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GCSE Physics

Complete Revision Summary

Forces

Waves

Magnestism and Electromagnetism

Space Physics

Magnetism and Electromagnetism

- Magnetism
- Magnetic Poles
- Magnetic Fields
- Electromagnetism
- The motor effect
- Flemming Left Hand Rule
- Electric Motor
- Electric Loudspeakers
- Induced Potential
- Generator Effect
- Microphones
- Transformers

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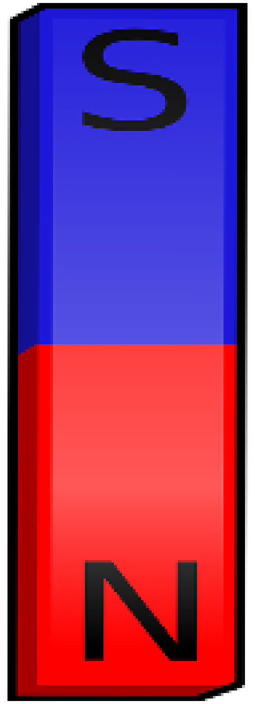
MAGNETS



Bar Magnet

Magnet has two poles. North Pole and South Pole

Permanent Magnets

Do not loose their magnetism
eg: Bar Magnet

Tempory Magnets

Can be magnetised and demagnetised.
eg Iron, Steel.

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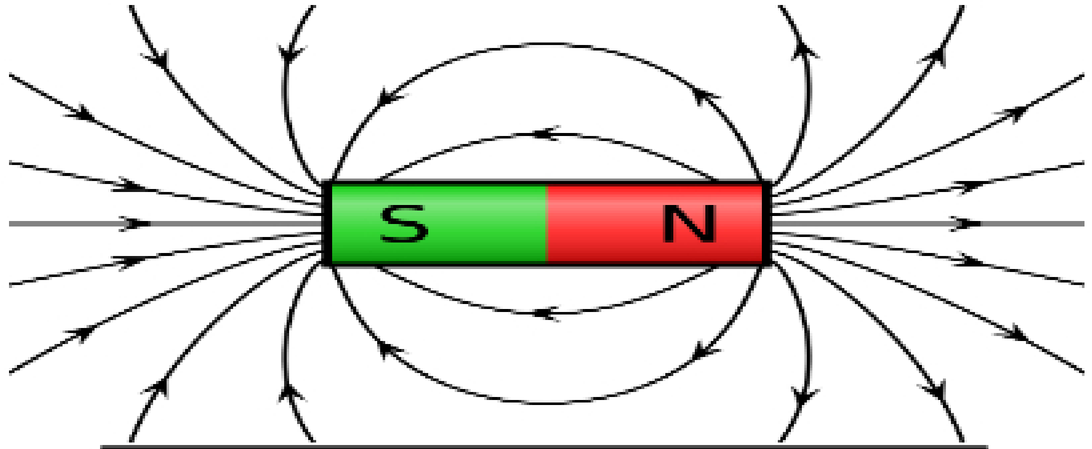
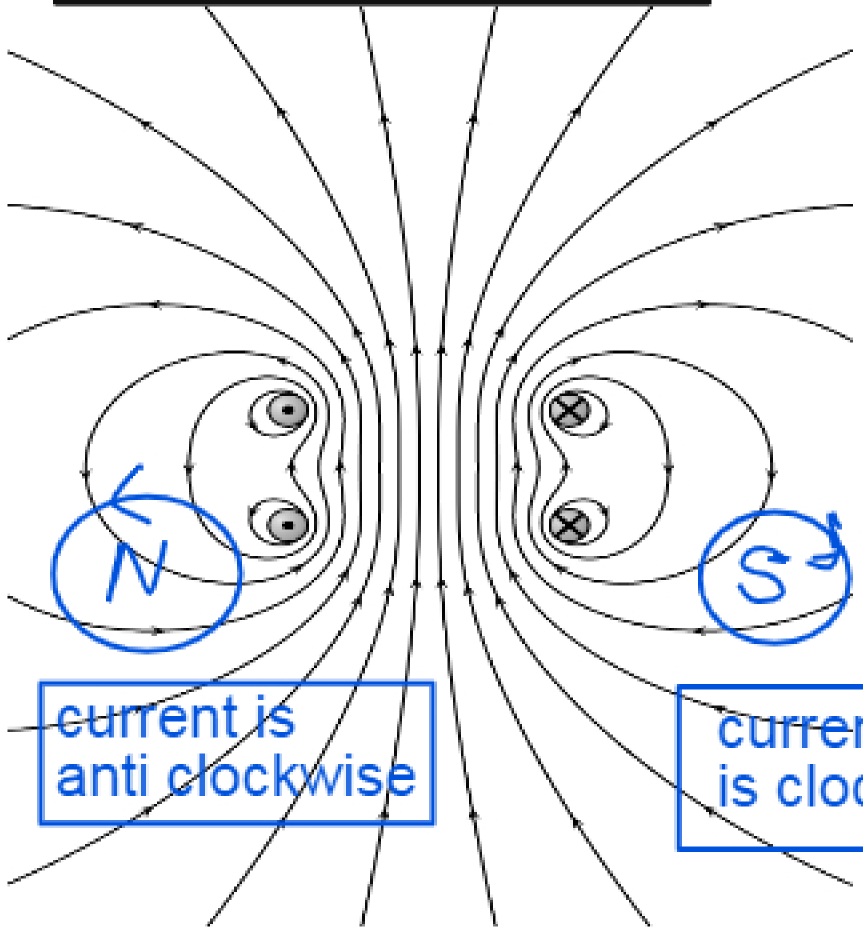
MAGNETIC FIELD



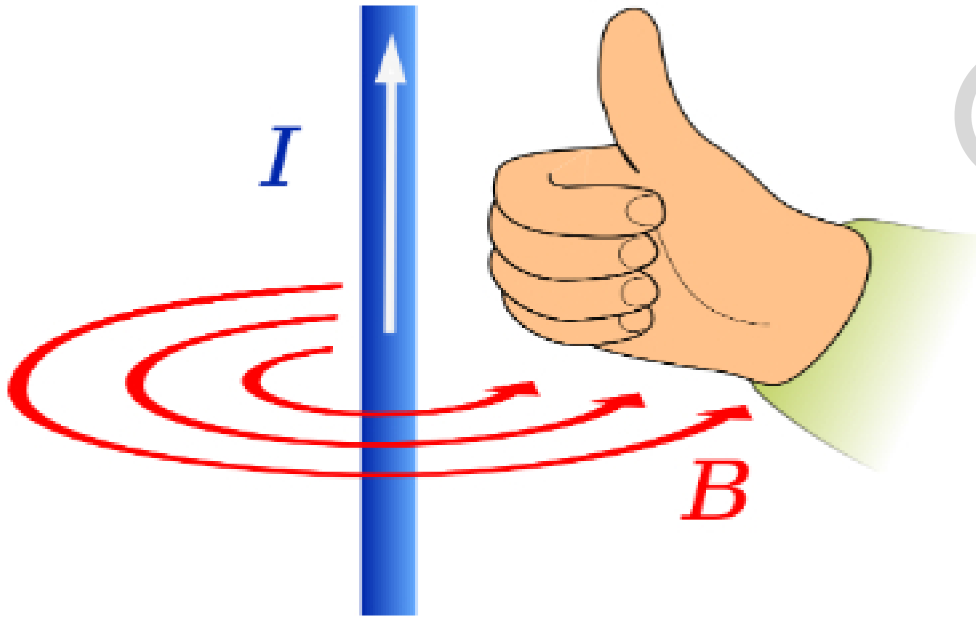
Magnetic filed in a bar magnet

Field lines are from north pole to south pole.



