AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.3.4

Factors affecting braking distance 2

Past-paper questions

Tier	**Foundation**
Question groups	**14**
Available paper years	**2008–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

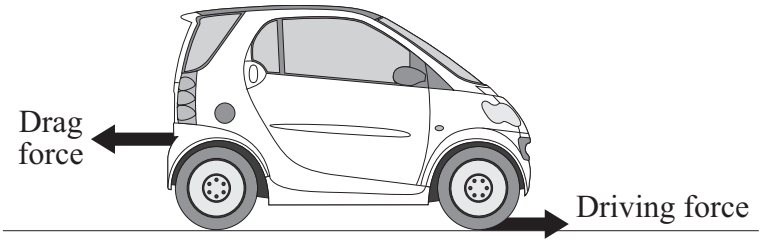
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.6.3.4 Factors affecting braking distance 2

Question 01

January 2008 | PHY2F | Original Q3 | Legacy

3 The diagram shows the horizontal forces acting on a car travelling along a straight road.



(a) Complete the following sentences by drawing a ring around the correct word in each box.

(i) When the driving force equals the drag force, the speed of the car is

decreasing
constant
increasing

.

(1 mark)

(ii) Putting the brakes on transforms the car's kinetic energy mainly into

heat
light
sound

.

(1 mark)

4.5.6.3.4 Factors affecting braking distance 2

Question 01 · continued

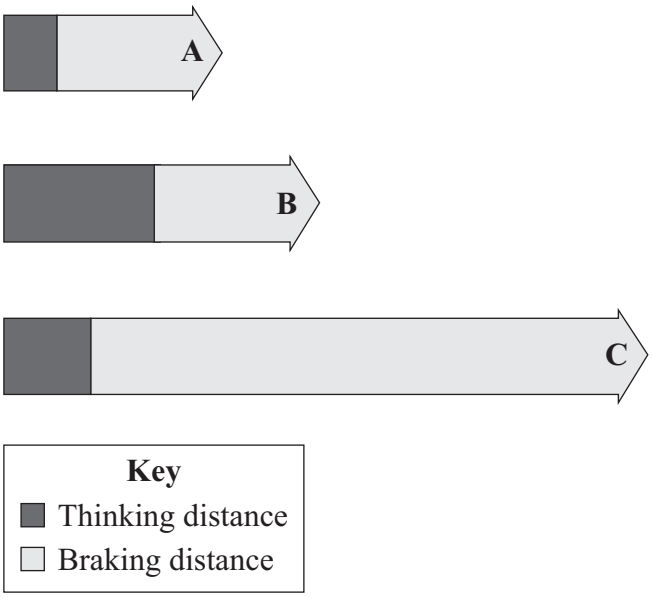
BLANK

(b) The charts, **A**, **B** and **C** give the thinking distance and the braking distance for a car driven under different conditions.

(i) Draw straight lines to match each chart to the correct conditions.

Draw only **three** lines.

Conditions	Charts
Speed = 22 m/s driver wide awake	
Speed = 13 m/s driver wide awake	
Speed = 13 m/s driver very tired	



(2 marks)

(ii) The three charts above all apply to dry road conditions.

How would the braking distances be different if the road were wet?

.....

.....

(1 mark)

5

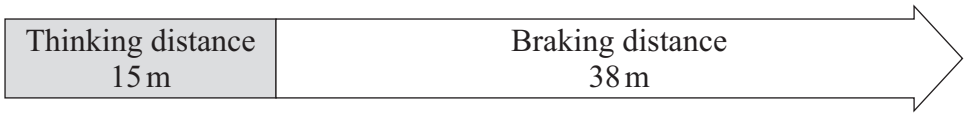
4.5.6.3.4 Factors affecting braking distance 2

Question 02

June 2008 | PHY2F | Original Q1 | Legacy

1 (a) A car driver makes an emergency stop.

The chart shows the 'thinking distance' and the 'braking distance' needed to stop the car.



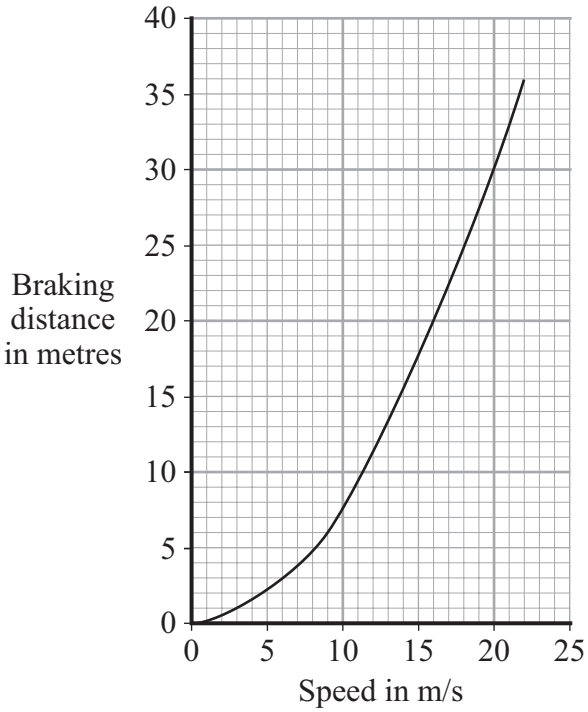
Calculate the total stopping distance of the car.

