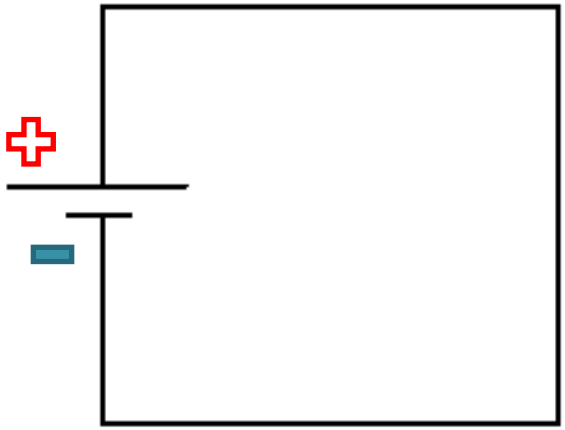
Current

What is Current?

Current is the **flow of electrons** through a circuit.

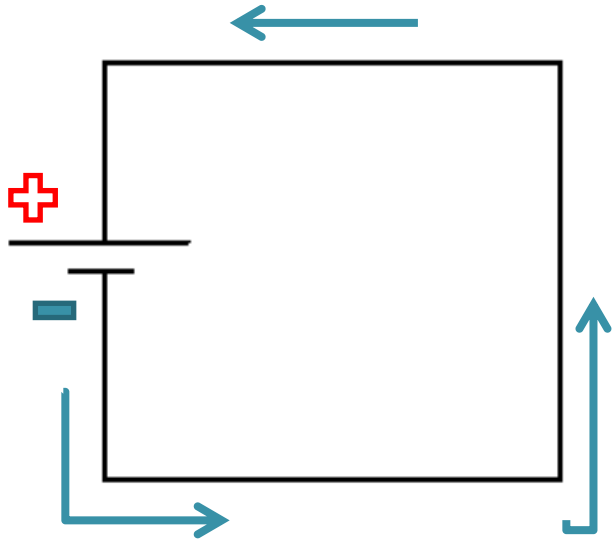
Why do Electrons Move?

- An electrochemical cell (battery) uses chemical reactions to move electrons. This creates a "potential difference" between the ends of the battery.
  - Positive terminal is positively charged
  - Negative terminal is negatively charged and has an excess of **electrons**

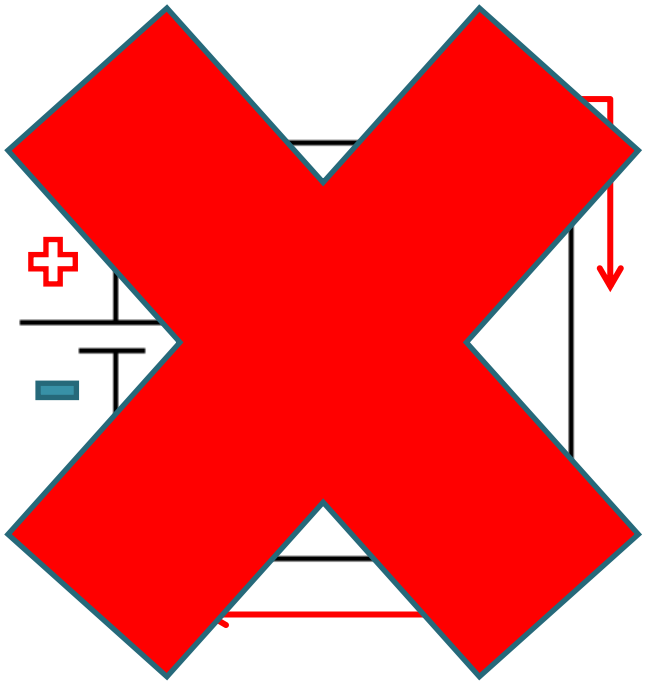


Why do Electrons Move?

- When a circuit connects the two ends of the cell, current flows through the wire.
  - Electrons are repelled by the **negative** terminal and are attracted by the **positive** terminal.
  - Electrons cannot move through **air (insulator)** but they can definitely move through a **wire (conductor)**!