Magnetic field in a solenoid.

Solenoid is a coil of wire.
Field are in straight line inside the solenoid and forms the loop at the end.



Magnetic filed in a current carrying wire

Field lines are according to the right hand rule.
Thumb points in the direction of current, the fingers give the magnetic field of line.
If the current is upwards, the magnetic field lines is anticlockwise.
If the current is downwards, the magnetic field lines is clockwise.

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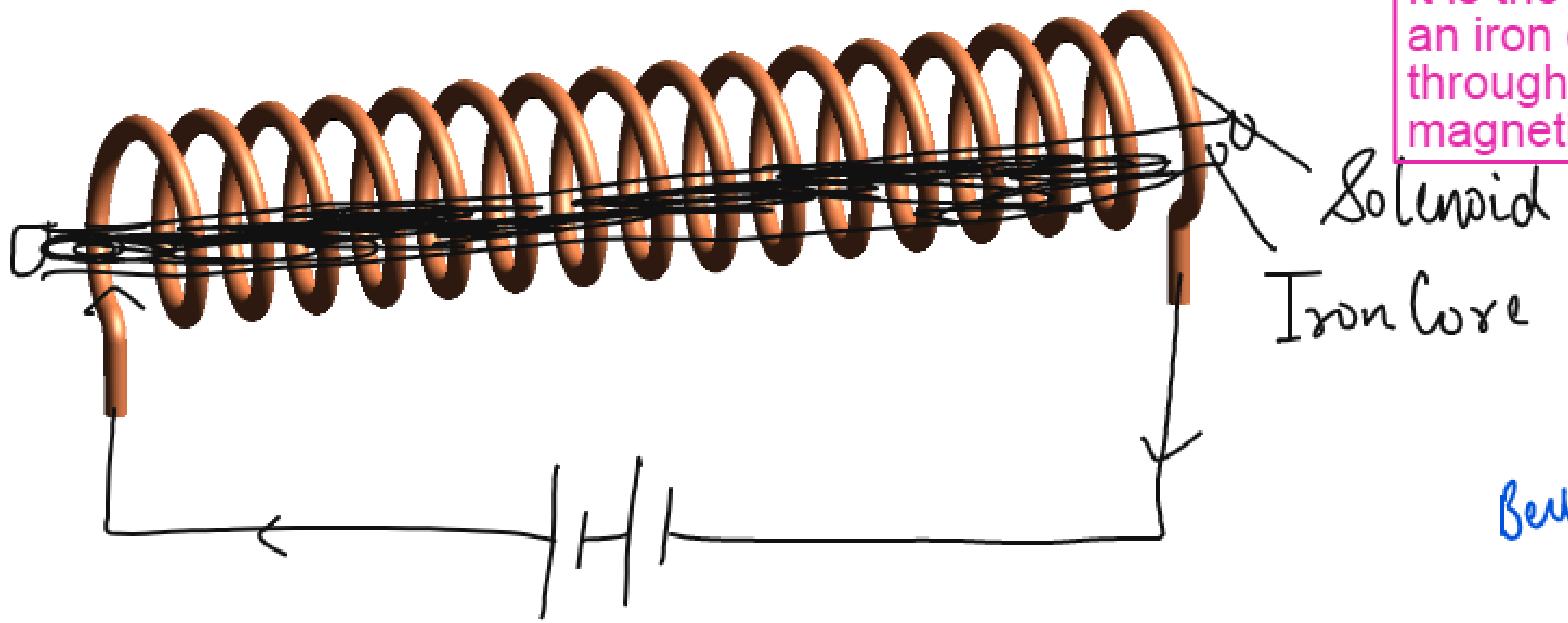
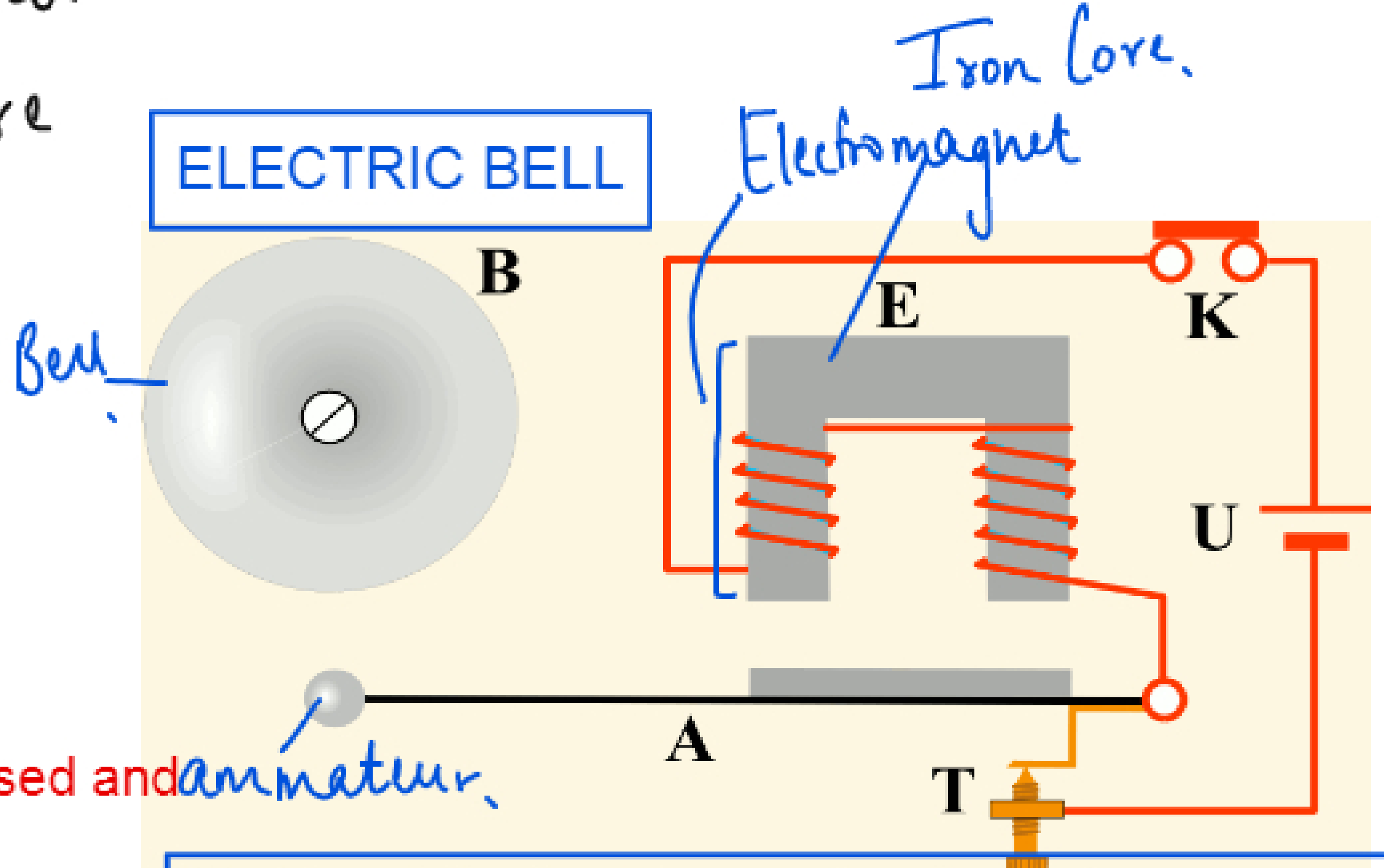
ELECTROMAGNETS

It is the solenoid wound around an iron core. When the current is passed through a solenoid, the iron core becomes magnetised.



