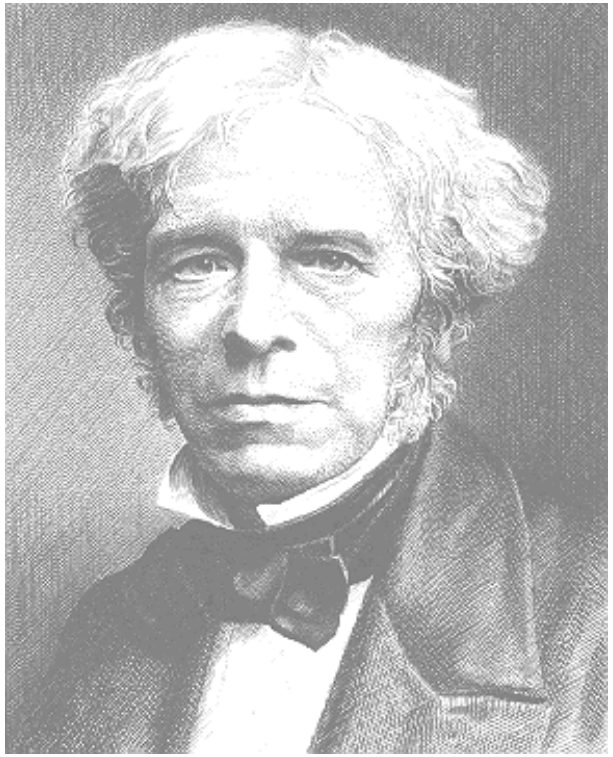
Introduction to Electronics

Lecture 14: AC Generator

You Light Up My Life!

Outline

1. Magnetic fields
2. Electricity and Magnetism
3. Magnetic forces and Charges
4. Electromagnetic Induction
5. Magnetic and Electromagnetic Applications (AC Generator)



Michael Faraday

22 September 1791–
25 August 1867

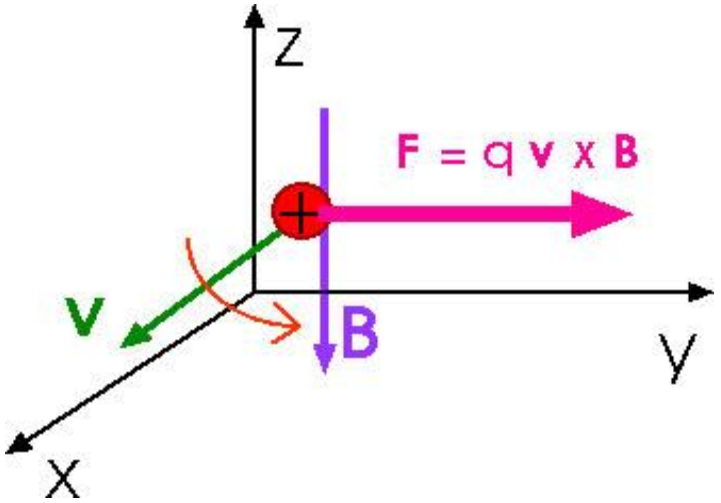
Forces and Charges

(1) Moving charges produce magnetic fields

(2) Stationary charge in a magnetic field will not suffer a magnetic force

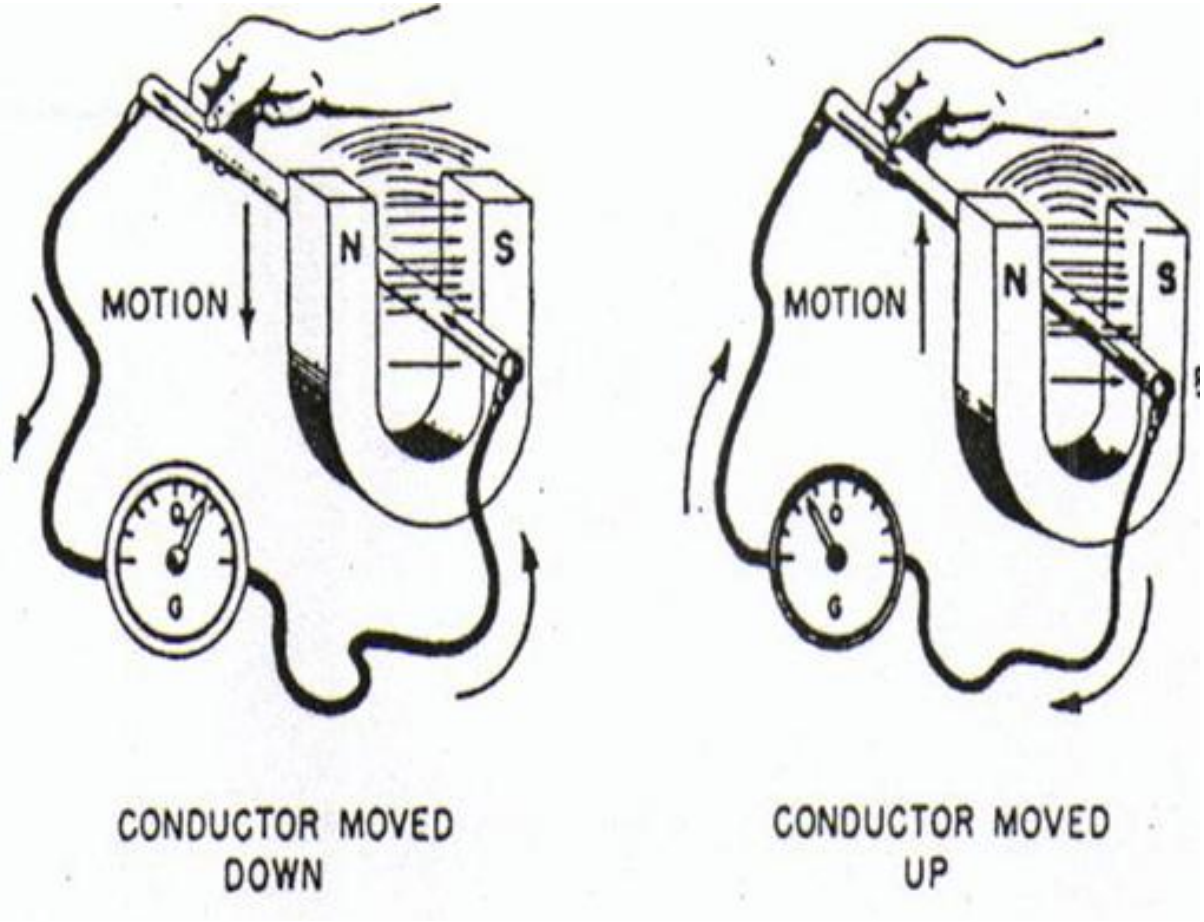
(3) Magnetic fields apply a force to a moving charge

Magnetic force: **$F=qvB\sin\theta$**



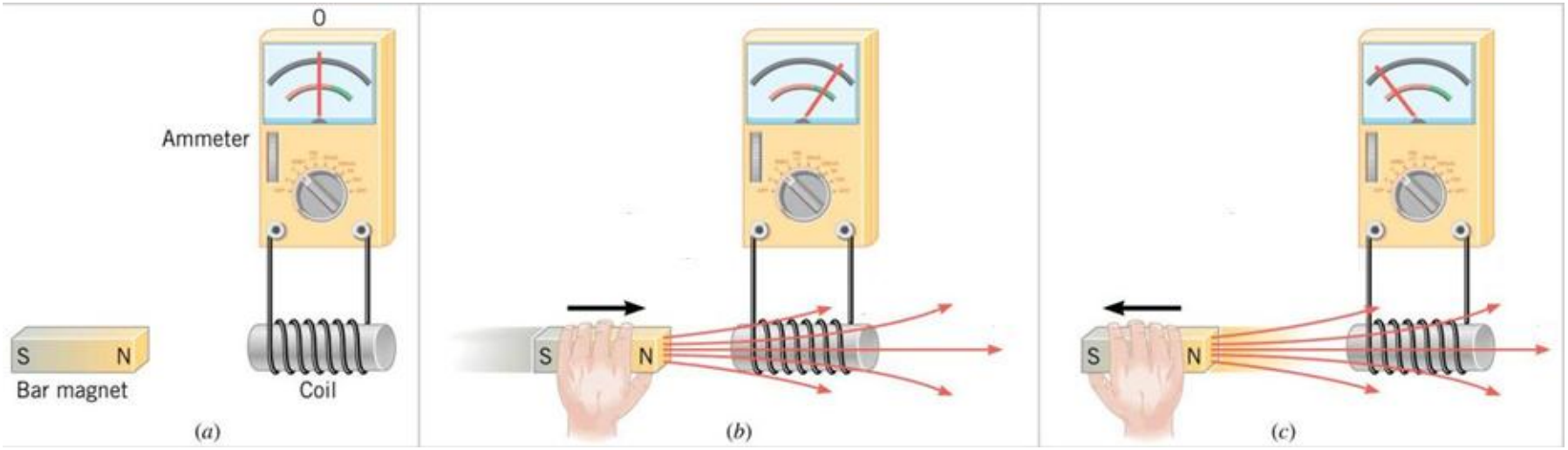
Farady's Experiment

When a conductor wire with closed loop moves in a magnetic field, a current flows in the loop.