.....

Stopping distance = ... m

(1 mark)

1 (b) The graph shows how the braking distance of a car driven on a dry road changes with the car's speed.



The braking distance of the car on an icy road is longer than the braking distance of the car on a dry road.

1 (b) (i) Draw a new line on the graph to show how the braking distance of the car on an icy road changes with speed.

(2 marks)

Question 1 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 02 · continued

for mark

1 (b) (ii) Which **two** of the following would also increase the braking distance of the car?

Put a tick (✓) in the box next to each of your answers.

rain on the road ☐

the driver having drunk alcohol ☐

car brakes in bad condition ☐

the driver having taken drugs ☐

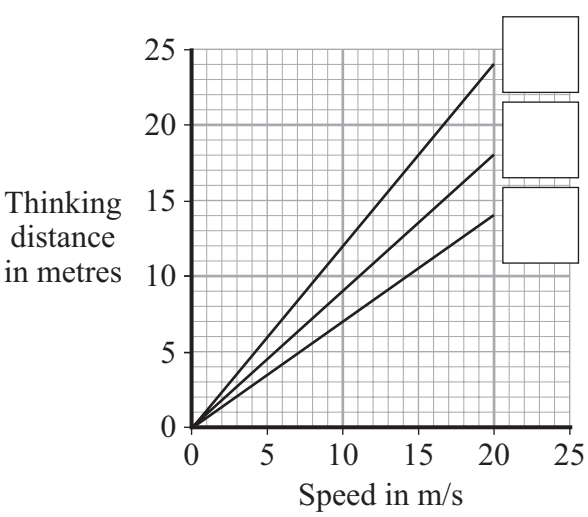
(2 marks)

1 (c) The thinking distance depends on the driver's reaction time.

The table shows the reaction times of three people driving under different conditions.

Car driver	Condition	Reaction time in seconds
A	Wide awake with no distractions	0.7
B	Using a hands-free mobile phone	0.9
C	Very tired and listening to music	1.2

The graph lines show how the thinking distance for the three drivers, **A**, **B** and **C**, depends on how fast they are driving the car.



1 (c) (i) Match each graph line to the correct driver by writing **A**, **B** or **C** in the box next to the correct line.

(2 marks)

4.5.6.3.4 Factors affecting braking distance 2

Question 02 · continued

for mark

1 (c) (ii) The information in the table cannot be used to tell if driver **C**'s reaction time is increased by being tired **or** by listening to music.

Explain why.

.....

.....

.....

.....

(2 marks)

9

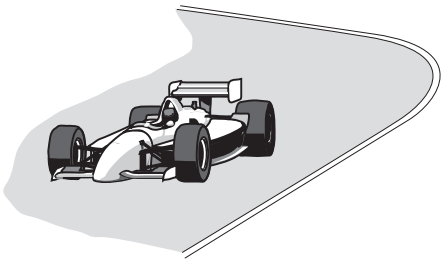
Turn over for the next question

4.5.6.3.4 Factors affecting braking distance 2

Question 03

January 2009 | PHY3F | Original Q3 | Legacy

3 (a) Complete the following sentence by drawing a ring around the correct line in the box.



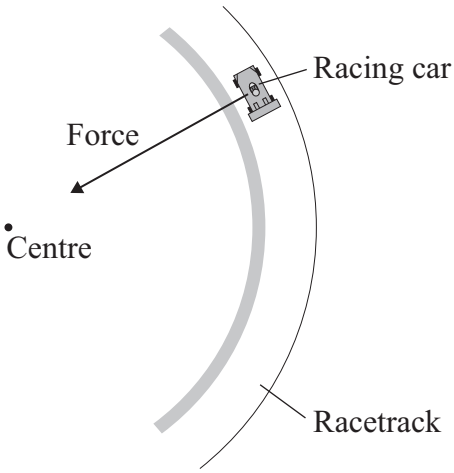
A racing car can accelerate by changing

its direction only
its speed only
either its direction or its speed

.

(1 mark)

3 (b) A racing car moves round a circular part of a racetrack.



A force acts on the racing car. The force is towards the centre of the circular part of the racetrack.

