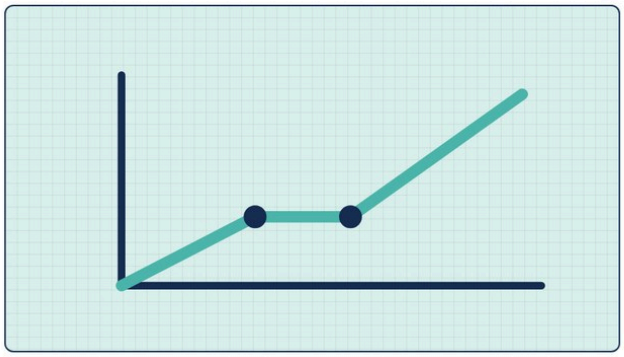
Physics · Describing motion in a straight line and in a circle

Motion



Motion

Teacher notes

Ask the class: are you moving right now? Most will say no, until someone points out that the Earth is spinning and orbiting the Sun. Use this to show that whether something moves depends on what we compare it with.

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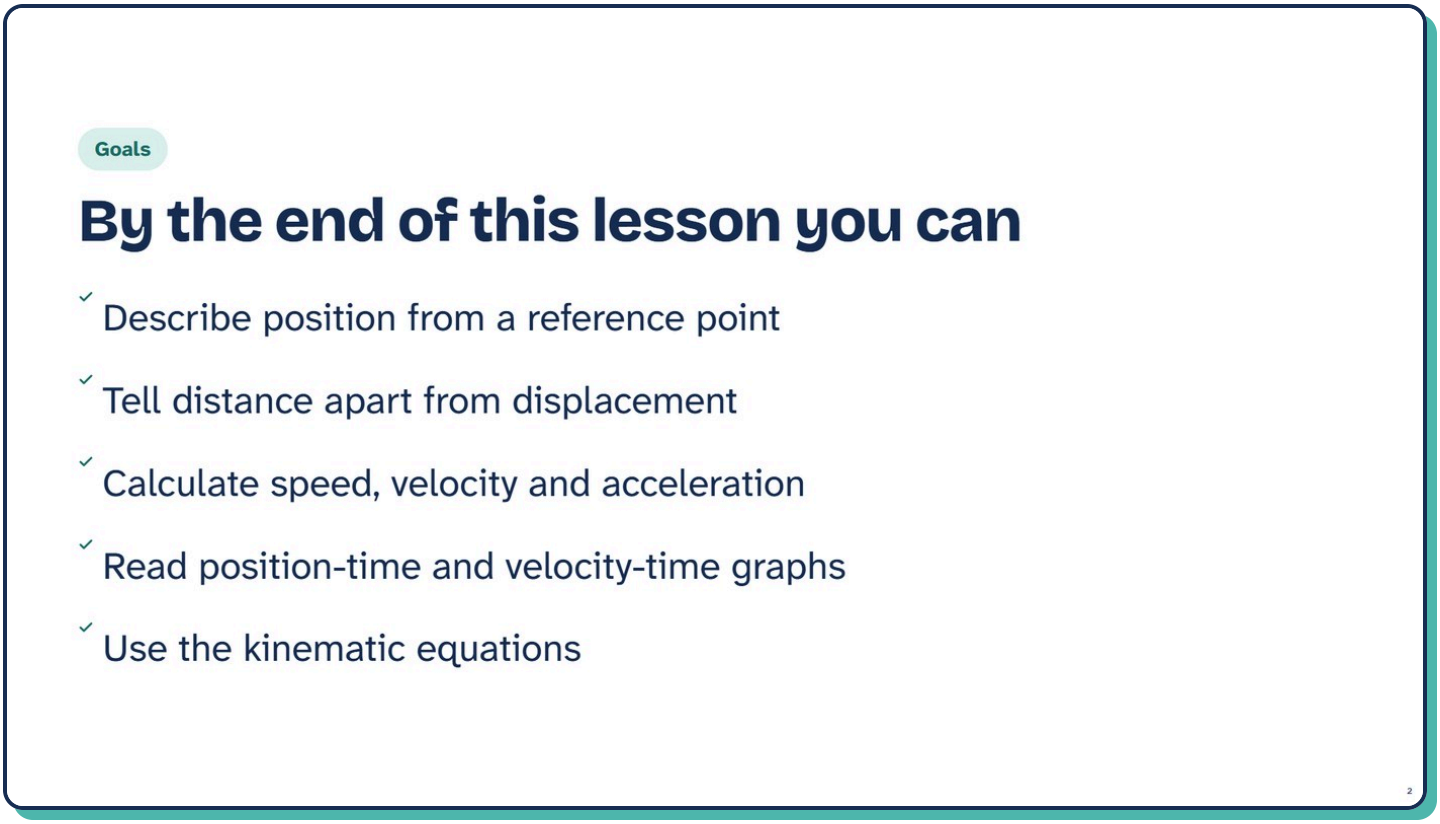
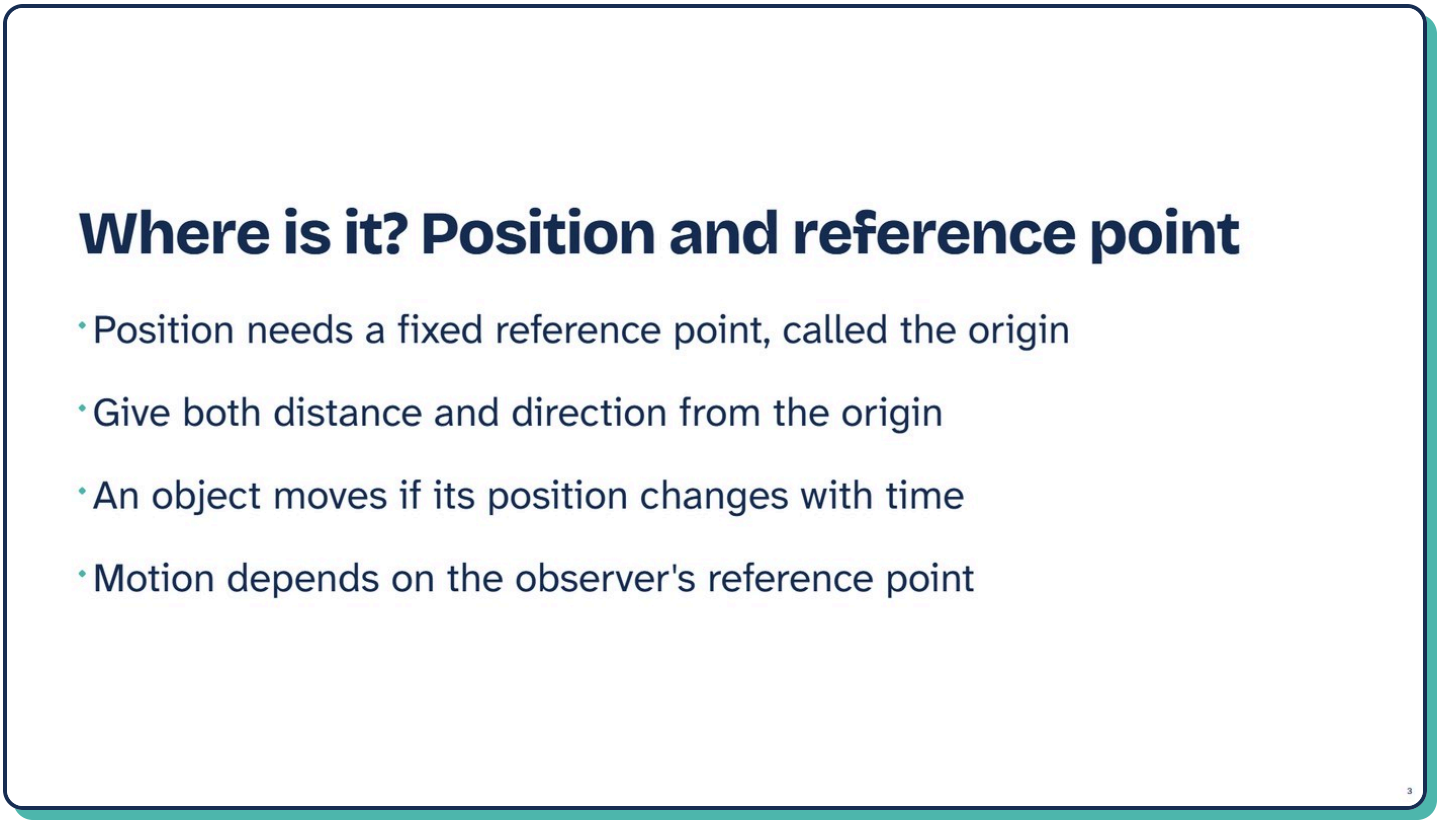


By the end of this lesson you can

Teacher notes

Tell students the lesson ends with calculations, so they should keep a notebook ready for the worked examples. Ask which objective they already feel confident about.



