

Factors affecting braking distance

4.5.6.3.3 · Forces · revision notes

Braking distance is how far a vehicle travels after the brakes are applied. You need to explain how speed, road and weather conditions and the condition of the brakes and tyres affect it, discuss what this means for safety, and estimate how emergency stopping distances change over a range of typical speeds.

Key facts

- Braking distance: the distance travelled under the braking force
- Wet or icy roads and worn tyres → less friction between the tyres and the road
- Car on a dry road: stopping distance ~25 m at 13 m/s, ~100 m at 31 m/s
- Increased by: greater speed, wet or icy roads, worn tyres, worn brakes, greater mass
- Worn brakes → smaller braking force → smaller deceleration

Notes

What braking distance is

- Braking distance is the distance a vehicle travels under the braking force, from when the brakes are applied until it stops.
- Braking depends on **friction**: between the brake pads and the discs on the wheels, and between the tyres and the road.

Factors that increase braking distance

- Greater speed**: the vehicle has more kinetic energy, so the brakes must do more work to stop it.
- Adverse road and weather conditions**: wet or icy roads (and loose gravel or leaves) reduce the friction between the tyres and the road. The tyres may skid, so the braking force is smaller.
- Poor condition of the tyres**: worn tyres with too little tread grip the road less, especially in the wet, because they cannot clear the water away.
- Poor condition of the brakes**: worn brakes cannot produce as large a friction force, so the deceleration is smaller.
- Greater mass**, e.g. a fully loaded vehicle: more kinetic energy at the same speed, so a longer braking distance for the same braking force.

Safety implications

- In wet or icy weather, drivers should slow down and leave a bigger gap to the vehicle in front.
- Speed limits are lower where hazards are likely, such as near schools, because stopping distance increases with speed.
- Regular checks of the brakes and the tyre tread keep braking distances as short as possible.
- Rough, high-friction road surfaces are often laid on the approach to junctions and crossings.

How to answer each type of question

Name and explain factors affecting braking distance

2 to 4 marks

Grade 4

1. Name a factor that affects the vehicle or the road, not the driver.
2. Explain its effect on friction (or on the kinetic energy to be removed).
3. Say that the braking distance increases.

Example. Give **two** factors, other than speed, that could increase the braking distance of a car. Explain why each factor increases the braking distance.

Model answer. An icy road (1): there is less friction between the tyres and the road, so the braking force is smaller (1).

Worn brakes (1): the brakes produce a smaller friction force, so the deceleration is smaller (1).

Don't lose marks

- ✗ Listing tiredness, alcohol or phones as factors that affect braking distance. They affect the thinking distance.
- ✗ Writing 'the road is slippery' without explaining that there is less friction between the tyres and the road.
- ✗ Writing 'bad tyres' without saying what is wrong (worn, too little tread) and what it does (less grip, less friction).
- ✗ Forgetting that a heavier, loaded vehicle has a longer braking distance at the same speed and braking force.

More tips

Memory tricks

- Braking distance factors are about the vehicle and the road: speed, mass, brakes, tyres, surface.
- Every factor comes back to one of two ideas: more kinetic energy to remove, or less friction to remove it with.
- Rough guide: wet roads can double the braking distance.

Exam technique

- Structure your answer: factor → effect on friction or kinetic energy → effect on braking distance.
- In estimate questions, state any values you assume and round your answer sensibly.
- Say 'friction between the tyres and the road' rather than just 'grip'.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Name factors that increase braking distance

Higher speed, wet or icy roads, worn brakes and worn tyres.

Grade 4

Explain how wet or icy roads affect braking

There is less friction between the tyres and the road, so the braking distance is longer.

Grade 5

Explain the effects of worn tyres and brakes

Worn tyres grip the road less; worn brakes produce a smaller friction force.

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