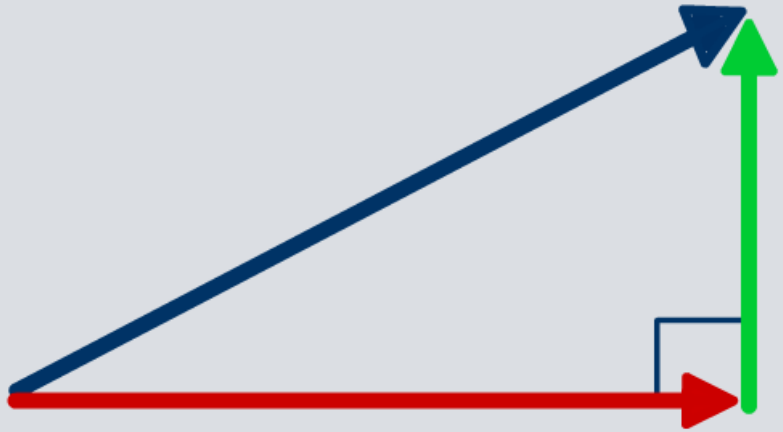
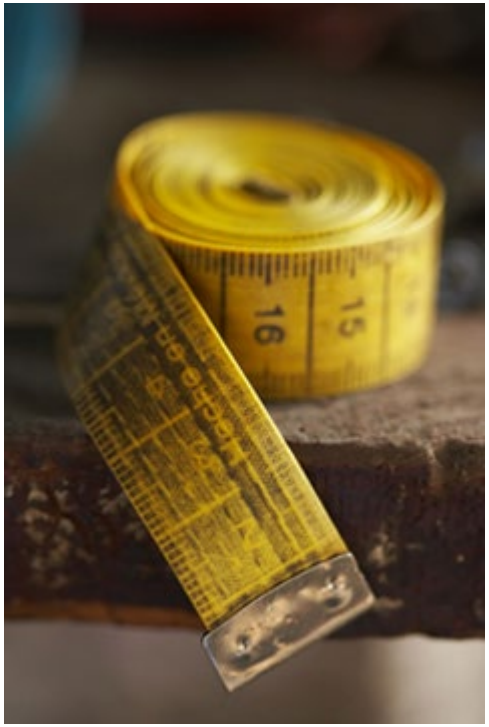
Vectors and Scalars



What is a scalar?

Scalar quantities are measured with numbers and units.



length

(e.g. 16 cm)

temperature

(e.g. 102 °C)

time

(e.g. 7 s)

What is a vector?

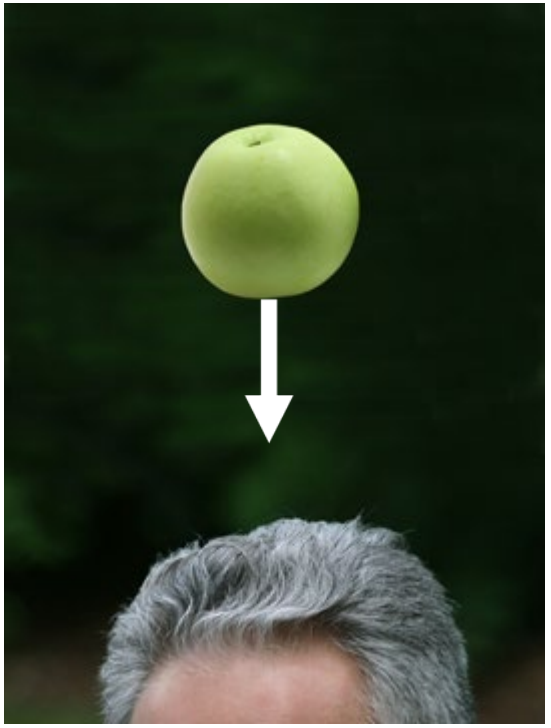
Vector quantities are measured with numbers and units, but also have a specific **direction**.

acceleration

(e.g. 30 m/s^2 upwards)

displacement

(e.g. 200 miles northwest)



force

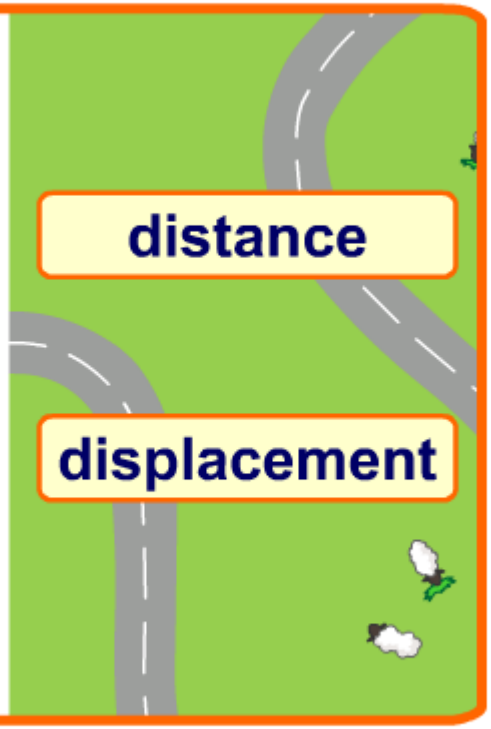
(e.g. 2 N downwards)

Comparing scalar and vector quantities

Distance or displacement?