Where is it? Position and reference point

Teacher notes

A passenger sitting in a moving train is at rest compared with the seat but moving compared with the platform. Ask students to describe the position of the classroom door from their own desk, with a distance and a direction. A common misconception is that rest and motion are absolute.

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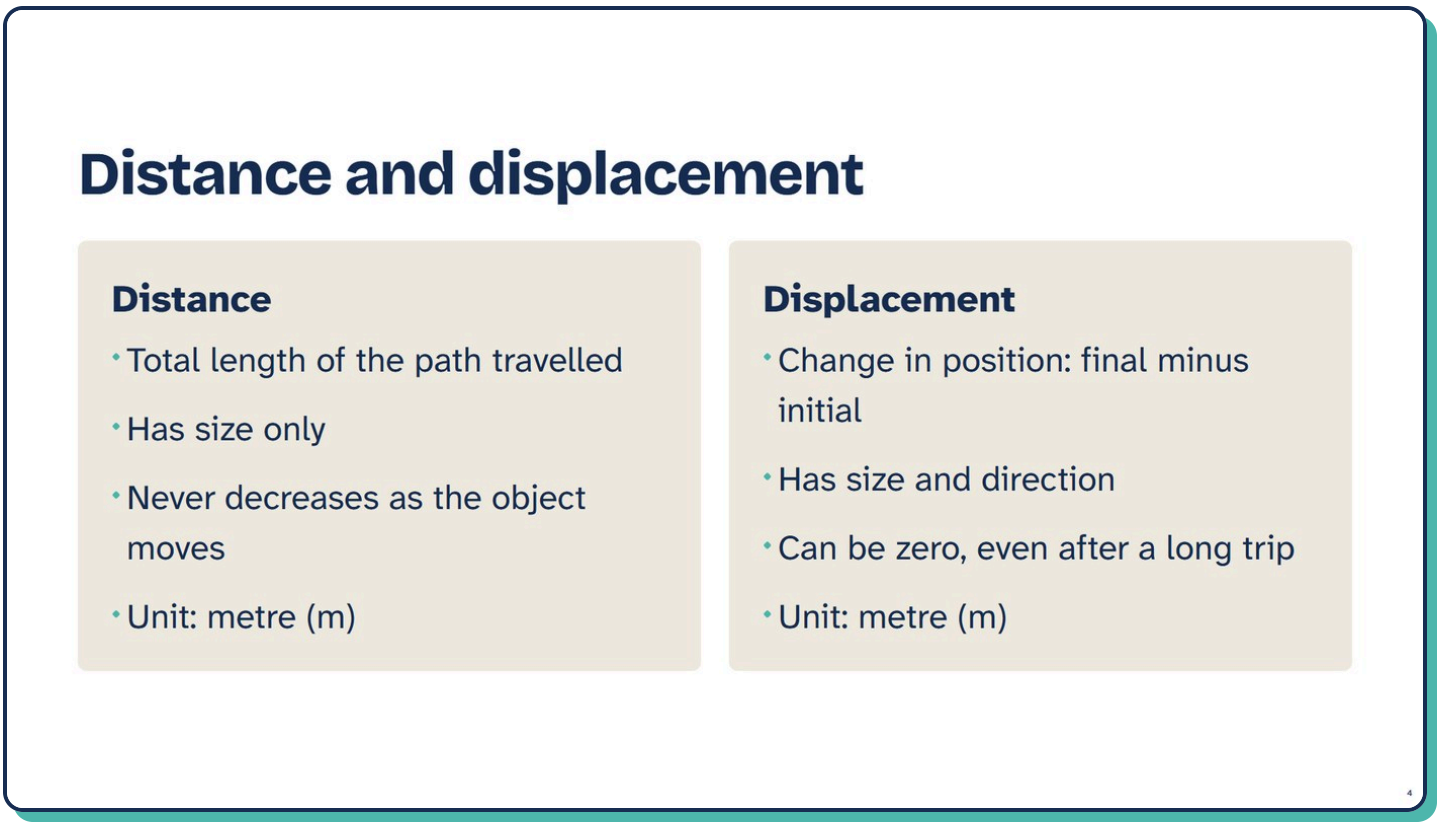
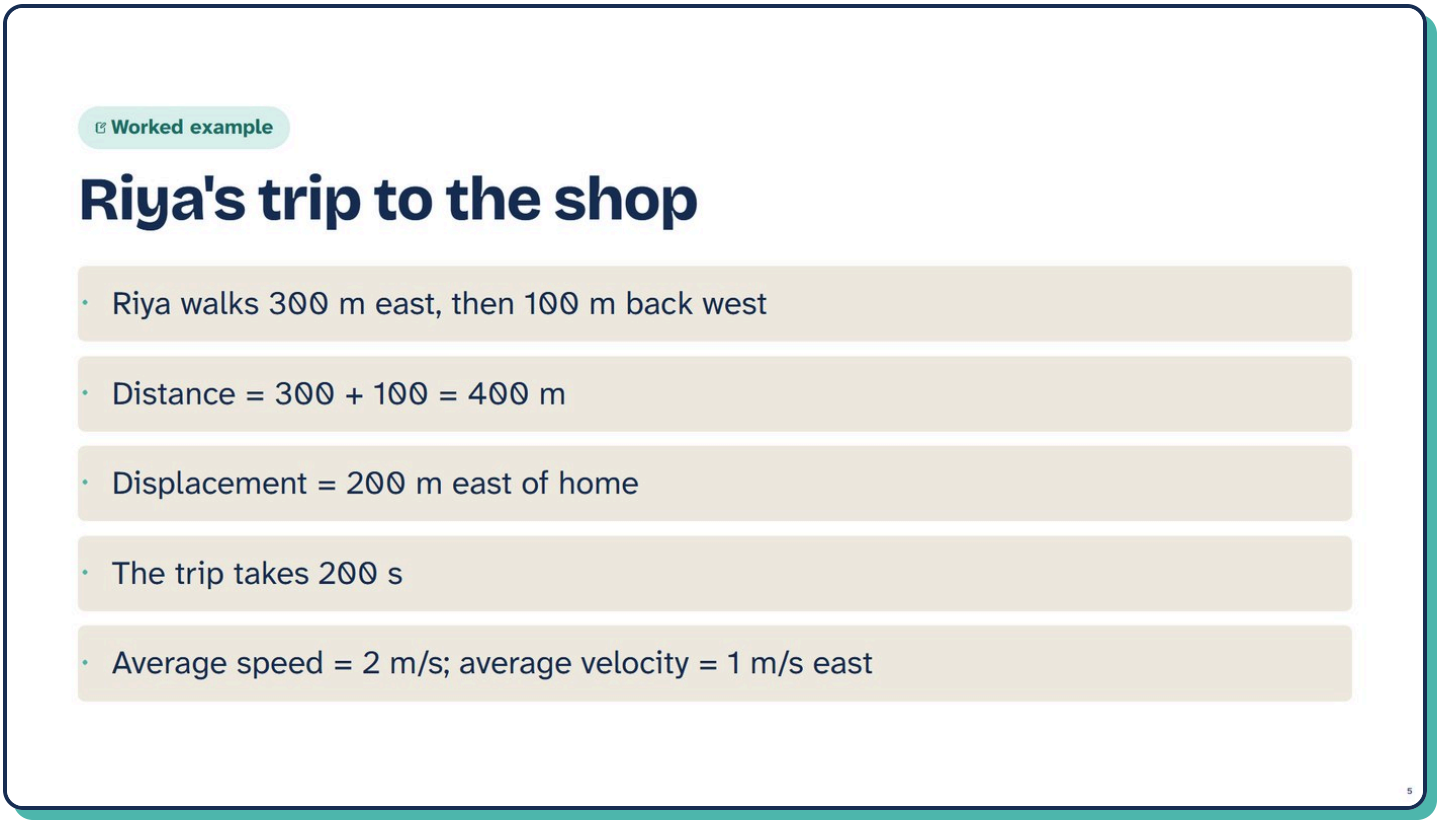


