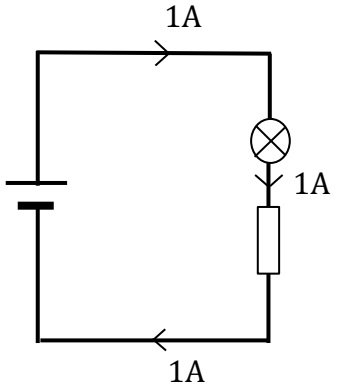
5.4.2 Circuit rules

videos

Charges flow around a circuit when the circuit is complete. The charges pick up energy in the battery/power supply and distribute it to components in the circuit. Charges are not destroyed in this process. We say that "charge is conserved".

Rule 1 – current in a series circuit

the current is the same all the way around a series circuit

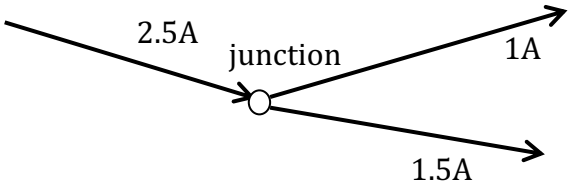


As charges can't be created or destroyed the rate of flow of charge (current) is the same at any point around the circuit - in this case 1A.

Rule 2 – current at a junction

"The sum of currents entering a junction = the sum of currents leaving a junction."

Because we can't create or destroy charges, the amount of charge flowing into a junction is equal to the amount of charge leaving a junction. (This is due to a conservation of charge). The rate at which charge flows is also conserved. If charges enter the junction more quickly, they will need to leave the junction more quickly. Electric current is the rate of flow of charges.

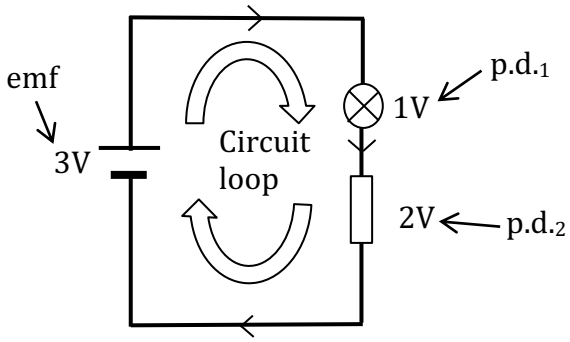


Rule 3 – voltages

"*The sum of emfs in a circuit loop = to the sum of voltages dropped (p.d.) across components in the circuit loop."*

This is perhaps the trickiest rule. We need to clarify what a circuit loop is. A circuit loop is one path taken by charges as they flow from one terminal of a power supply back round to the other.

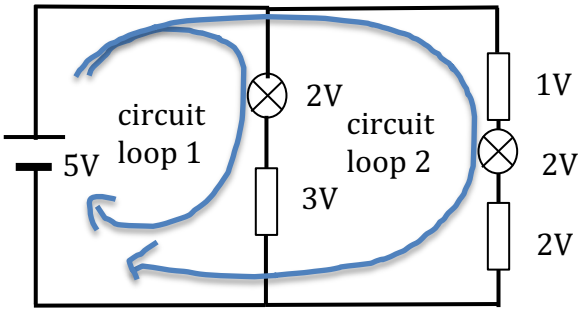
Let us have a look at the following series circuit:



Note: there is only one emf source in this circuit loop.

There is only one path (one circuit loop) that charges can take. Applying the rule for voltages, 3V = 1V + 2V. I have chosen a 1V and 2V as the p.d.s across the lamp and the resistor. Equally, they might be 1.5V and 1.5V, or 0.5V and 2.5V (The p.d.s depend on the relative resistances of the components). What is important is that the voltage supplied by the power supply is shared out (completely) around the circuit loop.

In circuits where there are junctions, there is more than one possible path (circuit loop) that the charges can follow. Rule 3 applies to all of the different circuit loops.

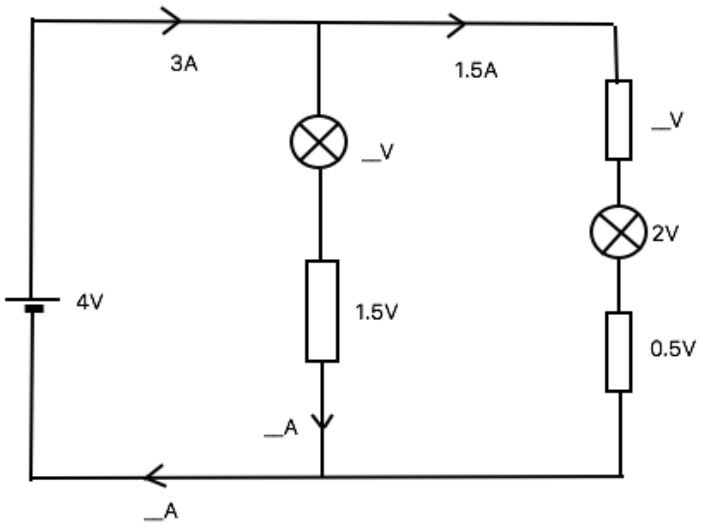


Don't worry about the individual p.d.s here. It is not important whether there is a 2V or a 1V p.d. across a particular component. What is important is that 2 circuit loops are possible and that the voltage supplied by the power supply (5V) is shared out around these 2 circuit loops. i.e. 5V = 2V + 3V for circuit loop 1 and 5V = 1V+ 2V + 2V for circuit loop 2.

As voltage represents the energy carried by charges, rule 3 is a consequence of the conservation of energy. The energy picked up by charges in the power supply is shared out around a circuit loop.

Apply the 3 rules to find the missing currents (_A) and voltages (_V) in the following circuits:

1)



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