BBC Bitesize – Physics

Episode 8 – Momentum

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. This is the eighth and final episode of our series on forces.

JAMES: Let's kick off our final episode, I'm emotional, where we'll be talking about momentum.

ELLIE: Momentum is mass multiplied by velocity, which is written out as 'p' for momentum equals 'm' for mass and 'v' for velocity.

JAMES: Momentum is measured in kilogram metres per second, mass is measured in kilograms, and velocity is measured in metres per second.

ELLIE: So James, let me test your memory. Do you still remember what we talked about in episode one?

JAMES: Gosh, a long time ago. Yeah, scalar and vector quantities. And because we measure momentum by both magnitude and direction, it is a vector quantity.

ELLIE: So James, I think it's time for an example. Okay, let's get on the motorway, not literally, and measure the momentum of a lorry. So look at that lorry over there. Its mass is 40,000 kilograms and it's driving up north to Edinburgh at a velocity of 20 metres per second.

JAMES: Speedy lorry. So to calculate its momentum, we would multiply its mass, that's 40,000 kilograms, by its velocity. 20 metres per second north. To get the answer, 800,000 kilogram metres per second north.

So Ellie, do you remember how we talked about dodgems in episode 7?

ELLIE: Yeah, the dodgem cars at the theme park.

JAMES: Yeah, we're gonna use those as the example again to describe our next topic, conservation of momentum.

ELLIE: Imagine there were just two dodgem cars in a rink that's completely closed off to the rest of the world. No other cars can come in, and those two cars can't leave.

JAMES: That would be a closed system, because it cannot be affected or affect anything outside of it.

ELLIE: Right, so when two objects collide in a closed system, the total momentum before an event is equal to the total momentum after an event. This is called conservation of momentum.

JAMES: Let's zoom in to an example. Okay, so let's say you and I we're in the dodgems. I'll take the green one.

ELLIE: Well, I'll take the blue one.

JAMES: Good. If I was driving straight towards you with a momentum of 60 kgm per second north, and you were driving straight towards me with a momentum of 50 kgm per second south, and then we collided, what would our combined momentum be?

I'll give you a second to use the equation to work it out. As a recap, remember the total momentum before an event is equal to the total momentum after an event.

Okay, so the answer is: our combined momentum before crashing will be 10 kgm per second north.

ELLIE: And our combined momentum after crashing would still be 10 kgm per second north. This is because energy can't move in or out of a closed system. Therefore, our momentum would be the same before and after we collide.

JAMES: So in this example, our cars would move together to the north. My car would push your car backwards.

ELLIE: Rude. However, we definitely wouldn't recommend driving straight into another car in a game of dodgems.

JAMES: Even for scientific research?

ELLIE: Not even for scientific research.

JAMES: We could also look at how this works when a total momentum of zero is conserved. Let's look at a party popper, for example. Didn't think I was going to say that, did you?

ELLIE: So, before you pull the string, the momentum is zero. So the total momentum after pulling it must be zero too.

JAMES: That means if you were to add up all the momentums of all the little bits of paper that came out the end of the party popper, they would all actually cancel each other out to make zero overall. A momentum of zero has been conserved. Zero fun was had at that party.

ELLIE: So let's summarise what we've learnt. Firstly, momentum equals mass multiplied by velocity.

Our second point is, in a closed system, the total momentum before an event is equal to the total momentum after the event. This is called conservation of momentum.

And finally, momentum is a vector quantity, which means both its magnitude and its direction must be given.

And sadly, with that comes the end of our eight-part series all about forces.

JAMES: We hope you found it helpful, and if you didn't get the chance to listen to all the episodes, please do go back. Make sure you can listen again and really get stuck into them. Thank you for listening to Bitesize Physics. If you're preparing for your GCSEs, firstly, good luck, and secondly, why not also check out our Bitesize Biology podcast, or our range of Bitesize English literature series.

ELLIE: There’s also the Bitesize Study Support podcast, which is full of tips to help you stay focused during revision and get the best out of your exam day.

BOTH: Bye!