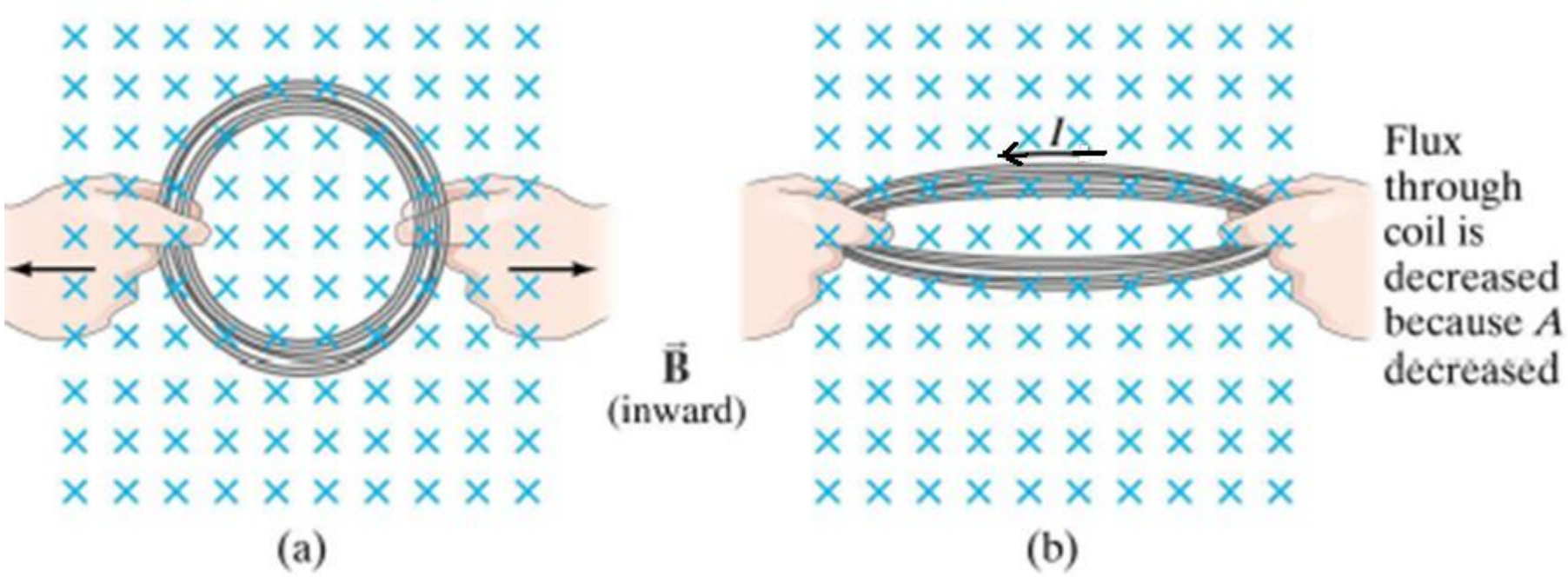
Electromagnetic Induction

1) When the pole of magnet entered a coil, current flowed in one direction
2) When the direction of magnet reversed, current flowed in opposite direction
3) Faster the magnet's motion, the greater the induced current.