ELECTRIC BELL



When the switch is closed,the curren flows through the electromagnet The iron core will become magnetics and will attract the ammateur which rings the bell.

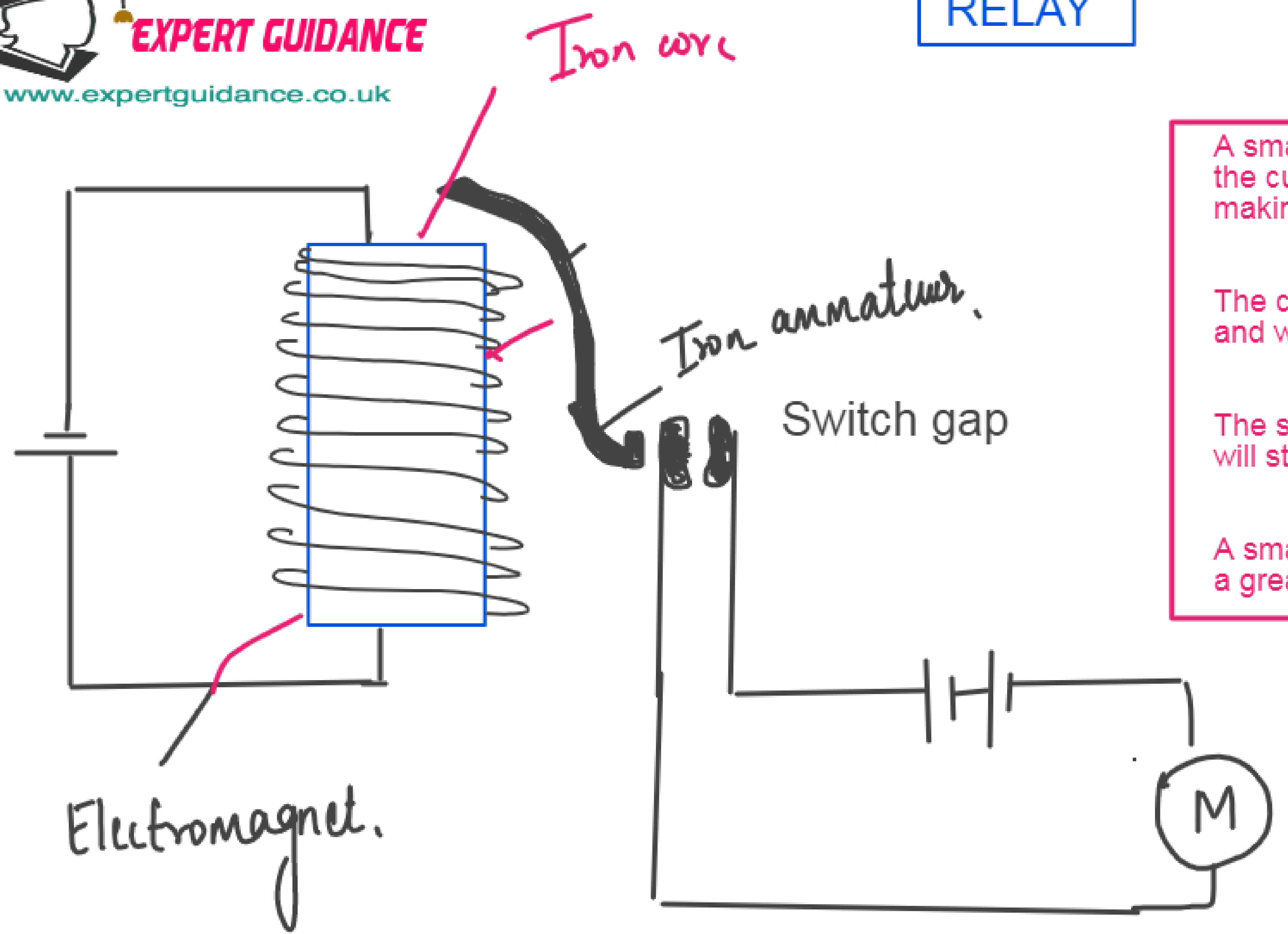
CIRCUIT BREAKER

It is an electromagnet which magnetised with a large flow of current and attracts the switch towards itself turning off the current.

SCRAPYARD CRANE

It has an electromagnet which is magnetised and then attracts the scap.

RELAY



A small amount of current will move the current in the electromagnet making the core magnetised.

The core will attract the iron ammateur and will close the switch gap.

The switch will be closd and the current will start flowing in the motor.

A small current switch on the device with a greater current.

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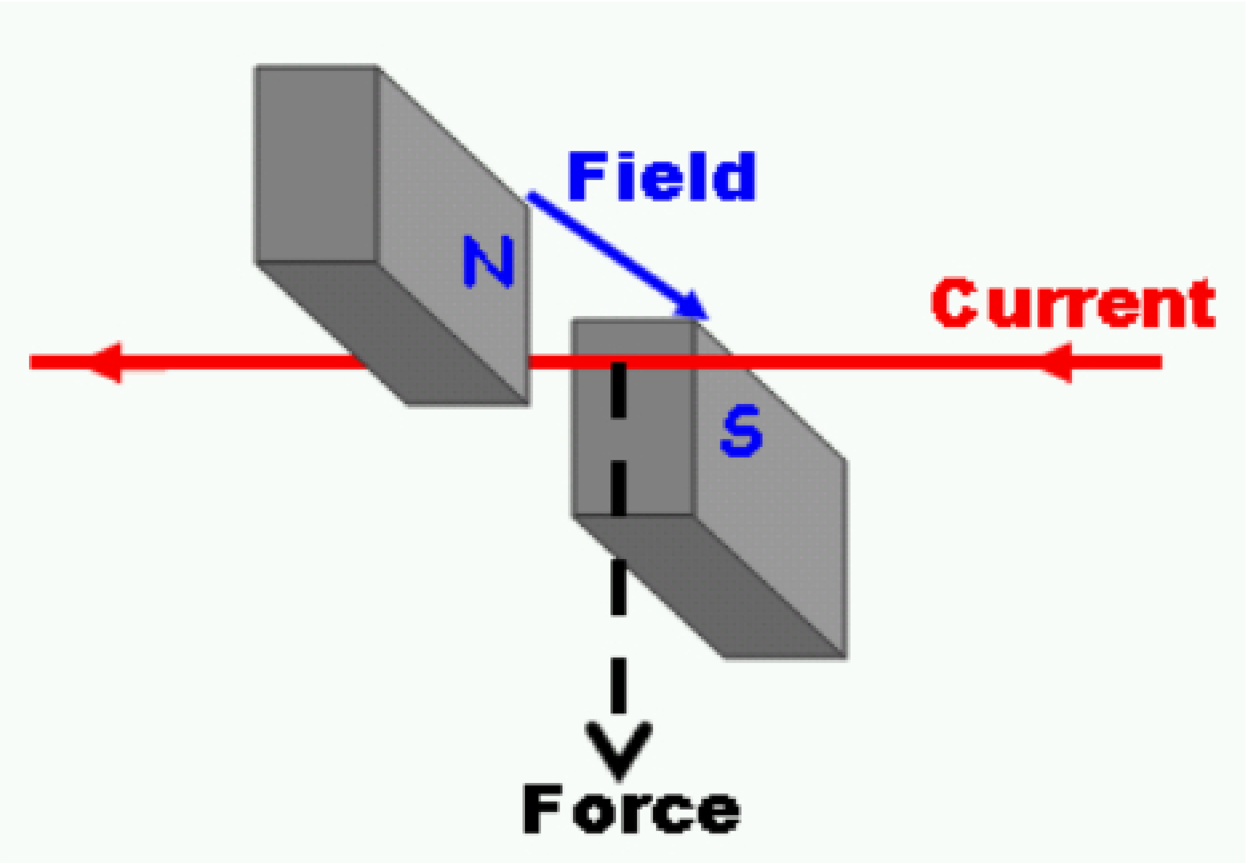
MOTOR EFFECT



When a current carrying wire is placed in a magnetic field, it experiences a force.

