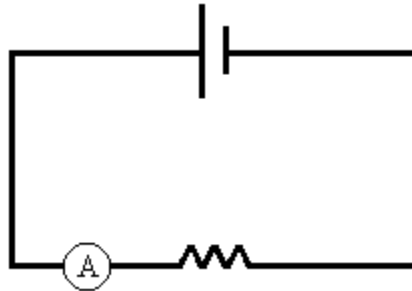


Note-A-Rific: Voltmeters & Ammeters

Voltmeters and ammeters are devices used to measure the electrical characteristics of parts of a circuit.

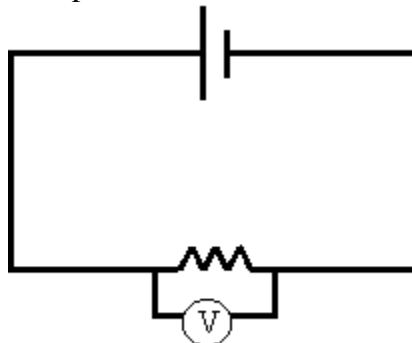
- **Ammeters** measure current.
- **Voltmeters** measure voltage (potential difference).
- The tricky part is wiring them into a circuit so that they don't have much of an effect on the circuit.
 - In the questions we do, we assume that we have "perfect" ammeters and voltmeters that have no effect on the circuit if wired properly.
- Because of the different quantities they measure, and because of the make up of a circuit, they must be wired into a circuit differently to each other.

Ammeters are always wired in series to the circuit.



- Since the current in a series circuit is the same all the way, the current you measure with the ammeter is also the current flowing through the resistor.
- If the ammeter was wired in parallel, part of the current would branch off into the ammeter, part into the resistor, and you wouldn't have an accurate reading of the current in the circuit.
- Since the ammeter is in series in the circuit you need to make sure that it has the lowest resistance possible.
 - If it has very much resistance at all, it would increase the overall resistance of the circuit and change the current you are measuring.

Voltmeters are always wired in parallel to the circuit.



- Anything that is connected in parallel has the same voltage across everything, so the voltage drop you measure across the resistor is accurate.
 - If there is no source of electricity or resistance between the connections of the voltmeter it will read zero, since no potential difference exists between the two points.
- If the voltmeter was wired in series, it would have a voltage drop of its own, but would not be able to measure the potential difference between two points in the circuit.
- Since the voltmeter is in parallel, we need to minimize how much of the current will branch off into it.
 - For this reason voltmeters always have very high resistances.

Most of the time you don't buy just a voltmeter or just an ammeter.

- Most people now buy multimeters, which have ammeters, voltmeters, and sometimes other meters built into one device.
- They are available with readouts in both old analog (dials and needles) and digital formats.

Example: Based on the previous information for this circuit from a previous section, we know the current in the circuit and the voltage drops. The battery is 9.0V and the current is 0.75A. Tell me what each ammeter and voltmeter in the other diagrams would read.

We need to consider what is happening to each ammeter in the

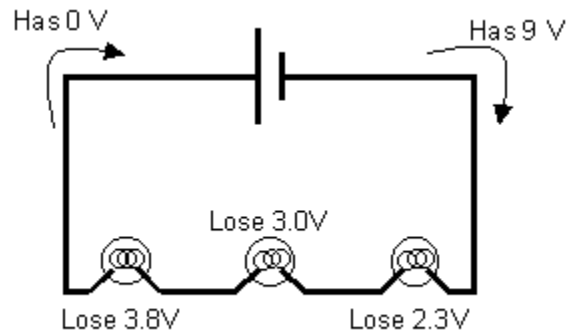
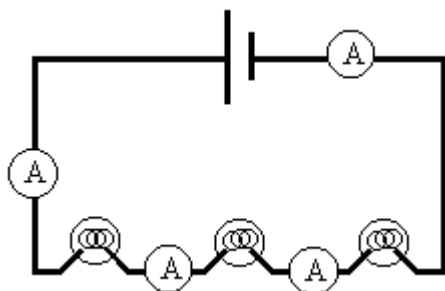


diagram below.

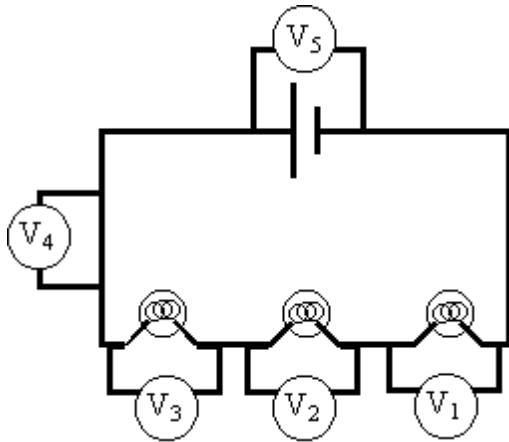
Remember that in a series circuit, the current is the same throughout. Otherwise we would be assuming that it was possible for charges to slow down and build up at certain spots.

All of these ammeters will read the same... 0.75A. If it was a parallel and the ammeters were in different branches, then we would get different



answers.

Next we look at each of the voltmeters placed in the circuit.



We know that at V_1 we will measure a 2.3V drop, at V_2 we will see a 3.0V drop, and at V_3 a 3.8V drop.

What about V_4 ? Is there any change in potential there...? Nope. There's no resistor of any sort, so there will be no drop in voltage. The voltmeter will read zero when placed here.

What will we see at V_5 ? There is a change in potential, it's just not a drop. Since this voltmeter is across the terminals of the

battery, it will show a potential increase. In this case it should read 9.0V, since that's the voltage of the battery.