4.5.6.3.4 Factors affecting braking distance 2

Question 03 · continued

for mark

Complete the following sentences by drawing a ring around the correct line in each of the boxes.

3 (b) (i) The force is caused by

electrostatics
friction
gravity

.

(1 mark)

3 (b) (ii) The force is a

centripetal force
circular force
perpendicular force

.

(1 mark)

3 (b) (iii) If another racing car has a greater mass and travels at the same speed around the same racetrack, then the force will need to

decrease
stay the same
increase

.

(1 mark)

3 (b) (iv) When the racing car goes faster, the force will need to

decrease
stay the same
increase

.

(1 mark)

Question 3 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 03 · continued

for mark

3 (c) This is an item from a newspaper.

No to racetrack plan

At last night's meeting, one local resident said, "The racetrack will be noisy but motor racing leads to safety improvements in all our cars."

"We'll need better brakes. Motor racing encourages speeding and leads to more accidents", said another.

Most of the residents were against the plan to build a racetrack.

Do you agree with most of the residents?

Put a tick (✓) in the box next to your answer and explain.

Yes ☐ No ☐ Not sure ☐

.....

.....

.....

.....

(2 marks)

7

4.5.6.3.4 Factors affecting braking distance 2

Question 04

January 2013 | PH2FP | Original Q8 | Legacy

8 A car has an oil leak. Every 5 seconds an oil drop falls from the bottom of the car onto the road.

8 (a) What force causes the oil drop to fall towards the road?

.....

(1 mark)

8 (b) The diagram shows the spacing of the oil drops left on the road during part of a journey from A to B.



Describe the motion of the car as it moves from **A** to **B**.

.....

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

8 (c) When the brakes are applied, a braking force slows down and stops the car.

8 (c) (i) The size of the braking force affects the braking distance of the car.

State **one** other factor that affects the braking distance of the car.

.....

(1 mark)

4.5.6.3.4 Factors affecting braking distance 2

Question 04 · continued

8 (c) (ii) A braking force of 3 kN is used to slow down and stop the car in a distance of 25 m.

Calculate the work done by the brakes to stop the car and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Work done =.....

(3 marks)

8

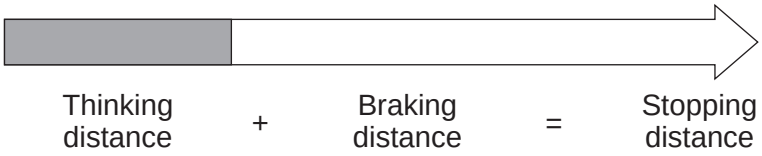
Turn over for the next question

4.5.6.3.4 Factors affecting braking distance 2

Question 05

June 2013 | PH2FP | Original Q6 | Legacy

6 The diagram shows how the thinking distance and braking distance of a car add together to give the stopping distance of the car.



6 (a) Use words from the box to complete the sentence.

distance	**energy**	**force**	**time**

The stopping distance is found by adding the distance the car travels during the driver's reaction ..... and the distance the car travels under the braking ..... . *(2 marks)*

6 (b) Which **one** of the following would **not** increase the thinking distance?

Tick (✓) **one** box.

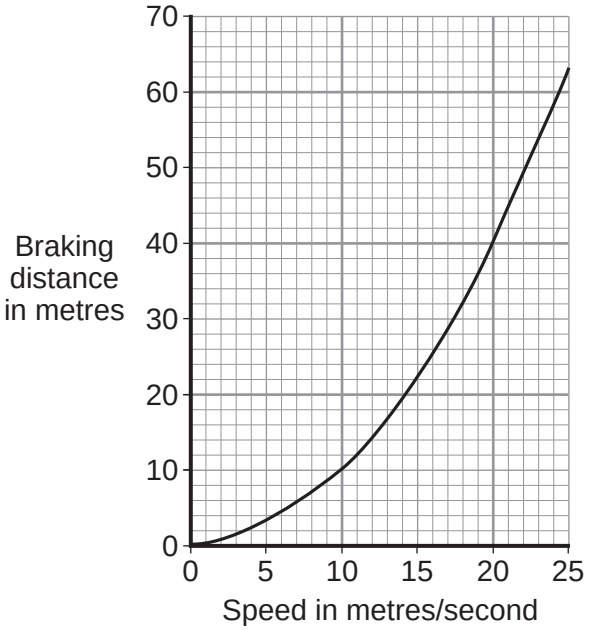
The car driver being tired. ☐

The car tyres being badly worn. ☐

The car being driven faster. ☐

(1 mark)

6 (c) The graph shows how the braking distance of a car changes with the speed of the car. The force applied to the car brakes does not change.



4.5.6.3.4 Factors affecting braking distance 2

Question 05 · continued

6 (c) (i) What conclusion about braking distance can be made from the graph?

