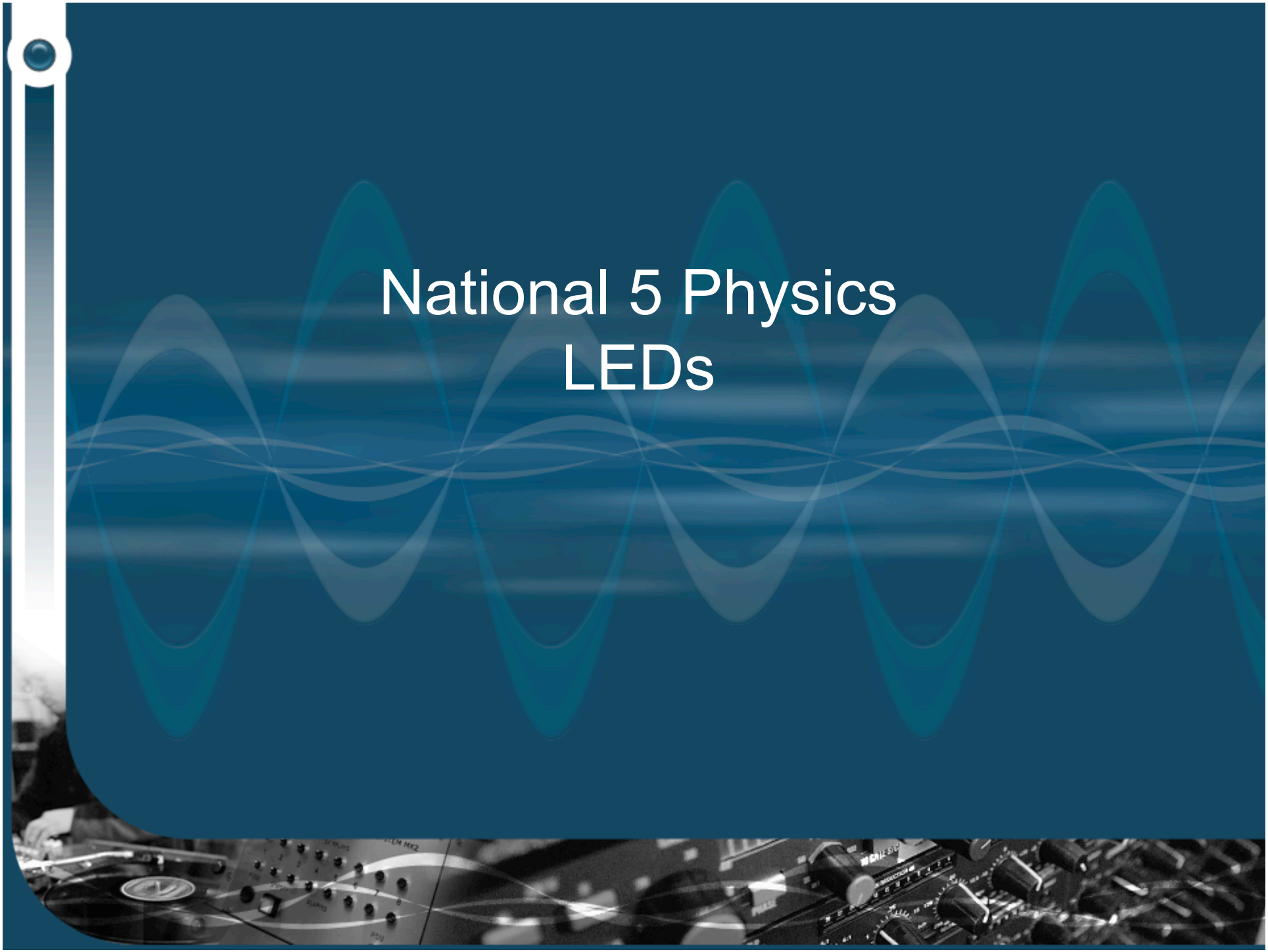
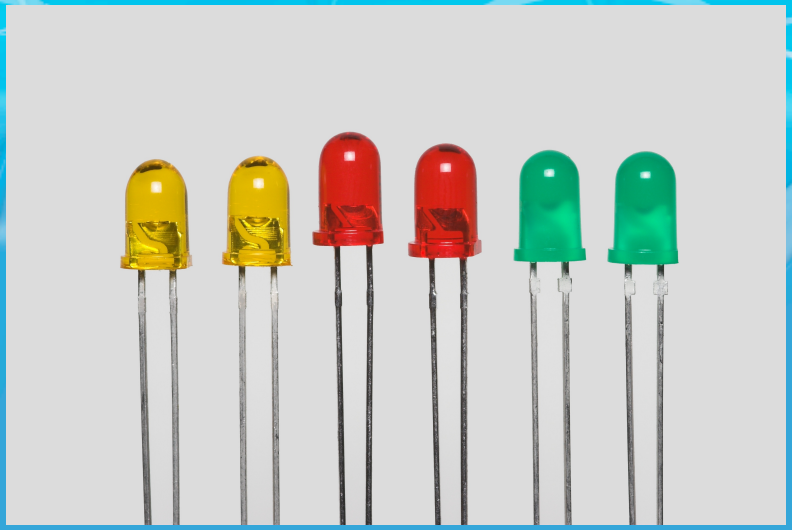
National 5 Physics
LEDs