Force can be increased by :-

a) Increasing the current
b) Taking Stronger magnet
c) Placing the coil perpenticular to the magnetic field.

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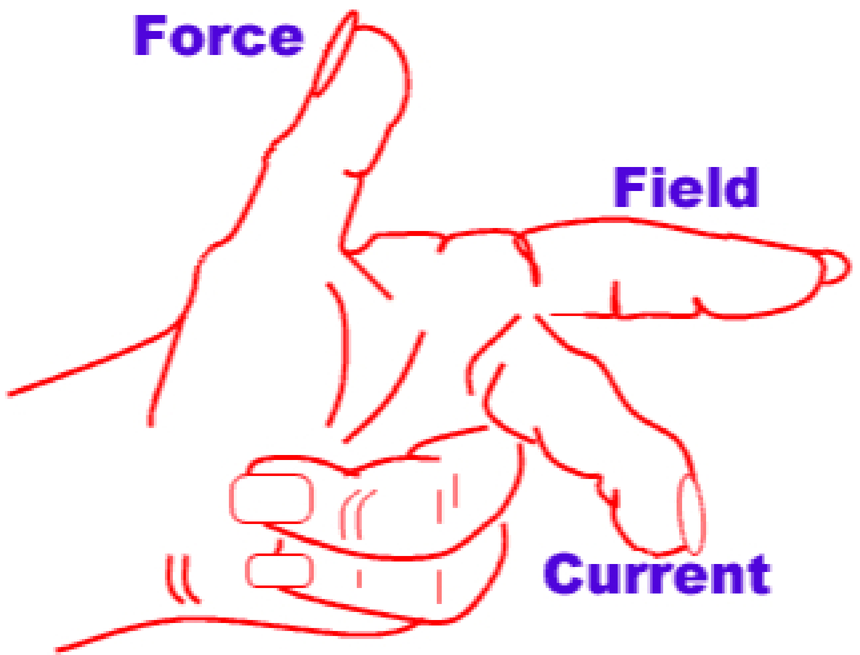
FLEMMING LEFT HAND RULE



First Finger:-	Magnetic Filed
Center Finger:	Current
Thumb:	Direction of Force

Force = B X I X L
(N) (T) (A) (m)

F = Force on the conductor
B= Magnetic Flux density
I = Current flowing through the conductor
L = Length of the conductor

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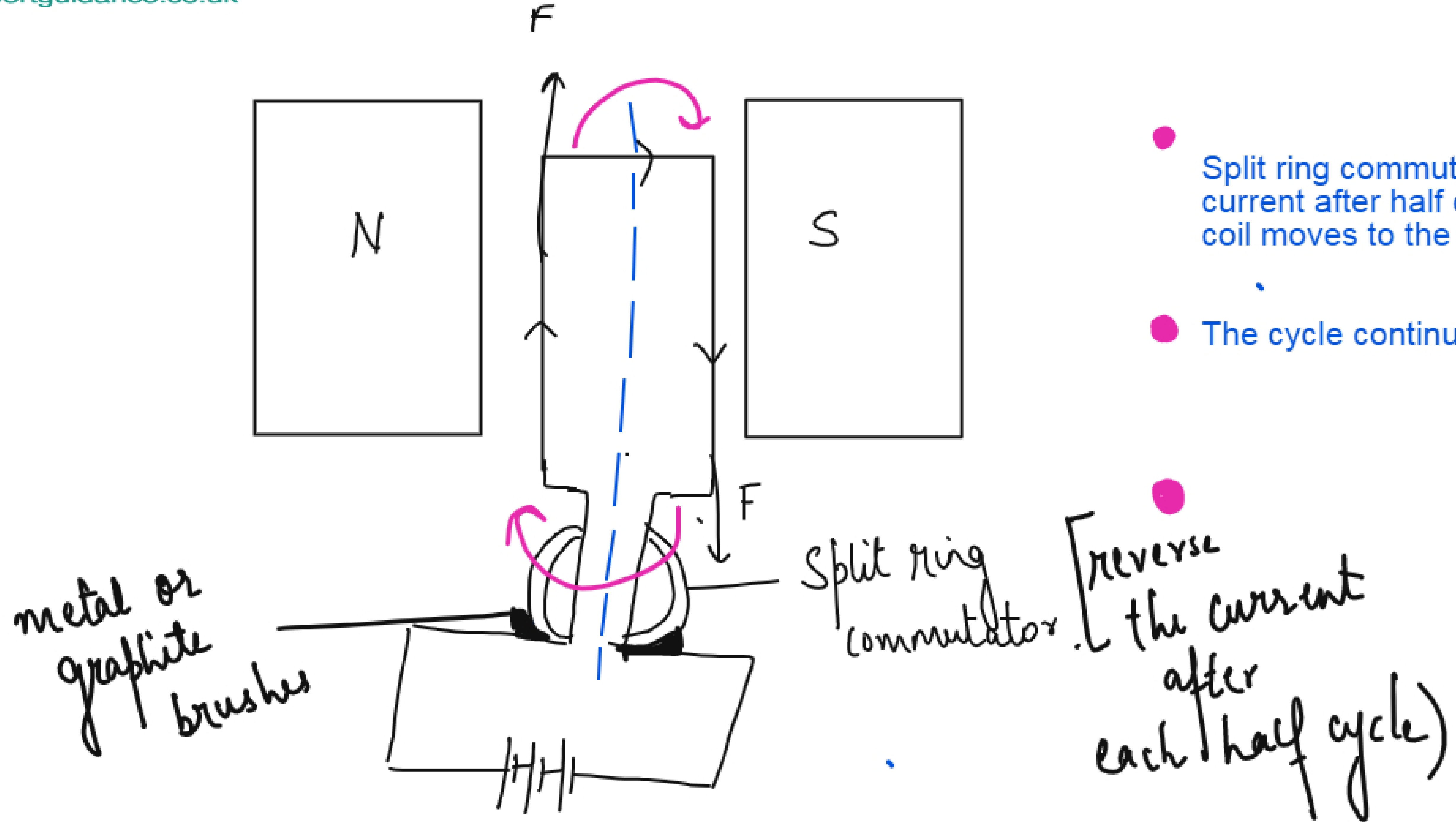

- Split ring commutator reverses the current after half cycle and the coil moves to the original direction.
- The cycle continues.
-