.....

.....

.....

.....

(2 marks)

6 (c) (ii) The graph is for a car driven on a dry road.

Draw a line on the graph to show what is likely to happen to the braking distance at different speeds if the same car was driven on an icy road.

(1 mark)

6 (d) A local council has reduced the speed limit from 30 miles per hour to 20 miles per hour on a few roads. The reason for reducing the speed limit was to reduce the number of accidents.

6 (d) (i) A local newspaper reported that a councillor said:

"It will be much safer because drivers can react much faster when driving at 20 miles per hour than when driving at 30 miles per hour."

This statement is wrong. Why?

.....

.....

(1 mark)

6 (d) (ii) The local council must decide whether to introduce the lower speed limit on a lot more roads.

What evidence should the local council collect to help make this decision?

.....

.....

.....

.....

(2 marks)

9

4.5.6.3.4 Factors affecting braking distance 2

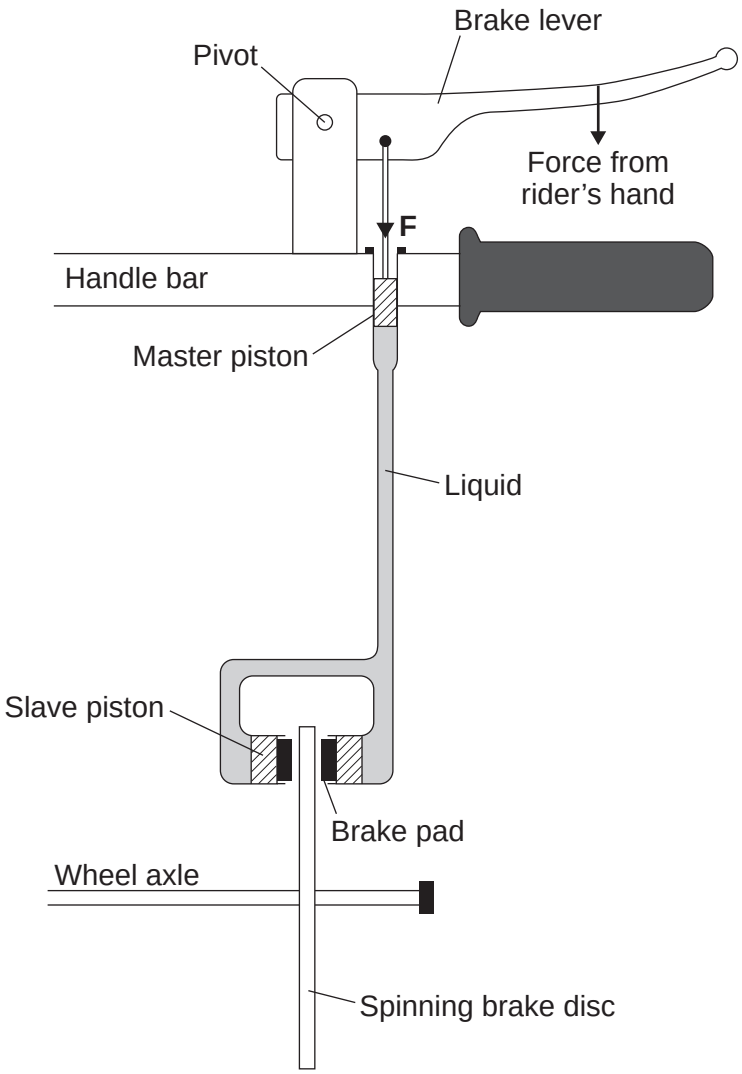
Question 06

June 2013 | PH3FP | Original Q6 | Legacy

6 Mountain bike riders use brakes to slow down.



Some mountain bikes use liquid-filled pipes to transmit the force from the rider's hand on the brake lever to the brake pads. These brakes are called hydraulic brakes.



4.5.6.3.4 Factors affecting braking distance 2

Question 06 · continued

6 (a) Draw a ring around the correct answer to complete each sentence.

6 (a) (i) Liquids can be used to transmit the forces in a brake system,

because liquids

- are incompressible.
- can flow.
- take the shape of the container.

(1 mark)

6 (a) (ii) The pressure in the liquid is transmitted

- against force **F** only.
- downwards only.
- in all directions.

(1 mark)

6 (b) When the rider's hand pulls on the brake lever, the force **F** applied to the liquid by the master piston is 80 N. The cross-sectional area of this piston is 50 mm^2.

Calculate the pressure, in N/mm^2, exerted on the liquid by the master piston.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Pressure = ... N/mm^2

(2 marks)

6 (c) The unit N/mm^2 is **not** the usual unit of pressure.

Which unit is usually used when calculating pressure?

