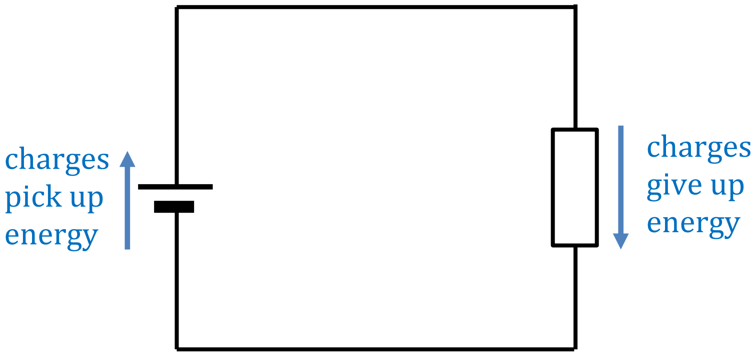
2.3.2 Alternative - voltages in series and parallel circuits using PhET

In a circuit, when charges pass through the power supply (in this case, a cell), they pick up energy. The 'voltage' of the power supply tells you how much energy is picked up for every coulomb of charge that passes. For example, a 12 volt power supply would supply 12 joules of energy for every coulomb of charge that passes.



The formula for voltage is given by:

$$V = \frac{\Delta E}{\Delta Q}$$

where ΔE = the amount energy picked up (in joules) by an amount ΔQ of charge (in coulombs)

The unit for voltage is the volt (V).

(1)✐If 3C of charge flows through a battery with a voltage of 5V, what total energy is transferred to the charges? (Hint: rearrange the equation, above, to get energy.)

When charges pass through a component in the circuit (such as the resistor, in the circuit shown above), they give up some of their energy. The energy given up by every coulomb of charge passing through the component called the potential difference and is given by the formula:

$$p.d. = \frac{\Delta E}{\Delta Q}$$

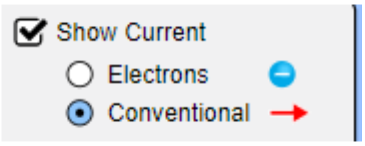
where ΔE = amount of energy given up (in joules) by an amount ΔQ of charge (in coulombs)

The unit for potential difference is the volt (V).

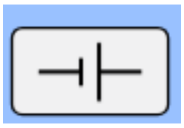
(2)✐Looking at the formula, above, what is an alternative unit for potential difference?

(3)✏10J of energy is given up when 4C of charge flows through a resistor. What is the potential difference across the resistor?

Run the following simulation:
https://tinyurl.com/y4d4uo9l

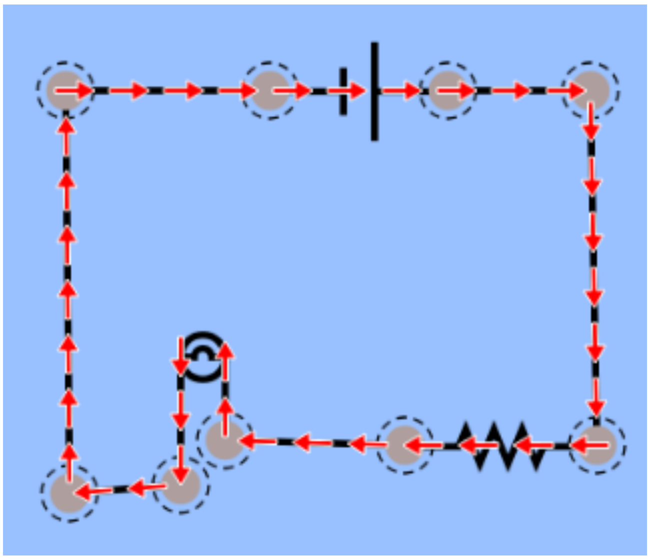


Select conventional current.



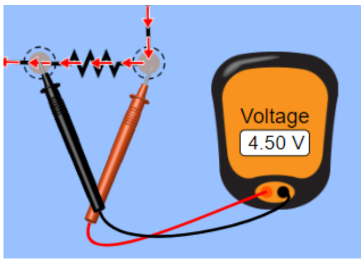
Select circuit symbols. Note that the symbols used (e.g. resistor) in this simulation are slightly different to that used for the GCSE course.

Construct the following circuit:



This is a series circuit consisting of a cell, a resistor and a light bulb. The arrows show the direction of the flow of 'conventional' current. Remember, by convention, that current is the 'rate of flow of positive charge', and so flows from the positive terminal of the cell around to the negative terminal.

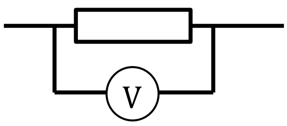
The voltage or potential difference can be measured using a voltmeter. We always measure the voltage across a component, so the probes of the voltmeter touch on either side.



In the diagram, right, the voltmeter is being used to measure the potential difference across the resistor.

If you see a negative reading, you should swap the probes around.

In a circuit diagram it would appear like this:



(4)✎ *In your circuit, measure the voltage of the power supply (V_S), and the potential difference across the resistor ($p.d._r$) and light bulb ($p.d._b$). Record your answers.*

V_S =

$p.d._r$ =

$p.d._b$ =

Now click on the resistor and use the slider to increase the resistance of the resistor.

(5)✎ *Again, measure the voltage of the power supply (V_S), and the potential difference across the resistor ($p.d._r$) and light bulb ($p.d._b$). Record your answers.*

V_S =

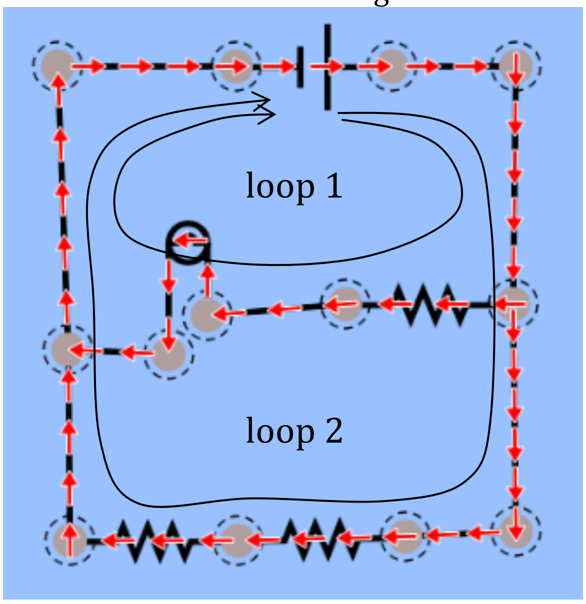
$p.d._r$ =

$p.d._b$ =

(6)✎ *Cross out the incorrect answers in the following statement:*

"In a series circuit the voltage of the power supply equals/is greater than/is less than the sum of p.d.s across components in the circuit."

Now construct the following circuit:



This is a parallel circuit. Note that there are two paths (or loops) for charges to take.

The energy that charges pick up in the power supply is always completely given up by the time they return to the power supply.

This means that the voltage of the power supply is shared out around any circuit loop.

(7)✏Work out the missing p.d.s in the following circuits. Write them in the spaces. (Hint: Trace the different loops charges can take around the circuit and apply the rule.)