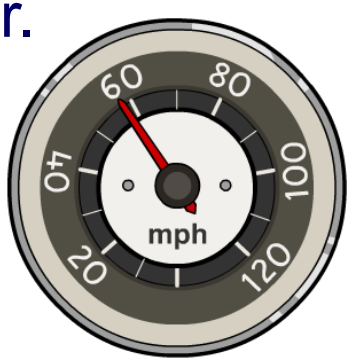
Distance is a **scalar** quantity, whereas displacement is a **vector** quantity.

Click 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. Speedometers in cars measure speed.

Velocity is a rate of change of **displacement** and has both magnitude and direction.

Averages of both can be useful:

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

$$\text{average velocity} = \frac{\text{displacement}}{\text{time}}$$

Vector or scalar?

Are these quantities scalars or vectors?

scalar	vector

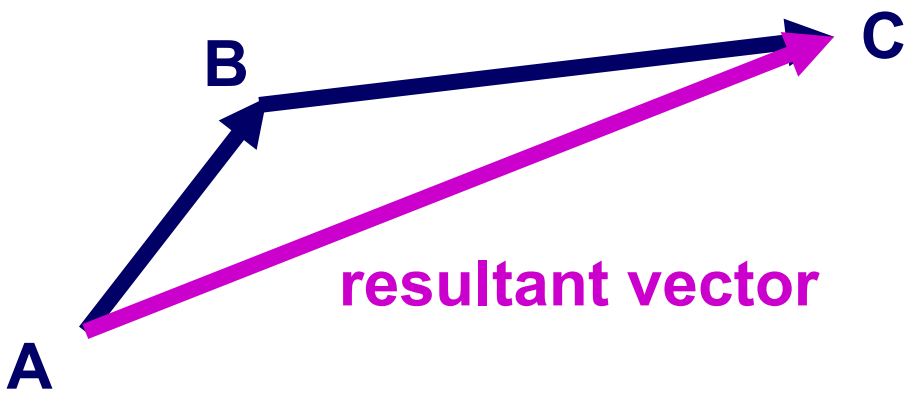
friction

solve

Adding vectors

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

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



Two or more displacement vectors can be added "nose to tail" to calculate a **resultant vector**.

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

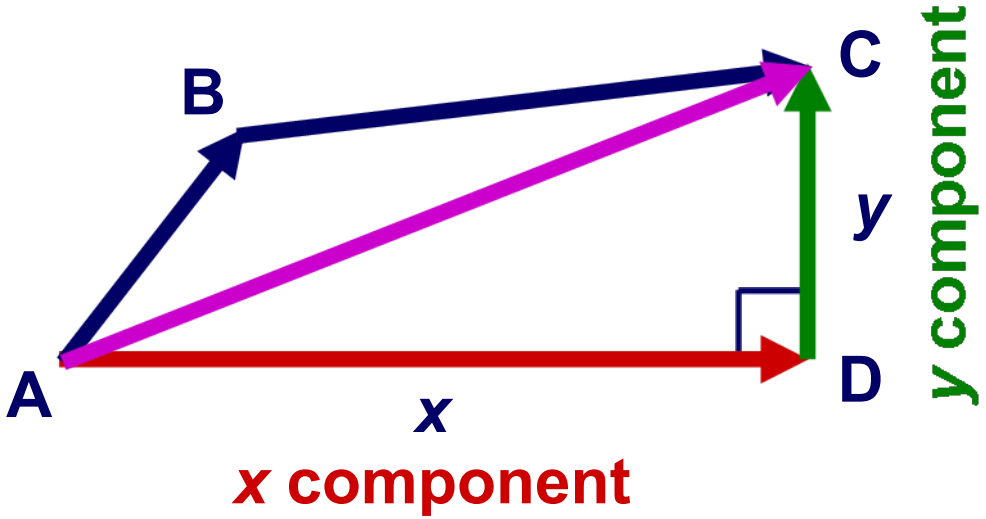
Simplifying vectors

Because of the way vectors are added, it is always possible to simplify a vector by splitting it into **components**.

Imagine that instead of traveling via B, the car travels via D:

Its displacement is the same, but it is now much easier to describe.

How would you describe the car's displacement in component terms?



The car has a final displacement of x miles east and y miles north. This can be represented by (x, y).

Understanding vector calculations

What is missing from each vector equation?

Equation 1 of 3

2,
Northeast

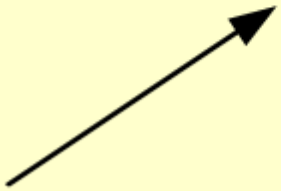
+

2,
Northwest

=

A

2, Northeast



2, North

2.8, West

2.8,
North

?

solve

next