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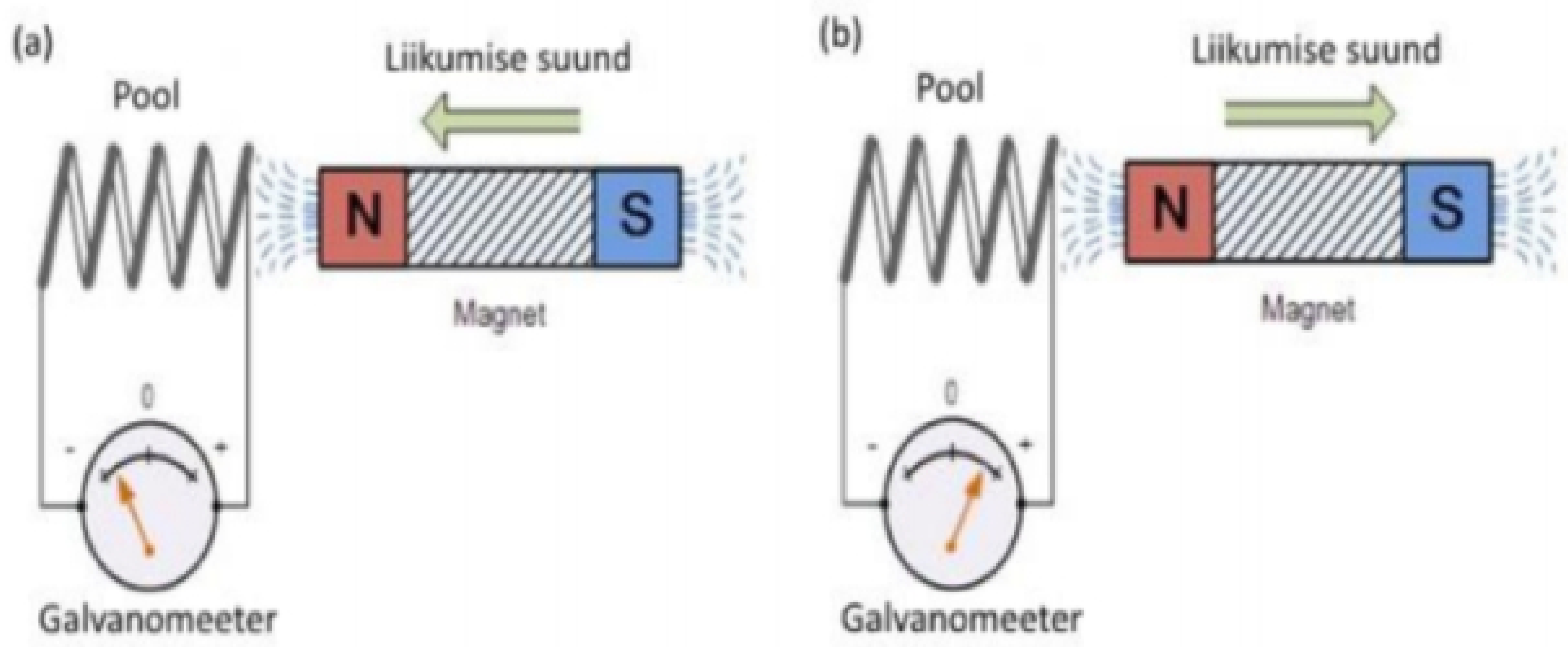
GENERATOR EFFECT



When the magnet is moved inside and outside of the wire it produces a current in the wire due to electomagnetic induction.

If the magnet is moved in the opposite direction the deflection is in the opposite direction.

Moving the wire or moving the coil has the same effect as both cuts the magnetic field lines.

When the wire is connected to a bult it will light up = GENERATOR EFFECT

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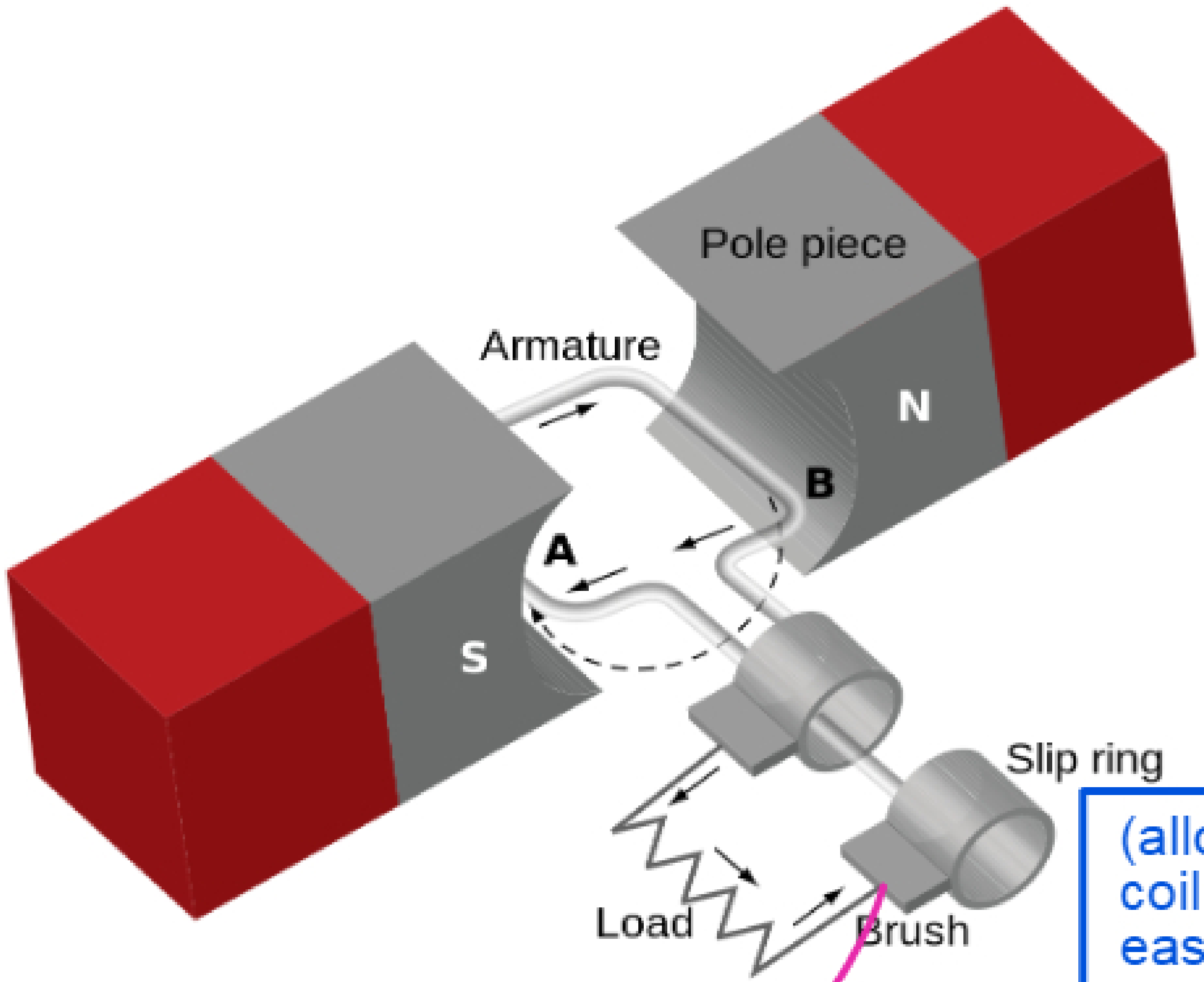
A coil is rotated in a magnetic field.

Rotating coil cuts the magnetic field of lines and produces an electric current through electromagnetic induction.

