

Electricity

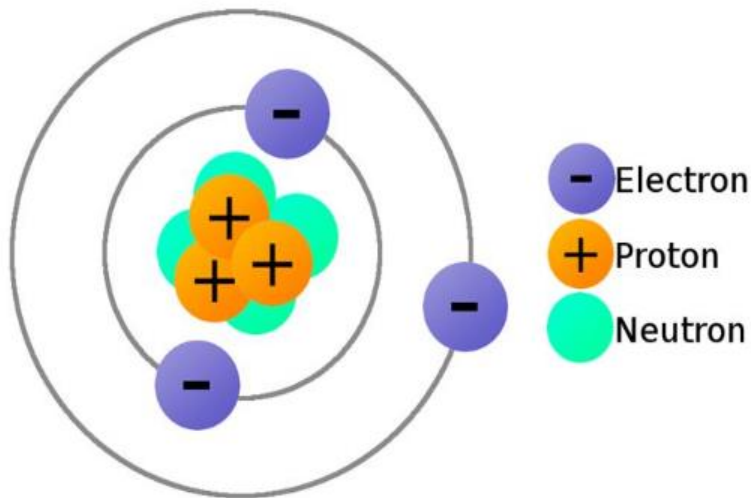
2015 EdExcel A-Level Physics
Topic 3

**Charge and
current**



Electric Charge

- Atoms consists of Negatively-charged electrons and Positively charged protons.
- Atoms have the same number of protons and electrons, they are NEUTRAL overall



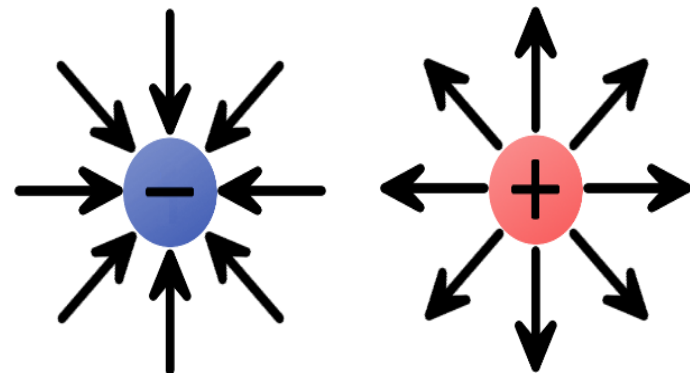
- Properties of charges
- Like charges repel
 - Unlike charges attract

Measuring Charge

The charge on an electron is very small, so we measure charge using units called “Coulombs” (C).

One electron has a charge of 1.6×10^{-19} C.

- Charge can be measured using a coulomb meter, and they usually measure in nano Coloumbs ($1\text{nC} = 10^{-9}$ C)
- Calculate the number of electrons that would make up 1 C of charge