Draw a ring around the correct answer.

N Nm^2 Pa

(1 mark)

6 (d) The rider applies a larger force to the brake lever. How would this increase in force affect the pressure in the liquid?

.....

(1 mark)

6

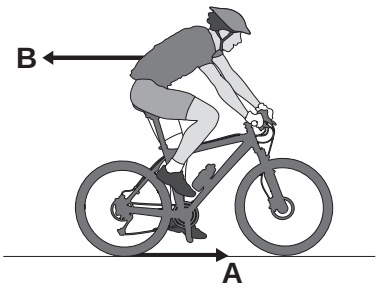
4.5.6.3.4 Factors affecting braking distance 2

Question 07

June 2014 | PH2FP | Original Q8 | Legacy

8 (a) **Figure 13** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 13



8 (a) (i) What causes force **A**?

Draw a ring around the correct answer.

[1 mark]

friction **gravity** **weight**

8 (a) (ii) What causes force **B**?

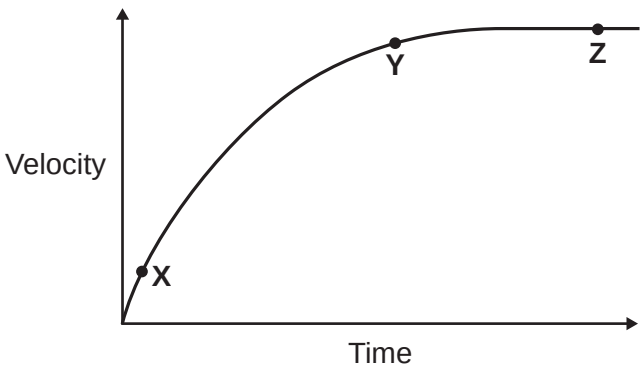
[1 mark]

.....

8 (a) (iii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 14 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

Figure 14



4.5.6.3.4 Factors affecting braking distance 2

Question 07 · continued

Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 14**.

[6 marks]

.....

.....

.....

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Extra space .....

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Question 8 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 07 · continued

8 (b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Work done = ...

8 (b) (ii) Complete the following sentences.

[2 marks]

When the brakes are used, the bicycle slows down. The kinetic energy of the bicycle ..... .

At the same time, the ..... of the brakes increases.

13

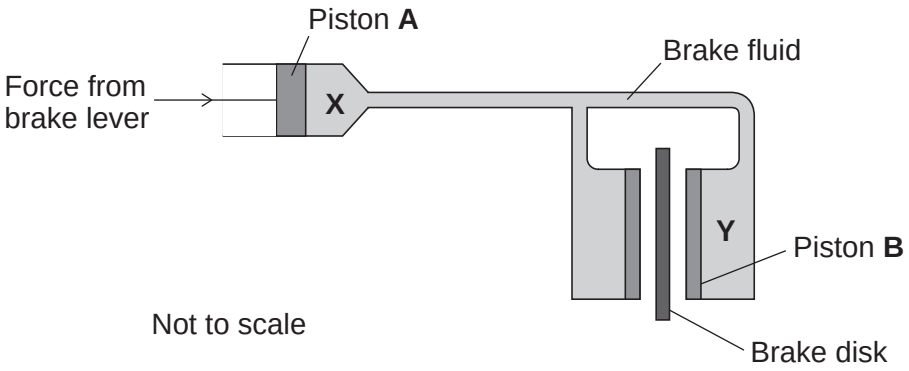
4.5.6.3.4 Factors affecting braking distance 2

Question 08

June 2016 | PH3FP | Original Q3 | Legacy

3 **Figure 4** is a simplified diagram of a hydraulic brake system.

Figure 4



3 (a) Which is the correct statement about the pressure at **X** and the pressure at **Y**?

[1 mark]

Tick (✓) **one** box.

The pressure at **X** is greater than at **Y** ☐

The pressure at **X** is the same as at **Y** ☐

The pressure at **X** is less than at **Y** ☐

3 (b) Piston **B** is larger than piston **A**.

How will this affect the size of the force on piston **B**?

Use the correct answer from the box to complete the sentence.

[1 mark]

smaller than	**the same as**	**larger than**

The force on piston **B** will be _____ the force on piston **A**.

4.5.6.3.4 Factors affecting braking distance 2

Question 08 · continued

3 (c) (i) A force of 24 N acts on piston **A**. The cross-sectional area of piston **A** is 8 mm^2.

Calculate the pressure in N/mm^2 at position **X**.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Pressure = _____ N/mm^2

3 (c) (ii) The unit N/mm^2 is not often used to measure pressure.

Which unit is usually used to measure pressure?

[1 mark]

Tick (✓) **one** box.

- newton ☐
- pascal ☐
- watt ☐

3 (d) The liquid used in the hydraulic brake system freezes at –30 °C.