Some output devices convert electrical energy into light energy

Bulbs

Light emitting diodes (LEDs)

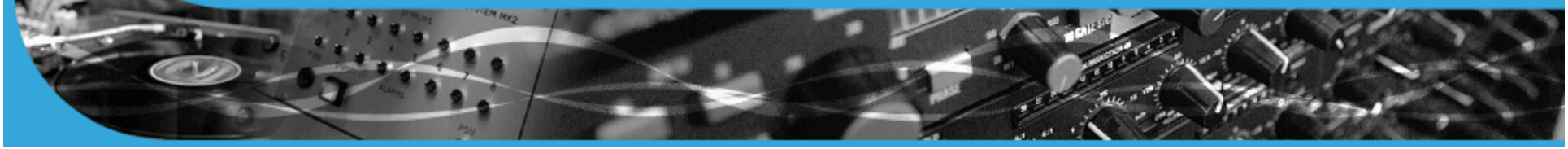


Experiment

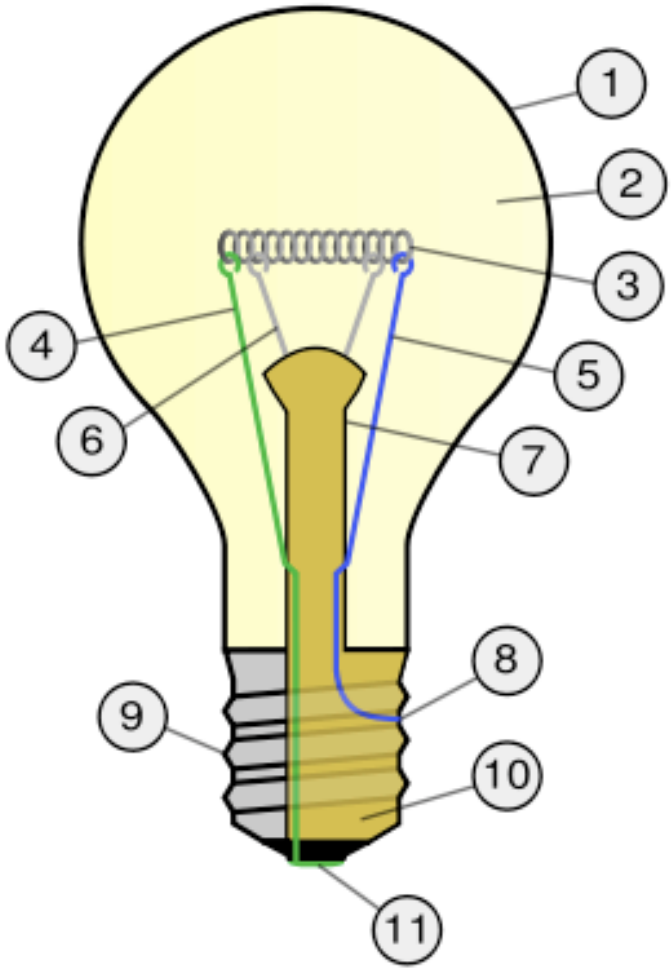
Comparing bulbs and LEDs.

