BBC Bitesize – Physics

Episode 5 – Energy transfers in everyday appliances

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 energy transfers in everyday appliances.

ELLIE: From the plug you use to charge your phone, to the batteries you use to power a remote, we're going to talk all about the electricity you use at home. So, let's begin!

JAMES: Every electrical appliance in your house is designed to transfer energy from one store to another. For example, in a TV remote, the chemical energy stored in the battery is transferred into the electrical energy store in the remote that's used to turn it on and let you change channels.

ELLIE: Or in a laptop, the electrical energy stored in your mains electricity is used to charge your laptop by transferring into the chemical energy store in the battery.

JAMES: In the UK, all electrical devices in a home should have labels on them that show the power rating of the device.

ELLIE: Power is how much energy is transferred per second. Which means something has a higher power rating if it transfers more energy in a given time. The unit of power is watts. And the symbol for that is a capital W.

JAMES: So if you're near a microwave or a kettle, look out for a sticker that shows how many watts that device operates on.

ELLIE: Okay, so let's get to our first equation of the day. Whoop whoop! Grab your pen and paper because we're about to hear how to calculate energy transferred.

Alright guys, so energy transferred equals power multiplied by time. Energy transferred is measured in Joules, J. Power is measured in watts, W, and time is measured in seconds, S. Sometimes energy transferred might be called 'work done'.

JAMES: Shall we look at a practical example for this? I always find that it helps me try and figure this out. So imagine you went swimming at the weekend and you left with really wet hair. You'd probably reach for the hair dryer straight away, right? But how much energy would you use? Let's work it out.

ELLIE: So, if your hairdryer has the power of 1,800 watts and you use it for five minutes, you would multiply 1,800 watts by 300 seconds to calculate that the energy transferred would be 540,000 joules.

JAMES: So how does energy transfer actually work? A good way to look at energy transfer is through the appliances that keep us hot or cool us down.

ELLIE: Let's say it's a hot summer day and your room is scorching. You might buy a small handheld fan to cool you down. When you pop the batteries into the fan and turn it on, there's a variety of energy transfers going on.

JAMES: Work is done when the chemical energy store in the battery, is transferred into the electrical energy store, which is then transferred into the kinetic energy store of the electric motor that makes the fan spin around and cool you down.

ELLIE: And we can see energy transfer in the appliances that warm us up too. Imagine it's a cold, snowy winter's night. Let's say you have one of those stand-alone electric heaters. When you plug it into the AC mains of your wall socket, it transfers energy from the electrical energy store into the thermal energy store of the heater to warm up your room.

JAMES: Energy transfer is linked to the potential difference a charge carries. Because when the charge transfers some energy to an appliance, the potential drops in the charge.

ELLIE: And to calculate the amount of energy transferred, you'll need another equation, so grab that pen and paper again so you can jot this down.

JAMES: Okay, here we go. Energy transferred equals charge flow multiplied by the potential difference. And here are the units of measurement. Energy transferred, or work done, is measured in joules, J. Charge flow is measured in coulombs, C. And potential difference is volts, V.

ELLIE: So let's look at a real life example. Imagine you're throwing a party and put fairy lights up around the room to make it feel a little bit magical. I do love my fairy lights, but how would you calculate the energy transferred by the fairy lights?

JAMES: Well, if the charge flow in the lights was 10 Coulombs and the potential difference was 20 volts, you would take 10 Coulombs and multiply it by 20 volts, which would give you the answer 200 Joules.

And finally, let's talk about the link between power, current and voltage. And you'll want to grab your pen and paper one last time for this one. Power equals potential difference multiplied by current. Power is measured in watts, W. Potential difference is measured in volts, V. And current is measured in amps, A.

ELLIE: Or, you could use another equation to calculate the power. So power equals current squared multiplied by resistance. Power is measured in watts W, current is measured in amps A, and resistance is measured in ohms.

JAMES: Okay, let's recap the three key lessons we learnt here. Firstly, every electrical appliance in your home is designed to transfer energy from one store to another. Secondly, the amount of energy an appliance transfers depends on how long the appliance is switched on and the power of the appliance. The equation to calculate that is energy transferred equals power multiplied by time, or energy transferred equals charge flow multiplied by the potential difference.

And finally, power equals potential difference multiplied by current, or, you can use an alternative equation, get ready for this one, power equals current squared multiplied by resistance.

ELLIE: Okay, and one last note. We've given you a lot of equations in this episode.

JAMES: So many. So many.

ELLIE: So many. So if you're a little bit overwhelmed, which is understandable, be sure to head to the BBC Bitesize website to read through all of this and study at your own pace.

JAMES: Yeah, that's good advice. We also wanted to give you some practical advice for your exam. So when you see a question about these topics, follow these three steps, okay? Number one, first and foremost, write down the values that you've been given.

Secondly, write down the thing you are being asked to find out or calculate. And thirdly, check through your list of equations to decide which one is the correct use. It's like having superpowers and picking the right superpower for the problem.

ELLIE: Also, in a question worth more marks, like 5 or 6, you might need to use more than one equation.

And we're at the end of the episode, so thank you so much for listening to BBC Bitesize Physics. If you found this helpful, go back and listen again and make some notes so you can come back to this as you revise.

JAMES: In the next episode of Bitesize Physics, we're going to be learning about something called the National Grid. Spoiler alert, it's not a big game of 4-in-a-row.

ELLIE: Oh, man. Bye!