AC and DC

Matthew Williams • Physics • May 20, 2026

AC and DC

Direct Current (DC)

Direct current (DC) flows in one direction only and at a constant value. Batteries and cells are DC sources. The current-time graph for a DC source is a horizontal straight line.

Alternating Current (AC)

Alternating current (AC) continuously reverses direction. The current (and voltage) follows a sinusoidal pattern with time. Mains electricity in most countries is AC, in the Caribbean this is typically 50 Hz or 60 Hz.

AC Parameters

Quantity	Symbol	Definition	Unit
Peak voltage	[Math: V_0]	Maximum voltage in either direction	V
Peak-to-peak voltage	[Math: 2V_0]	Total voltage swing from positive to negative peak	V
Period	[Math: T]	Time for one complete cycle	s
Frequency	[Math: f]	Number of cycles per second; [Math: f = 1/T]	Hz

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caption="Alternating voltage from a 50 Hz AC supply: period T = 0.02 s, peak voltage 325 V. The root-mean-square (RMS) voltage is 325/2 H2 230 V, this is what appliances are rated at."

height={260}

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Reading an AC generator graph (2018 Paper 02, Q3d)

Using the graph, determine the peak-to-peak voltage, the period, and the frequency of the alternating voltage.

(i) Peak-to-peak voltage and peak voltage

Peak-to-peak voltage read from graph $= 20\,\text{V}$

$$V_0 = \frac{20}{2} = 10\ \text{V}$$

(ii) Period

$$T = 0.04\ \text{s}$$

One complete cycle read from the graph.

(iii) Frequency

$$f = \frac{1}{T}$$

$$f = \frac{1}{0.04}$$

$$f = 25\ \text{Hz}$$

Peak current and effect of speed change (2021 Paper 02, Q5b and Q5c)

The peak voltage from the generator graph is $V_0 = 50\,\text{V}$.

(b)(ii) Calculate the peak value of the current when this voltage is applied across a 100 © resistor.

$$V_0 = I_0 \times R$$

$$50 = I_0 \times 100$$

$$I_0 = \frac{50}{100}$$

$$I_0 = 0.5\ \text{A}$$

(c) The generator is subsequently rotated at twice the original frequency. State the effect on:

(i) the period— the period halves, since $T = 1/f$ and frequency has doubled.

(ii) the output voltage — the peak voltage increases, because the coil cuts through magnetic field lines faster, inducing a greater EMF per revolution.

Half-Wave Rectification

A **diode** allows current to flow in only one direction. When an AC supply is connected through a diode, only one half of each AC cycle is allowed to pass. This is **half-wave rectification**.

<PlotlyGraph

data={[

{

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caption="Half-wave rectified output: only positive half-cycles pass through the diode. The output is always positive (DC direction) but pulsating, not smooth like a battery."

height={240}

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Comparison of waveforms:

Waveform	Description
DC (battery)	Constant, flat line, no variation
AC	Smooth sine wave, alternates positive and negative
Half-wave rectified AC	Positive half-cycles only; gaps where negative half-cycles were blocked

To smooth the output of a rectifier, a large capacitor is connected in parallel, it charges during peaks and discharges during gaps, reducing the variation.

> **Exam Tip**
>
> The period is read from the graph as the time for one complete cycle (crest to crest, or the distance from one zero crossing to the next on the same side). Frequency is $f = 1/T$, not $T/1$.
>
> For AC generator questions: doubling the rotation speed doubles the frequency, halves the period, and increases the peak voltage (more EMF generated per revolution).