

BBC Bitesize – Physics

Episode 1 - Scalar and vector quantities, contact and non-contact forces

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: We are going to be your guides. We're going to cover everything from forces to electricity, energy to gravity. We are going to explore some of the fun and complex parts of physics to help you revise.

ELLIE: And if you want to really get into it, be sure to grab a pen and paper, so you can make notes and try out equations throughout the whole episode.

JAMES: Absolutely, this is episode one of our eight-part series all about forces! So let's begin.

ELLIE: When it comes to physics, we're often measuring things we can and can't see, like weight, direction, and speed.

JAMES: And the types of things we measure can be split into two groups. So we have scalar quantities and vector quantities.

ELLIE: Okay, so what makes a quantity scalar or vector?

JAMES: Well, it's kind of in the name. Let's start with scalar quantities, which, as you might have guessed, sounds a bit like the word scale.

ELLIE: A scalar quantity is a physical quantity that only has a magnitude. The word magnitude means size, so examples of scalar quantities are mass and distance.

JAMES: Okay, so if you were to ask me how fast I drove my car here this morning, right, I would say 30 miles per hour. Or if you asked me how much pasta I was having for lunch later, I would say 50 grams of pasta. Is that right?

ELLIE: Exactly. A car's speed and the mass of pasta just have a magnitude. So they're scalar quantities because we just measure them with numbers.

JAMES: What's a vector quantity then?

ELLIE: Well, a vector quantity is something we measure with both magnitude and direction, like weight and displacement.

JAMES: Okay, so if I walked to the skate park and it was 2km to the east of my house, let's say, would that be a vector quantity?

ELLIE: Exactly, because there you're measuring displacement, so both the direction and distance.

JAMES: Okay, so another example would be diving, I don't know, five metres down into a swimming pool.

ELLIE: Yep, that's right, because you're talking about both a magnitude, five metres, and a direction downwards.

JAMES: Good. Okay, right, time to get your pen and paper out. Now, we want you to write down your own vector quantity, something that has both a direction and a magnitude. Now, remember that the word magnitude simply means size.

ELLIE: Like swimming 10 metres to the left or pushing 7 Newtons to the right or driving 20 miles per hour to the north.

JAMES: Ellie, this whole series is all about forces, so what is a force? Is that a scalar quantity or a vector quantity?

ELLIE: Drumroll, please? Force is a vector quantity because it has both a magnitude and direction. A force is a push or pull that can change the position, speed or state of an object. A force occurs due to an object interacting with another object.

JAMES: And we measure those forces in Newtons. The sign for that is an uppercase 'N'.

ELLIE: Exactly. Forces are vector quantities that are measured in Newtons and have a direction. So if you pushed a shopping trolley, you could say you pushed it 4 Newtons to the left.

JAMES: Yeah, and there are two different types of forces, aren't there?

ELLIE: Yeah, so there's contact forces and non-contact forces. So let's dig into the differences between them.

JAMES: Contact forces are forces that occur when the objects physically touch. For example, friction, air resistance and tension. Now one key thing to know about contact force is that when an object at rest exerts a force on the surface it's placed on, there's a reaction force that acts at right angles to the surface.

This is what we call a normal contact force. For example, a book on a table exerts a force down on the table, and the table exerts a normal contact force of the same size back up on the book.

ELLIE: Whereas, non-contact forces are forces that act between objects that aren't physically touching. For example, electrostatic force, magnetic force and gravitational force, which we'll hear more about in future episodes.

JAMES: Yes, we will look forward to that. But before we go, we're not quite finished yet. Let's do a quick summary of where we've got to so far, what we've learned. I think that's a good time to do that. Number one, magnitude simply means size despite the complicated word.

Number two, scalar quantities just measure magnitude, whereas vector quantities measure magnitude and direction. Three, forces are vector quantities. And four, finally, there are both contact and non-contact forces.

ELLIE: That's great, James. And thank you everyone for listening to Bitesize Physics. If you found this helpful, go back and listen again and make some notes so you can come back to them when you revise.

JAMES: Yeah, great idea. And in the next episode of Bitesize Physics, we are going to focus on one particular force. Gravity. Be sure to tune in then.

ELLIE: I can't wait. And until then, may the force be with you.

JAMES: See you next time. Bye!