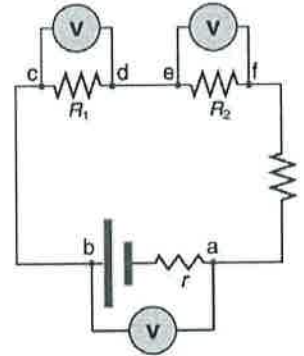


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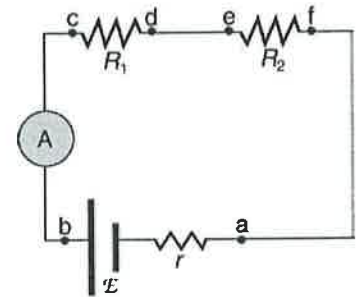
Notes - 21.4 DC Voltmeters and Ammeters

1. Voltmeters measure voltage, whereas ammeters measure current.

2. Voltmeters are connected in parallel with whatever device's voltage is to be measured. A parallel connection is used because objects in parallel experience the same potential difference.



3. Ammeters are connected in series with whatever device's current is to be measured. A series connection is used because objects in series have the same current passing through them.



4. Analog meters have a needle that swivels to point at numbers on a scale, as opposed to digital meters, which have numerical readouts similar to a hand-held calculator. The heart of most analog meters is a device called a galvanometer, denoted by G . Current flow through a galvanometer, I_G , produces a needle deflection proportional to the current. (This deflection is due to the force of a magnetic field upon a current-carrying wire.) A galvanometer can act as a voltmeter or an ammeter depending on how it is connected to the circuit.

5. When you use a voltmeter or ammeter, you are connecting another resistor to an existing circuit and, thus, altering the circuit. Ideally, voltmeters and ammeters do not appreciably affect the circuit.

6. The voltmeter, which is always placed in parallel with the device being measured, must have very little current flowing through it. To achieve this, the voltmeter's resistance must be considerably larger than the device being measured. Remember that a large resistance in parallel with a small one has a combined resistance essentially equal to the small one.
7. An ammeter is placed in series in the branch of the circuit being measured. As a result, its resistance adds to that branch. Therefore, so as to not appreciably affect the circuit, the ammeter's resistance must be very low compared with the resistances of the devices in the circuit. Remember that a small resistance in series with a large one has a combined resistance essentially equal to the large one.