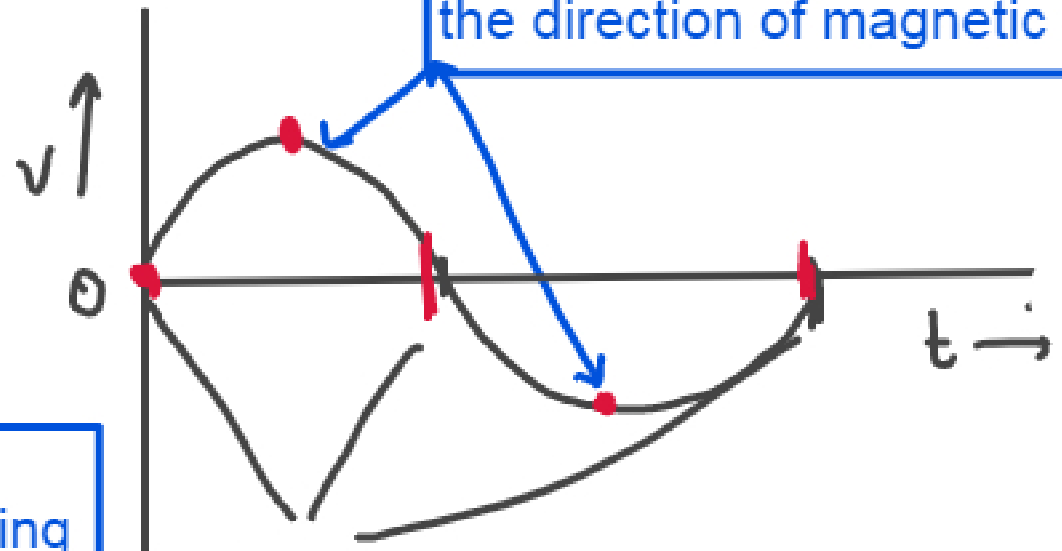


(allow coil to swing easily)

carbon brush

allow current to flow from split ring

Voltage is maximum as the coil is parallel to the direction of magnetic field.



Voltage is zero as coil is perpendicular to the direction of magnetic field.

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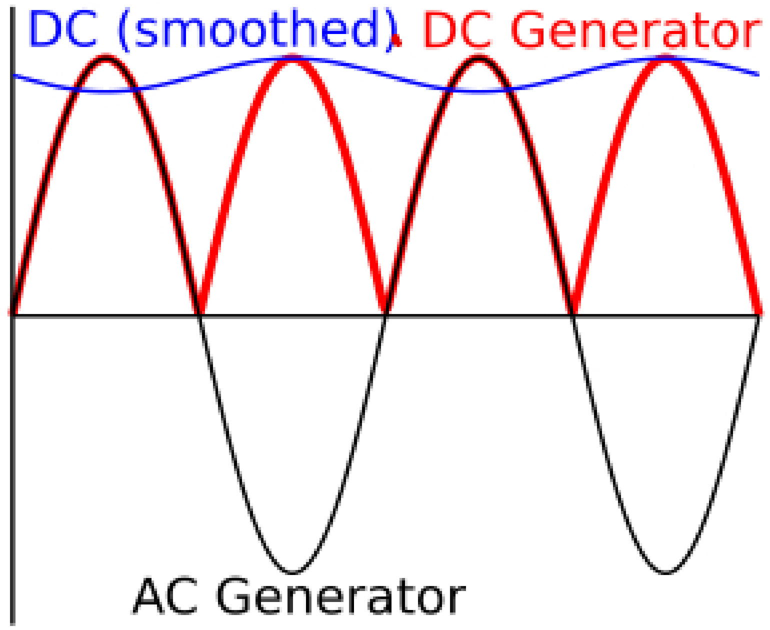
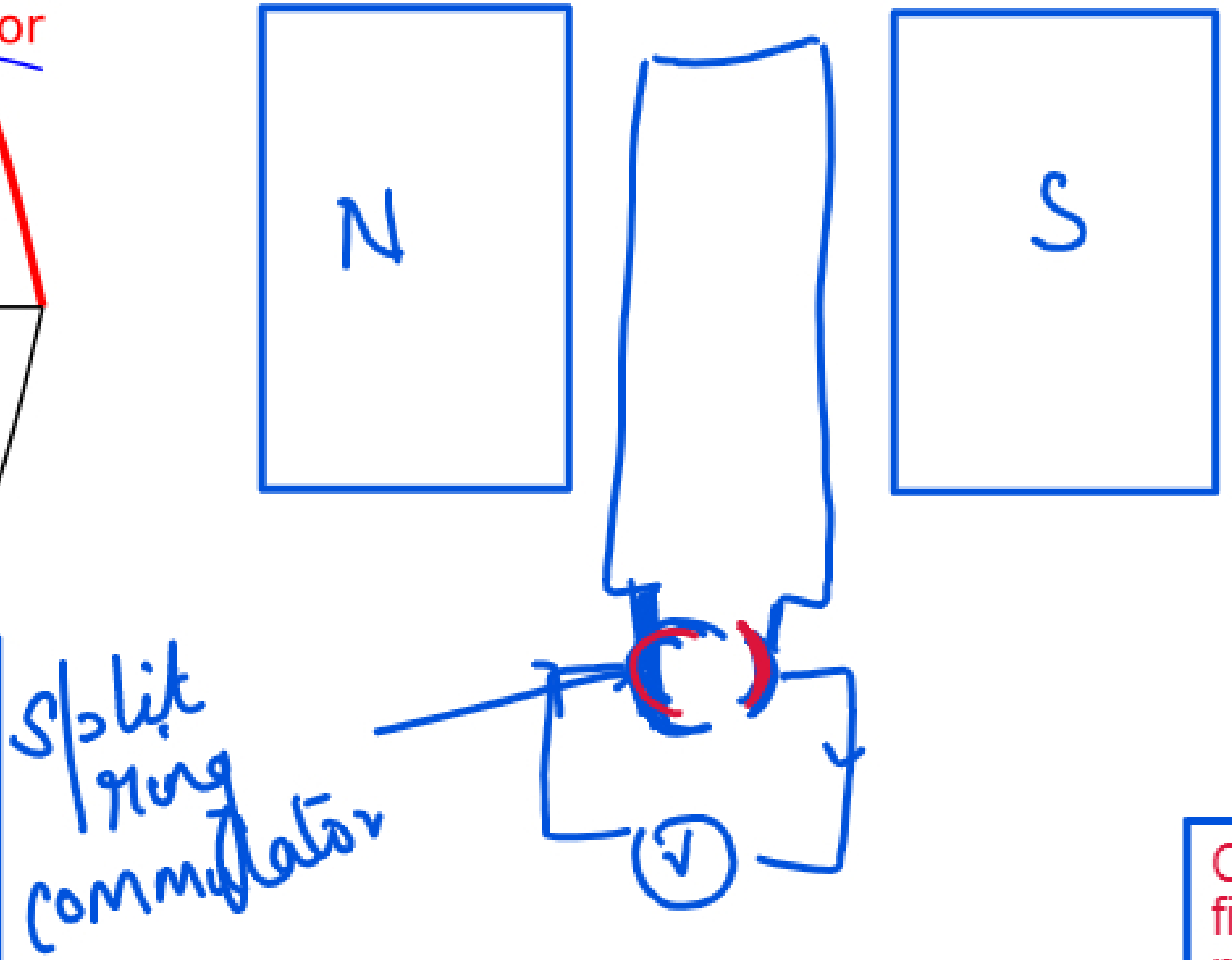
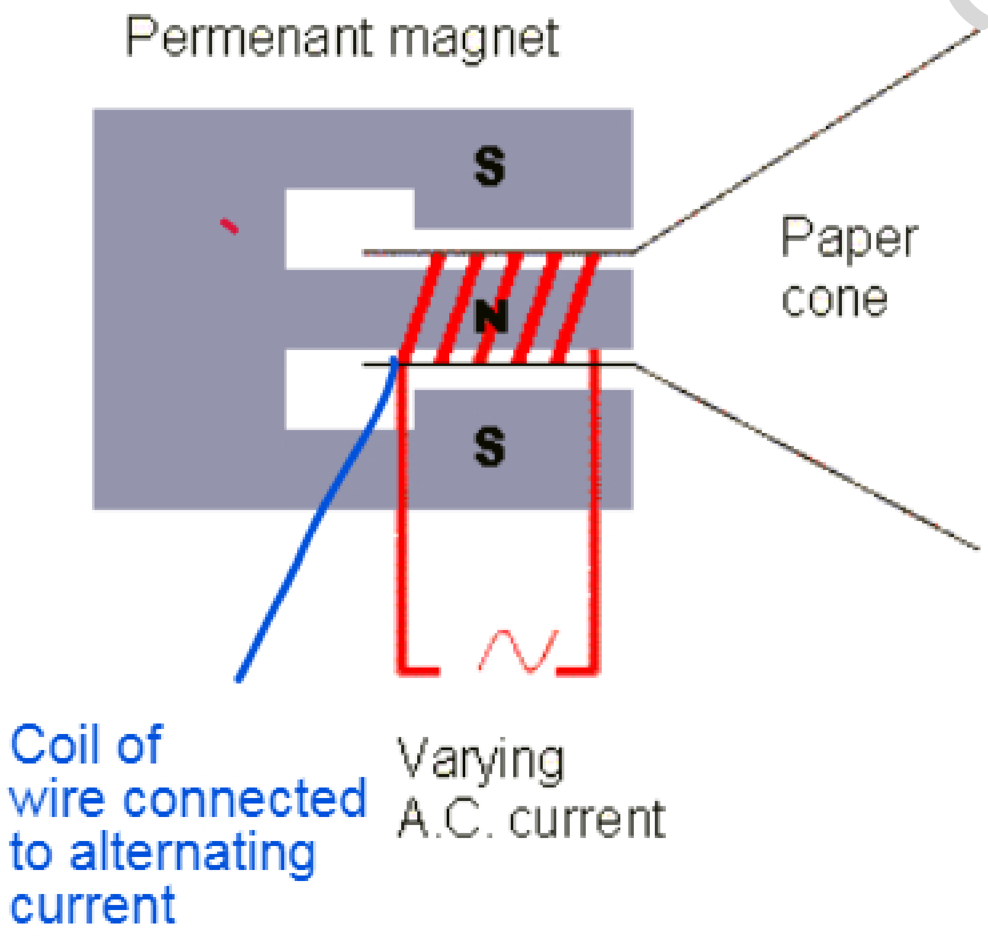


