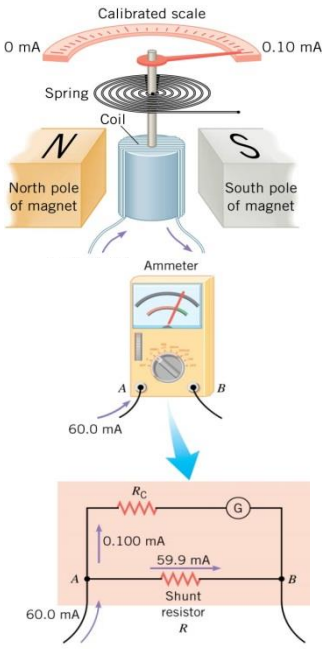
DC Voltmeters and Ammeters

- _____ (non-digital) meters
- Main component → _____



Ammeters

- Measures _____
- Inserted into _____ so _____ passes _____ it
- Connected in _____
- Coil usually measures only _____ current
- Has _____ _____ connected in _____ to galvanometer so excess current can _____
- A _____ lets you _____ which shunt resistor is _____
- Problems with Ammeters
  - The _____ of the coil and shunt _____ add to the _____ of the circuit
  - This _____ the _____ in the circuit
  - _____ ammeter has _____ resistance
  - Real-life good _____ have _____ resistance so as only cause a _____ change in current

Voltmeters

- Connected in _____ to _____ since parallel has same _____
- The coil works just like in the _____
- Given the _____ and the _____ of the coil → _____
- To give more range, a _____ resistor is connected in _____ with the coil
- Problems with Voltmeters
  - The voltmeter takes some the _____ out of the _____
  - _____ voltmeter would have _____ _____ resistance as to draw _____ current
  - Good voltmeter has large _____ resistance as to make the _____ draw (and voltage drop) _____

Homework

1. Suppose you are using a multimeter (one designed to measure a range of voltages, currents, and resistances) to measure current in a circuit and you inadvertently leave it in a voltmeter mode. What effect will the meter have on the circuit? What would happen if you were measuring voltage but accidentally put the meter in the ammeter mode?
2. Specify the points to which you could connect a voltmeter to measure the following potential differences in Figure 1: (a) the potential difference of the voltage source; (b) the potential difference across R_1; (c) across R_2; (d) across R_3; (e) across R_2 and R_3. Note that there may be more than one answer to each part.

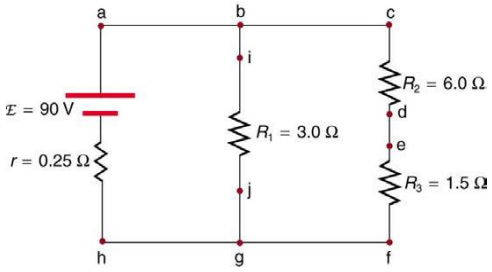


Figure 1

3. To measure currents in Figure 1, you would replace a wire between two points with an ammeter. Specify the points between which you would place an ammeter to measure the following: (a) the total current; (b) the current flowing through R_1; (c) through R_2; (d) through R_3. Note that there may be more than one answer to each part.
4. What is the sensitivity of the galvanometer (that is, what current gives a full-scale deflection) inside a voltmeter that has a 1.00-MΩ resistance on its 30.0-V scale? (OpenStax 21.42) **30.0 μA**

5. What is the sensitivity of the galvanometer (that is, what current gives a full-scale deflection) inside a voltmeter that has a 25.0-k Ω resistance on its 100-V scale? (OpenStax 21.43) **4.00 mA**

6. Find the resistance that must be placed in series with a 25.0-Ω galvanometer having a 50.0-μA sensitivity to allow it to be used as a voltmeter with a 0.100-V full-scale reading. (OpenStax 21.44) **1.98 kΩ**

7. Find the resistance that must be placed in series with a 25.0-Ω galvanometer having a 50.0-μA sensitivity to allow it to be used as a voltmeter with a 3000-V full-scale reading. Include a circuit diagram with your solution. (OpenStax 21.45) $\mathbf{6.00 \times 10^{7}\ \Omega}$

8. Find the resistance that must be placed in parallel with a 25.0-Ω galvanometer having a 50.0-μA sensitivity to allow it to be used as an ammeter with a 10.0-A full-scale reading. Include a circuit diagram with your solution. (OpenStax 21.46) $\mathbf{1.25 \times 10^{-4}\ \Omega}$

9. Find the resistance that must be placed in parallel with a 25.0-Ω galvanometer having a 50.0-μA sensitivity to allow it to be used as an ammeter with a 300-mA full-scale reading. (OpenStax 21.47) $\mathbf{4.17 \times 10^{-3}\ \Omega}$