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Practical Skills

Practice Exams

Speed and Velocity

Speed and velocity are similar, but in physics they're not quite the same...

Speed is Calculated from Distance and Time

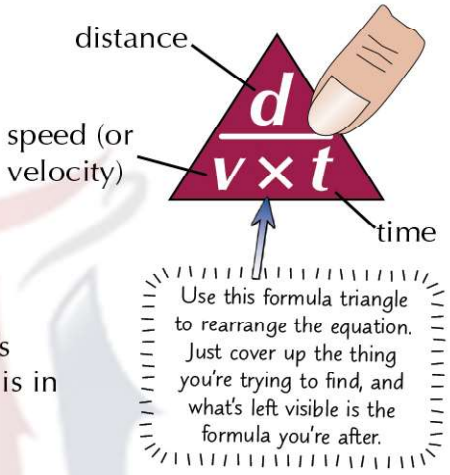
KEY TERM

Speed is just how fast you're going (e.g. 30 km/h or 20 m/s) with no regard to the direction.

For any object, the distance moved, (average) speed, and time taken are related by this formula:

You'd use the same formula to calculate velocity (see below).

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



Speed is measured in m/s (metres per second). To calculate speed in m/s make sure the distance you use in the formula is in metres and the time is in seconds. Other common units of speed are km/h and mph.

EXAMPLE:

A cat walks 20 m in 40 s.
a) Calculate its average speed.
b) How long will it take the cat to walk 75 m at this speed?

a) Use the formula for average speed.

$v = d \div t$
$= 20 \div 40 = 0.5$ m/s

b) Rearrange $v = d \div t$ using the formula triangle to get $t = d \div v$.

$t = d \div v$
$= 75 \div 0.5 = 150$ s

Velocity is Speed in a Given Direction

Velocity is very similar to speed, but it has a direction too. It has the same units as speed, and the formula for average speed can also be used to calculate average velocity.

Supplement

KEY TERM

Velocity is how fast you're going with the direction specified, e.g. 30 km/h north or 20 m/s at 60° above the horizontal.

This means you can have objects travelling at a constant speed with a changing velocity. This happens when the object is changing direction whilst staying at the same speed.

Supplement

Speed is how much distance you cover in a unit of time...

Learn the formula for speed but watch out for the units. If you're given the time in minutes, multiply by 60 to convert it to seconds. And make sure you're happy converting between km, cm and m.

Acceleration

Things rarely travel at the same speed — this is where acceleration and deceleration come in.

Changing Speed Means Acceleration

1) Acceleration is related to changing speed.

2) The faster the speed is changing, the greater the acceleration.

3) Deceleration means the speed is decreasing — the object is slowing down.

4) The unit of acceleration is m/s^2. Not m/s, which is speed (or velocity), but m/s^2.

5) The force of gravity makes objects accelerate towards the Earth. Acceleration due to gravity (g) is constant near the Earth. So an object in free fall will accelerate towards the Earth at a constant rate.

Changing Direction Means Acceleration Too

1) Acceleration is actually how quickly velocity is changing. The definition is:

KEY TERM

Acceleration is the change in velocity per unit time.

2) This change in velocity can be a change in speed or a change in direction, or both. You only have to worry about the change in speed bit for calculations. The formula for it is:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\frac{(v - u)}{a \times t}$$

Here 'v' is the final velocity and 'u' is the initial velocity, so $v - u$ is the change in velocity.

EXAMPLE:

A cat accelerates from 2 m/s to 6 m/s in 5.6 s. Find its acceleration.

Substitute the values into the formula.

$a = (v - u) \div t = (6 - 2) \div 5.6$
$= 4 \div 5.6 = 0.714... = 0.71\ m/s^2$ (to 2 s.f)

This formula for acceleration only works when the acceleration is constant.

3) A negative value for acceleration means something is slowing down (decelerating).

Supplement

Supplement

EXAM TIP

Make sure you're comfortable with using this equation...

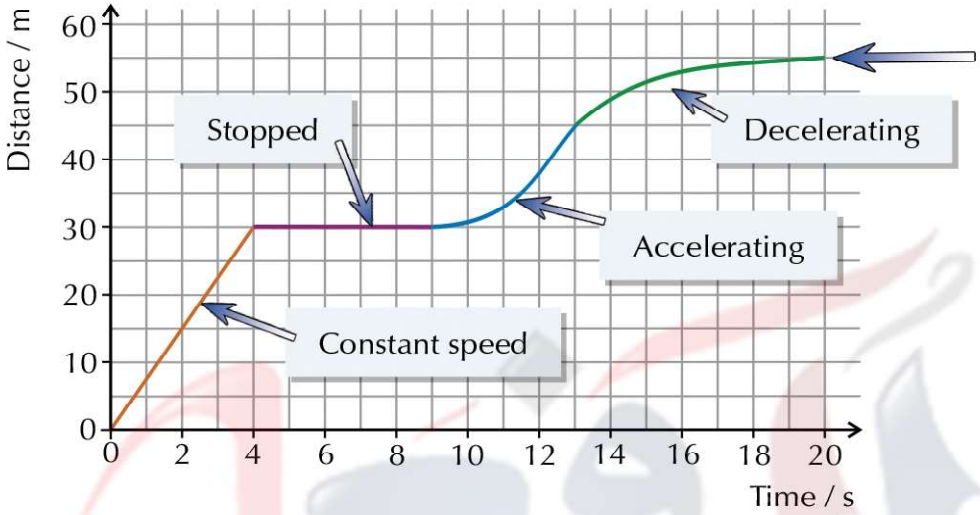
Don't get confused if a question says an object starts 'at rest' or 'is initially stationary'. This just means that the initial velocity, u, is 0. And if the object finishes at rest, the final velocity, v, is 0.

Distance-Time Graphs

Distance-time (D-T) graphs tell you how fast an object is moving and how far it's travelled. Simple as that really. Make sure you get them straight in your head before turning over...

Distance-Time Graphs Tell You How Far Something has Travelled

The different parts of a distance-time graph describe the motion of an object:



1) The gradient (slope) at any point gives the speed of the object.

2) Flat sections are where it's stopped.

3) A steeper graph means it's going faster.

4) Curves represent acceleration.

5) A curve getting steeper means it's speeding up (increasing gradient). This is acceleration.

6) A levelling off curve means it's slowing down (decreasing gradient). This is deceleration.

Calculating Speed from a Distance-Time Graph

To calculate the speed from a distance-time graph, just work out the gradient:

EXAMPLE:

Calculate the speed of the object from the graph above, between 0 and 4 s.

The vertical change between 0 and 4 s is 30 m.

$$\text{speed} = \text{gradient} = \frac{\text{change in vertical}}{\text{change in horizontal}} = \frac{30}{4} = 7.5 \text{ m/s}$$

Don't forget to use the scales of the axes to work out the gradient. Don't measure in cm!

You can also calculate the average speed of an object over a period of time by dividing the total distance travelled by the time it takes to travel that distance. For example, the average speed over the whole journey is 55 ÷ 20 = 2.8 m/s (to 2 s.f.).

Supplement

Supplement

EXAM TIP

Read the axes of any graph you get given carefully...

Make sure you don't get confused between distance-time graphs and speed-time graphs (which are coming up next). They do look quite similar, but they tell you different things...