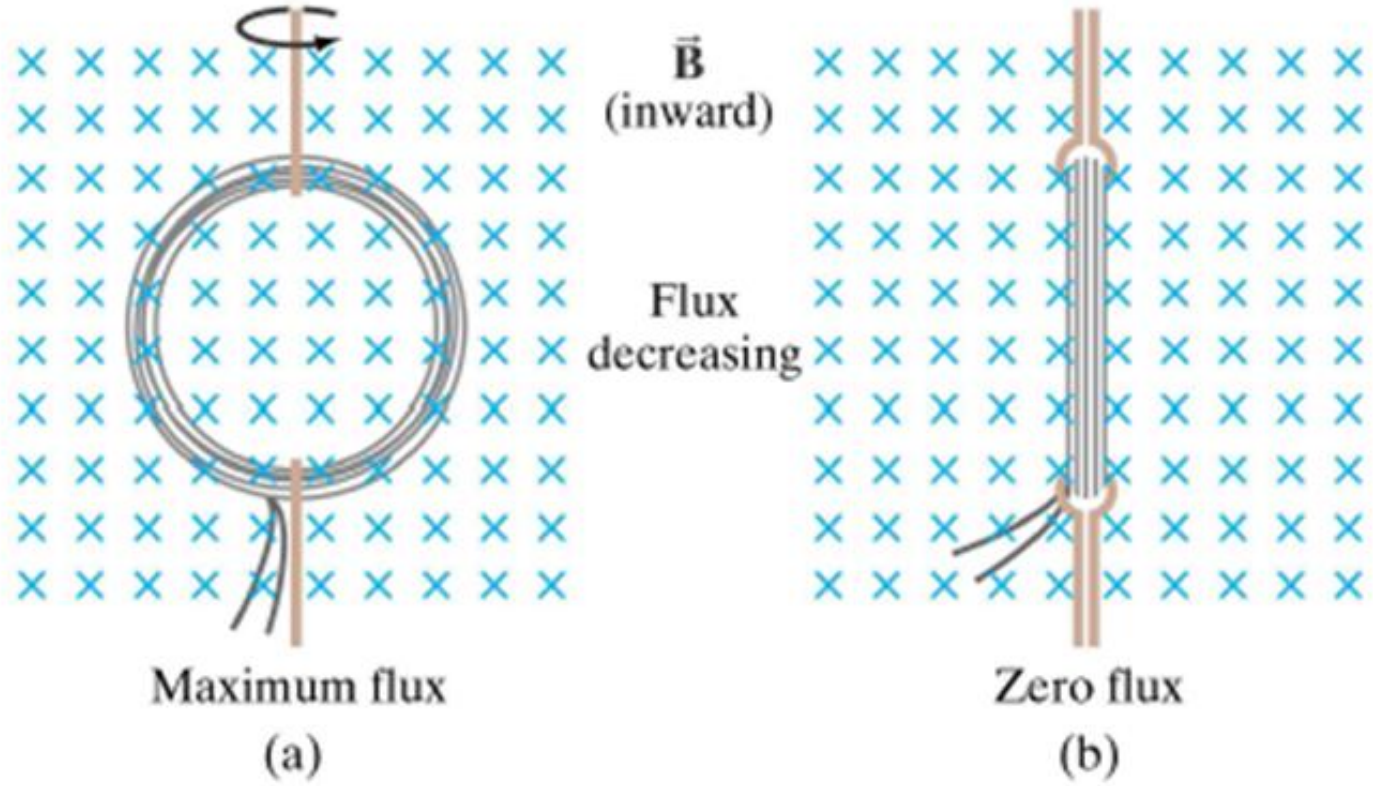
Magnetic Flux and the Current

Magnetic flux will change if the area of the loop changes



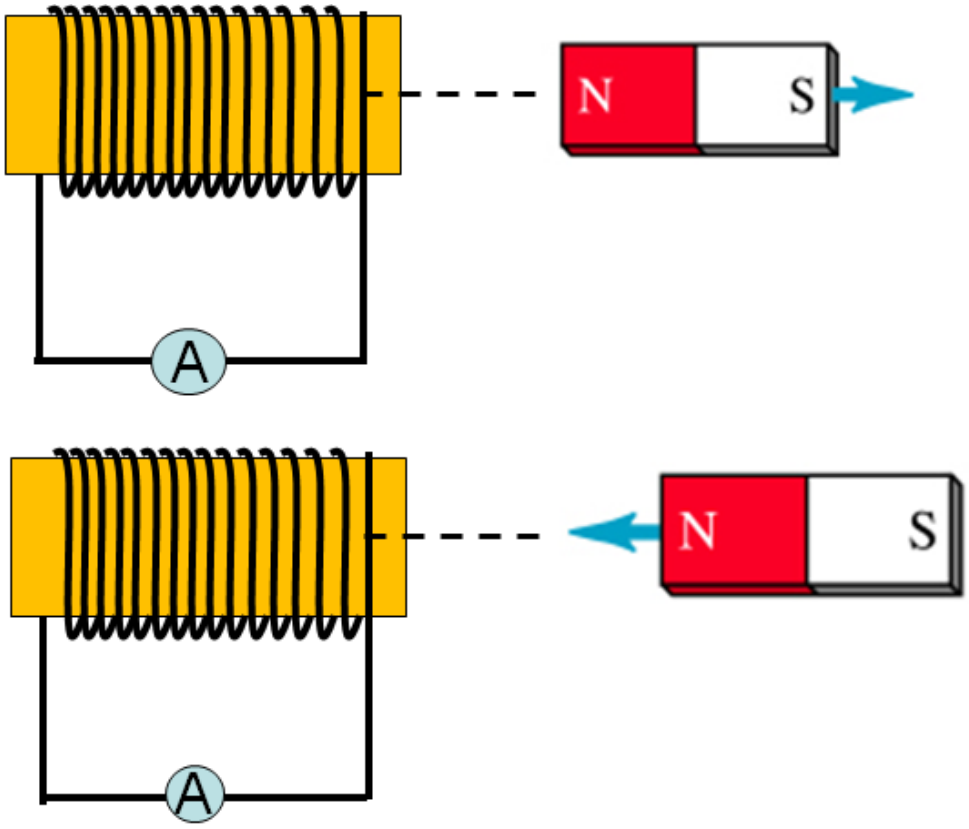
Magnetic Flux and the Current

Magnetic flux will change if the angle between the loop and the field changes.



Question?

What is the current flow direction in coil when the magnet is moved in the direction as shown below ?

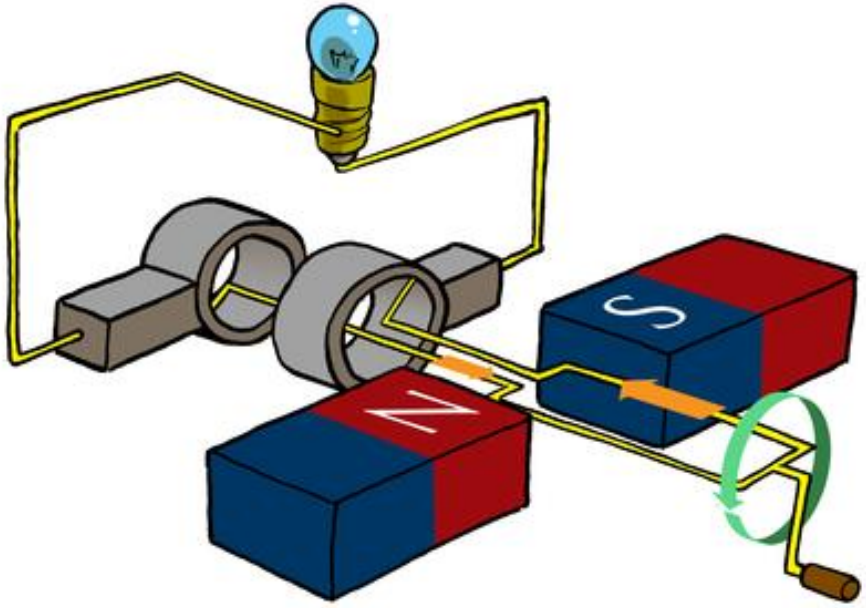


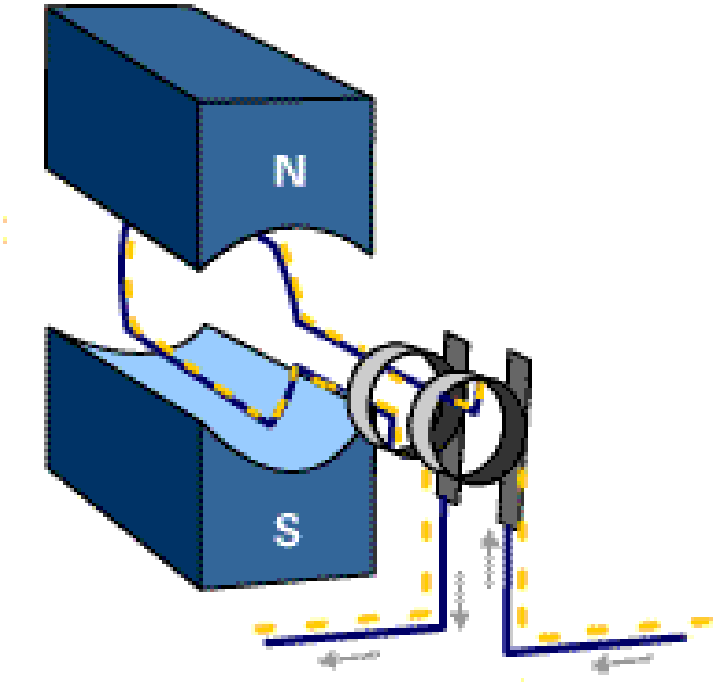
What is AC Generator?

1. An alternating current (AC) generator converts mechanical Energy to electrical energy by utilizing the principle of Electromagnetic induction
2. The mechanical energy is needed to produce motion between the magnetic field and the conductor
3. The mechanical energy may be man force, wind blowing, water tidal, ….

AC Generator

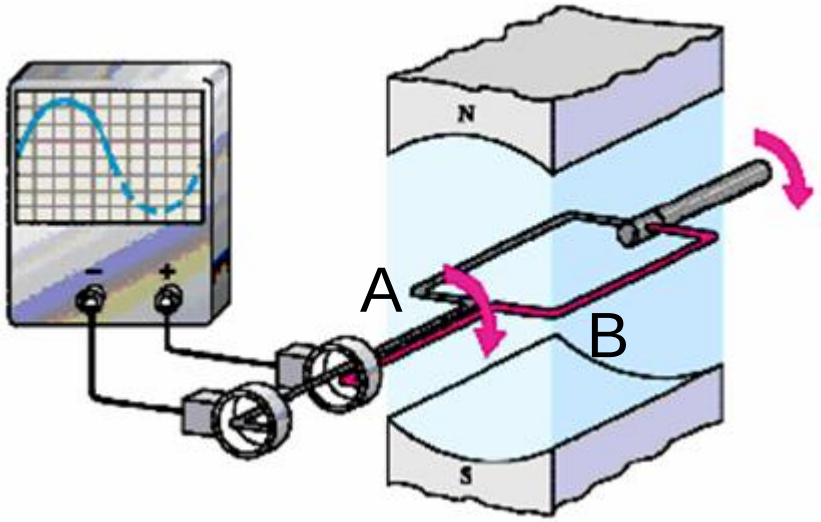
AC generator with slip rings and brushes. To let the current be useful, it has a special design, so that it can flow through a load.

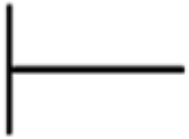


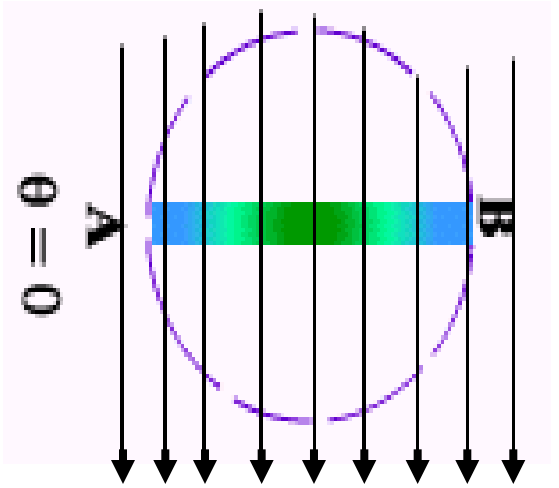


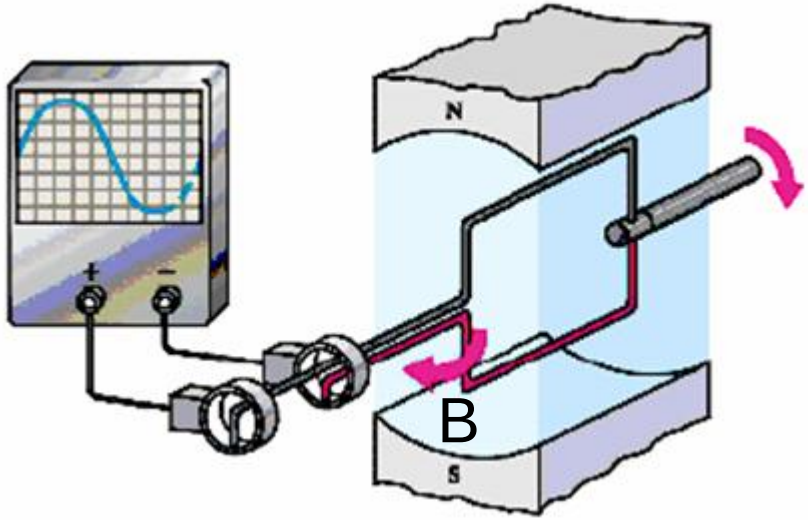
Rotating loop is called armature
Electromagnetic field is called field

