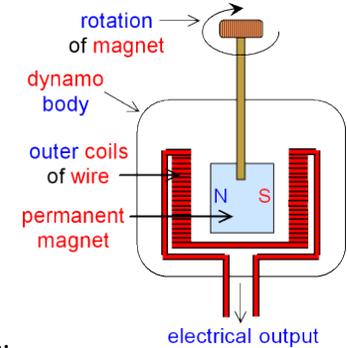


INDUCED POTENTIAL AND TRANSFORMERS – PHYSICS ONLY

1. If an electrical conductor moves relative to a magnetic field or if there is a change in the magnetic field around a conductor, a potential difference is induced across the ends of the conductor.
2. If the conductor is part of a complete circuit, a current is induced in the conductor. This is called the **generator effect**.
3. An induced current generates a magnetic field that opposes the original change, either the movement of the conductor or the change in magnetic field.

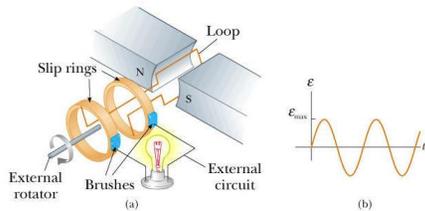
4. The current flowing through the circuit (and therefore also the induced potential difference) is **larger** when:
 - the **number of turns** in the solenoid is **increased**;
 - the **magnetic field** is **strengthened** (this can be done by using a stronger magnet or using several magnets at once); and
 - the magnet is moved in and out of the solenoid at a **greater speed**.

10. A bicycle **dynamo** is a simple generator.



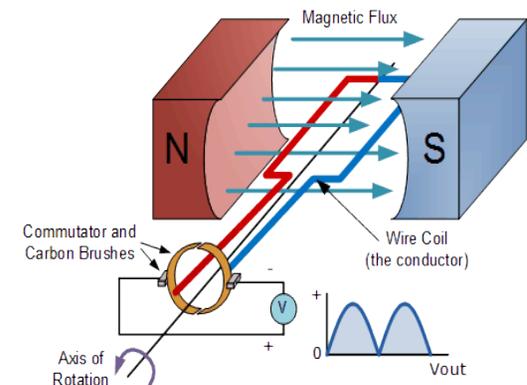
- 11.
12. The dynamo has a wheel that touches the back tyre. As the bicycle moves, the wheel turns a magnet inside a coil. This induces enough electricity to run the bicycle's lights.
13. The faster the bicycle moves, the greater the induced current and the brighter the lights.

5. An **alternator** is an AC generator.
6. As the coil or magnets spin past one another, the current rises, falls and reverses, giving an AC output.
7. Alternators are mostly used for generating electricity from vehicle engines.
8. Cars use alternators (driven by their engines) which charge up their batteries as they drive along.
- 9.



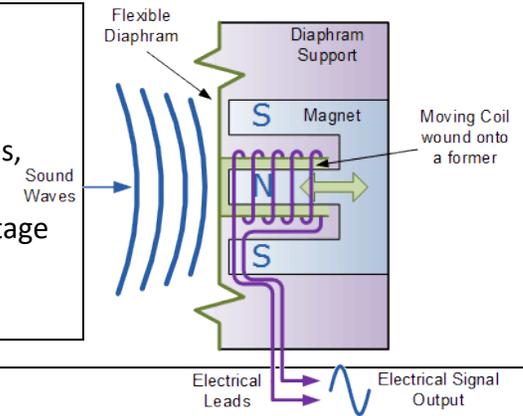
14. The generator effect is used in an alternator to generate AC and in a dynamo to generate DC.
15. A simple DC generator produces a steady supply of direct current electricity when it spins around.
16. A DC generator uses a **commutator** – a metal ring with splits in it.
17. The commutator periodically reverses the electrical contacts from the generator coil, reversing the current at the same time.
18. A simple loop of wire automatically reverses the current it produces every half turn (because it's rotating).
19. The commutator's job is to cancel out the effect of the coil's rotation so that a direct current is produced.

20.



INDUCED POTENTIAL AND TRANSFORMERS – PHYSICS ONLY

21. **Microphones** use the generator effect to convert the pressure variations in sound waves into variations in current in electrical circuits.
22. A coil is glued to the rear of a membrane, and there is a strong magnet surrounding this coil.
23. When sound waves hit the microphone, the membrane moves to the rhythm of the sound waves, and the coil on its back moves along with it.
24. The relative movement of the coil within its (stationary) magnetic gap induces a small signal voltage in this coil.
25. The sound wave is converted into an electrical signal.



26. A basic **transformer** consists of a primary coil and a secondary coil wound on an iron core.
27. Iron is used as it is easily magnetised.
28. The ratio of the potential differences across the primary and secondary coils of a transformer V_p (primary voltage) and V_s (secondary voltage) depends on the ratio of the number of turns on each coil, n_p and n_s :

$$29. \frac{V_p}{V_s} = \frac{N_p}{N_s}$$

potential difference, V_p and V_s in volts, V

E.g. $\frac{10,000}{500} = \frac{400}{20}$ Ratio = 20 : 1

30. In a **step-up transformer** $V_s > V_p$
31. In a **step-down transformer** $V_s < V_p$
32. If transformers were 100% efficient, the electrical power output (Watts, W) would equal the electrical power input.
33. $V_s \times I_s = V_p \times I_p$
34. $V_s \times I_s$ is the power output (secondary coil) and $V_p \times I_p$ is the power input (primary coil).

35. This is the basis of how a transformer works:

- The primary coil is connected to an AC supply.
- An alternating current passes through a primary coil wrapped around a soft iron core.
- The changing current produces a changing magnetic field.
- This induces an alternating voltage in the secondary coil.
- This induces an alternating current (AC) in the circuit connected to the secondary coil.