1. Wire up a bulb and LED separately.
2. Measure the current flowing in each device.
3. What happens when the voltage is changed?
4. What happens when the connections are reversed?
5. Examine the bulb and LED with a magnifying glass.

In your jotter:
Answer questions 3 & 4.
Write down any differences you notice between the bulb and LED, e.g. shape, light, size.



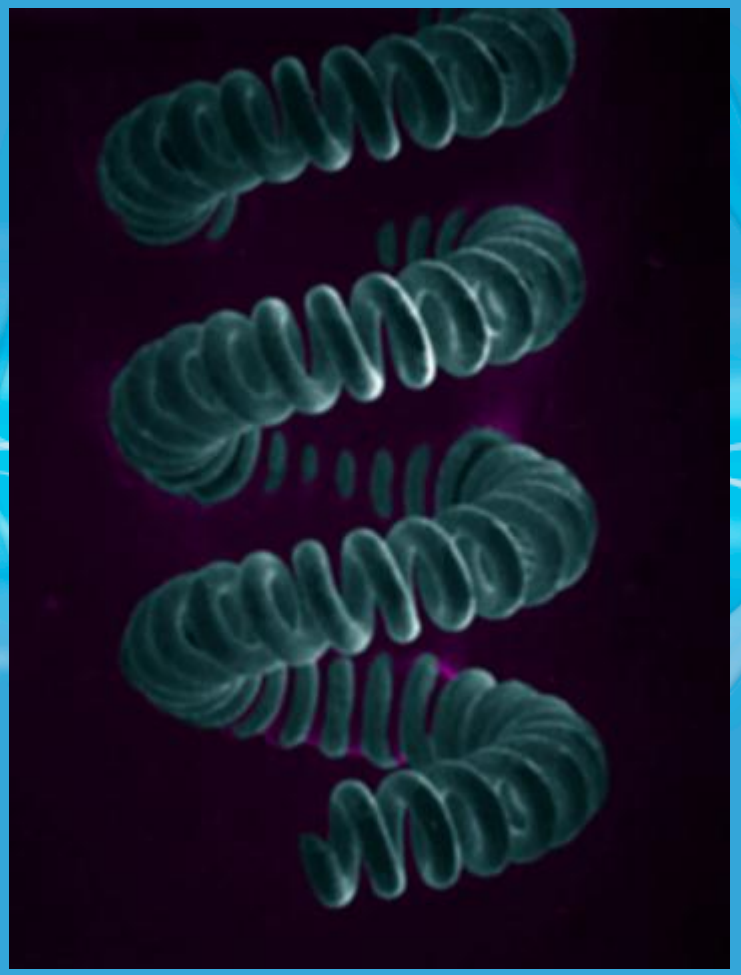
Filament Light Bulb



1. Glass bulb
2. Inert gas
3. Tungsten filament
4. Contact wire (goes to foot)
5. Contact wire (goes to base)
6. Support wires
7. Glass mount/support
8. Base contact wire
9. Screw threads
10. Insulation
11. Electrical foot contact