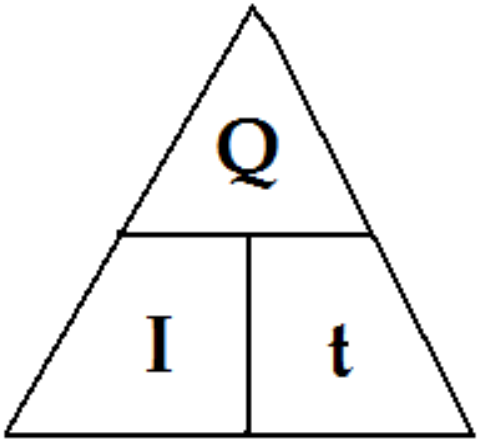


- When scientists discovered electric current, they assumed that positive charges were moving.
- This is called conventional current
  - defined as the direction positive charges move in a circuit
  - from positive to negative
  - we now know this isn't the way it actually works.



Calculating Current

Current is the amount of charge that passes a point in a circuit every second:



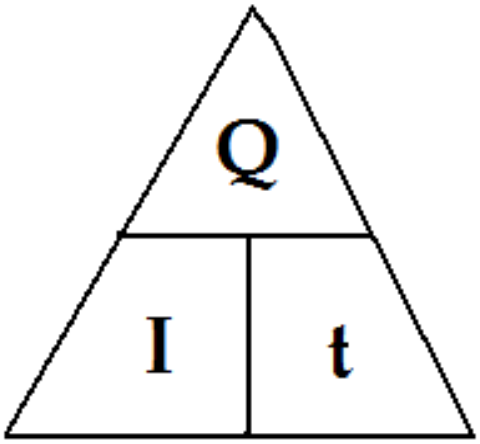
$$I = \frac{Q}{t}$$

I: is the symbol for **current**, measured in **amperes** (A)

Q: is the symbol for **charge**, measured in **coulombs** (C)

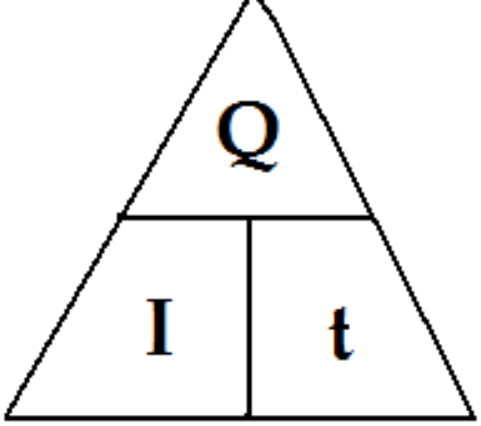
t: is **time**, measured in **seconds (s)**

Example #1



What is the current in a wire if 25 C of charge passes by a point in 5 seconds?

$$I = \frac{Q}{t} = \frac{25C}{5s} = \boxed{5A}$$



Example #2

If the current in a wire is measured to be 12 A, how much charge passes by a point in the circuit every minute?

$$Q = I \times t$$

$$= 12A \times 60s$$

$$= \boxed{720C}$$

Example #3

A current of 64 mA is equivalent to _____ A.

$$64\ \text{mA} \times \frac{1A}{1000mA} = 0.064\ \text{A}$$

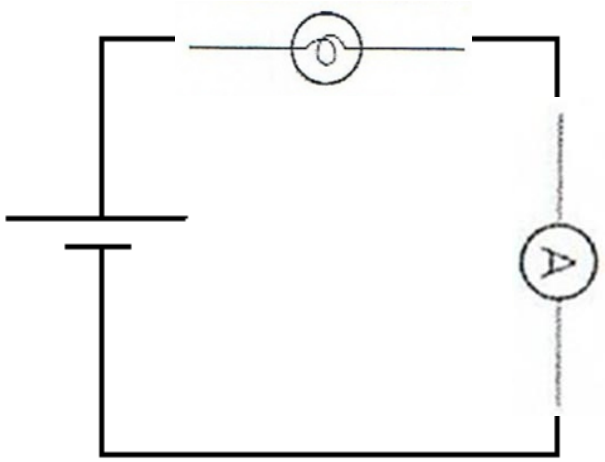
Example #4

A current of 0.0028 A is equivalent to _____ mA.

$$64\ \text{mA} \times \frac{1A}{1000mA} = \boxed{0.064\ \text{A}}$$

- Current is measured by a device called an **ammeter**.