Distance and displacement

Teacher notes

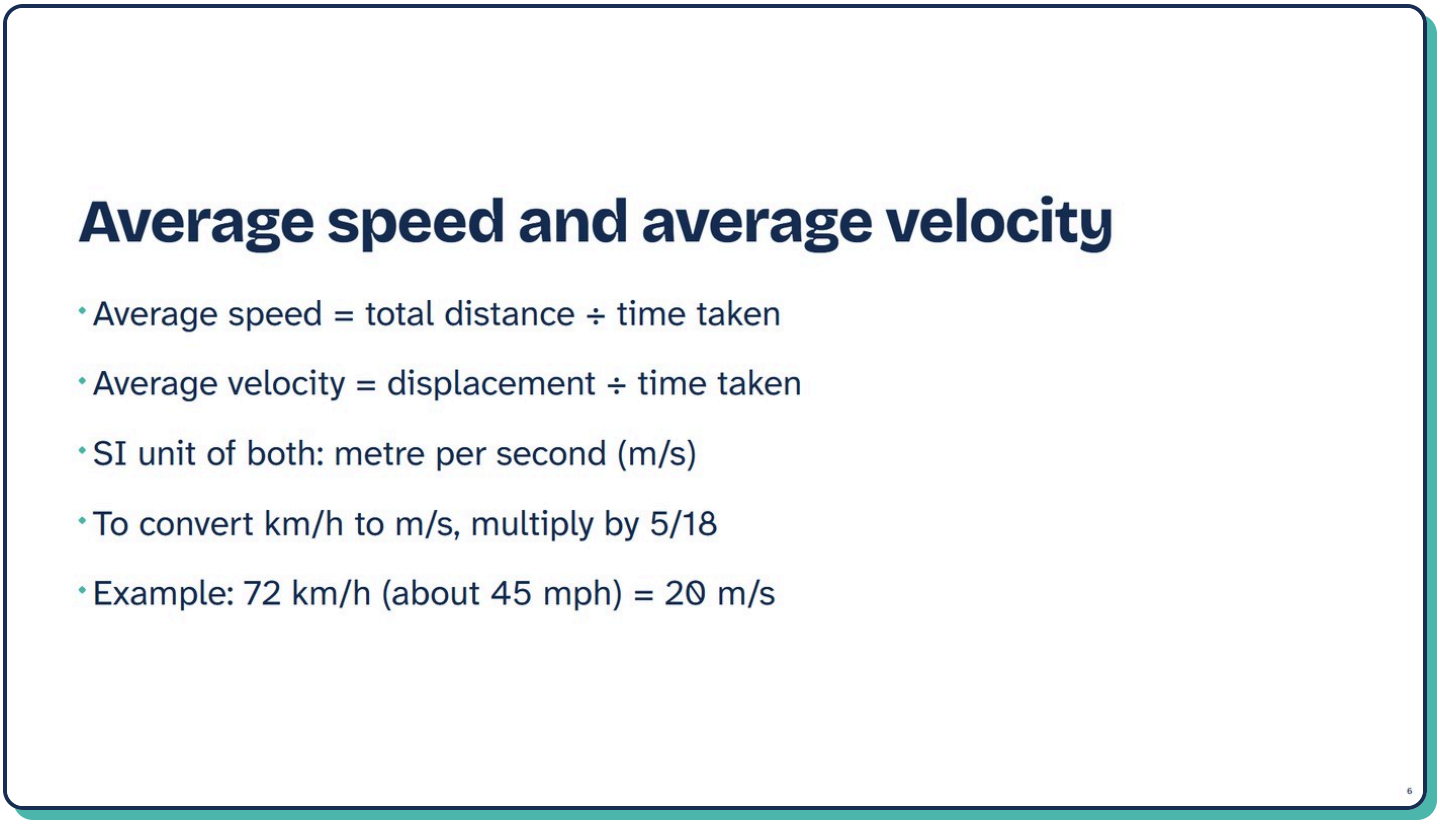
A student who runs one full lap of a school track and stops at the start has covered a distance but has zero displacement. The size of the displacement is never more than the distance. Ask: when are they equal? Only for motion in one direction along a straight line.



Riya's trip to the shop

Teacher notes

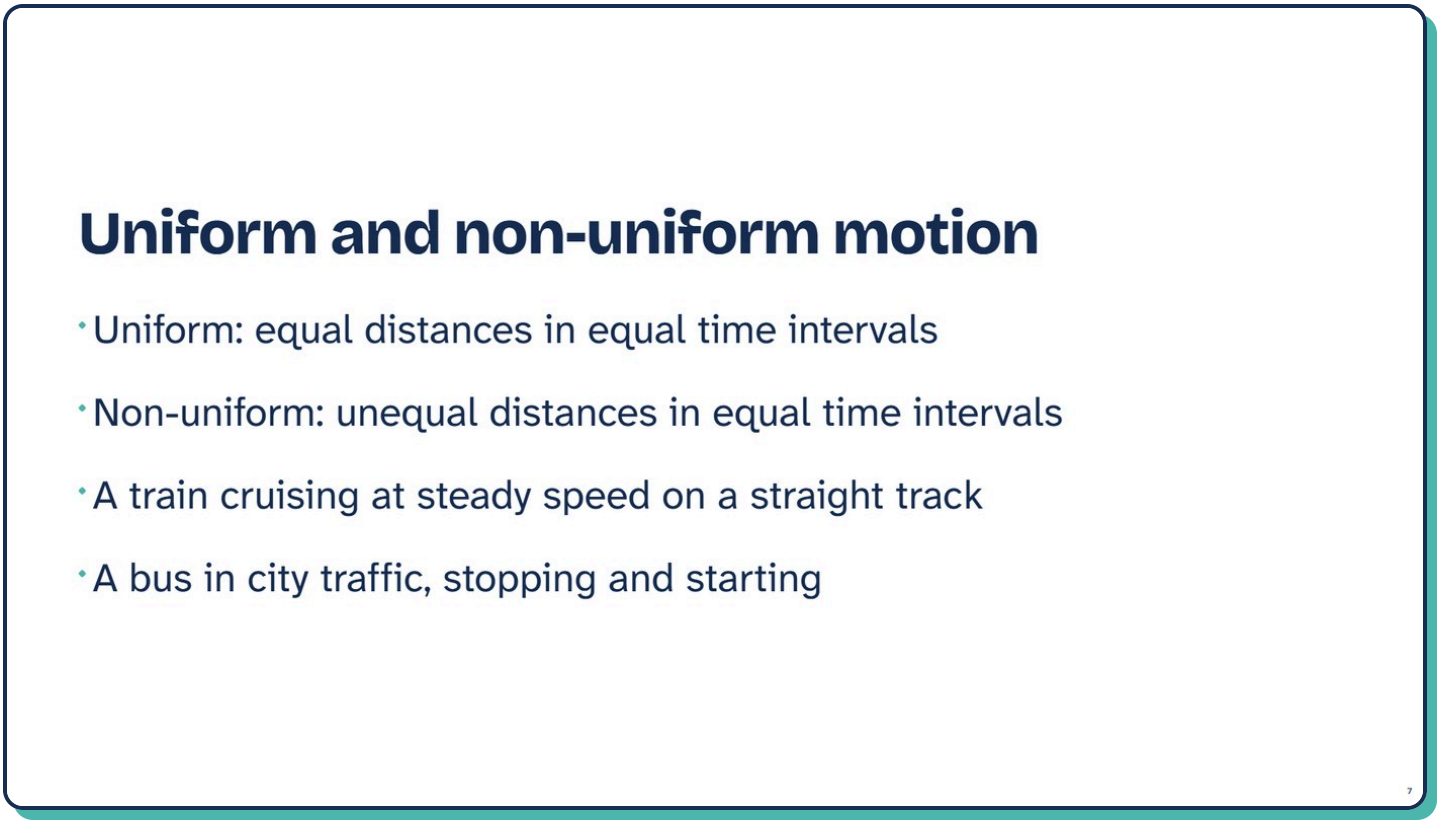
Work out each line on the board: average speed is 400 m ÷ 200 s and average velocity is 200 m ÷ 200 s. Ask why the two answers differ. The walking back cancels part of the displacement but still adds to the distance.



