

# OCR A Physics A-Level

## PAG 4.2

Circuits with more than one source of e.m.f

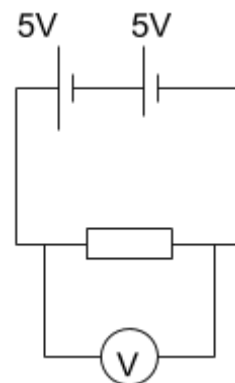


## Equipment

- Cells
- Leads
- Voltmeter
- Resistor

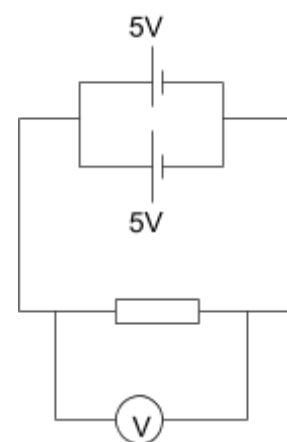
## Method

1. Set up the first circuit as shown in the diagram to the right, the cells do not have to be 5 V.
2. Record the voltage across the resistor, as the resistor is the only component this will be the potential difference supplied by the cells (with some error due to internal resistance).
3. Set up the second circuit as shown in the diagram below the first, once again record the current across the resistor.
4. Swap at least one of the cells in the series circuit so that they are of different voltages and record the reading on the voltmeter again.



## Calculations

- Calculate the expected combined potential difference for each cell combination using the rules about cells in series and parallel.
  - The combined potential difference for cells in series will be the sum of their individual voltages ( $V_{TOT} = V_1 + V_2 + \dots + V_n$ ).
  - 2 cells of the same voltage connected in parallel will have an overall potential difference of that same voltage. This is because their terminals are electrically at the same point so the potential between these two points is the same, however batteries connected in parallel have a longer lifetime than those connected alone.
- Compare the theoretical combined potential difference and compare it to the actual, discuss the reasons behind this difference e.g internal resistance.



## Safety

- Do not connect 2 cells of different voltage in parallel, particularly if the difference is large. 2 cells of different voltage connected in parallel will not remain at different voltages as the one of higher voltage will discharge into the one of lower until they are equal which can cause wires to be burnt, sparks when connecting the cells, overheating and failure of both batteries.
- Do not use high voltage batteries to minimise risk from electrocution.
- The resistor may get hot so touch it with caution.

## Notes

- The internal resistance of the cells will affect the reading on the voltmeter, adding a switch to the circuit, leaving it open and connecting a voltmeter across the cells would allow for a more accurate determination of their combined emf.

