

GCSE Physics (9 – 1)

Stopping Distances

Name:

Group:



Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.

For markers use	
Question	Mark
1	/5
2	/12
3	/6
4	/11
5	/6
Total	/40
%	
Grade	

Information

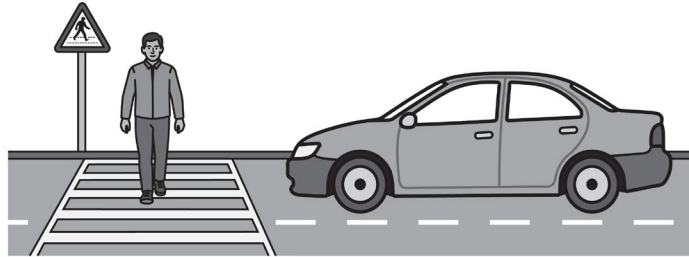
- The maximum mark for this paper is 40 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Whether it is a skydiver in freefall or a car braking at a junction, acceleration is the fundamental measure of how an object's velocity changes.

For each of the following questions **circle** the letter of the correct answer.

- a) A driver is travelling along a road when they suddenly see a hazard. They hit the brake pedal, and the car comes to a stop.



Which factor below will **only** increase the thinking distance of the driver?

- A The driver has consumed alcohol.
- B The road surface is wet and icy.
- C The car has worn brake pads.
- D The car is carrying a heavy load of passengers.

(1 mark)

- b) When a car brakes sharply, kinetic energy is transferred into another store of energy, causing the temperature of the brakes to increase.

Which energy store is the kinetic energy transferred into?

- | A | B | C | D |
|-----------------|--------------------------|--------------------------------|----------------|
| Chemical energy | Elastic potential energy | Gravitational potential energy | Thermal energy |

(1 mark)

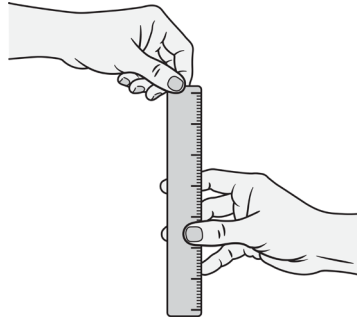
- c) A car is travelling at 20 m/s. Its braking distance is 24 m.

If the car doubles its speed to 40 m/s, what will its new braking distance be?

- | A | B | C | D |
|------|------|------|------|
| 24 m | 48 m | 72 m | 96 m |

(1 mark)

- d) A student drops a ruler between another student's fingers to test their reaction time. The figure below shows the drop.



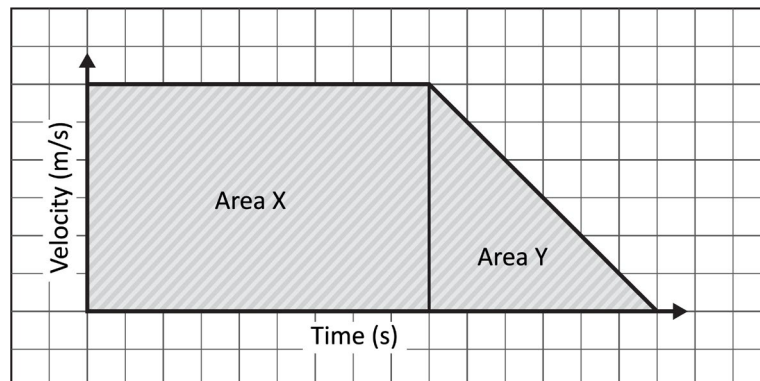
Why is a ruler drop test a valid way to measure reaction time?

- A The mass of the ruler is constant.
- B The ruler falls with a constant acceleration due to gravity.
- C The ruler reaches terminal velocity instantly.
- D The car is carrying a heavy load of passengers.

(1 mark)

- e) A train driver receives an automated signal to stop at the next station.

The train coasts at a constant speed for a few seconds before the driver applies the brakes, bringing the train to a halt. The velocity-time graph below shows the train's journey.



Which statement about the shaded areas under the graph is correct?

- A Area X is the braking distance and area Y is the distance travelled before the braking.
- B Area X is the time taken to brake, and area Y is the total stopping distance.
- C Area X is the distance travelled before the braking, and area Y is the braking distance.
- D Area X and area Y combined represent the braking distance.

(1 mark)

(Total for Question 1 is 5 marks)

2. A car manufacturer is testing the brakes on a new vehicle.

The car has a mass of 1400 kg.

During the test, the car is travelling at a steady velocity of 20 m/s. The driver presses the brake pedal, and the car comes to a complete stop over a braking distance of 35 m.

- a) Calculate the kinetic energy of the car just before the driver presses the brakes.

Kinetic energy = ... J
(3 marks)

- b) State the amount of work done by the brakes to bring the car to a stop.

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(1 mark)

- c) Use your answer to part (b) to calculate the average braking force exerted by the brakes.

Braking force = ... N
(3 marks)

d) State the equation that links acceleration, mass and resultant force.

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(1 mark)

e) Calculate the deceleration of the car as it brakes.

Deceleration = ... m/s^2
(2 marks)

f) Explain, using calculations if you wish, why doubling the speed of the car to 40 m/s would cause the braking distance to increase by a factor of four.

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(2 marks)

(Total for Question 2 is 12 marks)

3. A passenger jet touches down on a runway.



At the exact moment it touches down, the jet has 196,000 kJ of kinetic energy.
The jet has a mass of 80,000 kg.

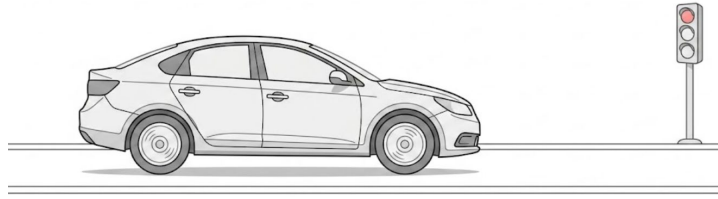
The thrust reversers and the wheel brakes apply a combined braking force of 250,000 N until the jet comes to a complete stop.

Calculate the total distance the jet travels along the runway before it stops.
You must show all of your working.

Braking distance = ... m
(6 marks)

(Total for Question 3 is 6 marks)

4. A driver is travelling along a straight road. They see a traffic light turn red ahead of them.



The car has a mass of 1200 kg and is travelling at a velocity of 15 m/s.

- a) Calculate the kinetic energy of the car before the driver presses the brakes.

Kinetic energy = ... J
(3 marks)

- b) The driver presses the brake pedal. The brakes apply a force of 6000 N to stop the car.
Assuming that all of the kinetic energy is transferred to the brakes, calculate the braking distance of the car.

Braking distance = ... m
(3 marks)

- c) State the energy transfer that takes place as the brakes are applied.

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(1 mark)

d) Explain the factors that can cause the **thinking distance** of a driver to **increase**.

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(4 marks)

(Total for Question 4 is 11 marks)

5. The total stopping distance of a vehicle is made up of the thinking distance and the braking distance.

Explain the factors that can cause the **braking distance** of a car to **increase**.

You should explain how each factor physically affects the braking of the car.

[illegible]

(6 marks)

(Total for Question 5 is 6 marks)