Average speed and average velocity

Teacher notes

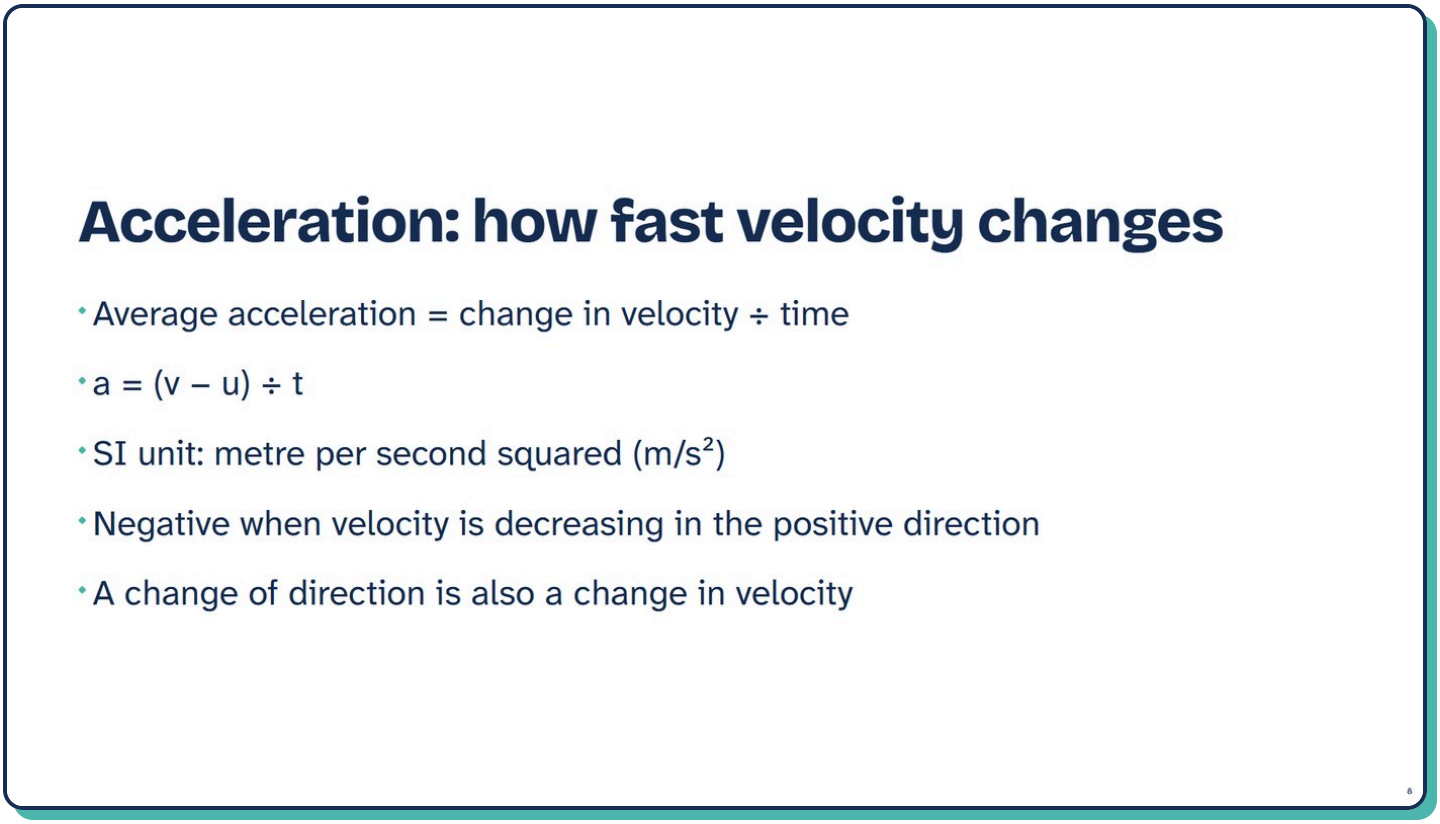
Show where 5/18 comes from: 1 km/h is 1000 m in 3600 s. Ask students to convert 36 km/h and 54 km/h; the answers are 10 m/s and 15 m/s. Remind them that velocity has a direction, so it can be negative.



