Scalars and Vectors
Scalars and Vectors

- Scalars and vectors
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**What is a scalar?**

**Scalar** quantities are measured with numbers and units. They have size, but not direction.

- **length** (e.g. 16 cm)
- **temperature** (e.g. 102 °C)
- **time** (e.g. 7 s)
Vector quantities are measured with numbers and units, but also have a specific direction.

- Acceleration (e.g. $30 \text{ m/s}^2$ upwards)
- Displacement (e.g. 200 miles north-west)
- Force (e.g. 2 N downwards)
Comparing scalar and vector quantities

Distance or displacement?

Distance is a scalar quantity, whereas displacement is a vector quantity.

Press the buttons to find out more about the difference between them.
Speed or velocity?

Distance is a scalar and displacement is a vector. Similarly, speed is a scalar and velocity is a vector.

Speed is the rate of change of distance in the direction of travel. Direction does not matter.

Velocity is a rate of change of displacement and has both magnitude (size) and direction.

Averages of both can be useful:

average speed = \frac{\text{distance}}{\text{time}}

average velocity = \frac{\text{displacement}}{\text{time}}
Vector or scalar?

Are these quantities scalars or vectors?

- **Scalar**: Speed
- **Vector**:
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Representing vectors

A vector quantity can be represented by an **arrow**.

- The **direction** of the arrow shows the **direction** of the vector.

- The **length** of each arrow represents the **magnitude** of the vector.

Using arrows to represent vectors is useful when we need to add vector quantities together.
Representing displacement

Displacement is a quantity that is independent of the route taken between start and end points.

If a car moves from A to C, first by travelling north to B and then east to C, its total displacement will be the same as if it had just moved north-east in a straight line from A to C.

Two or more vectors can be added ‘head to tail’ to calculate a resultant vector.

Any two vectors of the same type can be added in this way to find a resultant.
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