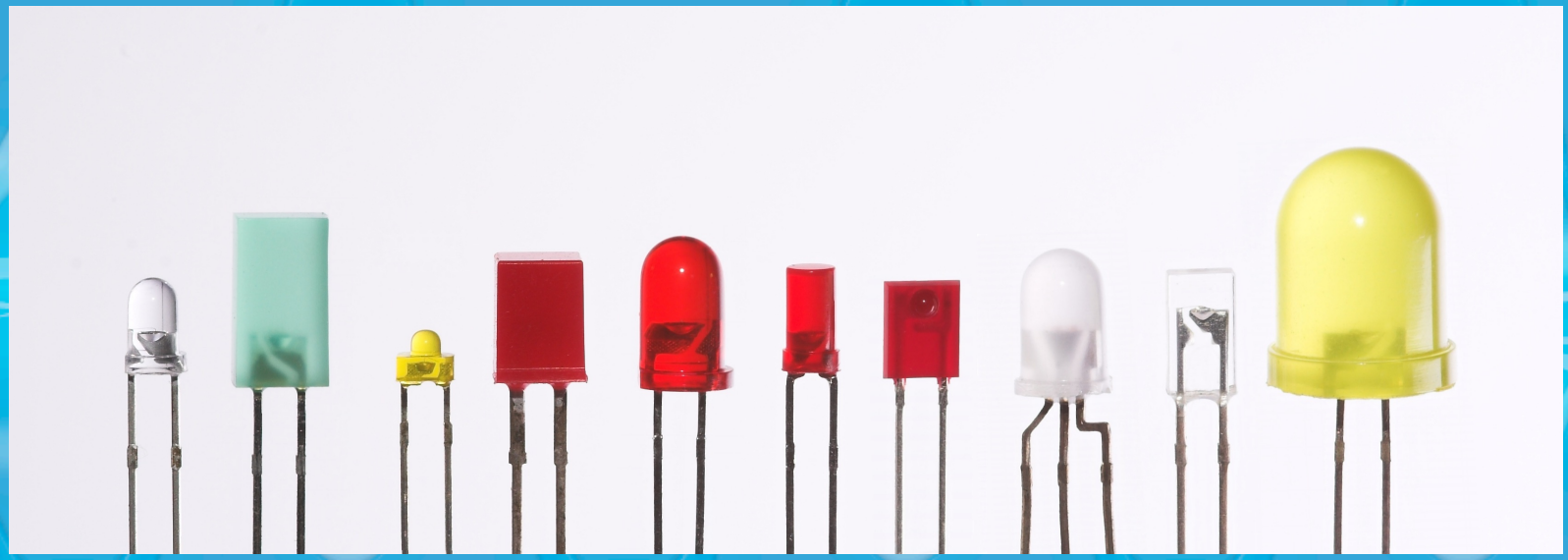
The Filament

This is an electron microscope image of the filament of a 60W bulb.



LEDs

LEDs are available in different shapes and sizes.



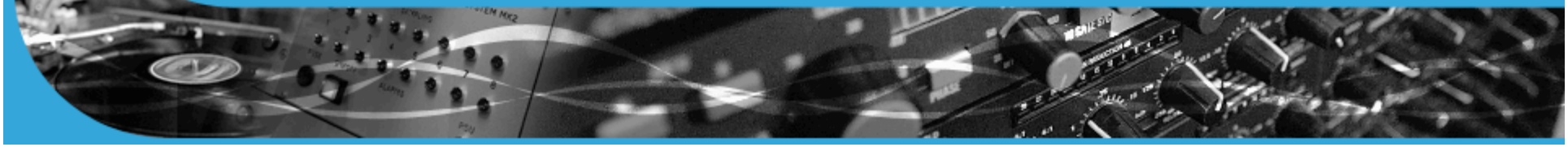
Comparison

Filament lamps

- Electric current is used to heat a filament until it emits light
- Light becomes brighter when current is increased
- No change when connections are reversed
- Can provide an analogue or digital output

