Stopping Distances and Reaction Times

The stopping distance of a vehicle is the distance covered between the driver first spotting a hazard and the vehicle coming to a complete stop. It's made up of the thinking distance and the braking distance.

Stopping Distance = Thinking Distance + Braking Distance

The longer it takes a car to stop after seeing a hazard, the higher the risk of crashing. The distance it takes to stop a car (stopping distance) is divided into the thinking distance and the braking distance:

The thinking distance is the distance the car travels in the driver's reaction time (the time between noticing the hazard and applying the brakes). It's affected by two main factors:

1) Your reaction time — this is increased by tiredness, alcohol, drugs and distractions.
2) Your speed — the faster you're going, the further you'll travel during your reaction time.

The braking distance is the distance taken to stop once the brakes have been applied. It's affected by:

1) Your speed — the faster you're going, the longer it takes to stop.
2) The mass of the car — a car full of people and luggage won't stop as quickly as an empty car.
3) The condition of the brakes — worn or faulty brakes won't be able to brake with as much force.
4) How much friction is between your tyres and the road — you're more likely to skid if the road is dirty, if it's icy or wet or if the tyres are bald (tyres must have a minimum tread depth of 1.6 mm).

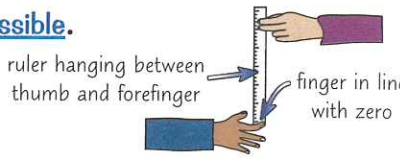
In the exam, you may need to spot the factors affecting thinking and braking distance in different situations. E.g. if a parent is driving her children to school early in the morning on an autumn day, her thinking distance could be affected by tiredness, or by her children distracting her. Her braking distance could be affected by ice, or by leaves on the road reducing the friction/grip.

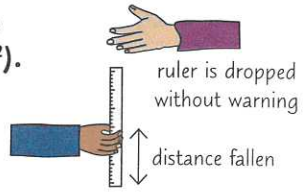
The Ruler Drop Experiment Measures Reaction Times

Everyone's reaction time is different and many different factors affect it (see above).

One way of measuring reaction times is to use a computer-based test (e.g. clicking a mouse when the screen changes colour). Another is the ruler drop test:

1) Sit with your arm resting on the edge of a table (this should stop you moving your arm up or down during the test). Get someone else to hold a ruler so it hangs between your thumb and forefinger, lined up with zero. You may need a third person to be at eye level with the ruler to check it's lined up.
2) Without giving any warning, the person holding the ruler drops it. Close your thumb and finger to try to catch the ruler as quickly as possible.
3) The measurement on the ruler at the point where it was caught is how far the ruler dropped in the time it took you to react.
4) The longer the distance, the longer the reaction time.
5) You can calculate how long the ruler was falling for (the reaction time) using the equations on p.146 because its acceleration is constant (and equal to g, 10 m/s^2).
6) It's hard to do this experiment accurately, so do a lot of repeats and take an average of the distance the ruler fell. Use this average in your calculations.
7) Make sure it's a fair test — keep the variables you aren't testing the same every time, e.g. use the same ruler for each repeat and have the same person dropping it.
8) For an experiment like this, a typical reaction time is around 0.2-0.6 s.
9) A person's reaction time in a real situation (e.g. when driving) will be longer than that, though. Typically, an alert driver will have a reaction time of about 1 s.





Stop right there — and learn this page...

Bad visibility also causes accidents — if it's foggy, it's harder to notice a hazard, so there's less room to stop.

Q1 Drivers on long journeys should take regular breaks. Explain why, in terms of stopping distance. [3 marks]

Stopping Distances and Reaction Times

1 The thinking distance for a driver in a car travelling at 40 mph is 12 m. The braking distance is 24 m.

Grade 4-6

a) State what is meant by thinking distance.

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[1]

b) Calculate the car's stopping distance when it is travelling at 40 mph.

Stopping Distance = ... m

[1]

[Total 2 marks]

2 Different people have different reaction times.

Grade 4-6

a) What is the typical reaction time for a person?

☐ **A** 1.3 – 1.8 s ☐ **B** 0.4 – 0.9 s ☐ **C** 0.1 – 0.2 s ☐ **D** 2.0 – 3.0 s

[1]

b) Give **three** factors that could affect a person's reaction time.

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[3]

[Total 4 marks]

3 A car is travelling down a road, and the driver has to brake suddenly.

Grade 4-6

a) Describe what is meant by braking distance.

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[1]

b) There are lots of leaves on the road, and the road surface is wet. Explain what effect this will have on the car's braking distance.

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[2]

[Total 3 marks]

4 The ruler drop test can be used to investigate people's reaction times. Grade 6-7

a) Describe **one** other method that can be used to test people's reaction times.

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[1]

b) Describe the steps involved when using the ruler drop experiment to investigate reaction times.

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[6]

[Total 7 marks]

5* A group of friends are driving home from a concert late at night. It is raining heavily and they are listening to loud music on the radio. Grade 6-7

Describe the factors that could affect the car's stopping distance and safety of the journey. Explain the effect each factor could have.

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[Total 6 marks]