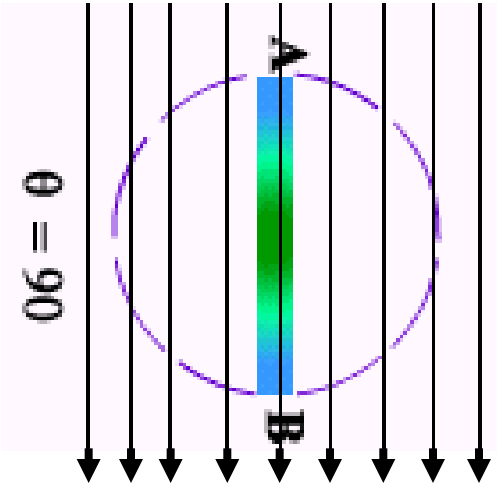
Induced Voltage in a AC GENERATOR



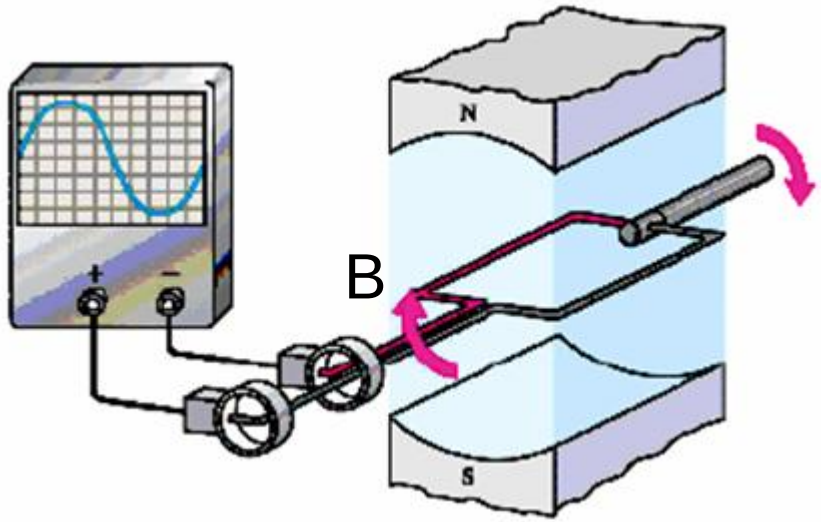


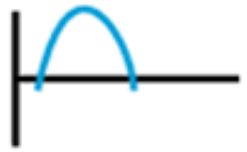


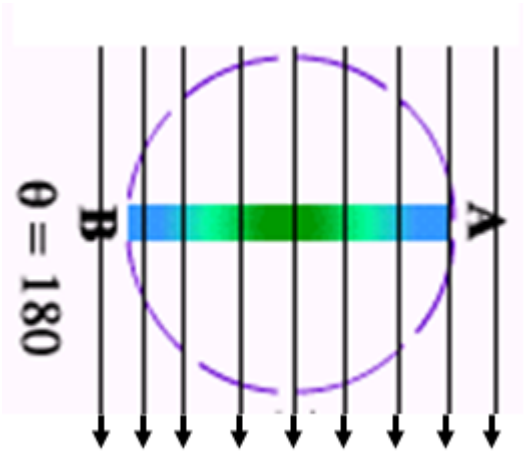


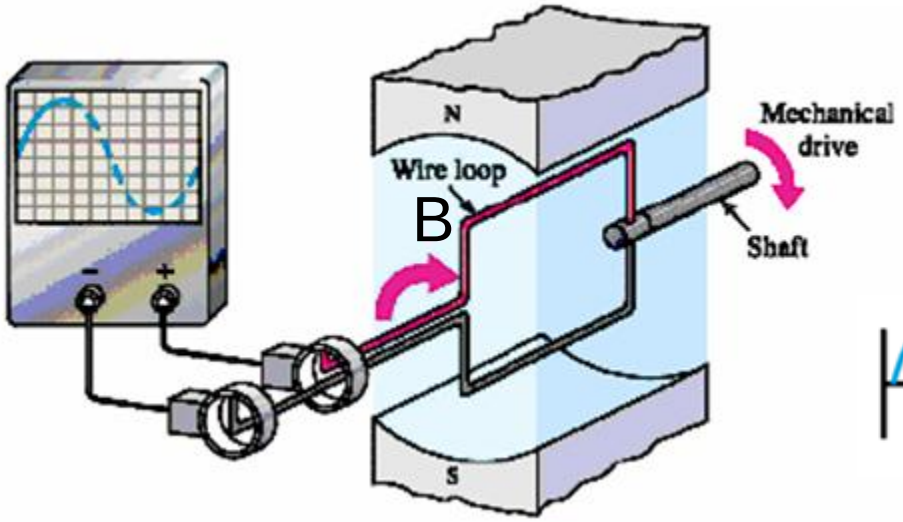


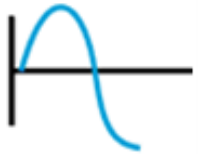
Electromagnetic Applications

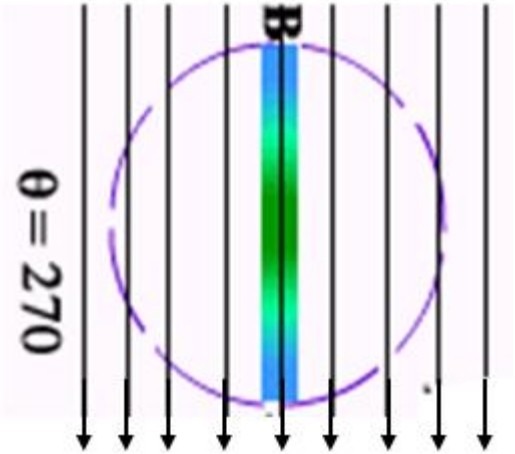




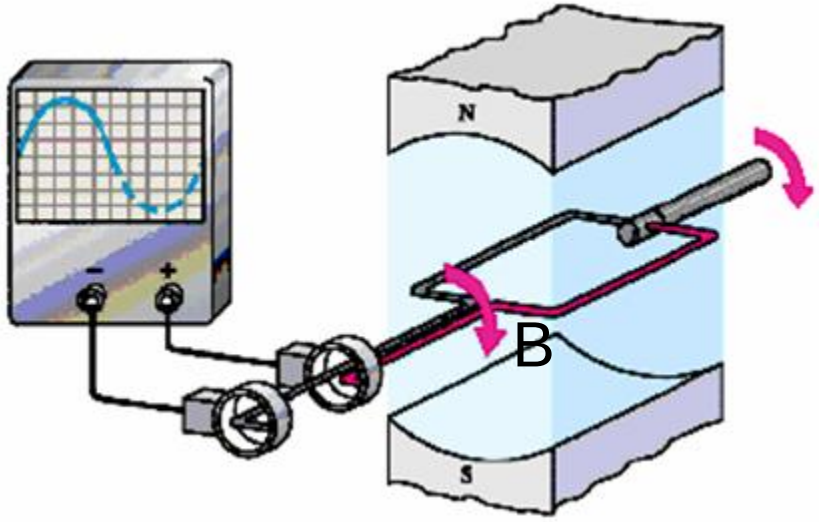


