BBC Bitesize – Physics

Episode 5 – Power

JAMES: Hello and welcome to the BBC Bitesize Physics podcast.

ELLIE: The series designed to help you tackle your GCSE in Physics and combined science.

JAMES: I'm James Stewart, I'm a climate science expert and TV presenter.

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

JAMES: And today we're going to be talking about power, how to calculate it and compare how much power different electrical devices use. Let us begin.

Ellie, if you could have any superpower in the world, what would it be?

ELLIE: Hmm, I think probably teleportation. Could you imagine being able to blink and go from London to, you know, the Amazon rainforest?

JAMES: Oh, wouldn't that be amazing? I think I would probably choose time travel. I'd love to go back in history and see like the first thing humans created or hang out with my great-great-great-grandfather, stuff like that.

But I didn't ask you that question because we're doing a spin-off show about superheroes. I asked you that because in this episode we are talking about power and to do that let's start with a scientific definition of power.

So power is the rate at which energy is transferred or the rate at which work is done. That means that the more powerful a device is, the more energy is transferred, or more work is done, each second.

ELLIE: To calculate power, you need a certain formula, so grab your pen and paper because you'll want to write this down.

So, power equals energy transferred, divided by time. So, let me repeat that with the units. Power, which is measured in watts, equals energy transferred, which is measured in joules, divided by time, which is measured in seconds. This means that an energy transfer of one joule per second is equal to one watt.

JAMES: If you want to learn more about power and energy transfer, be sure to listen to the energy transfer episode of our Bitesize Physics electricity series.

ELLIE: Yes, definitely go back and look at that. Right, so let's look at an example. So James, imagine it's a really hot summer's day so you buy an electric fan.

JAMES: The electric fan transfers 3,000 joules of energy in one minute. So how would you calculate the power of the fan if the equation to calculate the power is: power equals energy transferred divided by time.

ELLIE: If you missed a measurement or the equation, be sure to rewind, but we'll give you a few moments to pause, write that down and calculate it.

JAMES: Okay so to calculate the power rating of the fan, you would divide 3,000 joules by 60 seconds to get the answer, 50 watts.

ELLIE: What?

JAMES: Wahey. Therefore, the power rating of the fan is 50 watts. And you can often find the power rating of an appliance on a label, handily attached to its wires.

ELLIE: But, there's also another equation you can use to calculate power. So, let's grab your pen and paper. Okay, so power equals work done, divided by time. Let me repeat that with the units. Power, which is measured in watts, equals work done, which is measured in joules, divided by time, which is measured in seconds.

JAMES: Yeah, the main difference between those is instead of talking about energy transferred, we talk about work done. And to learn more about work done, be sure to listen to the work done episode of our BBC Bitesize Physics series on forces.

ELLIE: Let's look at another example. Imagine you're at a construction site and you're watching two different electric motors lift weights.

They both lift a 2 Newton weight by 10 metres. Motor one does it in 5 seconds, whereas motor two does it in 10 seconds.

JAMES: So to calculate how much energy they use, you would use the equation work done equals force multiplied by distance. So in this case, you multiply 2 newtons by 10 metres to get the answer 20 joules. But, how would we calculate how powerful each motor is?

ELLIE: Well, the equation for power is: power equals work done divided by time. So, I'm going to give you a few seconds to try and calculate the power of motor one and two using the equation.

JAMES: To calculate the power of motor one, you would divide its work done, which is 20 joules, by the time it takes, that was 5 seconds, to come up with the answer, 4 watts. And then to calculate the power of motor two, you would divide its work done, which was 20 joules, by its time, 10 seconds, to come up with the answer, 2 watts. That calculation would help you to understand why they both lift the same weight, but do it at different rates, because motor one is twice as powerful. Yeah, so if you need to move house and do some heavy lifting to get your furniture moved around, you'd probably use motor one to help you do that, otherwise you'd be very tired.

Let me just recap some of the key facts we learned today. So firstly, power is the rate at which energy is transferred or the rate at which work is done.

Secondly, the first equation to calculate power is: power equals energy transferred, divided by time. And the second equation to calculate power is: power equals work done, divided by time.

And finally, power is measured in watts. Work done is measured in joules. And time is measured in seconds.

ELLIE: So that's our introduction to power. In this next episode, we're going to be talking about the conservation and dissipation of energy, which is how it's used and wasted.

JAMES: Thank you for listening to Bitesize Physics. If you found this helpful, and I hope you did, go back and please listen again, make some notes as you go along the way, and always come back here whenever you want to revise from.

ELLIE: There's also a lot more resources available on the BBC Bitesize website, so be sure to check it out.

BOTH: Bye!