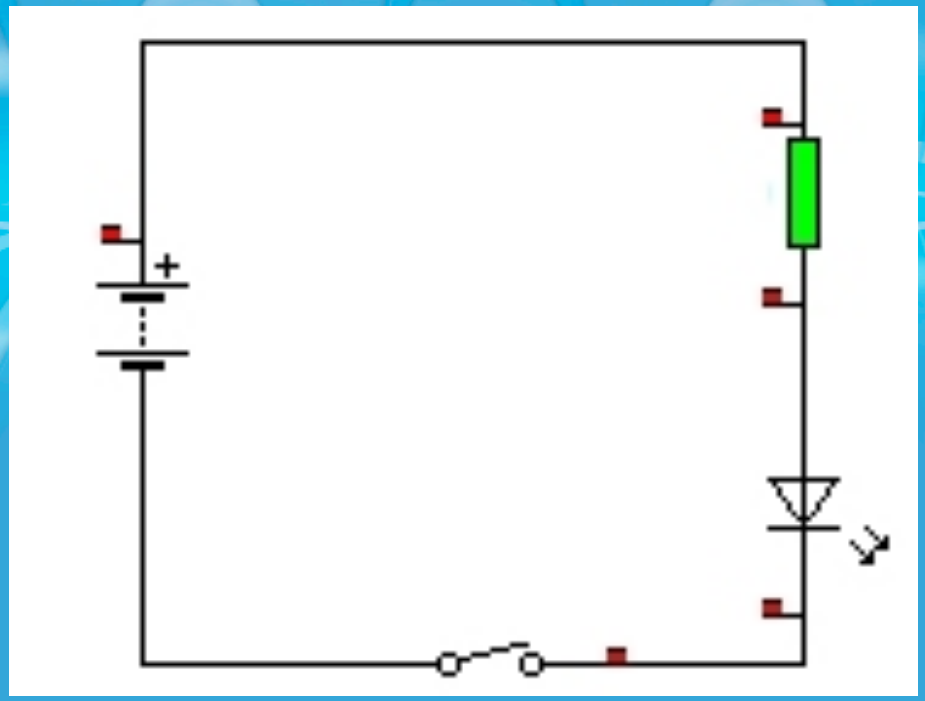
LEDs

- Only a small current is required
- LED does not get hot
- Brightness can't be increased very much
- Does not work when connections are reversed
- Usually used as a digital output device



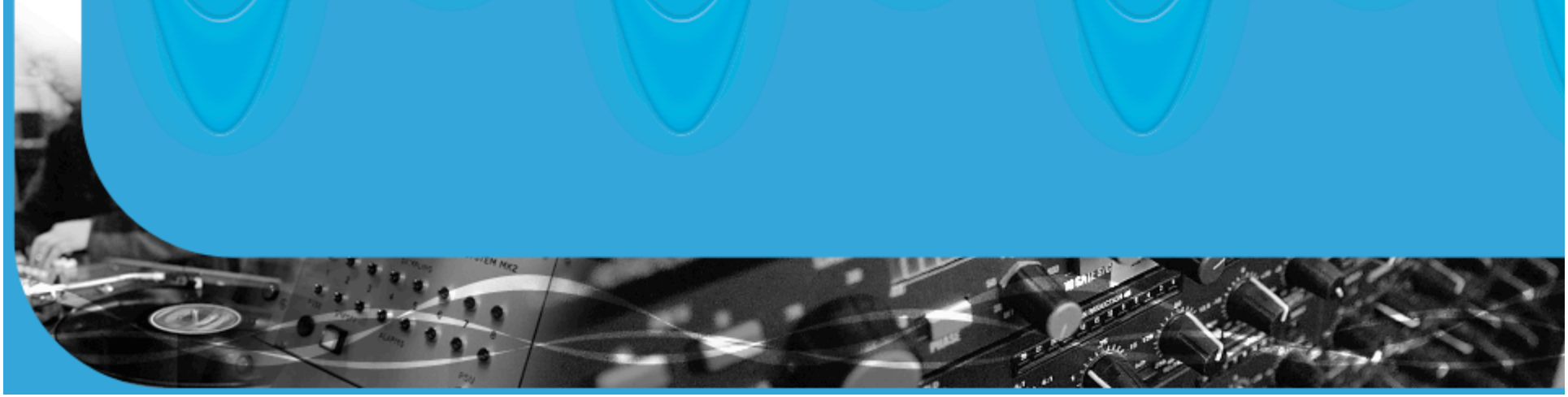
The problem with LEDs

LEDs require a series resistor to protect them from large currents that can cause damage.