Suggest **one** effect a temperature below –30 °C would have on the brake system.

[1 mark]

6

4.5.6.3.4 Factors affecting braking distance 2

Question 09

2 A car driver sees the traffic lights ahead change to red. The driver applies the brakes to stop the car.

The stopping distance of the car is the thinking distance plus the braking distance.

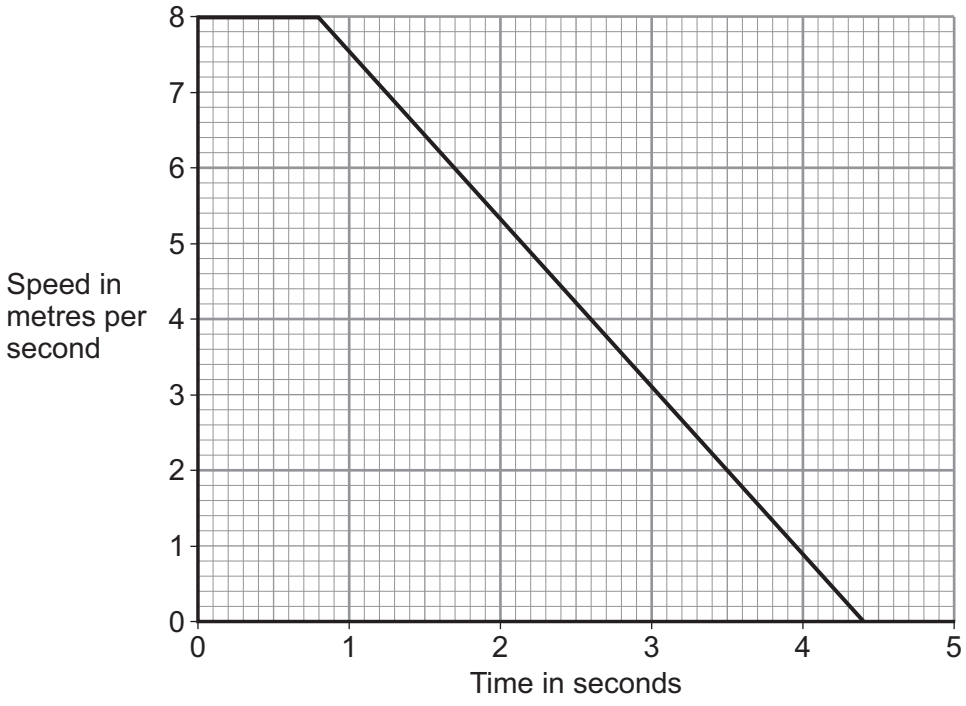
2 (a) Draw **one** line from each distance to the description of that distance.

[2 marks]

Distance	Description
Stopping	The distance the car moves between the brakes being applied and the car stopping.
Braking	The distance the car moves between the driver seeing the red light and the car stopping.
	The distance the car moves between the driver seeing the red light and applying the brakes.

2 (b) **Figure 3** shows how the speed of the car changes from the instant that the driver sees the traffic lights change to red.

Figure 3



4.5.6.3.4 Factors affecting braking distance 2

Question 09 · continued

2 (b) (i) What is the reaction time of the driver?

[1 mark]

Tick (✓) **one** box.

0.8 s ☐ 3.6 s ☐ 4.4 s ☐

2 (b) (ii) Using a mobile phone while driving may increase the reaction time of the driver.

Explain the effect of an increased reaction time on the stopping distance of the car.

[2 marks]

_____

_____

_____

_____

2 (b) (iii) The car has a mass of 750 kg

How is the kinetic energy of the car calculated when the car is travelling at 8 m/s?

[1 mark]

Tick (✓) **one** box.

$\frac{1}{2} \times 750 \times 8$ ☐

$\frac{1}{2} \times 750 \times 8^2$ ☐

$\frac{1}{2} \times 750^2 \times 8^2$ ☐

2 (b) (iv) Use the correct answers from the box to complete the sentence.

Each answer may be used once, more than once or not at all.

[2 marks]

decreases	**does not change**	**increases**

When the brakes of the car are applied,

the kinetic energy of the car _____ and

the temperature of the brakes _____ .

8

4.5.6.3.4 Factors affecting braking distance 2

Question 10

June 2018 | 8463/1F | Original Q1

0 1 **Figure 1** shows a cyclist riding along a flat road.

Figure 1



0 1 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the _____ energy store in the cyclist's body decreases and the _____ energy of the cyclist increases.

