

EMF & Internal Resistance

Physics

Why terminal voltage is less than EMF, and how to measure both.

Terminal potential difference equals EMF minus the potential dropped across the internal resistance.

$$V = \varepsilon - Ir$$

Plot V against I

The standard experiment.

Intercept = ε , gradient = $-r$

Open circuit

No current, no internal drop.

$$V = \varepsilon$$

Short circuit

Maximum current.

$$I = \varepsilon/r$$

THE COMMON MISTAKE

✗ **Treating a battery as an ideal source**

✓ **Including internal resistance under load**

At high current the internal drop becomes significant, which is why headlights dim when a car is started.

Maximum power transfer occurs when the load resistance equals the internal resistance — at only 50% efficiency.