- Typical amounts of current:
  - In a light bulb is 1A
  - In a TV is 4A
  - In a car starter is 500 A

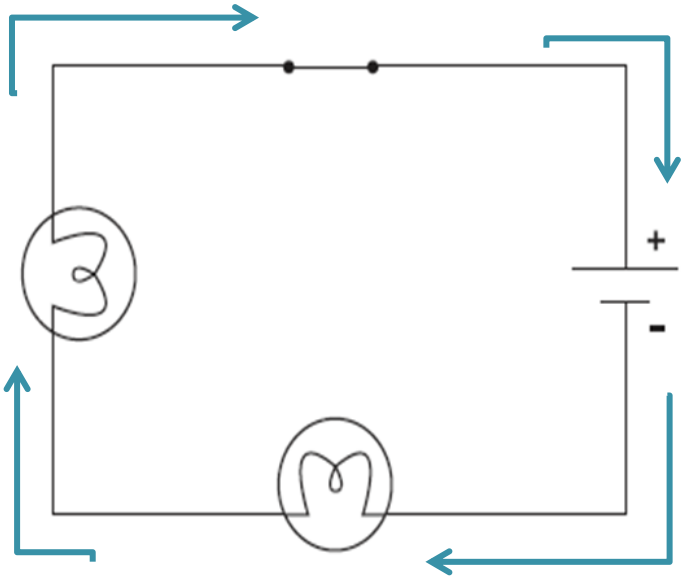


Series vs. Parallel

In a circuit, devices (such as light bulbs or batteries) can be placed in two different ways.

1. **SERIES**

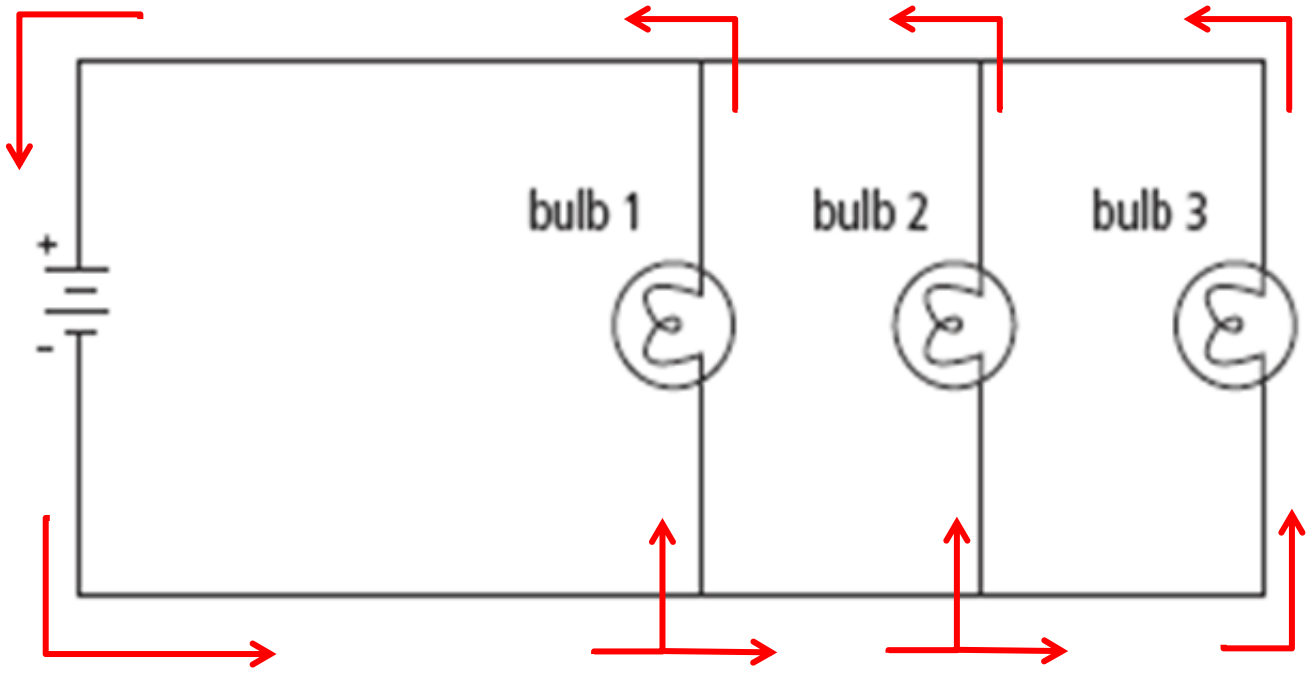
- When devices are placed in series, the current goes through a **single path** through all devices.
- In this circuit, there is only **one path** and the **current** goes through the two light bulbs in the series.



