202: Principles of electrical science  
**Handout 12: a.c. generation**

**Learning outcome**

The learner will:

1. Understand the fundamental principles which underpin the relationship between magnetism and electricity.

**Assessment criteria**

The learner can:

5.4 describe the basic principles of generating an A.C. supply in terms of: (a single-loop generator, sine-wave, frequency, EMF, magnetic flux)..

**a.c. generation**

When a conductor cuts through a magnetic field, at right angles to the magnetic flux, an **EMF** (electromotive force) is induced in the conductor.

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| 01 generation.png |

The diagram shows a single loop coil which rotates between the poles of a magnet. Slip‑rings and carbon brushes are used to make contact with the coil. The former consist of a brass or copper shell connected to each side of the coil.

As the loop rotates, its sides cut through the magnetic flux set up by the poles and so an EMF is induced in the loop.

We have already seen that when a conductor moves **across** a magnetic field, it **cuts the flux** and an **EMF is generated** in it.

When the conductor moves **along or parallel** to the magnetic field, **no flux is cut** and therefore **no EMF** is induced.

If the conductor moves at right angles to the field, flux is cut at the maximum rate and a maximum EMF is induced.

If the conductor cuts the field at an angle, the induced EMF will depend on the angle between the line taken by the conductor and the magnetic flux, which means that the induced EMF will be somewhere between 0 and maximum value.

Consider the single loop rotated between poles, as in the diagram on the following page; the EMF generated will be as shown.

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| 02 generation.png | The single loop with slip-rings is a form of a.c. alternator.  The simple alternator generates one **cycle** of its waveform for every complete revolution that it makes.  If more pairs of poles are added, the alternator will produce one cycle for each pair of poles during one revolution.  The frequency (symbol f) of an alternator is the number of cycles it produces every second.  Frequency is measured in **hertz (Hz)**.  The waveform produced is known as a **sine wave**. |

A machine having P pairs of poles and running at N rev/sec generates a frequency of f Hertz. Therefore:

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| where: |  |  |  |
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|  |  |  | (a North and South are one pair) |

**Plotting a sine wave to represent an a.c. waveform**

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| 03 generation.png |
| 03 generation.png |