Uniform and non-uniform motion

Teacher notes

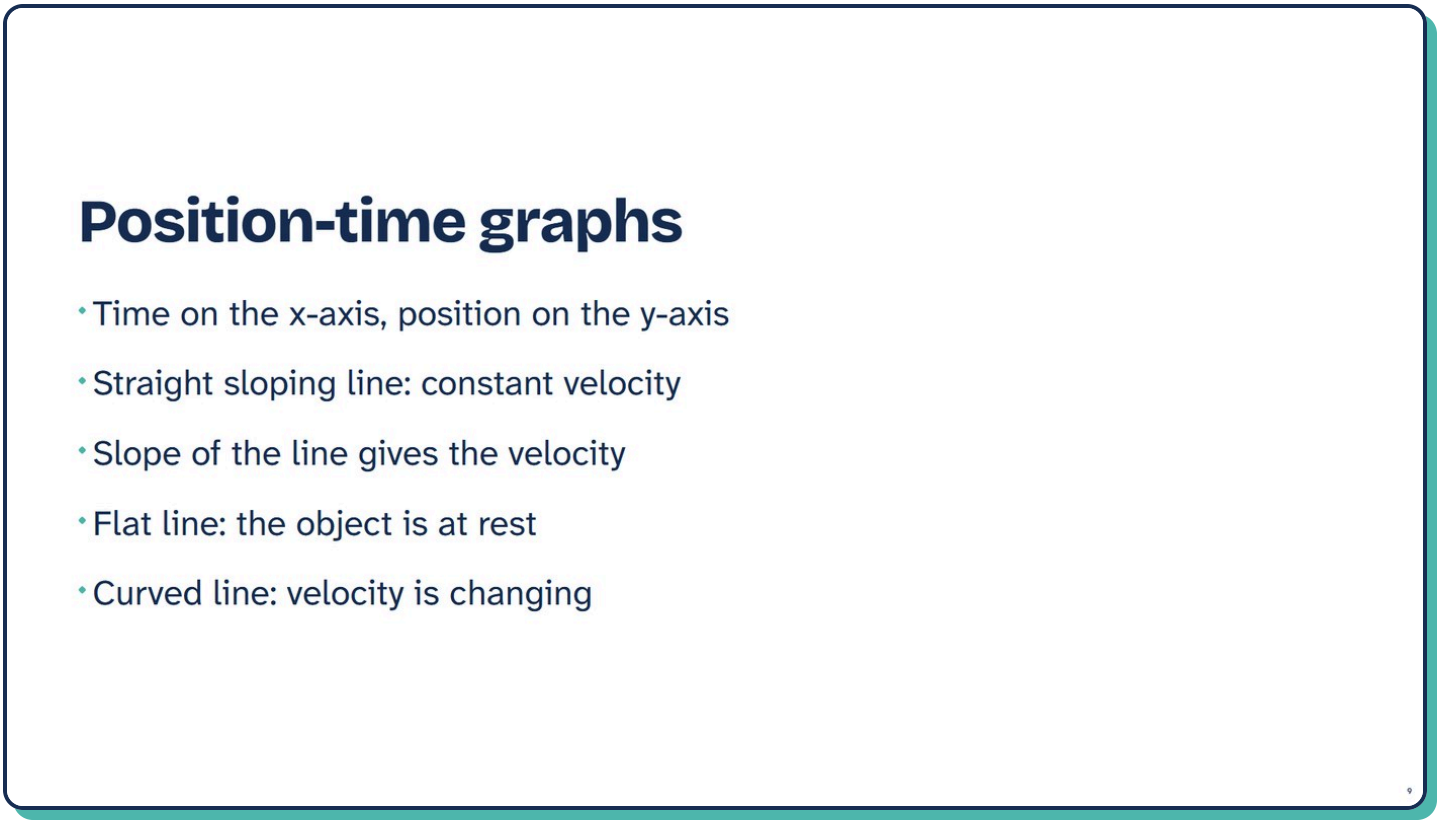
Ask students to give one example of each from their journey to school. Point out that truly uniform motion is rare in daily life; most real motion is non-uniform, which is why we talk about average speed.



Acceleration: how fast velocity changes

Teacher notes

Here u is the initial velocity and v the final velocity. Braking gives negative acceleration, which is sometimes called retardation. A common misconception is that a fast object must have a large acceleration; a car cruising at a steady 100 km/h in a straight line has zero acceleration.



Position-time graphs

Teacher notes

Sketch three quick graphs and ask students to act out each one by walking. Stress that a graph is not a map of the route; it shows how position changes with time. A steeper slope means a greater velocity.

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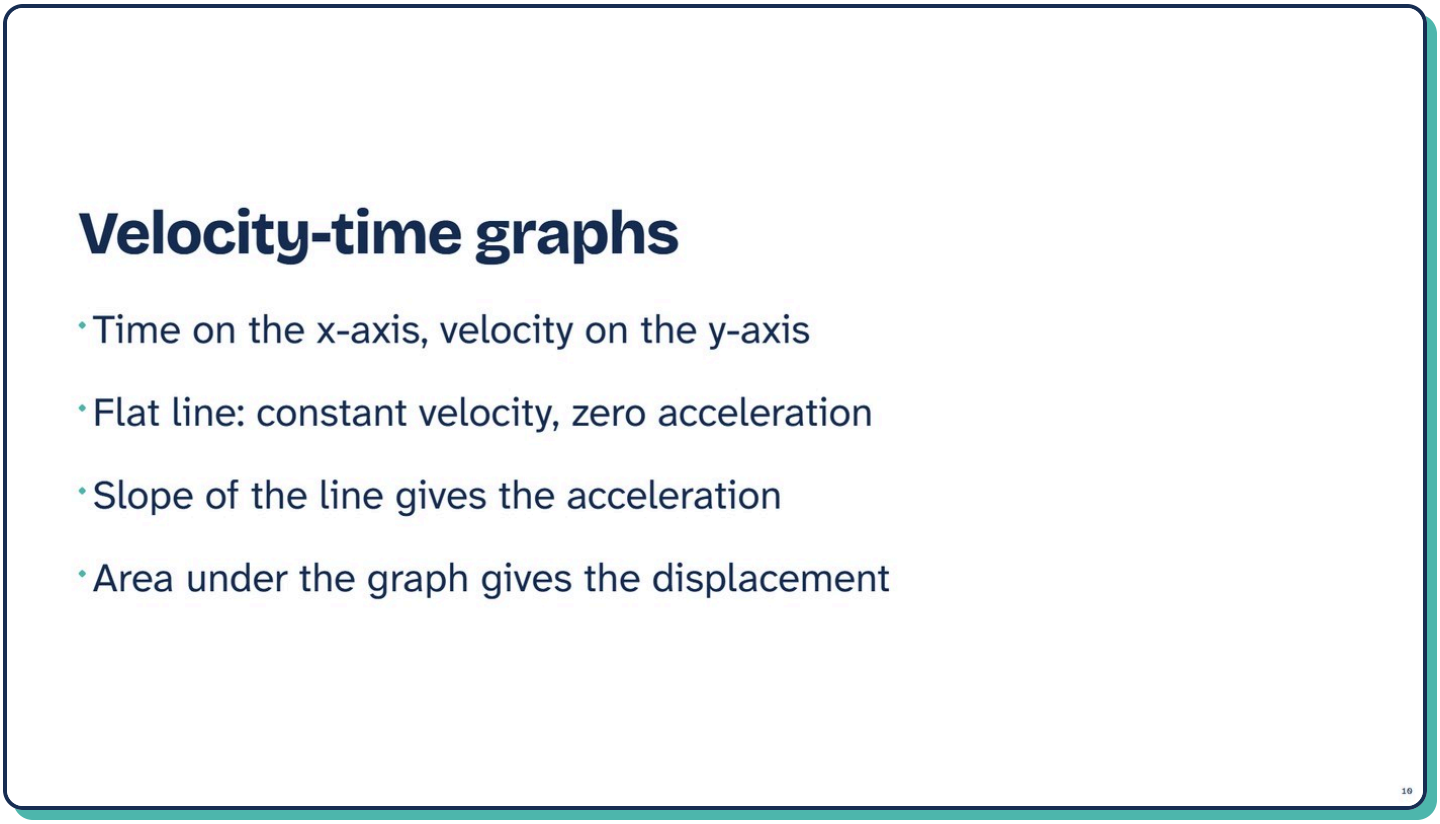
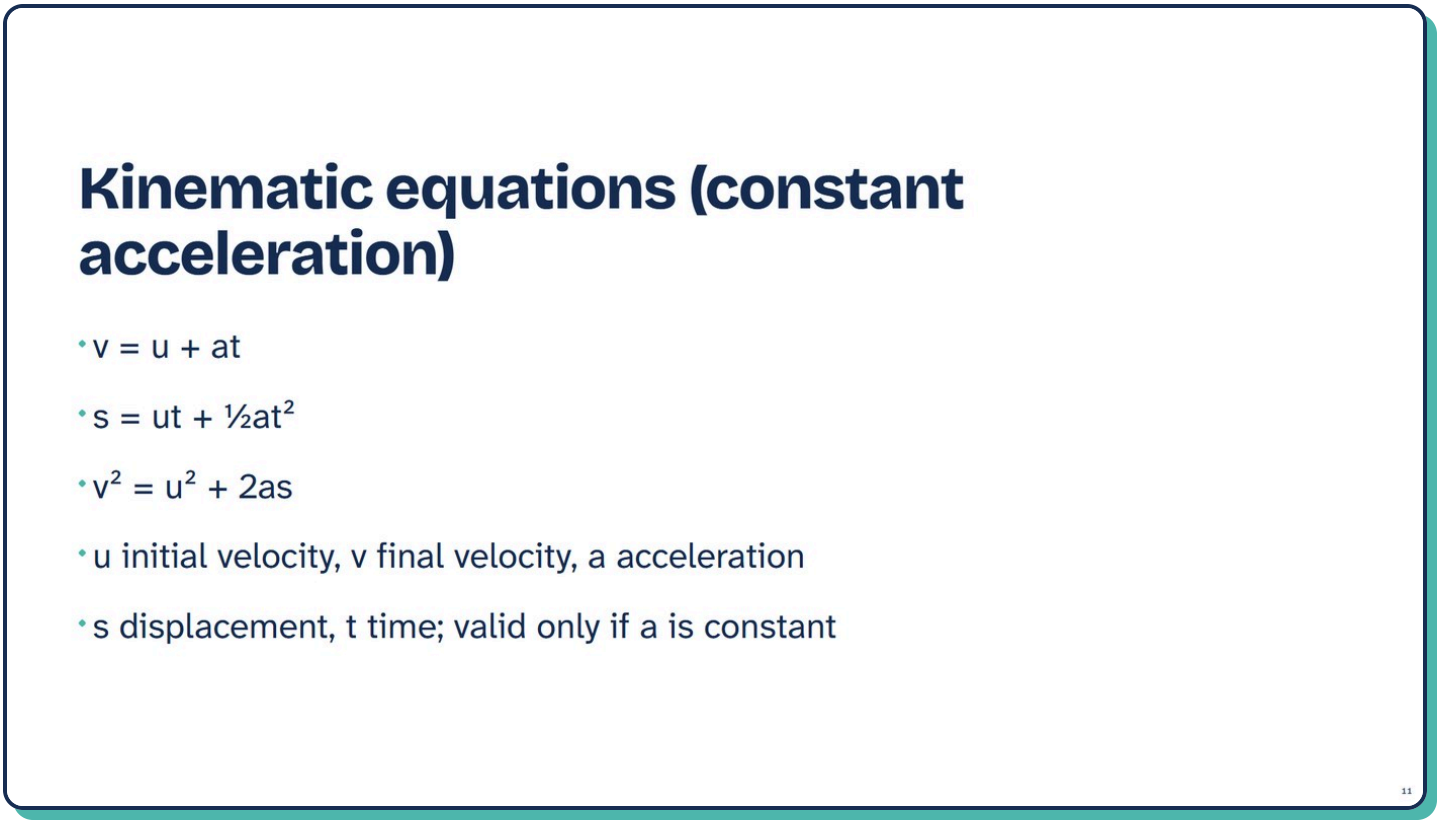