Measuring Charge

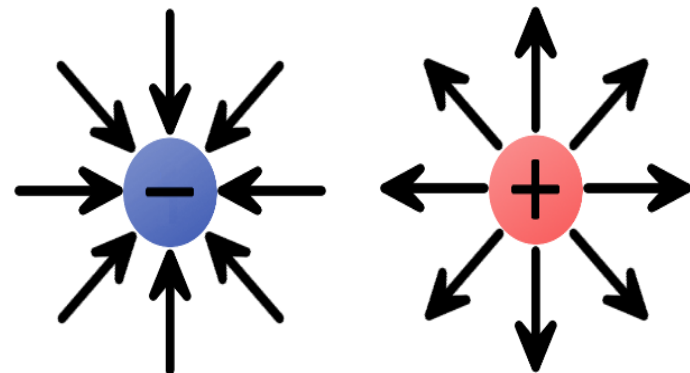
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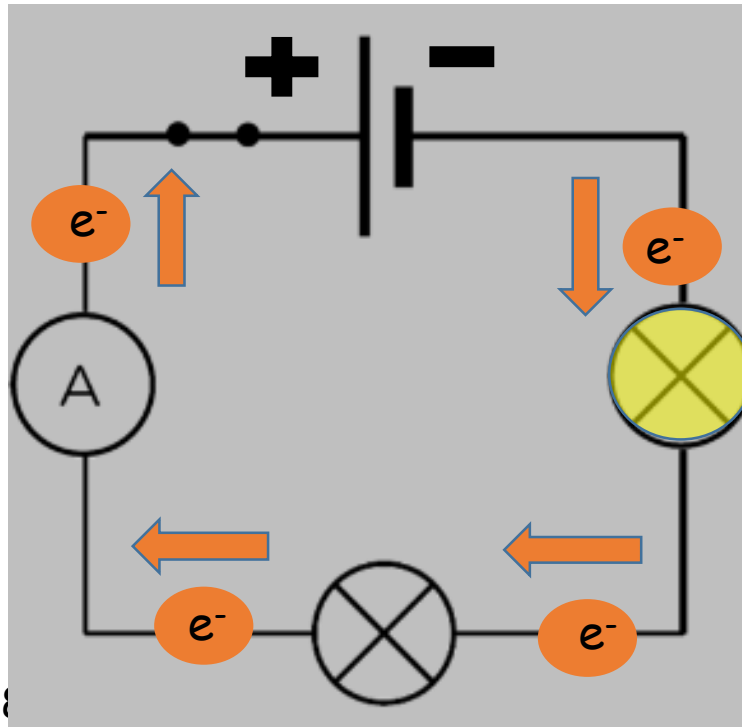
$$= 1 \text{ C} / 1.6 \times 10^{-19} \text{ C}$$

$$= 6.25 \times 10^{18} \text{ electrons}$$



Electric Current

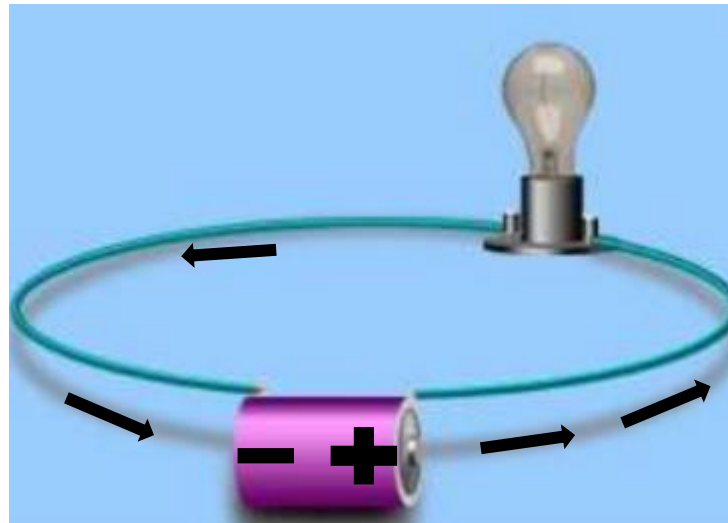
An electric current is the rate of flow of electric charge. This current flows due to electrons moving



Electrons travel away from the negative and towards the positive terminal

Conventional Current

Technically electrons go from negative to positive terminal but, we usually talk about “conventional current” which moves from positive to negative:



Calculating Charge And Current

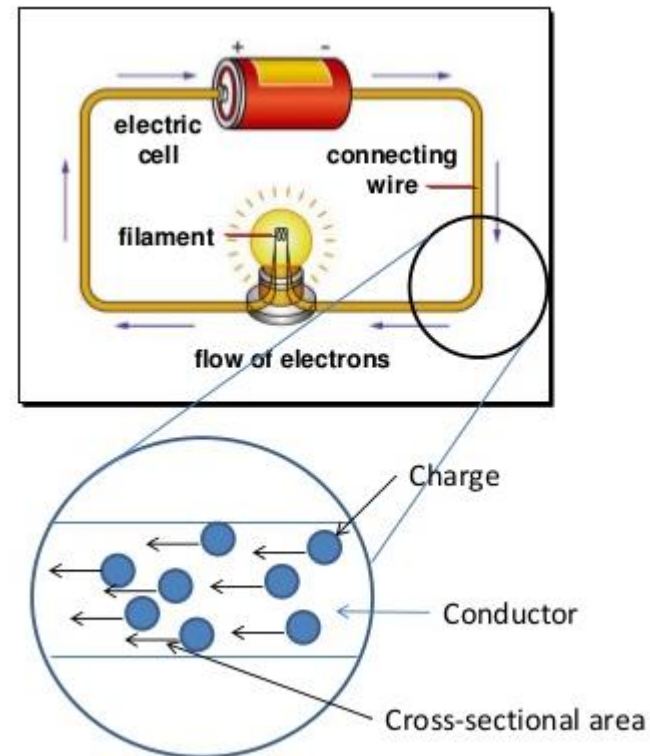
Electric current is the rate of flow of charge. This means, it's how much charge flows per second. One Amp (1 A) is equal to one Coulomb per second (1 Cs⁻¹). Charge and current are related by the equation:

$$\text{Current} = I = \frac{\Delta q}{\Delta t}$$

$I = \text{ampere (A)}$

$\Delta q = \text{coulomb (c)}$

$\Delta t = \text{second (t)}$



Example

1. A battery supplies 5 C over a period of 100 seconds. What is the current?

Formula: $I = \frac{\Delta q}{\Delta t}$

Given Data:

Charge = $\Delta q = 5 \text{ C}$

Time = $\Delta t = 100 \text{ sec}$

Current = $I = ?$

by putting values in formula

$$I = 5/100$$

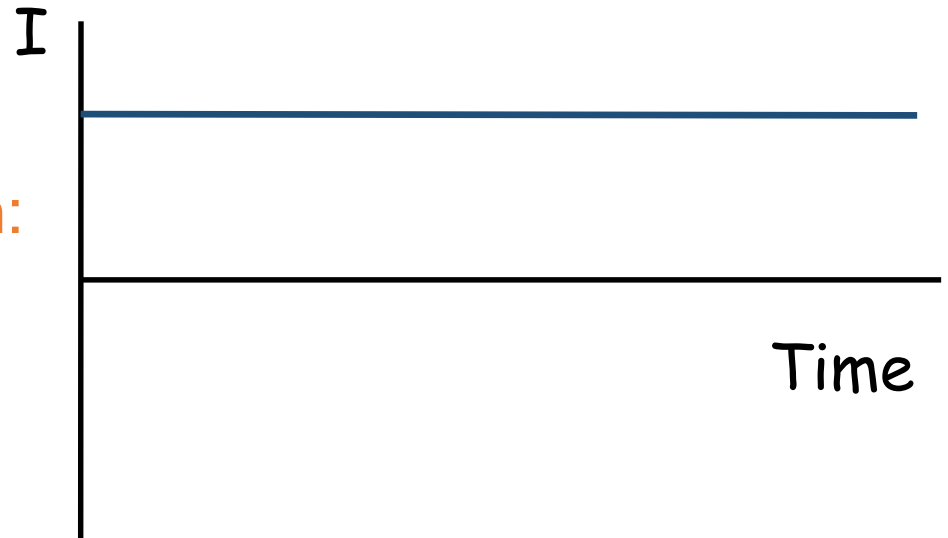
$$I = 0.05 \text{ A}$$

Practice questions

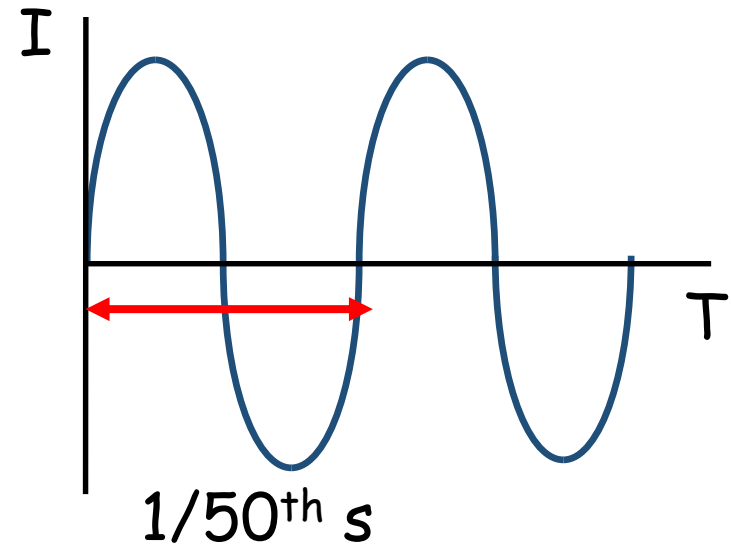
1. If 3 batteries are connected for 2 minutes and together provided a current of 0.6 A. How much charge flowed?
2. If a car battery provides a current of 100A and it has a capacity of 25 Ah (Amp-hours) How much charge does it contain? (In Coulombs). How long can it be used for?

DC and AC revision

DC is Direct Current, current that flows only in one direction:



AC is Alternating Current, the current continually changes direction. For UK main, it changes 50 times every second (frequency = 50Hz)



Revision...

- Electric current is the rate of flow of _____ around a circuit. We use an _____ to measure it and it is measured in _____.
- Potential difference (also called _____) is the energy per unit charge and measures how big the push is on the electrons. We use a _____ to measure it and it is measured in _____.
- Resistance is anything that resists an electric current. It is measured in _____.

Words: volts, amps, ohms, voltage, ammeter, voltmeter, charge

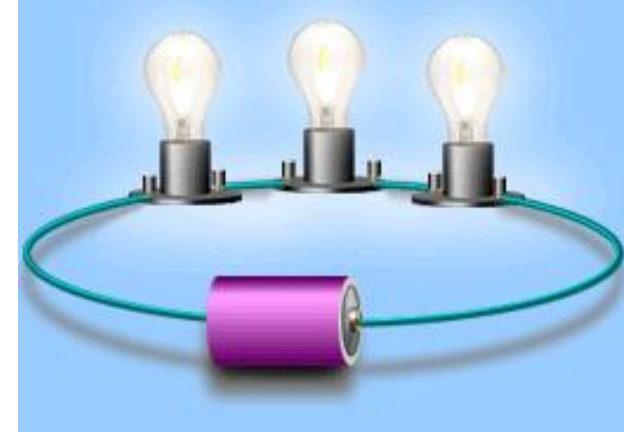
Simple Circuits

Series circuit

All in a row

One path for electricity

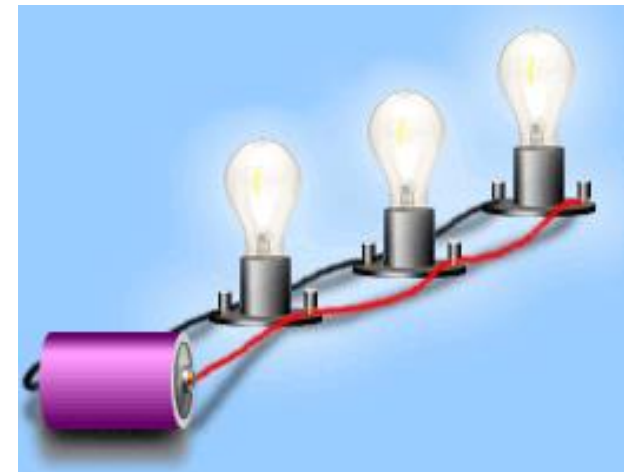
If one light goes out, the circuit is broken