0 1 . 2 The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

_____

_____

_____

_____

Kinetic energy = _____ J

4.5.6.3.4 Factors affecting braking distance 2

Question 10 · continued

0 1 . 3 When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 1 . 4 How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

[1 mark]

- Decreased ☐
- Increased ☐
- Not affected ☐

7

4.5.6.3.4 Factors affecting braking distance 2

Question 11

June 2019 | 8463/2F | Original Q10

1 0 . 1 The driver of a vehicle sees a hazard on the road.

The driver uses the brakes to stop the vehicle.

Explain the factors that affect the distance needed to stop a vehicle in an emergency.

[6 marks]

4.5.6.3.4 Factors affecting braking distance 2

Question 11 · continued

10.2 Write down the equation which links distance, force and work done.

[1 mark]

10.3 The work done by the braking force to stop a vehicle was 900 000 J

The braking force was 60 000 N

Calculate the braking distance of the vehicle.

[3 marks]

Braking distance = _____ m

10.4 The greater the braking force, the greater the deceleration of a vehicle.

Explain the possible dangers caused by a vehicle having a large deceleration when it is braking.

[2 marks]

12

4.5.6.3.4 Factors affecting braking distance 2

Question 12

November 2021 | 8463/2F | Original Q8

0 8 The thinking distance and braking distance for a car vary with the speed of the car.

0 8 . 1 Explain the effect of **two** other factors on the **braking** distance of a car.

Do **not** refer to speed in your answer.

[4 marks]

Question 8 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 12 · continued

0 8 . 2 Which equation links acceleration (*a*), mass (*m*) and resultant force (*F*).

[1 mark]

Tick (✓) **one** box.

resultant force = mass × acceleration ☐

resultant force = mass × acceleration^2 ☐

resultant force = $\frac{\text{mass}}{\text{acceleration}^2}$ ☐

resultant force = $\frac{\text{mass}}{\text{acceleration}}$ ☐

0 8 . 3 The mean braking force on a car is 7200 N.

The car has a mass of 1600 kg.

Calculate the deceleration of the car.

[3 marks]

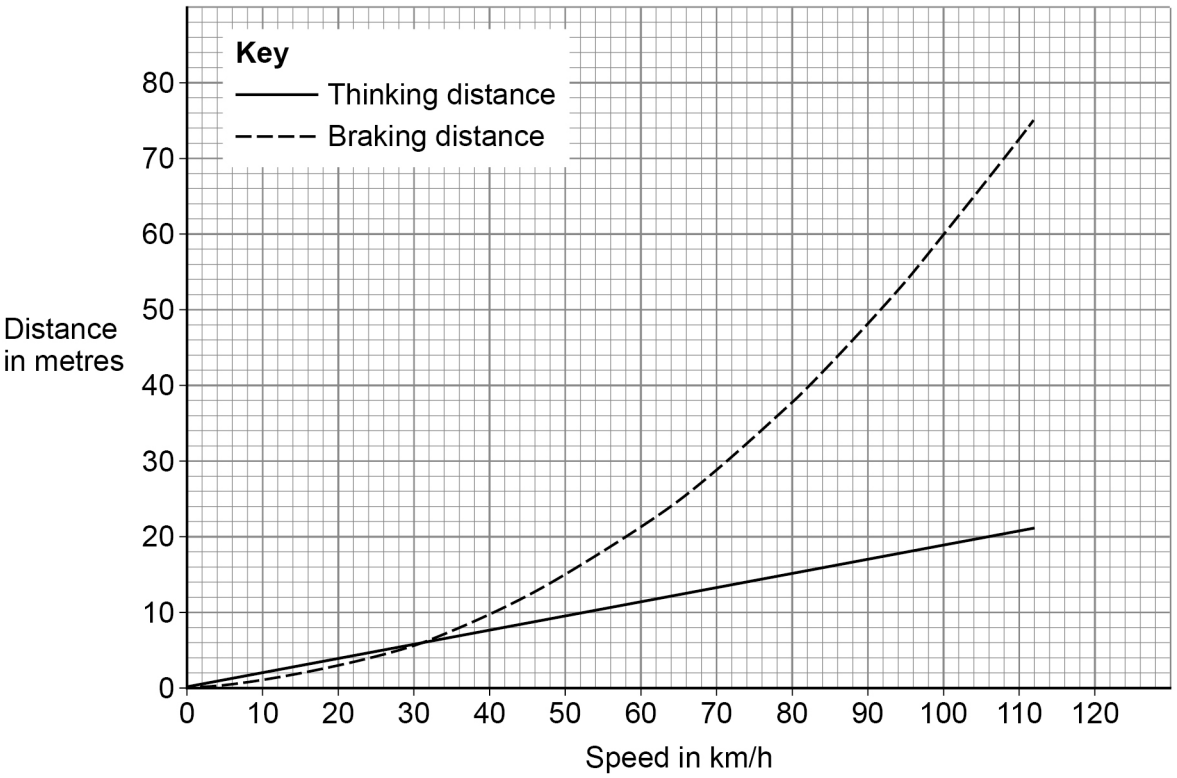
Deceleration = _____ m/s^2

4.5.6.3.4 Factors affecting braking distance 2

Question 12 · continued

0 8 . 4 **Figure 18** shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 18



Determine the stopping distance when the car is travelling at 80 km/h.

