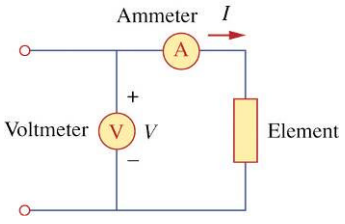
Lesson 5: Practical sources and meters

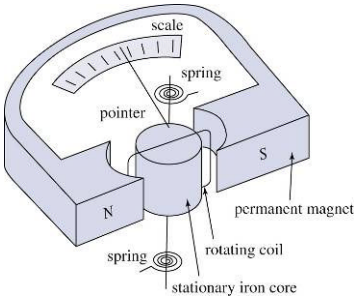
Ideal meters



For accurate measurement, our meters should not affect the parameters being measured.

- An ideal ammeter should have no voltage drop across it and hence _____ resistance.
- An ideal voltmeter should shunt no current through it and hence _____ resistance.

The d'Arsonval meter



D'Arsonval meters are constructed by suspending an coil between the poles of a permanent magnet.
They are characterized by their _____ (I_{fs}) which will cause the meter to fully deflect, typically 10-μA to 10-mA.
The rotating coil has a small resistance (R_m).

Ammeters

Large currents are handled by adding a _____ resistor (R_n).

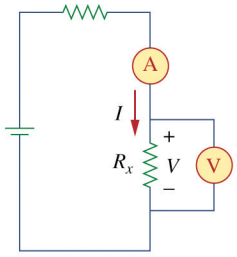
Voltmeters

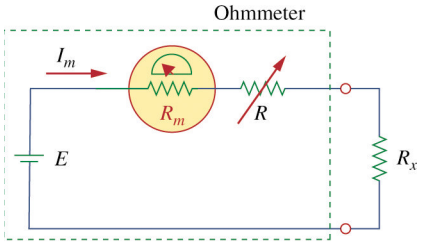
A d'Arsonval meter can also function as a voltmeter by combining it with a large series resistance (R_n).

Ohmmeters

To measure resistance, we need to know both voltage and current.
Ohmmeter consists of a d'Arsonval meter, a variable resistor (R) and a _____ (E).

- How do we choose R such that $I_m = I_{fs}$ when $R_x = 0\ \Omega$?





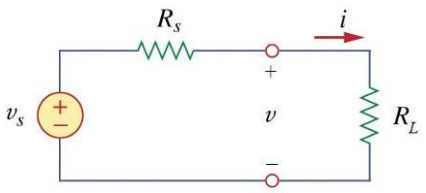
Ideal sources

An ideal source is an active element that provides a specified voltage or current that is completely independent of other circuit elements.

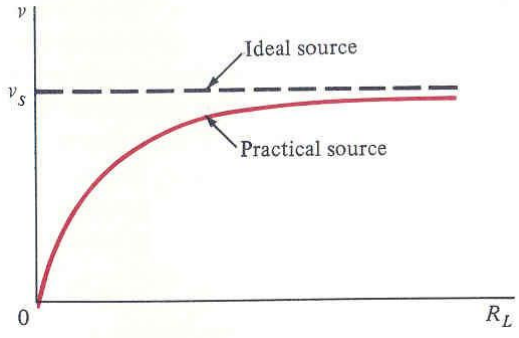
Practical voltage sources

A real or _____ source supplies its rated voltage when its terminals are not connected to a load (_____) but its voltage drops off as the current it supplies increases.

We can model a practical source using an ideal source v_s in series with an _____ resistance R_s.



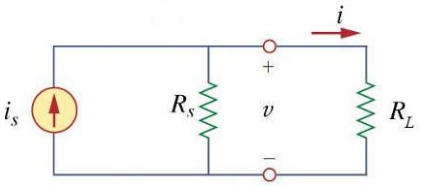
For a practical voltage source, both i and v vary with R_L.



Practical current source

A practical current source supplies its rated current when its terminals are _____ but its current drops off as the load increases.

We can model a practical current source using an ideal current source i_s in parallel with an internal resistance R_s.



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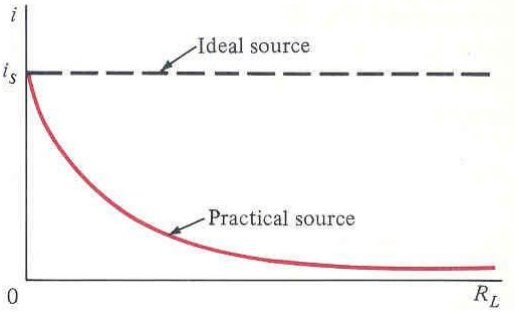
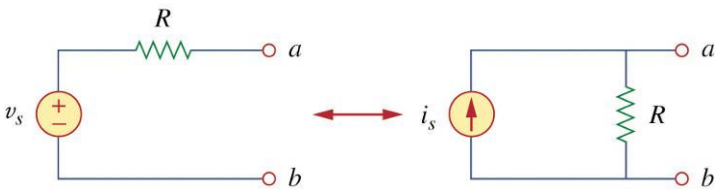


Source transformation

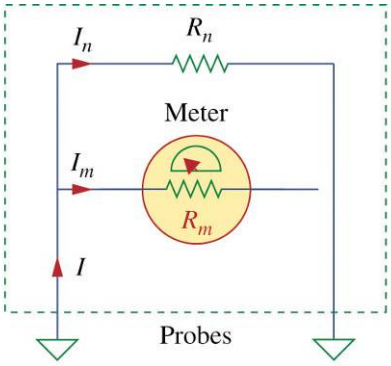
The two circuits representing practical sources are actually _____ circuits.



Source transformation is the process of replacing a voltage source v_s in _____ with a resistor R by a current source i_s in _____ with a resistor R, or vice versa.

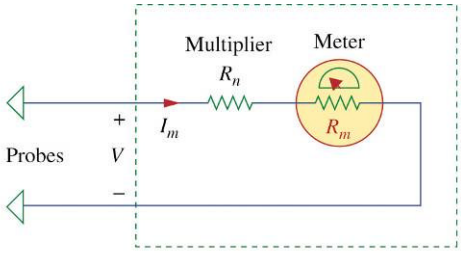
Example Problem 1

If a d'Arsonval meter has an internal resistance R_m= 50 Ω and a full-scale current I_{fs} = 1mA, determine R_n such that the meter will fully deflect when I = 1 A.



Example Problem 2

Determine R_n for a voltmeter to have a full-scale voltage of 100 V using a d'Arsonval meter with R_m= 100 Ω and a full-scale current I_{fs}= 50 μA.



Example Problem 3

Use source transformation to determine v_o.