2. **PARALLEL**

- When devices are placed in parallel, there are 2 or **more paths** that the current can take

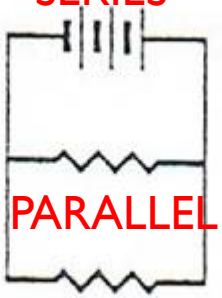
- Current **splits**: some electrons go through one device, and some go through the other(s).



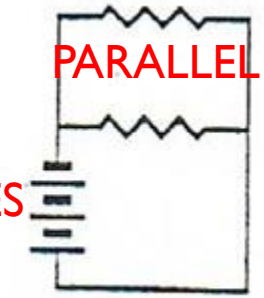
- Decide whether each circuit is **S**eries, **P**arallel, or a **C**ombination of the two.

A.

B. SERIES



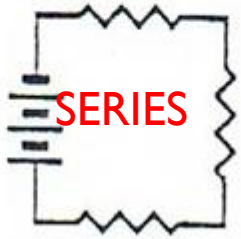
C.



D.

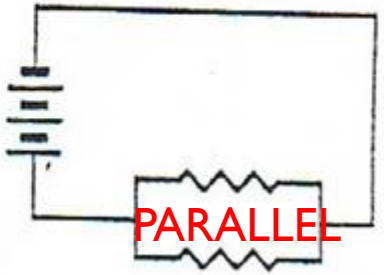
PARALLEL

E.



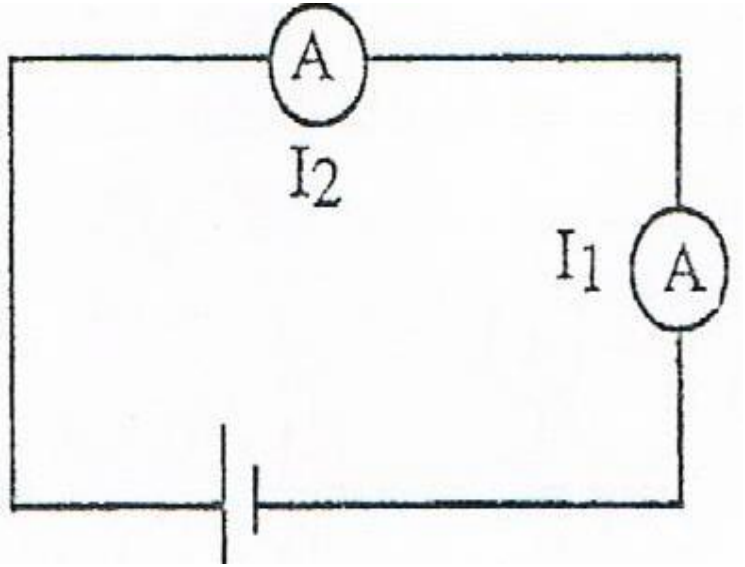
F.

SERIES



Calculating Current in SERIES

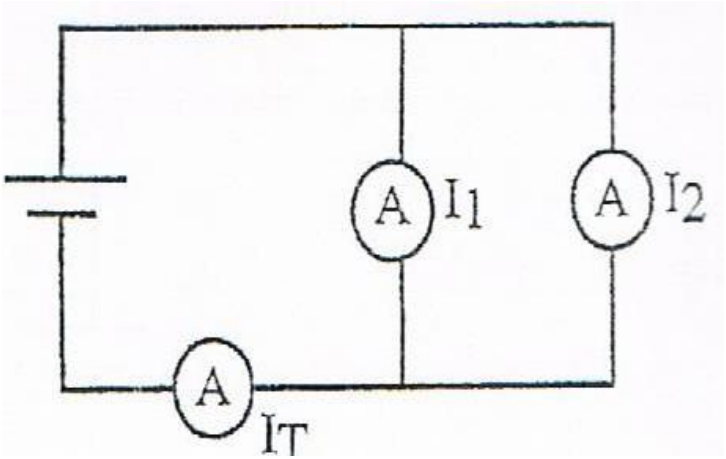
- **Current** (I)
  - Measured in Amperes (A)
  - When you place an Ammeter in SERIES the current **stays the same**
- Series: $I_{Total} = I_1 = I_2$