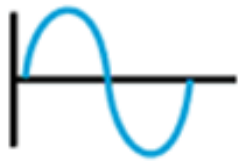


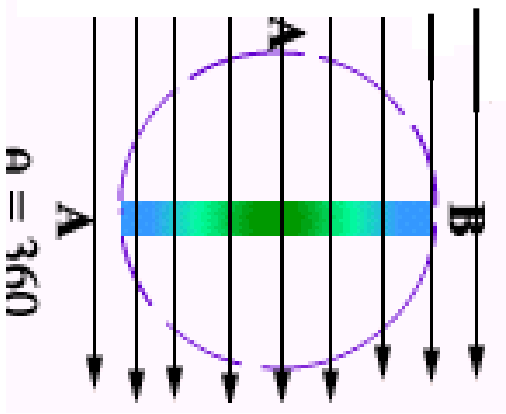


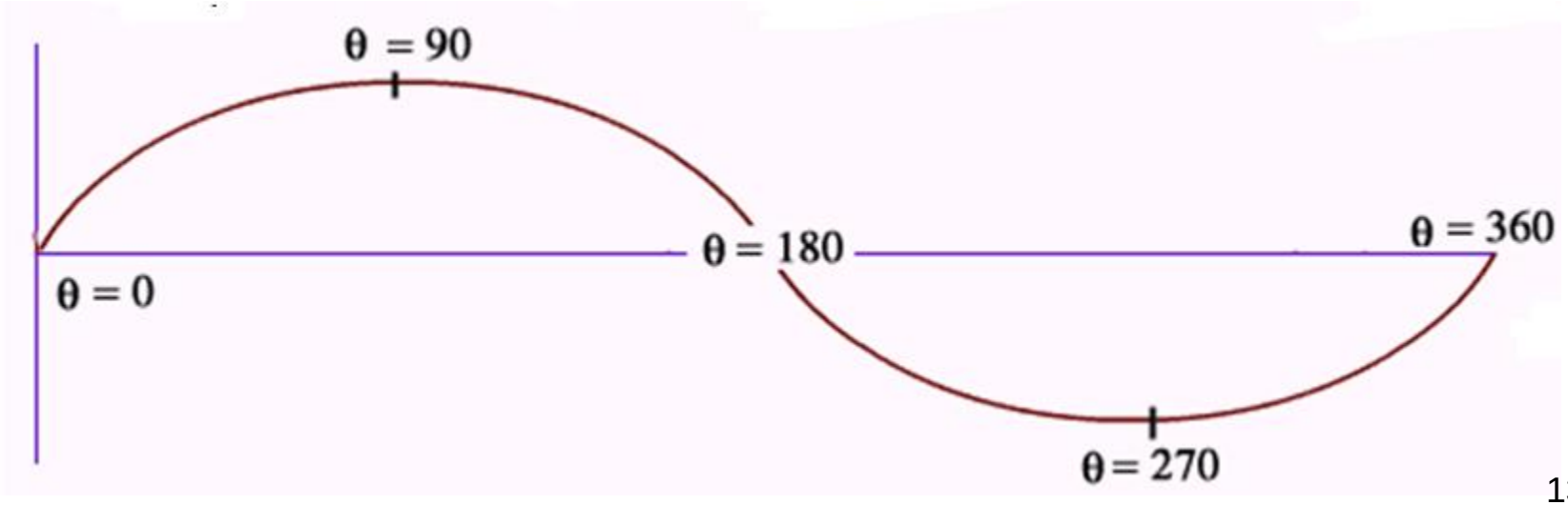


Electromagnetic Applications

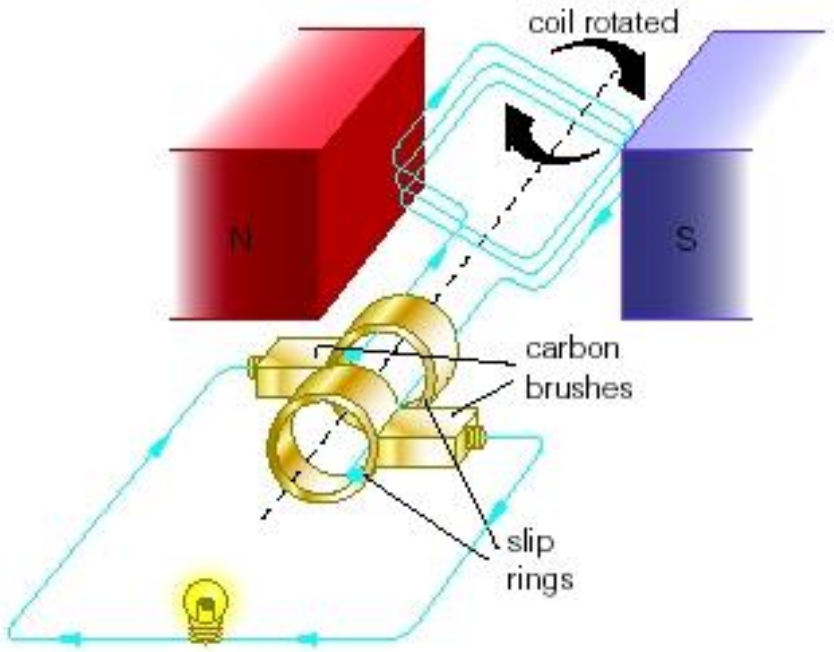








Multiple Loops

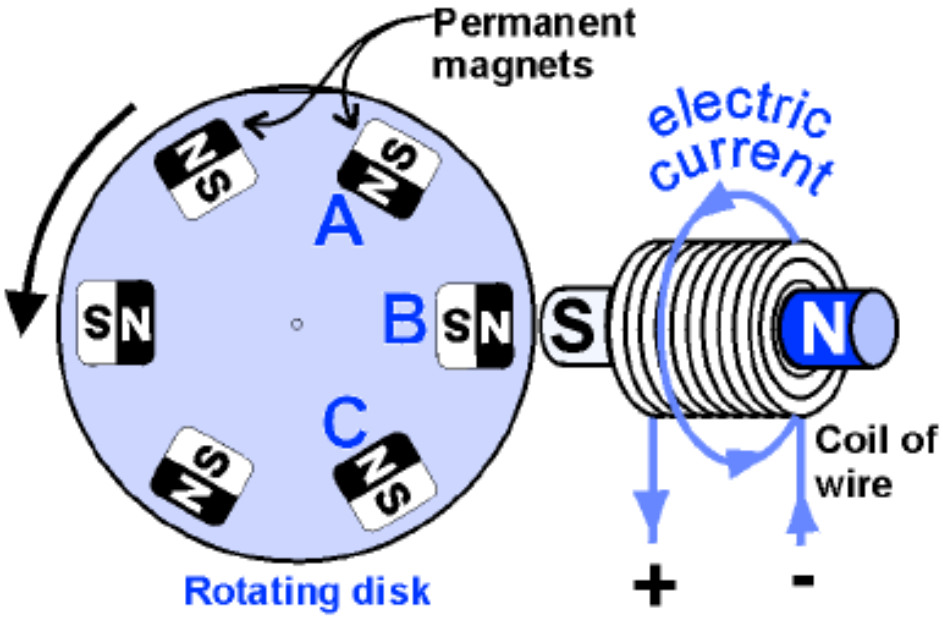


- The number of turns in the coil.
- Strength of the field.
- The speed at which the coil or magnetic field rotates.

