetic Field induces an EMF

As the coil rotates, the flux linking it changes





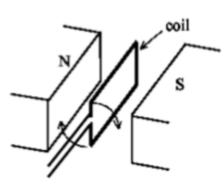
Position 1



Maximum EMF and Current

1. sides of coil move perp. through field
2. plane of coil is parallel to field
3. normal of coil is per. to field

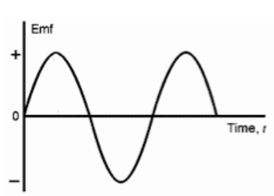
Position 2



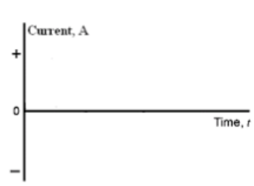
Minimum EMF and Current

1. sides of coil move parallel to field
2. plane of coil is perp. to field
3. normal of coil is parallel to field

Mark when the coil is in positions 1 and 2.

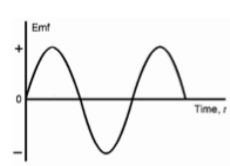


Sketch the graph of the induced current.



Sketch a graph of the induced emf for a coil with:

twice the frequency of rotation.



half the frequency of rotation.