Parallel circuit

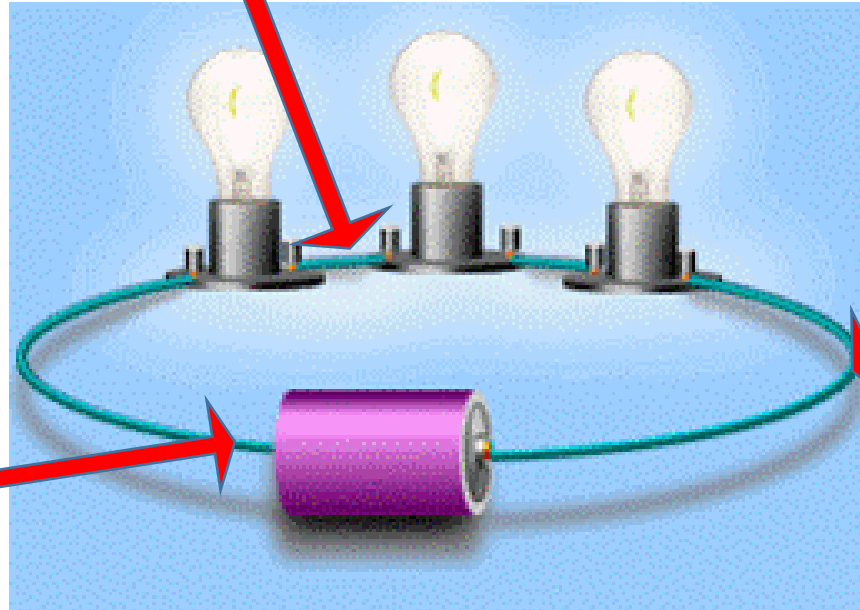
Many paths for electricity

If one light goes out, the others stay on



Current in a Series Circuit

The current here is?



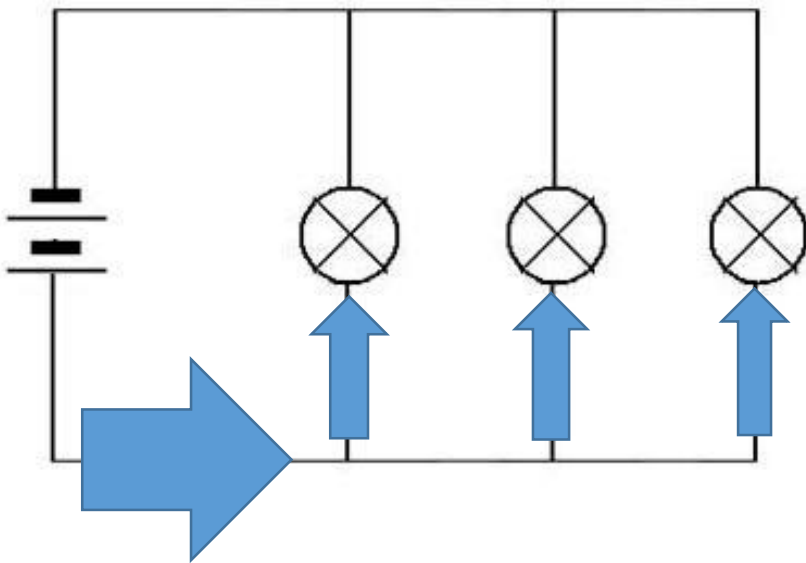
The current here is?

If the current here is 1 A

As the charge in the circuit must be conserved, the current in series circuit is the SAME all the way round.