AC Generators

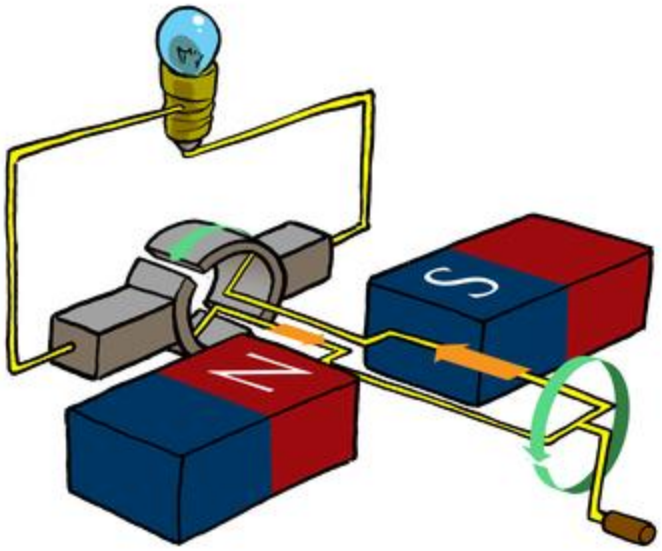
Another design for AC Generators

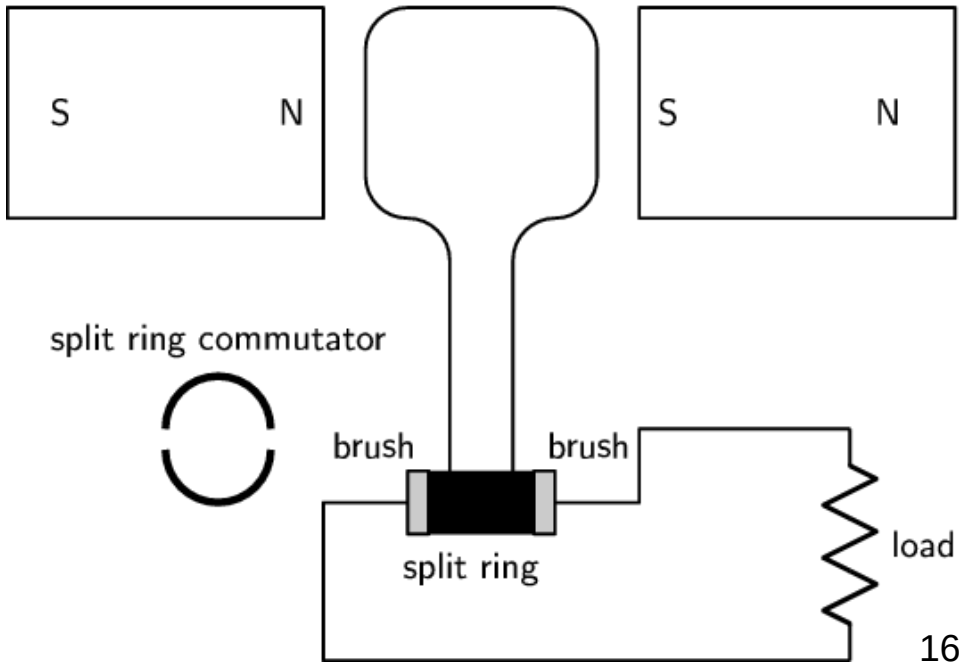
Magnetic flux change can cause a current flow in a coil of wire



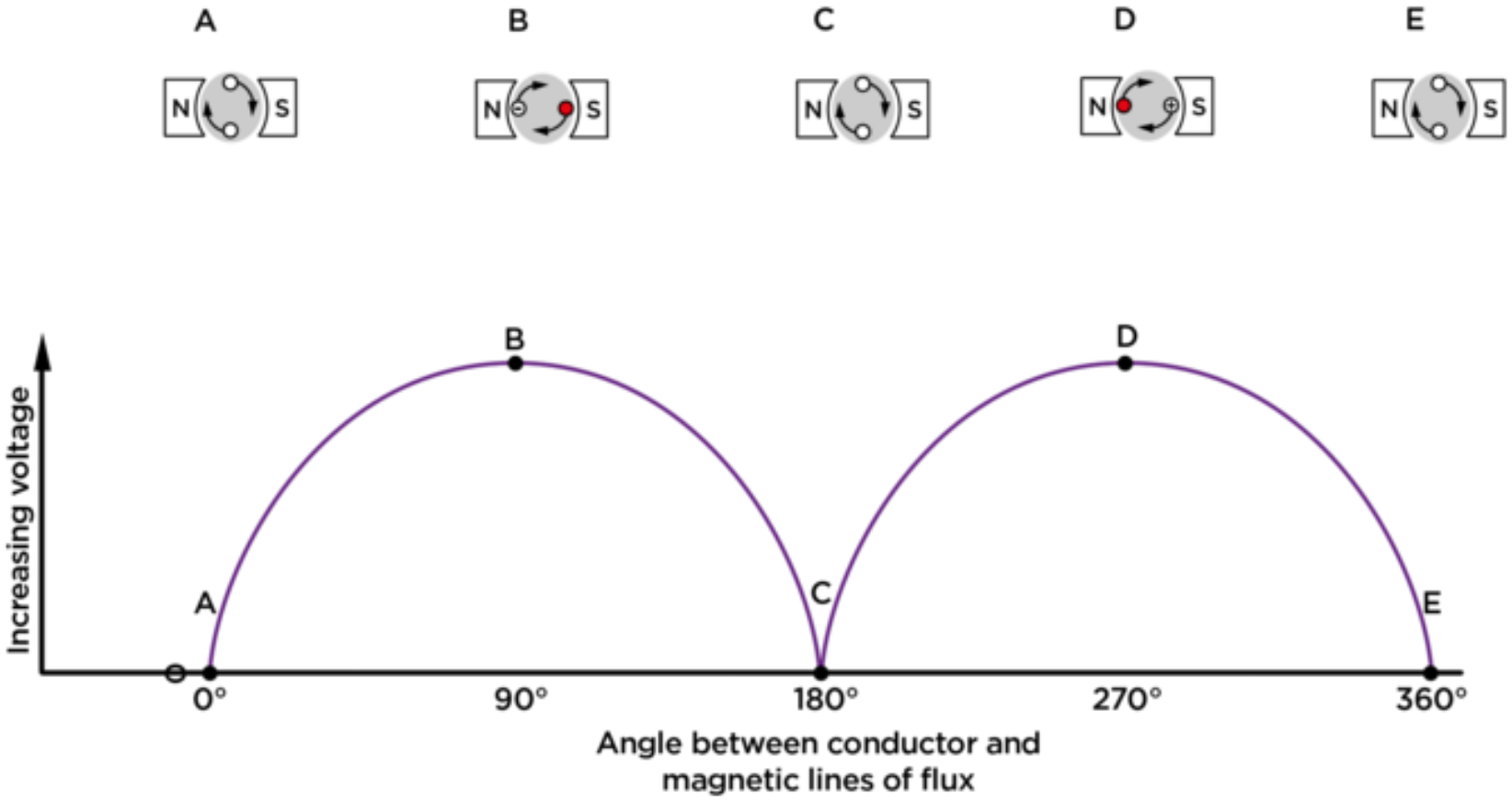
DC Generator

1. One slip ring with two pieces, called a commutator, so the current in the external circuit does not change direction.
2. The split-ring commutator accommodates for the change in direction of the current in the loop, thus creating direct current (DC) current going through the brushes and out to the circuit.