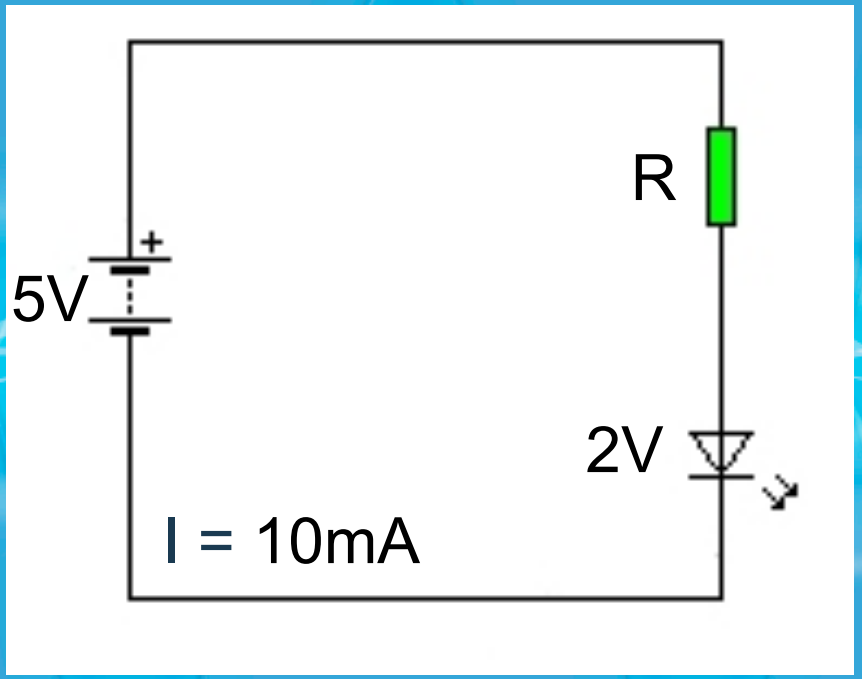


LED manufacturers provide information on the maximum safe operating voltage and current.

We can use this information to calculate the size of the series resistor.



How to calculate the series resistance

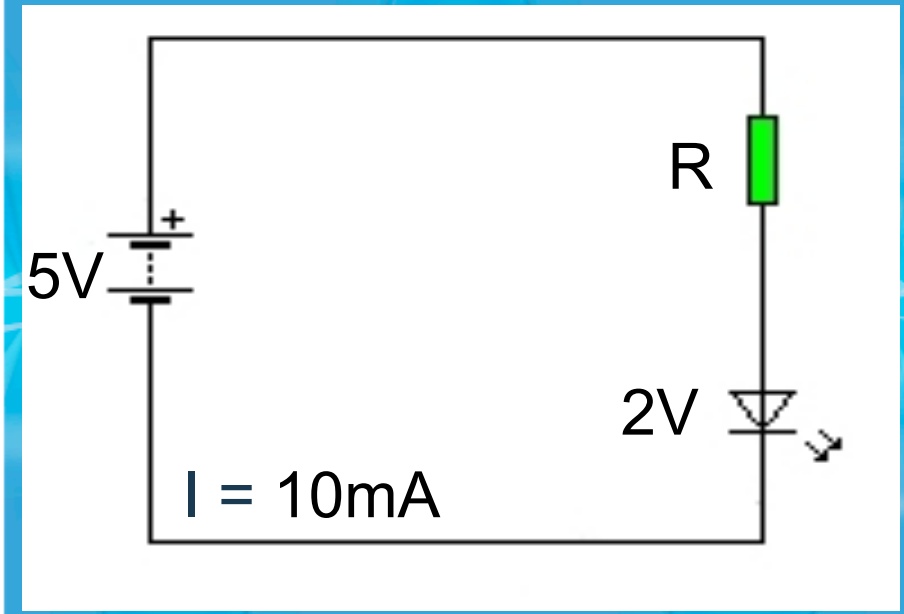


Example:

A manufacturer says the voltage drop across the LED must not exceed 2V and the maximum current allowed is 10 mA.