Current in a parallel circuit

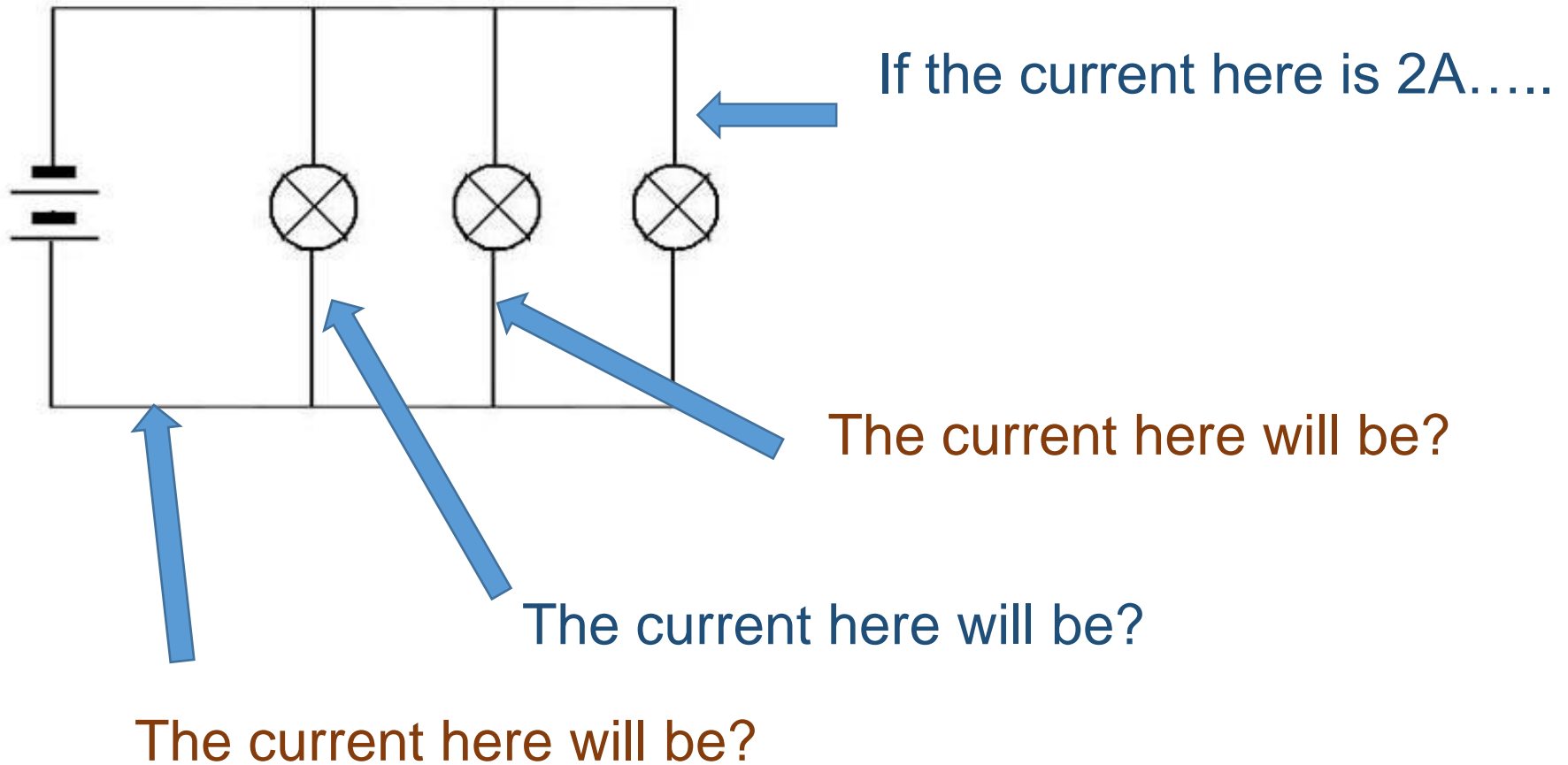
Assume 3 similar bulbs:



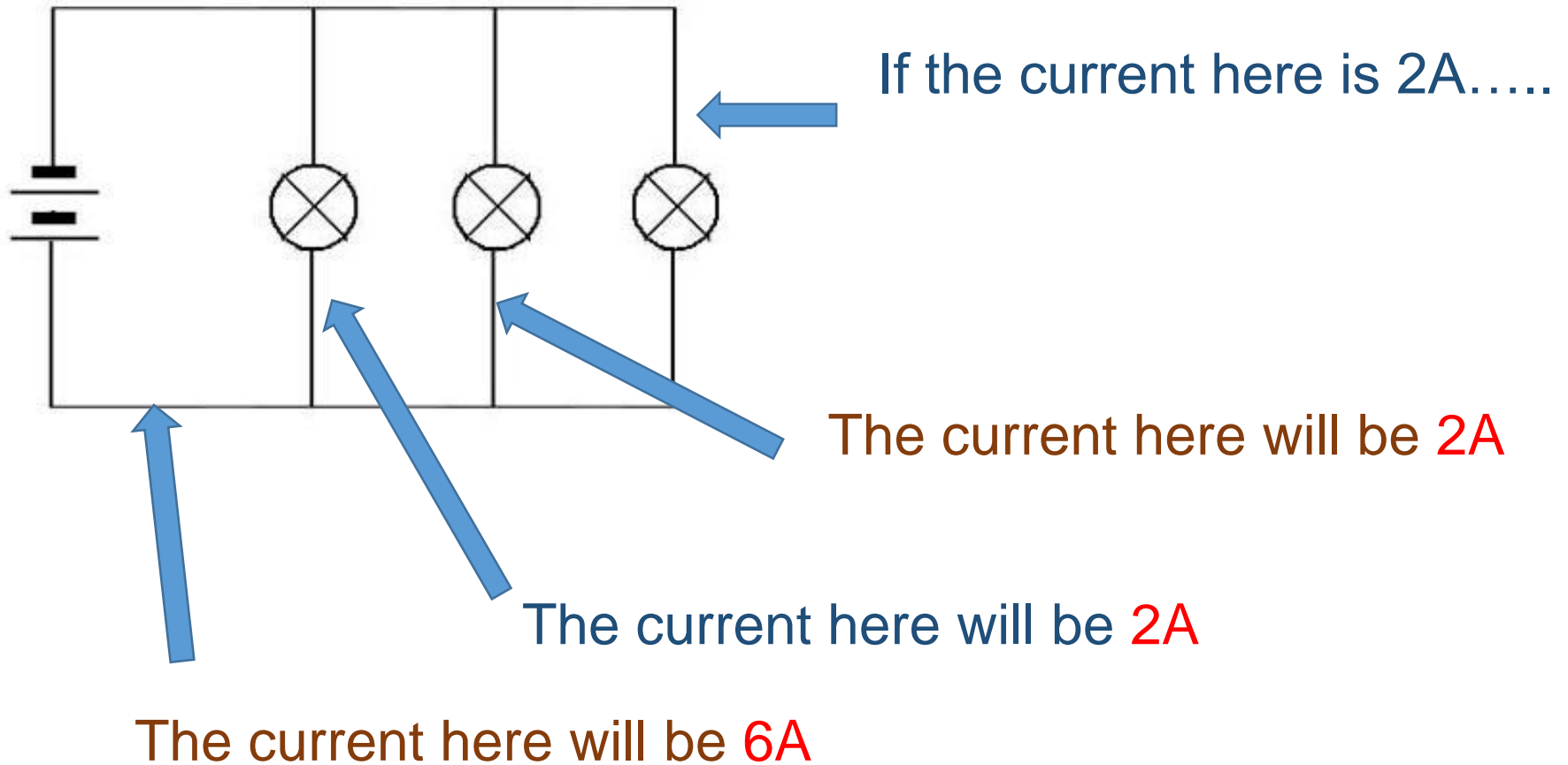
Total circuit
current

$\frac{1}{3}$ of the total current will
go through each bulb

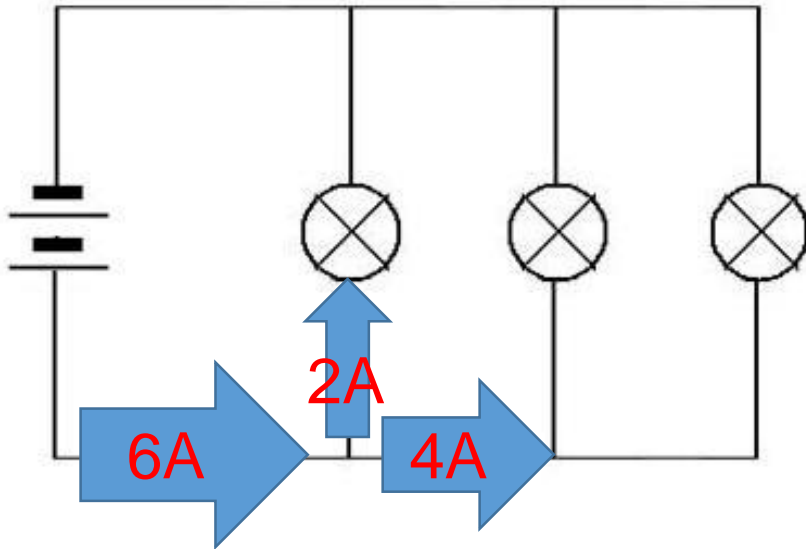
Current in a parallel circuit



Current in a parallel circuit



