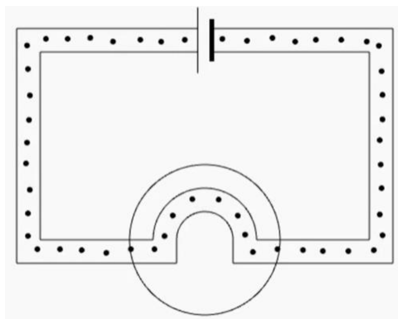
Part 1 – Current as coulombs of charge passing a point each second

- We buy Coca-Cola by the can, not the molecule. For similar reasons, we measure charge by the coulomb (C), not the electron
- To make one coulomb of electric charge we need about 6 billion billion electrons, but electrons and the atoms they come from are so small that there are about ten coulombs of free electrons in every millimetre of copper wire
- In our electric circuit animations we imagine lumping together these billions of free electrons into a single coulomb of charge represented by a black dot

Each black dot represents one coulomb of electric charge

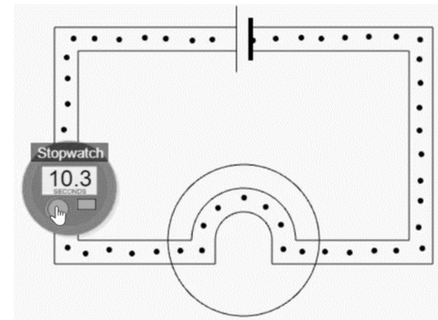


- And it's these single coulombs of electric charge that we imagine moving round the circuit and forming the electric current
- Faster charges mean a bigger current. Slower charges mean a smaller current
- Even though current is related to the speed the charges move at, what's important is the number of coulombs of charge passing a point each second
- If the same amount of charge passes a point in the same time then by definition the currents are the same

Part 2 – Measuring current by timing charges | Equation I = Q / t

- We can calculate current using our simulation by counting the number of charges that pass a point each second
- We'll get a more accurate answer if we count the number of charges that pass a point in, say, 10 seconds and then divide by 10

Measuring current by counting the number of coulombs of charge passing a point in 10 seconds (and then dividing by 10 to get coulombs per second = amperes)

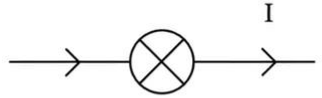


- The unit of current is the ampere (A)
- 1 ampere = 1 coulomb per second
- 1 A = 1 C/s
- 2 A = 2 C/s, etc
- Just like we use the letter m as the symbol for mass and t as the symbol for time, we tend to use a capital Q as the symbol for electric charge (this is because it used to be short for 'quantity of electricity')
- We use a capital I for electric current (because current used to be called electrical ‘intensity’, due to its magnetic effects)
- To calculate current we use the equation $I = Q / t$
- This says the current flowing past a point is equal to the amount of charge flowing past that point divided by the time it took to flow

Part 3 – I = Q / t Example calculation

- To calculate current we use the equation I = Q / t
- This says the current flowing past a point is equal to the amount of charge flowing past that point divided by the time it took to flow
- We can use the acronym ESAU to remind us of the four steps we use to solve a numerical problem - Equation, Substitution, Answer, Unit

6 coulombs of charge flow through the bulb in 30 seconds. Calculate the current flowing through the bulb.



Q = 6 C

t = 30 s

ESAU

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

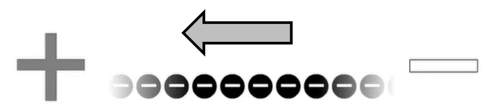
$$I = \frac{6}{30}$$ Substitution

$$I = 0.2\ A$$ Answer, Unit

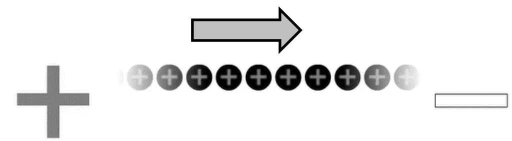
Calculating current when you're given charge and time

Part 4 – Conventional current: Imagining all charges are positive and move from positive to negative

- In wires, the charged things that are flowing - the electrons - are negative
- But in liquids they're negative and positive ions moving in opposite directions
- It turns out that it's easier if we pretend that electric currents always consist of positive charges moving in the sense positive to negative
- This is called 'conventional current'
- When negative charges like electrons or negative ions are flowing, we imagine replacing them with positive charges flowing in the opposite direction
- In electric circuits the charges are already there and they all start moving everywhere at the same time, so it doesn't really matter which way we think they're moving



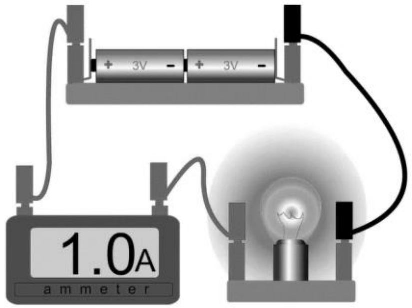
Imagine replacing with



Replacing real negative electrons with imaginary positive charges flowing in the other direction to make conventional current

Part 5 – Using an ammeter: Put it in the way of the current you want to measure

- To measure current in a real circuit we use an ammeter
- We need to break the circuit and put the ammeter in the way so that all the current flows through it
- This is called connecting the ammeter 'in series'
- An ammeter is a bit like a speedometer for charges - the faster the charges, the higher the current
- But it's not the speed of the charges that's most important - it's the amount of charge passing a point each second



Connecting an ammeter so all the current flowing through the bulb has to flow through the ammeter, too