Calculation

First find V_R



$$V_{supply} = V_{LED} + V_R$$

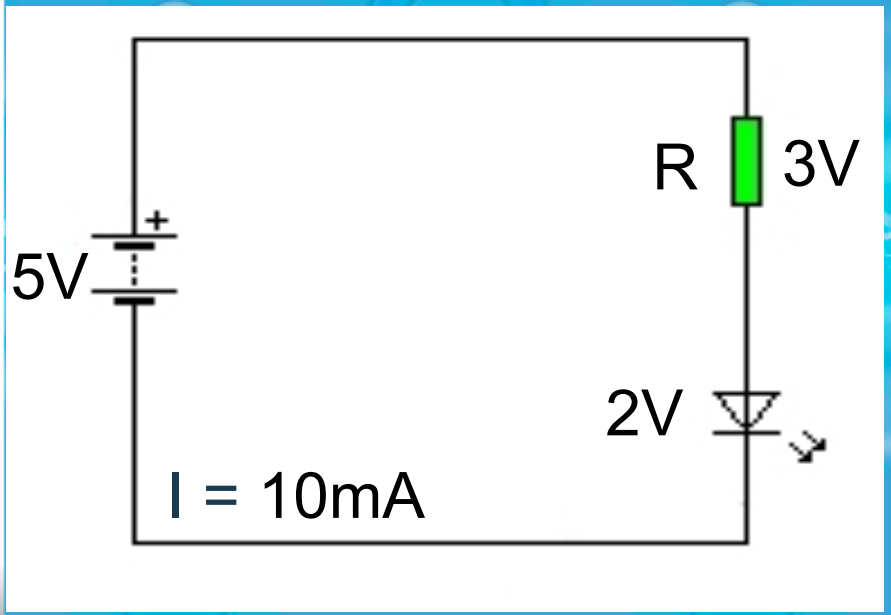
so

$$V_R = V_{supply} - V_{LED}$$

$$V_R = 5V - 2V$$

$$= 3V$$

Use **Ohm's Law** to find R



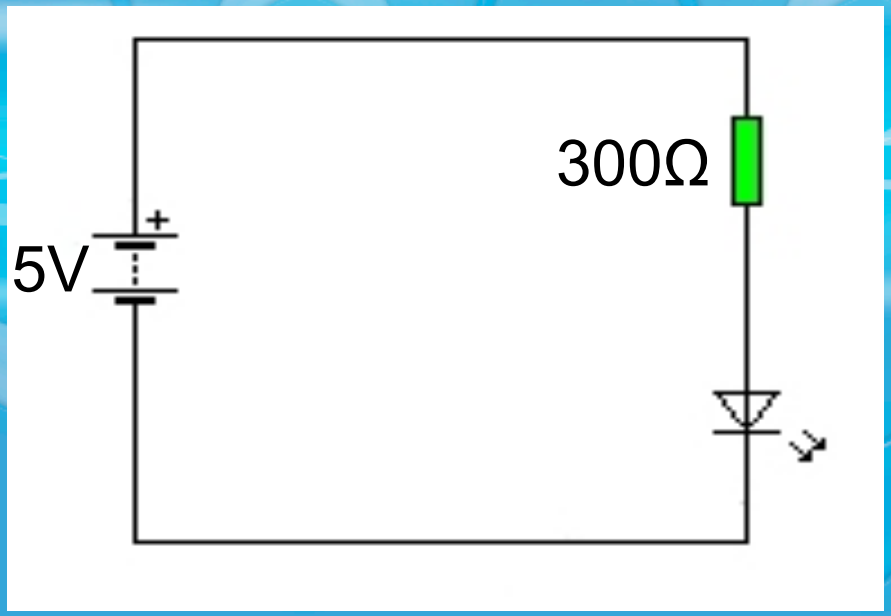
$$R = \frac{V_R}{\text{maximum current}}$$

$$= \frac{3V}{0.01A}$$

$$= 300\Omega$$

Solution

So our final LED circuit would look like this.

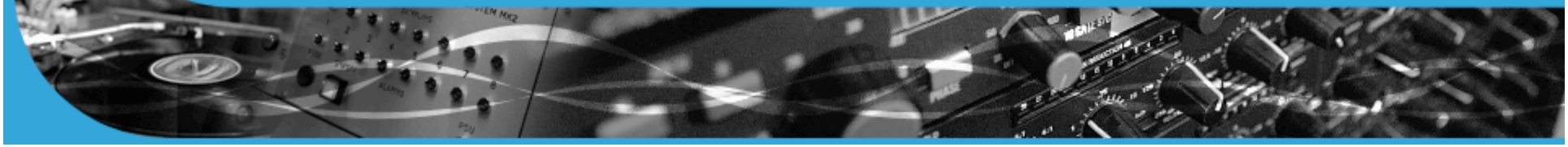


Try these examples.

1. An LED takes 10mA and 1.5V to work correctly.

(a)What value of series resistor is required if a 6V battery is used?

(b) Draw a circuit diagram showing how the resistor, LED and battery are connected.



Try these examples.

2. An LED requires 0.01A and 3.2V to work correctly.

(a)What protective resistor is required with a 9V supply?

(b) Calculate the resistance of the LED.