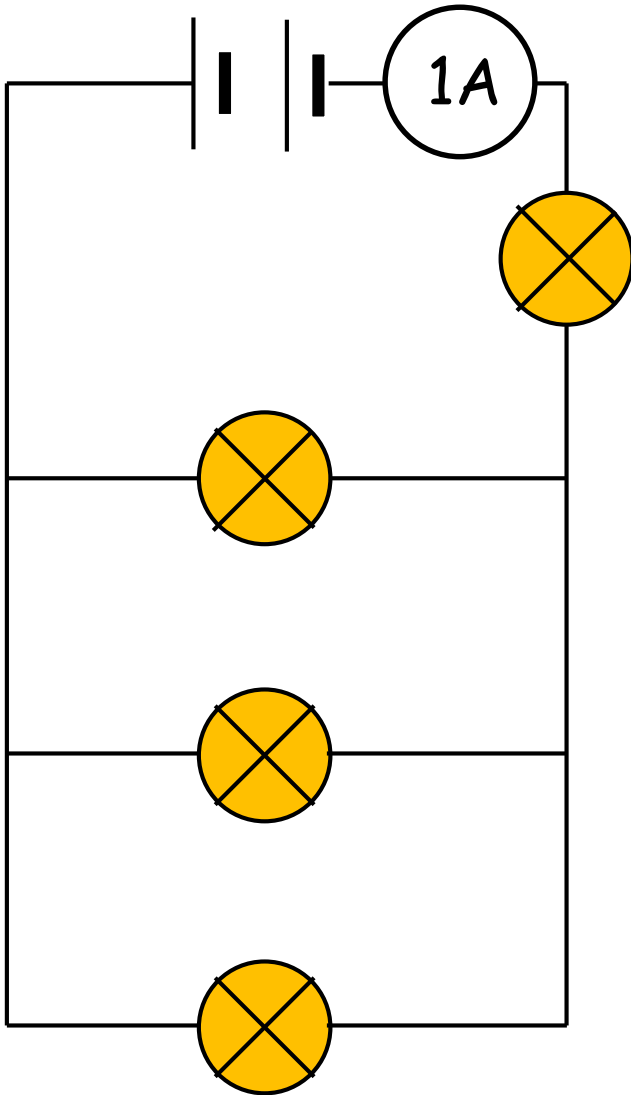
Current rule for parallel



"The current into a junction equals the current leaving the junction"

$$6A = 2A + 4A$$

Example question



What current flows through each bulb?