Velocity-time graphs

Teacher notes

Draw a line rising from 0 to 20 m/s over 20 s and ask for the acceleration (1 m/s^2) and the displacement (the triangle's area, 200 m). This graph is used on the next slides to build the kinematic equations.



Kinematic equations (constant acceleration)

Teacher notes

Show how each equation comes from the velocity-time graph: the slope gives the first and the area gives the second. The third is obtained by combining them to remove t. Remind students to pick the equation that contains the three quantities they know and the one they need.

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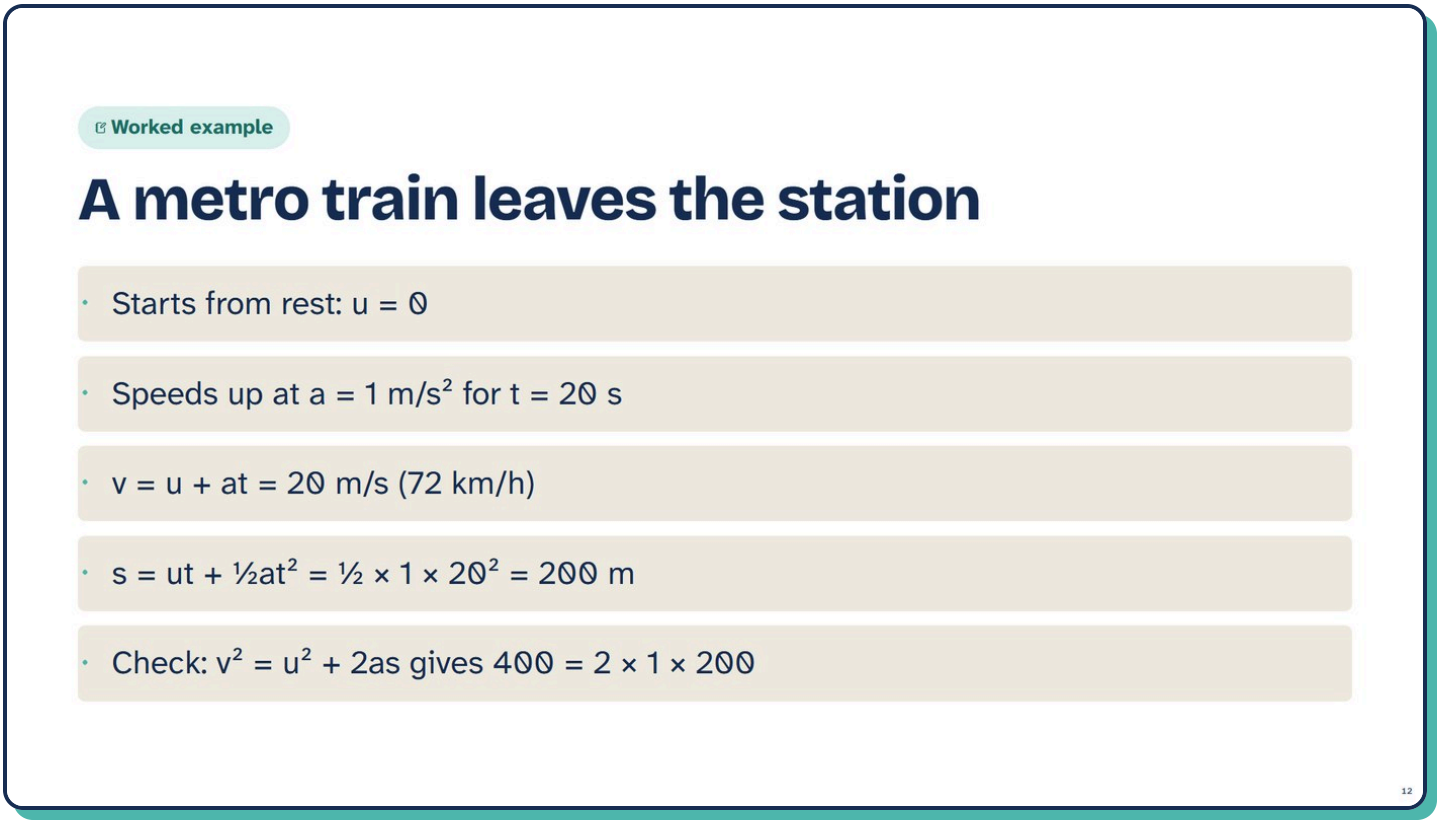
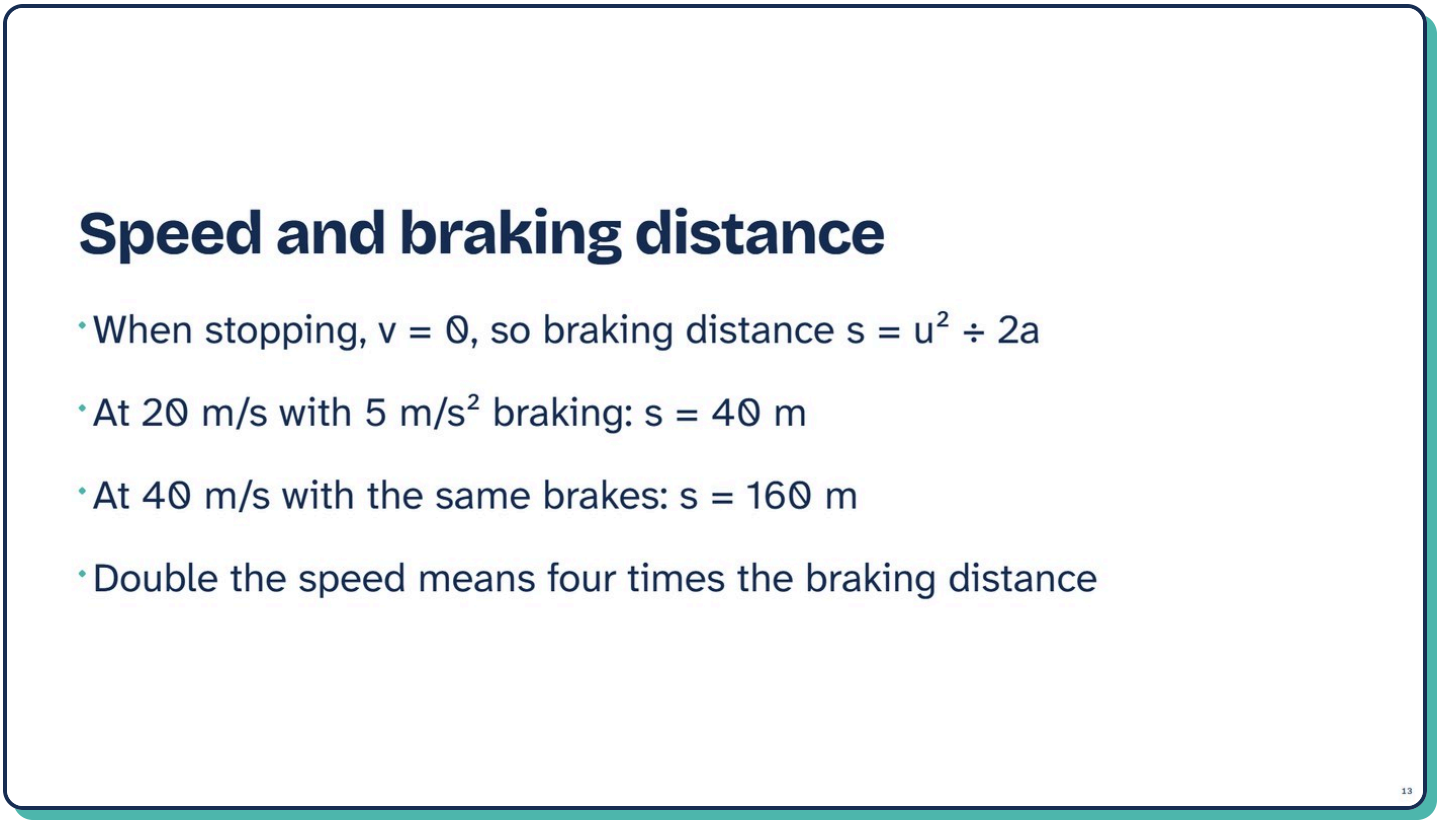


