

## 2.2 Charge and current

We have seen that charge is a property of protons (positive) and electrons (negative). Charge has the symbol  $Q$ . Charge is measured in coulombs ( $C$ ).

An electron has a charge of  $-1.6 \times 10^{-19} C$ .



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(1) ✎ How many electrons are there in  $-1C$  of charge?

Current is defined as the rate of flow of positive charge. Current has the symbol  $I$  and is measured in amperes ( $A$ ).

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

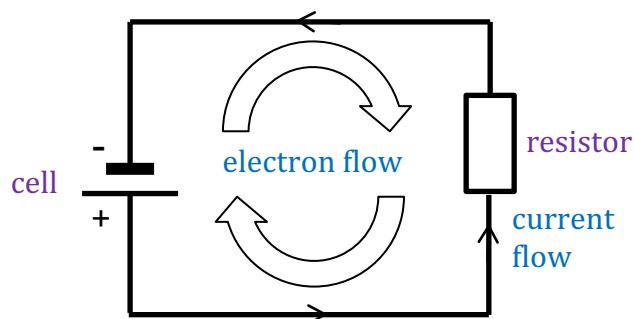
where  $\Delta Q$  = quantity of charge that flows in a time  $\Delta t$

(2) ✎  $5C$  of charge flows past a given point in a circuit in  $0.2$  seconds. What is the current?

(3) ✎ A current of  $0.5A$  flows for  $30$  seconds. What is the total amount of charge that passes?


(4) ✎ A total charge of  $13C$  passes a certain point in a circuit when a current of  $0.03A$  is flowing. How long does the current flow for?


Consider the following simple circuit:




Electrons are flowing in copper wires around the circuit, through a resistor. The cell provides the 'push' to move the charges around. As electrons are negatively


charged, they are attracted to the positive terminal of the cell, and so flow clockwise around the circuit. However, as current is defined as the rate of flow of positive charge, we consider the direction of 'conventional' current to be in the opposite direction to the electron flow (so, anti-clockwise).


(5)  What device do we use to measure current?

(6)  How is this device connected in a circuit? Sketch a circuit diagram to show this.

A useful model for current flow is to think of water flowing through pipes (without leaks!). Water molecules represent charges and current is the amount of water that flows past a point, per second.

(7)  In the water model, what could you use to represent the cell? (Hint: The cell pushes charges around the circuit.)

(8)  In the water model, what could you use to represent the resistor? (Hint: The resistor resists the flow of charges.)

(9)  How would the current compare if you measured it at different locations in the circuit on the first page? Explain your answer. (Hint: Think about current in the water model.)