Motor has slip ring commutator instead of slip rings

So due to this commutator the current is not reversed so it gives only DC current.





Current is switched on it generated a magnetic field which interact with the permanent magnetic field and produces force. When the current reverses the direction of force reverses generating sound waves.

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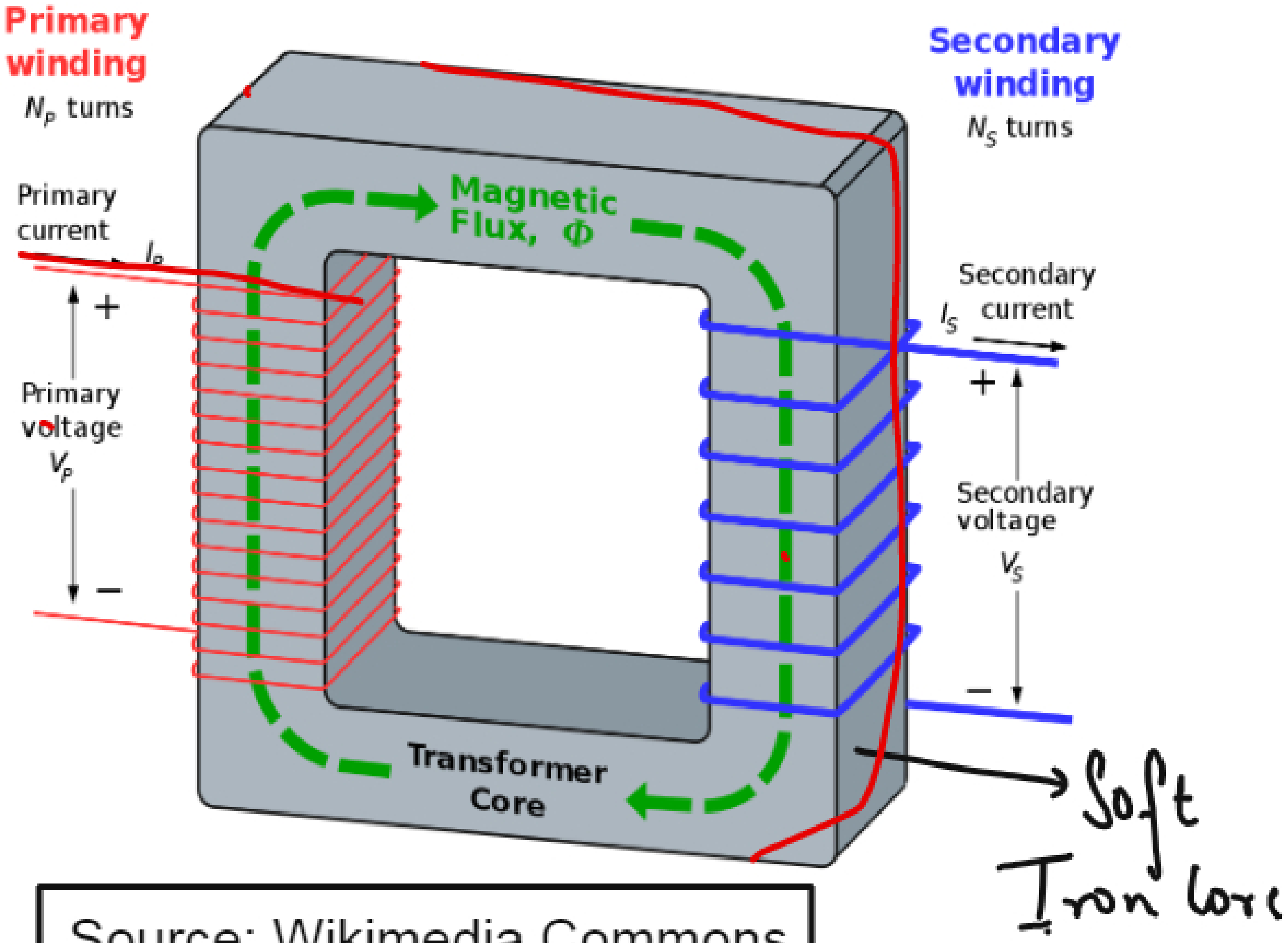
TRANSFORMERS

Only Works with Alternating Current



Source: Wikimedia Commons

It is the device which is used to increase (step up) or decrease the voltage (step down) or the potential difference.

Primary coil and the secondary coil is wound around the soft iron core.

Primary coil is connected to an AC supply.
Input Voltage

Changing Electric current in the primary coil creates a magnetic field.

The changing magnetic field cuts along the secondary coil and produces a voltage. Output Voltage

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

Vp = Voltage across primary coil
Vs= Voltage across secondary coil
Np= Number of turns in primary
Ns= Number of turns in secondary

Transformer Efficiency

Power across primary = Power across secondary

$$V_p I_p = V_s I_s$$

- V_p: Voltage across primary
- I_p: Current across primary
- V_s: Voltage across secondary
- I_s: Current across secondary

If the number of turn in primary is 20 and input voltage is 230 V. What are the number of turns in secondary if the voltage generated in secondary is 460 V ?

$V_p = 230V$, $N_p = 20$

$V_s = 460V$, $N_s = ?$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$N_s = \frac{N_p \times V_s}{V_p} = \frac{20 \times 460}{230} = 40 \text{ turns}$$

A transformer input voltage is 230 V and the current is 20 A. What is the output voltage if the ouput current is 10 A.

