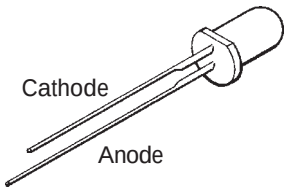
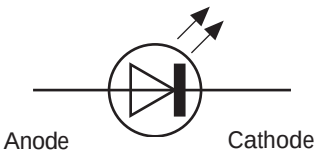
INVESTIGATING THE LED

An LED is made from a semiconductor material, gallium arsenide phosphide, which emits light when a current of between 5 and 20 mA passes through it. Because the LED is a diode, it can only pass current in one direction - when it is forward biased. The LED emits no light when it is reverse biased. This is important as it means the anode must be connected to the positive side of the power supply to operate correctly. (An LED may be damaged if reverse biased.)



When a positive voltage is applied to the anode, the LED lights up. An external resistor **R** has to be connected in series with an LED to limit the current **I** through it to about 10 mA. The value of this resistance can be calculated from the formula:



$$R = \frac{V - V_f}{I}$$

The voltage dropped across the LED is typically 2 V.
So, for a supply voltage of V = 9 V,

$$R = \frac{9 - 2}{10 \times 10^{-3}} \qquad \left(\begin{array}{l} 10\ \text{mA} = 0.010\ \text{A} \\ = 10 \times 10^{-3}\ \text{A} \end{array} \right)$$

$= 700\ \Omega$

Choosing the nearest preferred value gives R = 680 Ω

Q1 The table below is the information given in a catalogue for a standard LED. Work out the value of the resistor needed if it is to be used with a 15 V power supply.

Technical specification (at 25 °C)

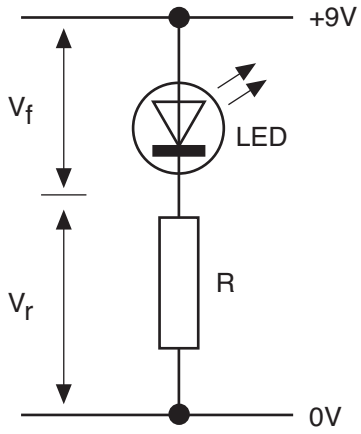
I_f max. mA	I_f typ. mA	V_f at I_f typ. V
30	10	2

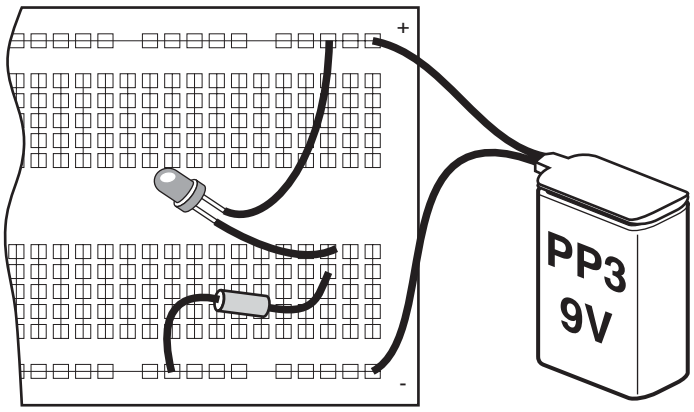
I_f max. = maximum forward current.
I_f typ. = typical forward current.

V_f = forward voltage across the LED.

INVESTIGATING AN LED USING A PROTOTYPING BOARD

Set up the circuit below on the prototyping board as shown. The flat side of the LED is nearest to the cathode and the longer leg shows the anode position.





Use a multimeter on the DC 10 V range to measure the voltage V_f across the LED, V_r the voltage across the resistance R, and V the voltage across the combination.

Q1 What is the sum of V_f and V_r?

Switch the multimeter to the DC 50 mA range and measure the current I_f through the LED. You will have to connect the multimeter between the LED and the resistance.

Draw a table as shown.

V	R	I_f	V_r	V_f

Use three other different values of resistance (>390Ω) and enter these results in the table.

Q2 What happens to the current I as the value of R increases?