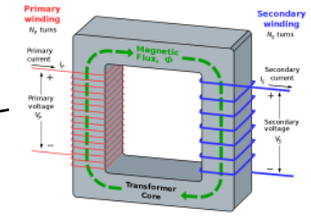
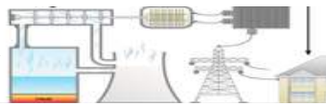
Physics SP13 Electromagnetic Induction

The National Grid

From power stations	***Electrical energy is transferred at high voltages***	Improves the efficiency by reducing heat loss in transmission lines.
To homes, factories and buildings	***Electrical energy is transferred at lower voltages***	Makes it safer for appliances and users



Step-up transformers	Step-down transformers
Increase voltage, decrease current	***Decrease voltage, increase current***
Increases efficiency, reduces heat loss.	Makes safer for houses.



National Grid	***Distributes electricity generated in power stations around UK***

HIGHER ONLY

Transformers	***Change the size of alternating voltage***
Made up of two coils of insulated wire wound on an iron core.	

Alternating current in the primary coil creates a magnetic field, which is constantly changing.

The magnetic field is carried to the secondary coil by The iron core.

The magnetic field induces a changing potential difference in the secondary coil.

Step-up transformers	***More turns on secondary coil***	Potential difference increases
Step-down transformers	***More turns on primary coil***	Potential difference decreases

Electromagnetic induction

Electromagnetic induction	***The induction of potential difference across an electrical conductor which is affected by a change in an external magnetic field.***

p.d. can be induced in two ways:
- Moving the conductor in a magnetic field
- Changing or moving the magnetic field

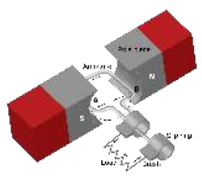
Factors affecting size of induction	Depends on: • Number of turns in a coil • The strength of magnetic field • How fast the wire moves or the magnetic field changes.

Reversing the magnetic field, reverses the direction of the induced p.d.

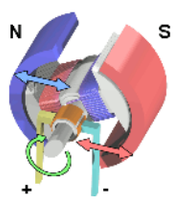
HIGHER ONLY

A changing magnetic field can induce a p.d. in a wire. Current then flows.

A coil is used so there is more wire in the changing magnetic field.



Generators	***Coil of wire rotating inside a magnetic field. The end of the coil is connected to slip rings.***	Produces altering current.
Dynamo	***Coil of wire rotating inside a magnetic field. A commutator switches over the connection every half turn.***	Produces direct current.

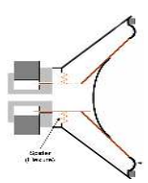


Rotating electromagnetic surrounded by coils of wire.

Large scale generators work in the same way in power stations.

Loud speakers	***Converts variations in electrical current into sound waves .***	Varying current flows through a coil that is in a magnetic field. A force on the wire moves backwards and forwards as current varies. Coil connected to a diaphragm. Diaphragm movements produce sound waves.

Microphones	***Converts pressure variations in sound waves into variations in current in electrical circuits.***



PHYSICS HIGHER ONLY

$V_P \div V_S = N_P \div N_S$

Potential difference across primary coil ÷ Potential difference across secondary coil = Number of turns on primary coil ÷ Number of turns on secondary coil

Transformers and energy

Potential difference across primary coil X current in primary coil = Potential difference across secondary coil X current in secondary coil

$V_P \times I_P = V_S \times I_S$

PHYSICS HIGHER ONLY

Transmitting power at high voltage is more efficient — *Use these questions to prove this.*

Power = Energy transferred ÷ time taken

Electrical Power = Current X Potential difference

Power = Current squared X Resistance