**Announcements**

* Please bring a 2-liter soda bottle by next Monday

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**Circuits**

I can describe, interpret, and solve problems involving series and parallel circuits.

**ADVANCED PLACEMENT PHYSICS 1 EQUATIONS**

Electron charge magnitude, $e = 1.60 \times 10^{-19}$ C

Coulomb’s law constant, $k = \frac{1}{4\pi\epsilon_0} = 9.0 \times 10^9 \text{ N m}^2/\text{C}^2$

$F = \frac{q_1 q_2}{r^2}$

$I = \frac{\Delta Q}{\Delta t}$

$V = \frac{E}{A}$

$I = \frac{\Delta V}{R}$

$P = I \Delta V$

**Words**

A 12-V car battery is connected to one of the car's 3-brake lights. The circuit is completed by a connection to an ammeter, which is a device that measures current.

**Drawing**

A 12-V car battery is connected to one of the car's 3-brake lights. The circuit is completed by a connection to an ammeter, which is a device that measures current.
Most frequently, however, an electric circuit is drawn using standard symbols for the circuit elements.

**Voltmeters**

**Voltmeters** are tools used to measure the potential difference between two points in a circuit.

- The voltmeter is connected in parallel with the element to be measured.
- You can remove the voltmeter from the circuit without breaking the circuit.
- Voltmeters have very high resistance so as to minimize the current flow through the voltmeter and the voltmeter's impact on the circuit.

**Ammeters**

**Ammeters** are tools used to measure the current in a circuit.

- The ammeter is connected in series with the circuit, so that the current to be measured flows directly through the ammeter.
- The circuit must be broken to correctly insert an ammeter.
- Ammeters have very low resistance to minimize the potential drop through the ammeter.

**Question**

In the electric circuit diagram below, possible locations of an ammeter and a voltmeter are indicated by circles 1, 2, 3, and 4. Where should an ammeter be located to correctly measure the total current and where should a voltmeter be located to correctly measure the total voltage?

**PRACTICE**

Series and Parallel Circuit Interactives