BBC Bitesize – Physics

Episode 2 – Current, resistance and potential difference

ELLIE: Hello, and welcome to the BBC Bitesize Physics podcast.

JAMES: The series designed to help you tackle your GCSE in physics and combined science. I'm James Stewart, I'm a climate science expert and TV presenter.

ELLIE: And I'm Ellie Hurer, a bioscience PhD researcher.

ELLIE: Just a reminder that we're covering lots of topics in this series, so make sure you take a look at the rest of the episodes too.

JAMES: Yeah, let's get started because today we're talking all about current, resistance and potential difference.

In the last episode of the podcast, we gave you definitions of current and charge. Feel free to go back and listen to that one, but in this episode today we're gonna be talking about how those actually work when the current flows through an electrical component, something like a wire.

ELLIE: The current through component depends on both the resistance and the potential difference, also known as the voltage across the component.

JAMES: Resistance in a circuit is provided by components. You can have a component that is called a resistor. But other components such as a bulb, motor, and even wires provide resistance.

ELLIE: Resistance reduces the current as it makes it harder for the current to flow. And there's an equation that links the amount of resistance with current and potential difference.

So grab your pen and paper. The equation is: potential difference equals current multiplied by resistance. Let me repeat that again. Potential difference equals current multiplied by resistance.

JAMES: Now remember that potential difference is also known simply as voltage and is measured in volts. Current is measured in amps, and resistance is measured in ohms. The equation on an exam paper could therefore be written as: V equals I multiplied by R.

ELLIE: I know that's a lot to take in, so maybe pause this episode for a moment and write down that equation and then let's apply it to an example.

JAMES: Imagine a circuit. It's a simple one with a lightbulb, a cell, and an ammeter. How would you calculate the potential difference if the current is 2 amps and the lightbulb has a resistance of 58 ohms?

ELLIE: Well, potential difference equals current multiplied by resistance, so 2 amps multiplied by 58 ohms. And your answer would be... 116 volts.

JAMES: If you want to try more examples just like this to prepare you for the kind of questions you might get in an exam, visit the BBC Bitesize website for quizzes and more.

ELLIE: In an electric circuit, a resistor is a component that resists current. All components in a circuit have some resistance, but there are a few specific resistors you should learn about.

JAMES: Yeah, let's look at the first type of resistor, the fixed resistor, which always has the same value for resistance. This means that if you increase the potential difference, the current must also increase, because potential difference equals current multiplied by resistance.

ELLIE: In fact, potential difference and current are directly proportional. So what that means is that if the potential difference doubles, so does the current.

JAMES: And that type of resistor is called an ohmic conductor. There are other types of resistors that aren't ohmic, which means their value for resistance changes. And I think we should get stuck into that as well. When it comes to components like lamps and thermistors, the resistance is not a constant. It actually changes as the current does.

ELLIE: And for example, let's take, say, a filament light bulb. That's the kind of light bulb that has a squiggly wire in it. In a filament lightbulb, the resistance increases as the temperature of the lightbulb increases. So once it's at its full brightness, it gets pretty hot. So the resistance will have increased.

JAMES: And that's because the particles in that filament of the lightbulb are vibrating faster because of that higher temperature, making it harder and harder for the electrons to flow through. Now, this is not a proportional relationship, as if the potential difference increases, the current does not increase at the same rate.

Let's look at another example, a diode. So in this example, the current that flows through a diode only flows in the one direction. So diodes have a very high resistance in the reverse direction.

ELLIE: In the forward direction. Diodes have a large resistance at low potential differences, but at higher potential differences, the resistance decreases a lot. So, current increases.

JAMES: Okay, let's talk about resistance in another type of component, a thermistor.

ELLIE: When the temperature of a thermistor increases, it gets hotter and the resistance decreases. And when the temperature decreases and gets cooler, the resistance increases.

Yeah, there's one type of thermistor that you can find in many homes. A thermostat is the device people use to change the temperature of the heating around the house.

JAMES: And finally let's talk about resistance in another type of component yes, we haven't run out of components just yet, an LDR. An LDR is a light dependent resistor and it has a similar pattern to a thermostat.

Now they're the things you have on like your light sensors at home, so we use them for street lights, night lights, that kind of thing.

The resistance of an LDR decreases as light intensity increases. And the resistance increases as the light intensity decreases.

ELLIE: So, how might questions about all these different components and resistance come up in an exam?

JAMES: Great question! Uh, yeah, you might be shown or even asked to draw the correlation on a graph. So, grab your pen and your paper and we'll show you just how to do that.

ELLIE: So, start off by drawing a big cross graph with two intersecting lines. Label the y axis, the vertical one, as current. And label the x axis, the horizontal one, as potential difference.

JAMES: With an ohmic conductor, resistance is a diagonal line from one corner of the graph to the other, passing through the origin, that's the intersection of the axis.

ELLIE: And when it comes to a diode, resistance increases with a diagonal line upwards once the potential difference has reached a small positive value.

JAMES: And finally when it comes to a filament lamp, resistance curves in an s shape across both the bottom left and the top right square of the graph.

ELLIE: While drawing this out might help you start to visualise it, I definitely recommend checking out the Bitesize website to see what these graphs actually look like.

Okay, so let's recap the main lessons we learned in this episode. So firstly, we learned the equation potential difference is equal to current multiplied by resistance.

Next, we learned that the current through an ohmic conductor is directly proportional to the potential difference across the resistor.

And last but not least, the resistance of components such as lamps, diodes, thermistors and LDRs is not constant.

JAMES: Thank you for listening to Bitesize Physics. In the next episode we are going to dig in to series and parallel circuits.

ELLIE: If found this helpful, go back and listen again and make some notes so you can come back to this as you revise.

BOTH: Bye!