A metro train leaves the station

Teacher notes

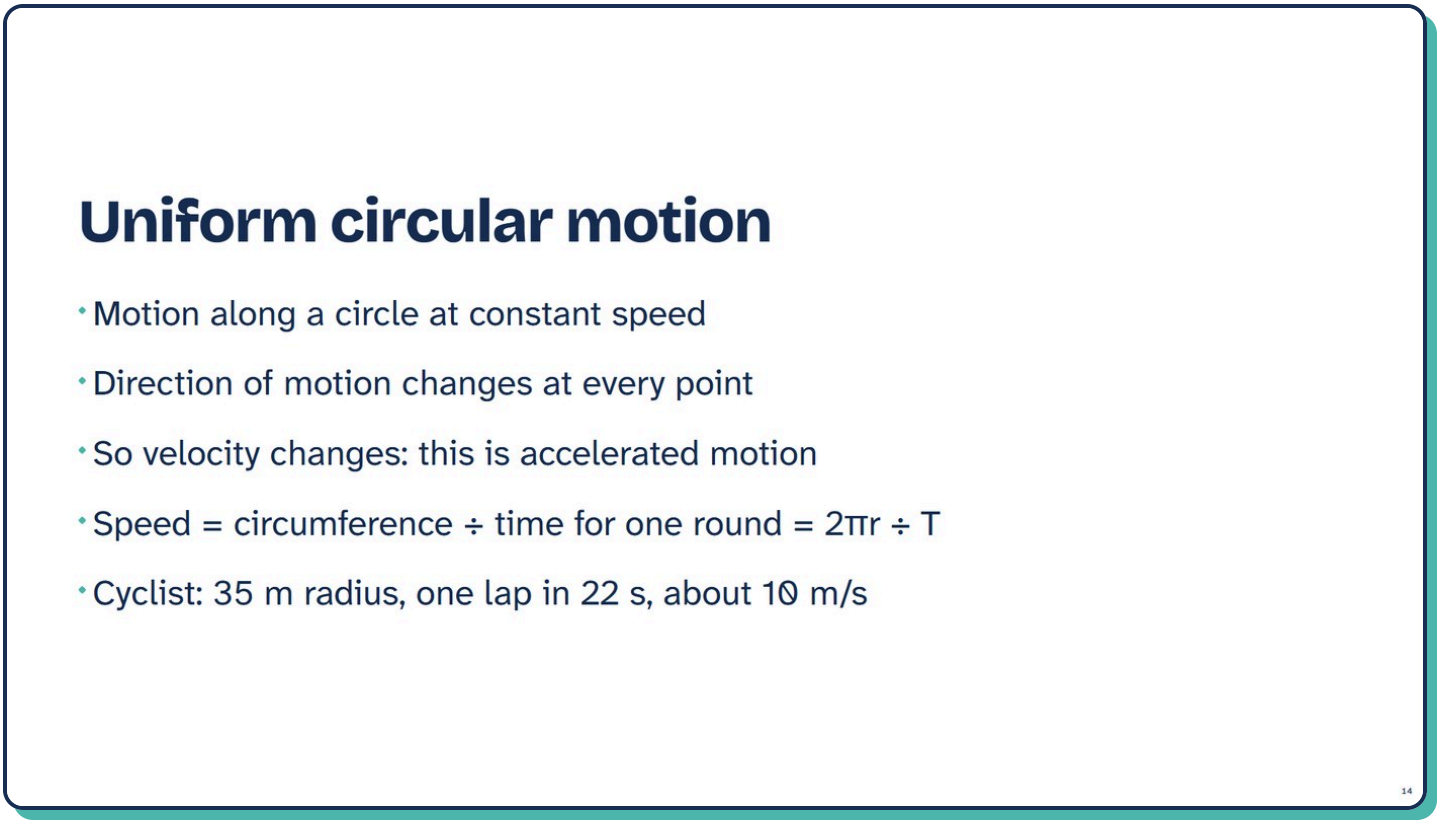
The numbers are chosen for easy arithmetic, not taken from any particular metro line. Ask students to find how far the train travels in the first 10 s; the answer is 50 m, a quarter of the distance in 20 s. Checking with a second equation is a good habit.



