Speaker one

Have you ever wondered how some of our devices can charge so quickly?

Understanding the characteristics of electrical components is crucial to designing devices that can charge our phones safely and speedily.

Speaker two

Well, we can understand the behavior of components through their current-voltage or I-V characteristics. These are usually displayed as a graph.

Speaker one

There are three components that we need to generate I-V characteristics for.

These are: a resistor, a filament bulb and a diode.

For this experiment you will need the following equipment.

Pause the video to take a closer look.

These components may get hot while you're using them so switch off the circuit when not taking readings to avoid injury and limit the current to the lamp. First we're going to build a circuit to test the resistor. We'll follow the circuit diagram carefully starting from the positive side

of the battery. Once complete, we'll add the voltmeter.

Speaker two

Okay, remember that an ammeter is always connected in series in a circuit.

This measures the current. However, a voltmeter should always be connected in parallel

because this measures the potential difference across the component being tested.

Speaker one

By changing the resistance of the variable resistor, we vary the potential difference supplied to our component.

Let's start with a value of zero ohms. We can then take our first voltmeter and ammeter readings, which we will add to our table of results.

Speaker two

We'll then alter our variable resistor

setting four more times, which will give us 4 additional values of potential difference and current.

Speaker one

An I-V characteristic curve should also include negative values.

This is where the potential difference is supplied to the components in the opposite direction.We just need to swap over connections to the battery and repeat the entire experiment.

Speaker two

We can now plot our I-V characteristic graph. We're plotting potential difference on the x-axis and current on the y-axis. Finally, we can test our other components.

Simply disconnect the resistor and replace with the next component to be tested.

Speaker one

So now we'll test our final component,

which is the diode.

Speaker two

OK, but there are two things there.

Speaker one

Yes. So, because of the diode, we need a protective resistor.

Speaker two

OK.

Speaker one

So I'll put that in place first. Also, because the current

through this circuit is quite small, we're going to replace this ammeter with a more sensitive one.

Speaker two

OK.

Speaker one

So take that one out.

Speaker two

That...wh-

Speaker one

And that goes there.

Speaker two

OK.

Speaker one

And then now I'm going to replace the light bulb with a diode.

Speaker two

OK. We then repeat the steps we followed for the resistor.

Speaker one

Once we've collected the data

for all three components our I-V characteristic graphs should appear as follows.

A resistor gives a straight-line graph that runs right through the origin, showing that the current is directly proportional to the potential difference.

Speaker two

Now, a filament bulb increases in resistance as the current increases.

As the potential difference increases, the current does increase, but at an ever decreasing rate. Both of these components behave in the same way regardless of which way the current is flowing.

However, a diode gives a very different I-V characteristic because when it's connected

in a forward direction a certain level of potential difference is required to cause a current to flow.

Above this value, the resistance decreases significantly, so current increases rapidly with potential difference. However, when connected to a reverse

potential difference, no current flows at all. The resistance is infinite in the reverse direction.

Speaker one

Circuit designers use I-V characteristics to help select the most appropriate electrical component for when designing a circuit to, for instance, charge your mobile phone quickly and safely.

Speaker two

And acceleration in m/s^2 on the y-axis.

Speaker one

Our results definitely support Newton's second law. The one that says force is directly proportional to acceleration as long as the mass is kept constant. I was worried, but yeah, Newton has triumphed through.