Calculating Current in PARALLEL

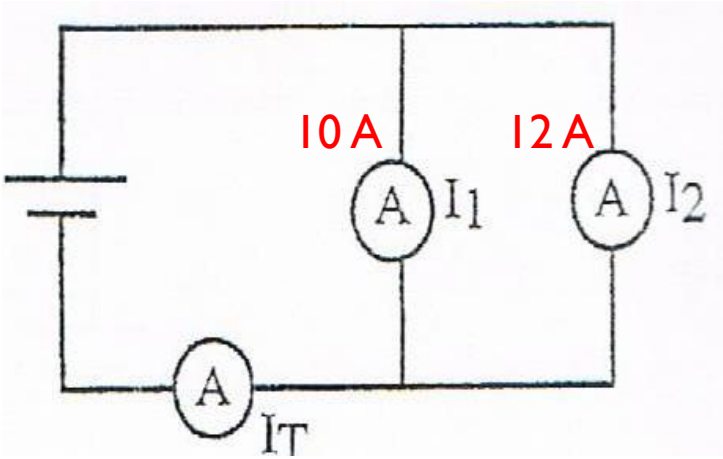
- **Current** (I)
  - Measured in Amperes (A)
  - When you place an Ammeter in PARALLEL, you **add** the current to find a total.
- Parallel:

$$I_{Total} = I_1 + I_2 + \ldots$$



Example #4

Find the total current for the following circuit.



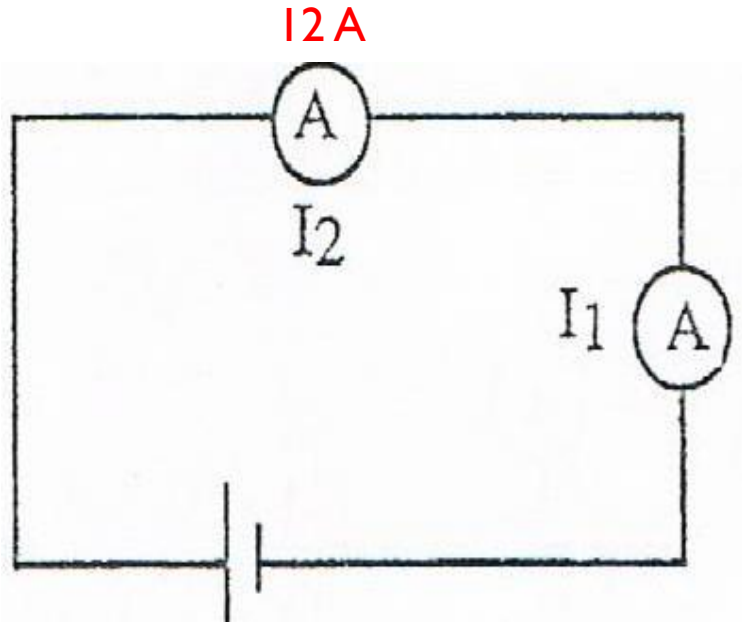
$$I_{Total} = I_1 + I_2$$

$$= 10\ A + 12\ A$$

$$= \boxed{22\ A}$$

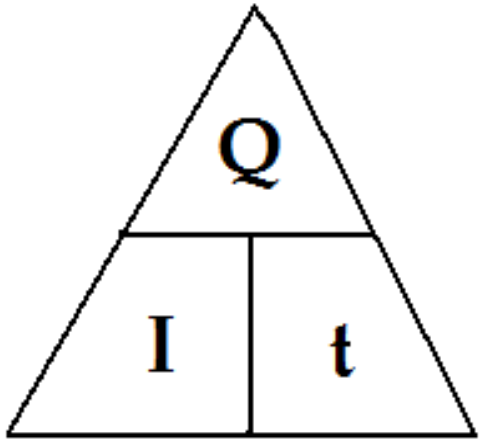
Example #5

Find the total current for the following circuit.



$$I_{Total} = I_2 = I_1 = \boxed{12A}$$

Example #6



How long does it take 40 C of charge to pass by a point if the current in the circuit is 0.76 A ?

$$t = \frac{Q}{I} = \frac{40C}{0.76A} = \boxed{52.6s}$$