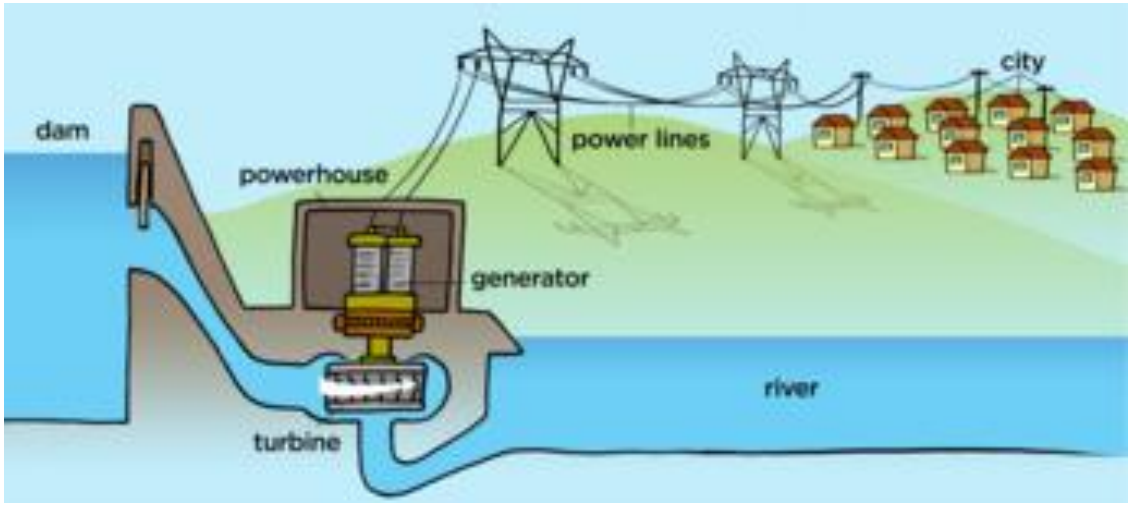
DC Generator

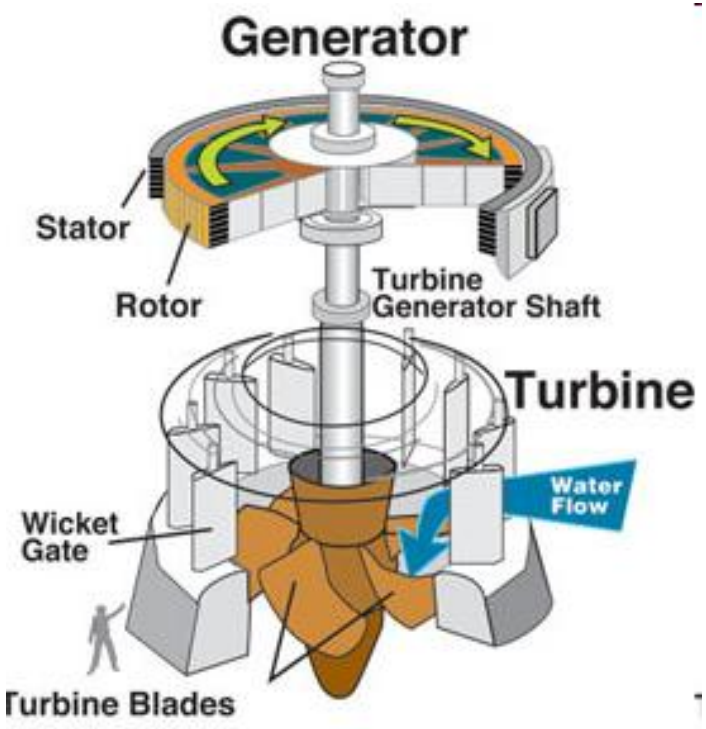


1. What are the differences between an AC and a DC generator?

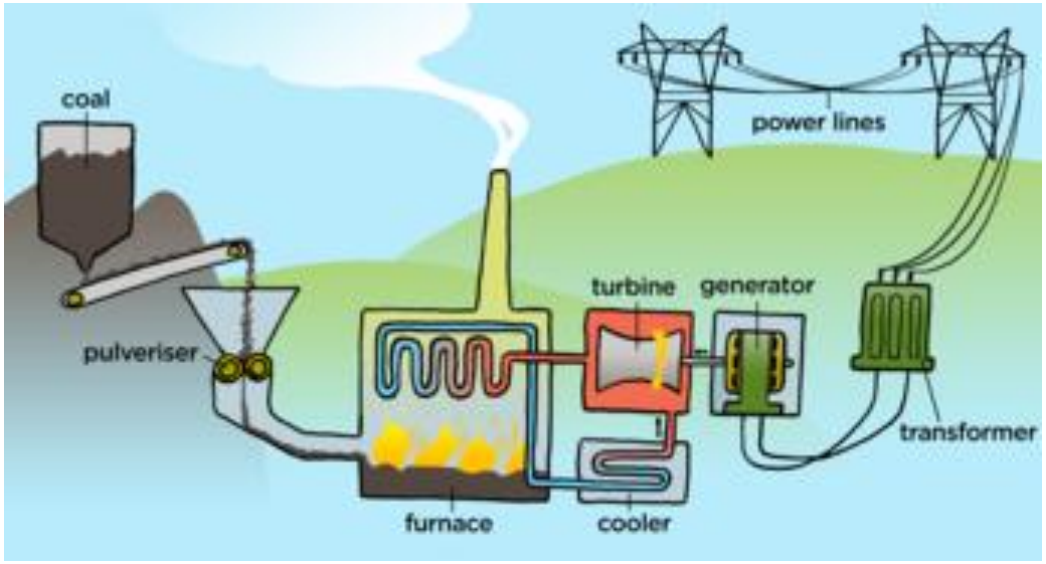
Hydroelectric power

To produce electricity for mass distribution (to homes, offices, factories and so forth), AC generators are usually used and driven by flowing water.

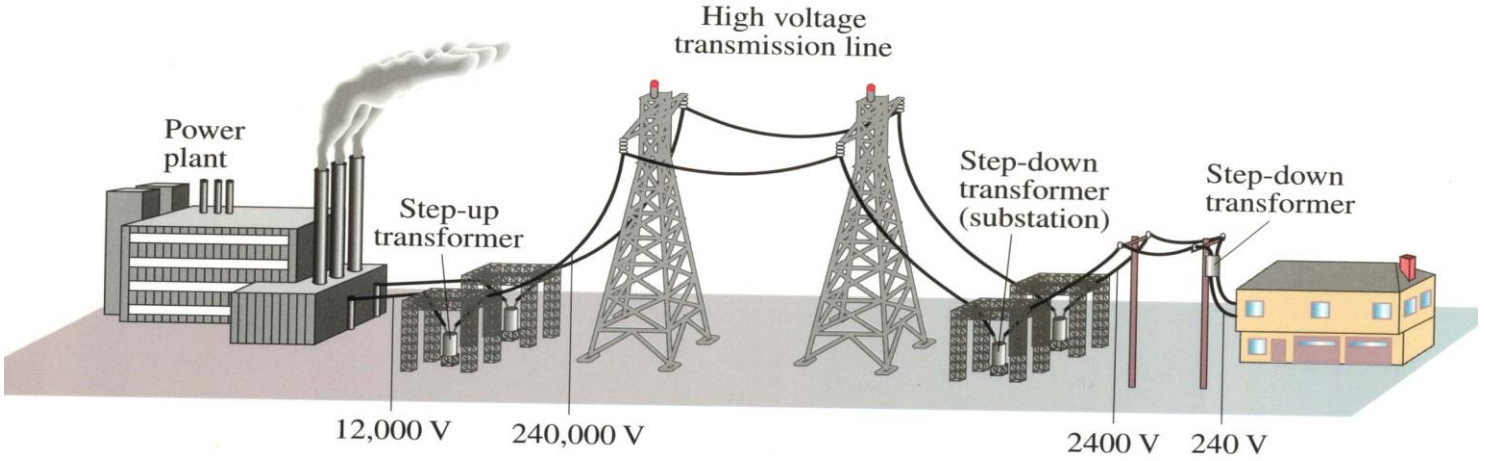




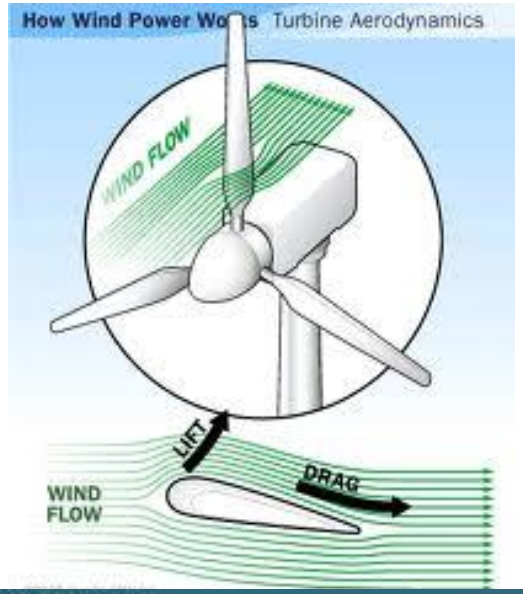
Thermal Power



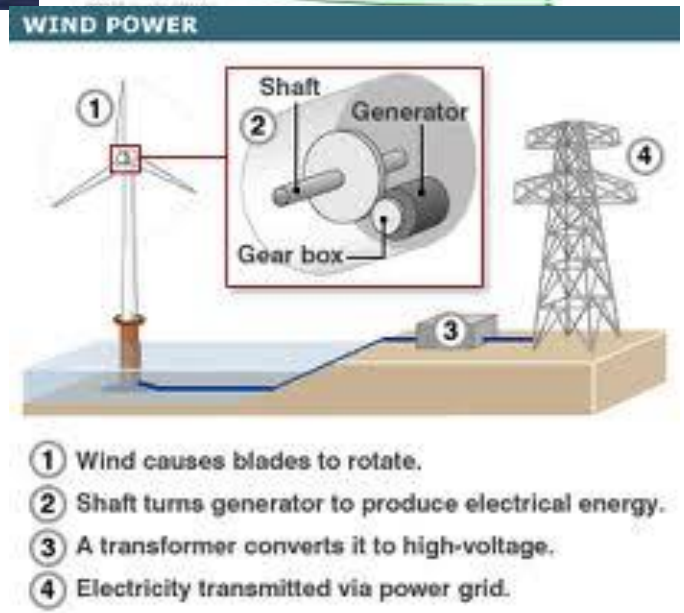
Main power supply
But Pollution,



Wind Power


How Wind Power Works
Turbine Aerodynamics
WIND FLOW
LIFT
DRAG
WIND
FLOW


Wind Turbine
Charger / Controller
Battery Bank
Inverter


WIND POWER
1
2
Shaft
Generator
Gear box
3
4
1 Wind causes blades to rotate.
2 Shaft turns generator to produce electrical energy.
3 A transformer converts it to high-voltage.
4 Electricity transmitted via power grid.

Tidal Power

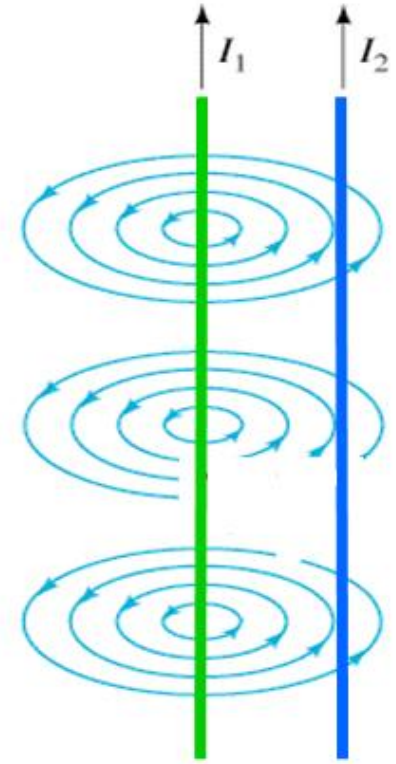
Tidal Power as it is also called, is another form of hydro power that utilises large amounts of energy within the oceans tides to generate electricity

1. The energy it produces is free and clean as no fuel is needed
2. produce a great deal of free and green energy.
3. Tidal energy is not expensive.

