THE PHYSICS QUESTION BANK · AQA GCSE PHYSICS

Road Safety Campaign – Stopping Distances

A one-hour lesson. Find out why a car needs so much room to stop, use real stopping-distance data, then design a road safety campaign for the road outside a school.

Name: _____ Class: _____ Date: _____

How to use this worksheet: work through the steps in order and write your answers in your exercise book. Copy every blue 📝 box neatly – these are your revision notes. When you have finished a step, check your work against the **Answers** at the end and correct anything in a different colour.

📝 COPY INTO YOUR BOOK

By the end of this lesson I will be able to:

1. explain thinking distance and braking distance

2. list what affects each one

3. use data to show how speed changes stopping distance

4. describe how to measure reaction time.

Step 1: Starter (5 minutes)

A car is driving at 30 mph. A child runs out in front of it. **Guess:** how many car lengths does it travel before it stops? (A car is about 4 m long.)

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Stopping distance = thinking distance + braking distance

Thinking distance: how far the car travels during the driver's reaction time.

Braking distance: how far the car travels once the brakes are applied.

Step 2: Read and write (8 minutes)

Copy these three questions into your book. Then read the text and answer them in full sentences.

1. What two distances add up to the stopping distance?
2. Give three things that increase a driver's reaction time.
3. Give three things that increase braking distance.

📖 READ

Why can't a car stop straight away?

When a driver sees a hazard, the car doesn't stop straight away. First the driver has to react. The distance the car travels during this **reaction time** is the **thinking distance**. Then the driver brakes, and the car travels a further distance while it slows down – the **braking distance**. Together they make the **stopping distance**.

Reaction time is longer if the driver is **tired**, has drunk **alcohol**, has taken **drugs**, or is **distracted** – for example by a phone. Braking distance is longer if the car is going **faster**, if the

road is **wet or icy**, or if the **tyres or brakes are worn**. A heavier vehicle also needs longer to stop.

📝 **COPY AND COMPLETE**

Thinking distance increases if the driver is _____, has drunk _____, or is _____. Braking distance increases if the road is _____ or _____, or if the tyres or brakes are _____.

Step 3: Key facts (5 minutes)

During the reaction time, the car travels at full speed. At higher speeds, a bigger braking force is needed to stop in time – very large decelerations can make the brakes overheat or the car skid.

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A typical reaction time is between 0.2 s and 0.9 s.

When a car brakes, friction does work on the wheels. This transfers energy from the car's kinetic energy store to the thermal energy store of the brakes, which heat up.

Step 4: Read the data (8 minutes)

Typical stopping distances for a car on a dry road (Highway Code):

Speed	Thinking distance	Braking distance	Stopping distance
20 mph	6 m	6 m	12 m
30 mph	9 m	14 m	23 m
40 mph	12 m	24 m	36 m
50 mph	15 m	38 m	53 m
60 mph	18 m	55 m	73 m
70 mph	21 m	75 m	96 m

Q1 What happens to the thinking distance when the speed doubles from 20 to 40 mph?

Q2 What happens to the braking distance when the speed doubles from 20 to 40 mph?

Q3 A driver using their phone has double the thinking distance. What is their stopping distance at 30 mph?

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If the speed doubles: thinking distance doubles, but braking distance goes up about 4 times.

Step 5: Main task – Road Safety Campaign (14 minutes)

The council has asked you to design a campaign to persuade drivers to slow to 20 mph outside a primary school. Plan your poster or leaflet. It must include:

- A headline that grabs drivers' attention.
- Two facts from the data table, e.g. comparing 20 mph and 30 mph.
- One warning about reaction time (phones, tiredness or alcohol), explaining WHY it matters.
- One warning about road conditions, explaining WHY wet or icy roads are dangerous.
- A physics explanation using the words kinetic energy and braking force.

Use "…so…" to link each fact to what it means for a child crossing the road.

Step 6: Exam practice (15 minutes)

> 📝 **COPY INTO YOUR BOOK**
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> **Thinking distance = speed × reaction time (s = v t). Speed in m/s, time in s, distance in m.**

Q1 (3 marks) A car travels at 13 m/s. The driver's reaction time is 0.7 s. Calculate the thinking distance.

Q2 (4 marks) Explain why a car's braking distance is greater on a wet road with worn tyres.

Q3 (6 marks) Describe how a student could use a ruler to measure a person's reaction time, and how to make the results as accurate as possible.

✅ Add up your marks out of 13.

Step 7: Exit ticket (5 minutes)

If you have a ruler and a partner, try the ruler-drop test three times each. Then finish:

- The most surprising thing I learned today is…
- Doubling the speed makes the braking distance about… times longer.
- One thing I'm still not sure about is…

Answers

Only look at these once you have written your own answer!

Step 1: Starter (5 minutes)

About 23 m – roughly 6 car lengths. The car keeps moving at full speed while the driver reacts, before the brakes even start working.

Step 2: Read and write (8 minutes)

(1) Thinking distance + braking distance. (2) Any three: tiredness, alcohol, drugs, distractions such as a phone. (3) Any three: higher speed, wet or icy roads, worn tyres, worn brakes, heavier vehicle.

Gaps: tired · alcohol · distracted · wet · icy · worn

Step 4: Read the data (8 minutes)

Q1 It doubles (6 m → 12 m). Q2 It goes up four times (6 m → 24 m) – kinetic energy = ½mv², so doubling speed gives four times the energy. Q3 18 + 14 = 32 m.

Step 5: Main task – Road Safety Campaign (14 minutes)

Model: Headline – "At 30, you need 11 more metres to stop. Our children don't have them." Data – 12 m at 20 mph vs 23 m at 30 mph. Reaction time – a phone increases reaction time, so the car travels further before braking. Road conditions – wet or icy roads reduce friction, so braking distance increases. Physics – a faster car has much more kinetic energy, so the brakes must do more work; with the same braking force that takes a longer distance.

Step 6: Exam practice (15 minutes)

Q1: s = v t (1); s = 13 × 0.7 (1); s = 9.1 m (1).

Q2: Wet road and worn tyres reduce friction between tyres and road (1); so the maximum braking force without skidding is smaller (1); smaller force gives smaller deceleration (1); so the car travels further before stopping (1).

Q3: Arm resting on a table, hand over the edge; partner holds a metre ruler with zero level with the top of the thumb; partner drops it without warning and the person catches it; record the distance fallen; convert distance to reaction time with a table or equation (longer distance = longer time); repeat at least 5 times, calculate a mean, ignore anomalies, vary the time before dropping.