Speed and braking distance

Teacher notes

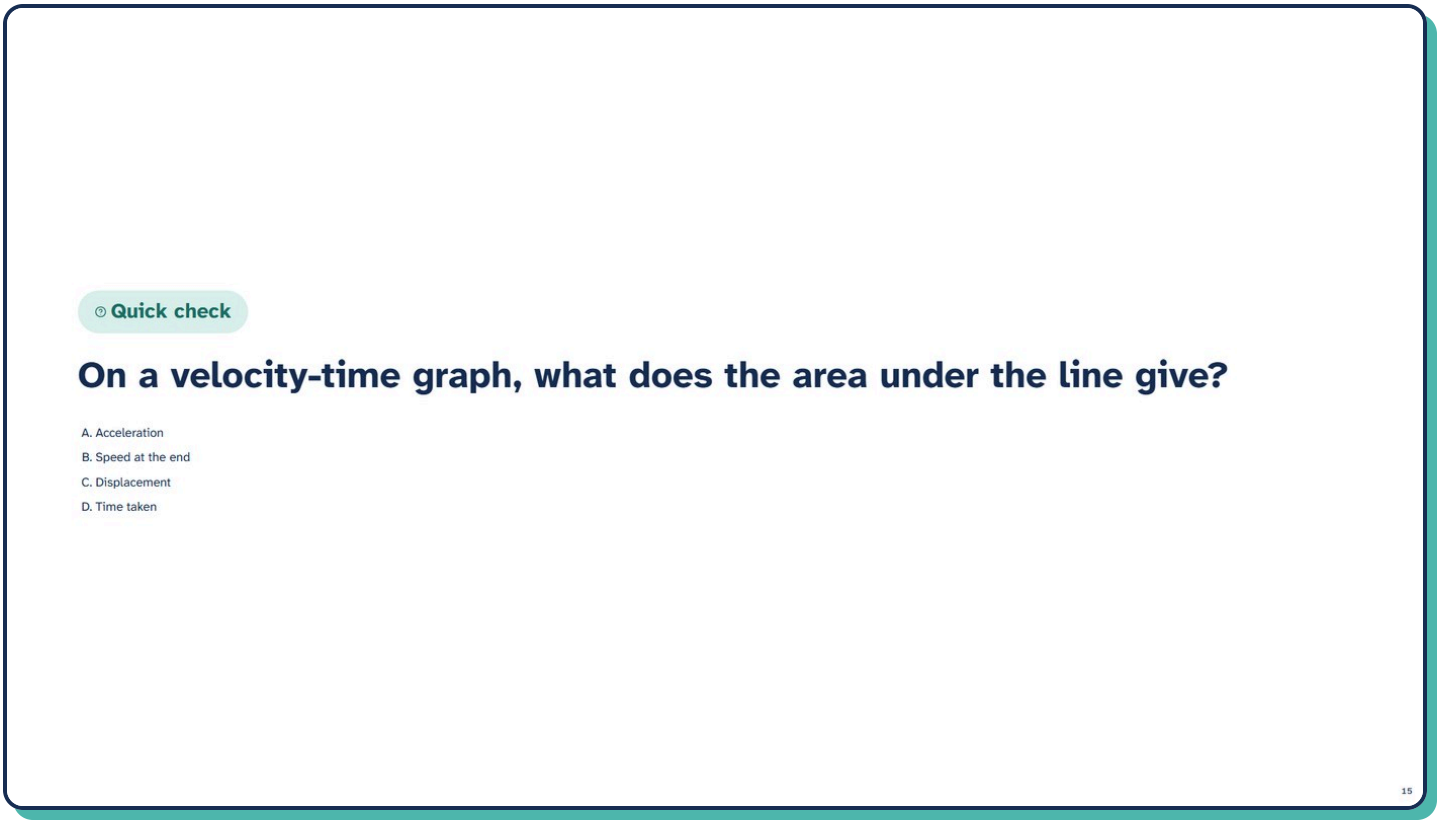
Here a is the size of the deceleration, so the minus sign has been handled. This ignores the driver's reaction time, which adds even more distance, so real stopping distances are longer. Ask students why highways have speed limits and why drivers should keep a safe gap.



Uniform circular motion

Teacher notes

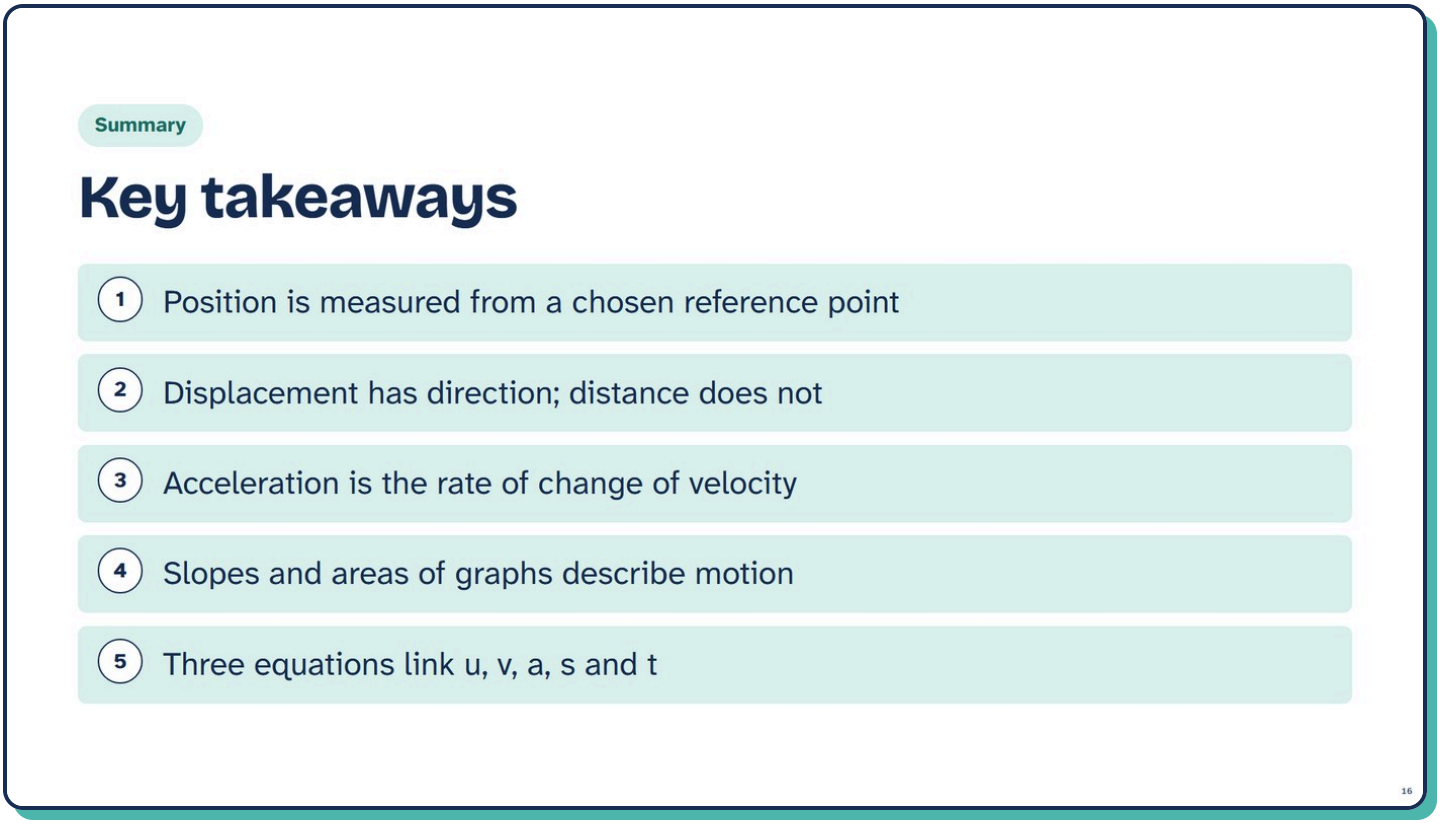
For the cyclist, 2 × (22/7) × 35 m = 220 m per lap, and 220 m ÷ 22 s = 10 m/s. After one full lap the displacement is zero, so the average velocity for the lap is zero. Ask: can an object have constant speed but still be accelerating? Yes, in circular motion.



Quick check

Teacher notes

Answer: C, displacement. The slope of a velocity-time graph gives acceleration, which is the most common wrong choice. Ask a student to explain the difference between slope and area in their own words.



Key takeaways

Teacher notes

Ask students to write the three kinematic equations from memory and say when they apply. Then move to the five-question quiz. Homework: time a vehicle or a friend over a measured distance and calculate the average speed.