1/4 Check your Understanding

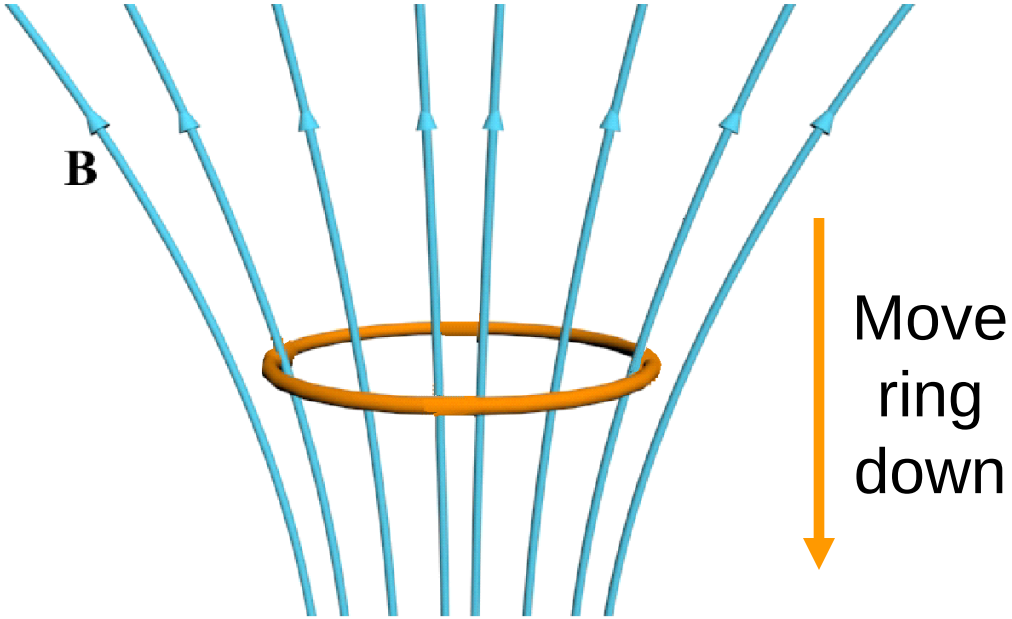
1. Two straight wires run parallel to each other, each carrying a current in the direction shown below. The two wires experience a force in which direction?

1) toward each other
2) away from each other
3) there is no force
4) Not sure



2/4 Check your Understanding

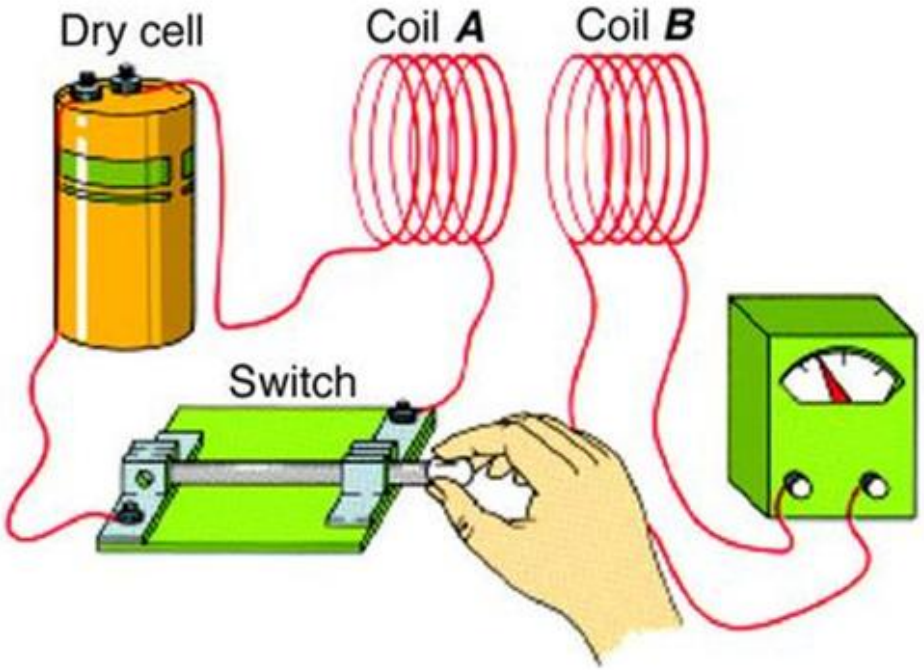
Moving Towards N pole



As ring approaches, what happens to flux?

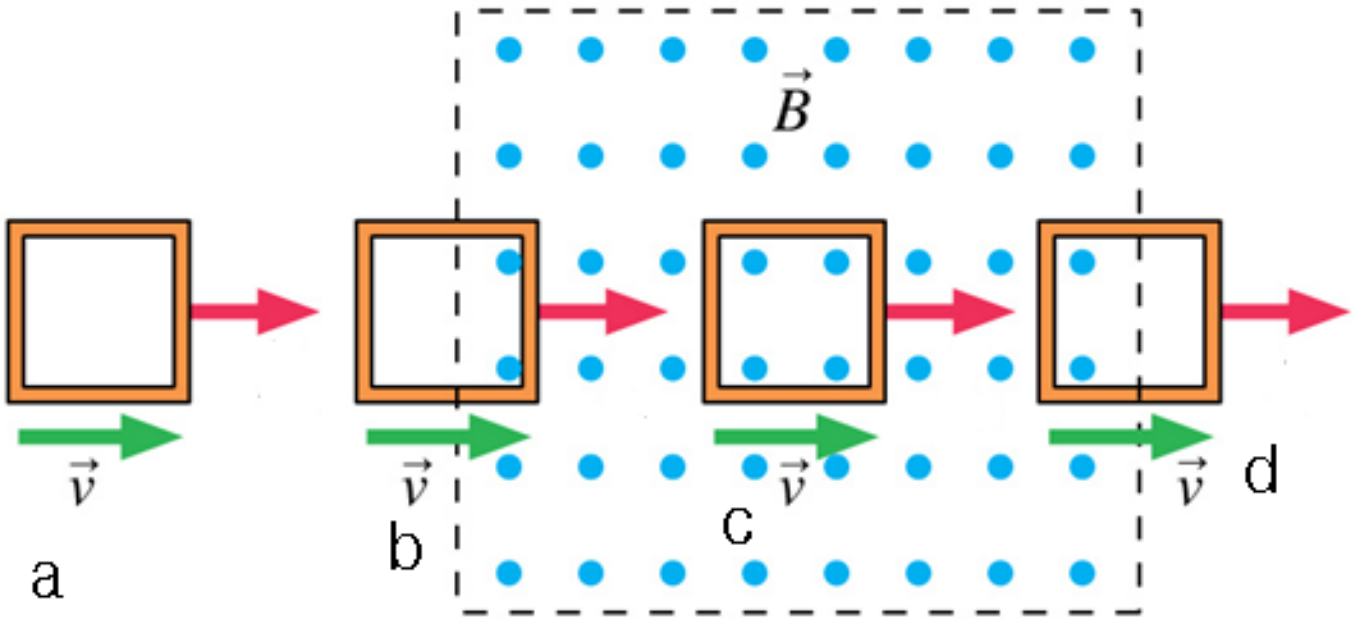
3/4 Check your Understanding

1) When the switch is turned on, will the coil B has current to flow? Why?
2) When the switch is turned on for a long enough time, will the coil B has a current to flow? Why?
3) When the switch is turned off, will the coil B has a current to flow? Why?



4/4 Check your Understanding

What's the current flowing direction in the square loop when it is moving at the position of a, b, c and d?



a) zero b) clockwise c) counter-clockwise

Summary

1. Magnetic fields apply a force to a moving charge

   Magnetic force: **$F=qvB\sin\theta$**

2. When change the magnetic flux passing through a loop, a current is induced in the loop wire at the same time.

3. Need to know how to judge the flowing direction of the current

4. AC generators: convert mechanical energy into electric energy. Need to know the mechanism of AC generator: Several methods to drive an AC generator.