$V_p = 230V$, $V_s = ?$

$I_p = 20A$, $I_s = 10A$.

$$V_p \times I_p = V_s \times I_s$$

$$230 \times 20 = V_s \times 10$$

$$\frac{230 \times 20}{10} = V_s$$

$$= 460V$$

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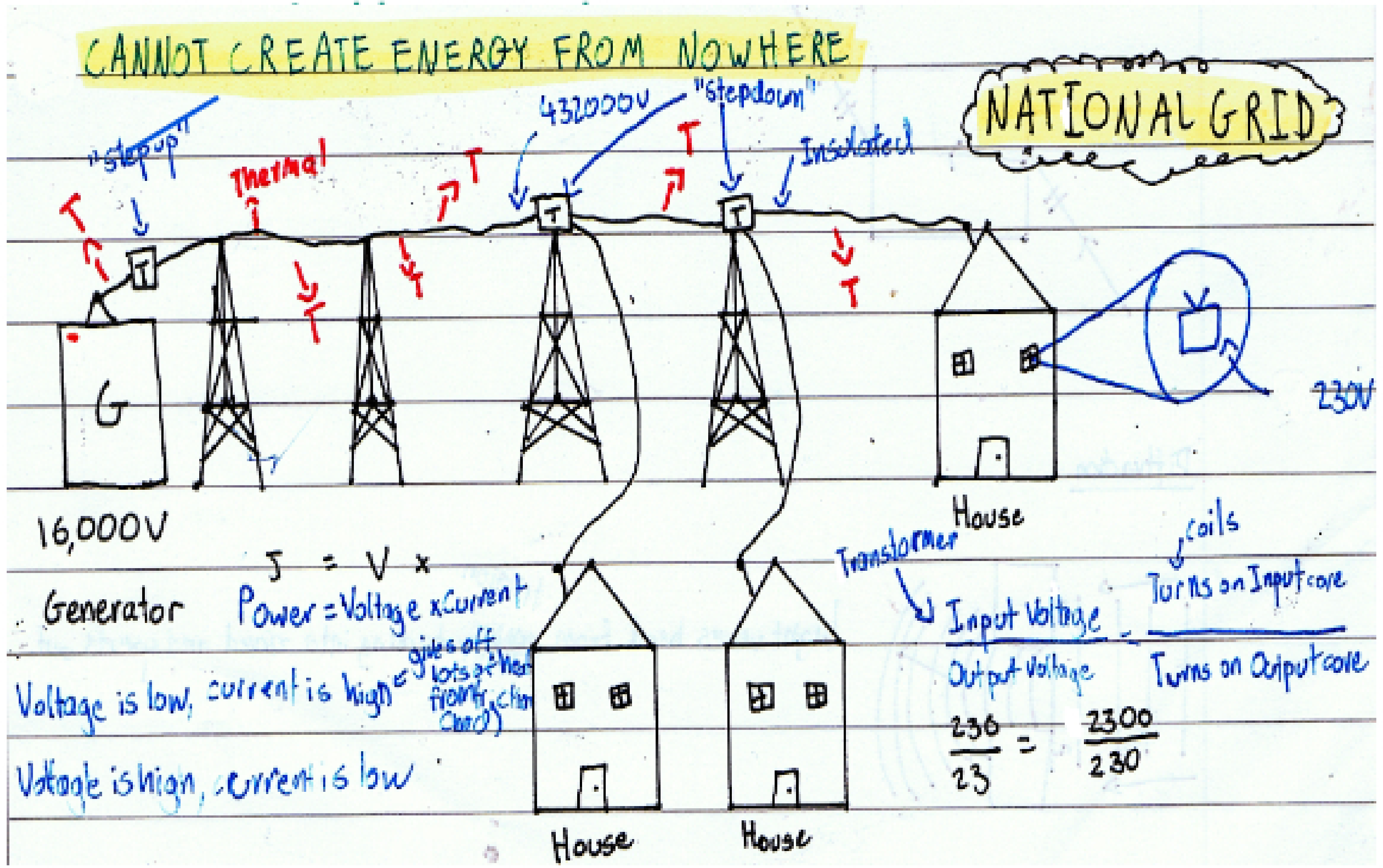
NATIONAL GRID



STEP UP TRANSFORMER	STEP DOWN TRANSFORMER
Increase the voltage	Decrease the voltage
It has more turns in secondary than in primary.	It has more turns in primary than in secondary.
Voltage in secondary is greater $= I_s \times N_s \uparrow$	Voltage in secondary is lower. $= I_s \times N_s \downarrow$
Connected next to the power station to transmit high voltage to reduce the heating effects of current turing transmission.	Connected to the power supply before it reaches homes to reduce the voltage to 230 V.

Increasing voltage for transmission increases the voltage and decreases the current. High current causes heating and results in loss of energy. By increasing the voltage, current is lowered and energy loss is prevented so transmission is efficient.

$H \propto I^2$

KEY TERMS

- Magnet
- Magnetic Field Lines
- Induce Magnetism
- North Pole
- South Pole
- Solenoid
- Electromagnets
- Relay
- Circuit Breaker
- Electric Bell
- Motor Effect
- Flemming Left Hand Rule
- Magnetic Flux density
- Split Ring Commutator
- Electromagnetic Induction
- Generator Effect
- Alternator
- Dynamo
- Transformer
- Step Up Transformer
- Step Down Transformer
- Transformer Efficiency
- National Grid

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NEXT STEP

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- CHECK SPECIFICATION
- EXAM QUESTIONS ON THIS TOPIC

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A mains (230 volt) transformer has 11,500 turns on its primary coil and 600 turns on its secondary coil. Calculate the voltage obtained from the secondary coil.

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} \; ; \; \frac{230}{V_s} = \frac{11500}{600}$$

$$\rightarrow \frac{600}{11500} \times 230 = 12V$$

A step-down transformer converts 11,500 V into 230 V. The power output is used to run a 2,000 W kettle. Calculate the current flowing in the primary coil.

$$P = IV \; ; \; I = \frac{P}{V} = \frac{2000}{230} = 8.7A$$

$$V_p I_p = V_s I_s$$

$$11500 \times I_p = 230 \times \cancel{8.69565217} \; 8.7$$

$$I_p = \frac{2001}{11500}$$

$$I_p = 0.174 A = 0.2 A$$

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Calculating momentum

A moving object has momentum. This is the tendency of the object to keep moving in the same direction. It is difficult to change the direction of movement of an object with a lot of momentum.

Momentum can be calculated using this equation:

$p = m \times v$

where:

p is the momentum in kilograms metres per second, kg m/s

m is the mass in kilograms, kg

v is the velocity in m/s

For example, what is the momentum of a 5 kg object moving with a velocity of 2 m/s?

momentum = 5 × 2 = 10 kg m/s

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Direction

Notice that momentum does not just depend on the object's mass and speed. Velocity is speed in a particular direction, so the momentum of an object also depends on the direction of travel. This means that the momentum of an object can change if:

the object speeds up or slows down ✓
the object changes direction ✓

Two railway carriages collide and move off together. Carriage A has a mass of 12,000 kg and moves at 5 m/s before the collision. Carriage B has a mass of 8,000 kg and is stationary before the collision. What is the velocity of the two carriages after the collision?

A → 12000 × 5 = 60 000 kg m/s

B → 8000 × 0 = 0 kg m/s

Total momentum afterwards → 60 000 kg m/s

12000 + 8000 = 20 000 kg

p = mv ; v = p ÷ m → 60 000 ÷ 20000 = 3 m

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