Year 11 ATAR Physics – Investigation for Internal Resistance of a Battery

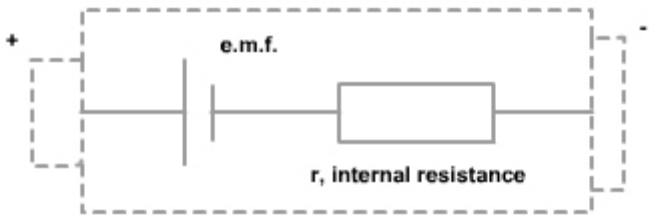
Reference: https://www.bbc.co.uk/bitesize/guides/zxx66sg/revision/1

At its most simple:

When we consider a source of emf we look at it as a black box device which can provide energy to electrons which can be dispersed by an external circuit. However; this same current or flow of electrons must also pass through the source itself and this utilises some of the potential provided by the source.

Q. If a source (battery) had zero internal resistance what would happen if the battery was shorted out?

For all intents and purposes we can consider this internal resistance as acting in series with the source of **emf** (**electromotive force**) and thus the actual voltage supplied by the cell will be reduced in proportion to the current delivered (as shown in the diagram of a battery below).



Q. If we measure the voltage of the source when current flow is zero, what is the PD across this resistance and how would voltage measured compare to the emf?

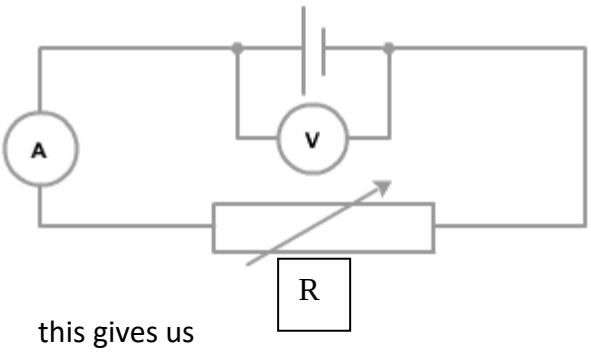
Q. Voltmeters have a high resistance but not infinite, is it possible to get a 100% accurate reading of emf using a voltmeter?

It is possible however to measure the output of a cell (V and I) and use this data to project a zero current reading and thus determine emf of the source.

If we consider the circuit shown:

we can see that emf $\varepsilon = I R_T$

where $R_T = R + R_I$ (External resistance + internal resistance)



this gives us

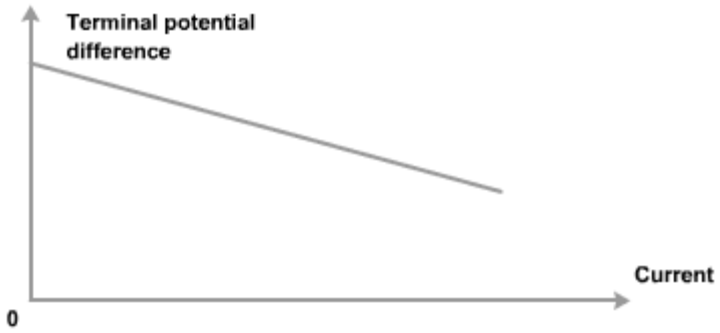
$$\varepsilon = I (R + R_I)$$

and thus

$$\varepsilon = V + I R_I$$

Remember in this equation, emf is a characteristic of the source (maybe as produced by a specific chemical reaction) while V is the measured supply voltage.

This equation can be used along with the circuit shown, to determine values for emf and the internal resistance (you may have to determine how to extract this information from data collected using the following graph as a hint).



Task: Investigation for Internal Resistance of a Battery

(Investigation 12.4 Exploring Physics 11 pp. 123-124)

Compare and contrast the internal resistance of 'fresh' and 'used' batteries

The objective of this investigation is to gain an insight into the behaviour of electrical sources. A basic characteristic of batteries and power supplies is their internal resistance which affects their performance depending on load characteristics, and in the case of batteries, their use. You will be given three periods with access to the electrical equipment to investigate this topic. You will be required to submit a short, independently written discussion (maximum of 2 pages + a graph) which, as a minimum, considers the questions posed above, and addresses the post-lab discussion questions on p. 124 of your Exploring Physics text, and which lists a minimum of 4 references used. Your discussion is to be submitted before you sit the CAP validation in Week 6. It is up to your teacher as to whether they may be submitted electronically or as a hard copy.