OCR B Physics A-Level

PAG 3.3

### Determining the internal resistance and maximum power of a cell

Internal Resistance of a cell

Equipment
- Battery or cell
- Voltmeter
- Ammeter
- Variable resistor
- Switch

Method
1. Set up the apparatus as shown in the diagram.
2. Set the variable resistor to its maximum value.
3. Close the switch and record voltage from the voltmeter and the current from the ammeter, open the switch between readings to prevent heating of the variable resistor.
4. Decrease the resistance of the variable resistor and repeat this, obtaining pairs of readings of V and I over the widest possible range.
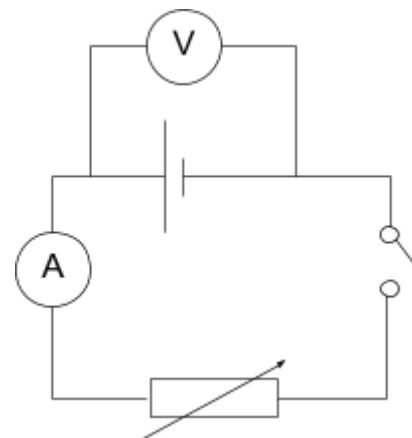
Calculations
- $\varepsilon = I(R + r) = V + Ir \Rightarrow V = -rI + \varepsilon$, this is in the form *y=mx+c* (a straight line graph)
- Plot a graph of V against I and draw a line of best fit. The y-intercept will be the emf and the gradient will be the negative internal resistance.

Safety
- Another resistor can be included in series with the other to avoid high currents which could be dangerous and make the wires and variable resistor get hot.

Improvements and Notes
- Only close the switch for as long as it takes to take each pair of readings. This will prevent the internal resistance of the battery or cell from changing during the experiment.
- Use fairly new batteries/cells because the emf and internal resistance of run down batteries can vary during the experiment.
- Check there is no systematic error from the ammeter and voltmeter by calibrating them beforehand.
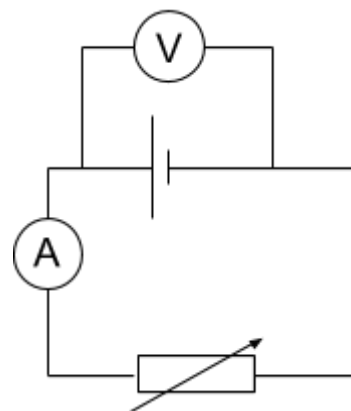
Maximum Power of a Cell

Equipment
- Battery
- Ammeter
- Voltmeter
- Variable resistor

Method
1. Record the terminal voltage (reading on the voltmeter) for at least 8 different current values determined by altering the variable resistor, the range should be quite wide in order to see the trend in results clearly.

Calculations
- Calculate the power supplied by the battery for each current value by using $P = VI$ and also calculate the resistance at each current value by $R = V/I$. The headings for the table your results and calculations should be recorded in are illustrated below:

Current/A	Voltage/V	Power/W	Resistance/Ω

- Plot a graph of power against resistance, it should have an arched shape in which the peak of the arch shows the maximum power of the cell, you should find that maximum power occurs when the variable resistor's resistance is equal to the internal resistance of the cell.

Safety
- Do not use too high a voltage as the components can become too hot, be damaged and the risk of electrocution is greater.