[2 marks]

Stopping distance = _____ m

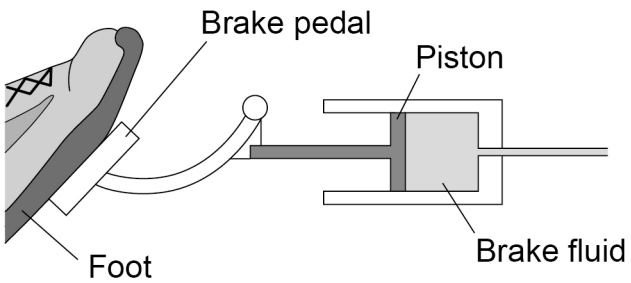
Question 8 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 12 · continued

Figure 19 shows part of the braking system for a car.

Figure 19



0 8 . 5 Which equation links area of a surface (A), the force normal to that surface (F) and pressure (p)?

[1 mark]

Tick (✓) **one** box.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☐

$p = \frac{A}{F}$ ☐

4.5.6.3.4 Factors affecting braking distance 2

Question 12 · continued

0 8 . 6 When the brake pedal is pressed, a force of 60 N is applied to the piston.

The pressure in the brake fluid is 120 000 Pa.

Calculate the surface area of the piston.

Give your answer in standard form.

Give the unit.

[5 marks]

Surface area (in standard form) = _____ Unit _____

16

4.5.6.3.4 Factors affecting braking distance 2

Question 13

June 2023 | 8463/2F | Original Q2

0 2 The stopping distance of a car is the braking distance added to the thinking distance.

0 2 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**electrostatic**	**kinetic**
nuclear		**thermal**

A driver applies the brakes to a moving car.

As the car slows down, there is a decrease in the _____ energy of the car.

The work done by friction causes an increase in the _____ energy store of the brakes.

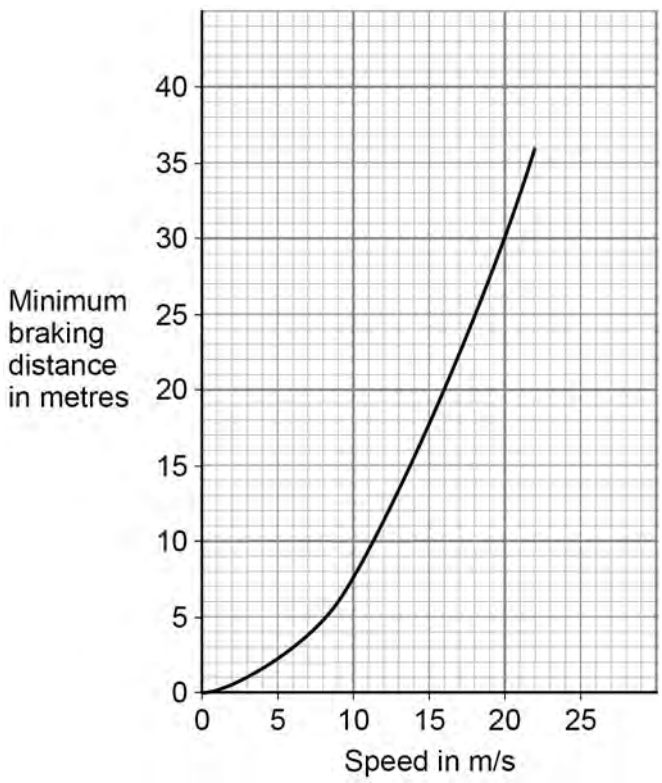
Question 2 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 13 · continued

0 2 . 2 **Figure 3** shows how the speed of the car affects the minimum braking distance of the car.

Figure 3



Describe the relationship between the speed of the car and the minimum braking distance of the car.

[1 mark]

0 2 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the road becomes icy, the braking distance _____.

4.5.6.3.4 Factors affecting braking distance 2

Question 13 · continued

A car driver applies the brakes to decelerate the car as it approaches a road junction.

The car decelerates at 0.25 m/s^2.

mass of the car = 1600 kg

0 2 . 4 Calculate the time taken for the velocity of the car to decrease from 12.5 m/s to 5.0 m/s.

Use the equation:

$$\text{time taken} = \frac{\text{change in velocity}}{\text{deceleration}}$$

[3 marks]

Time taken = _____ s

0 2 . 5 Calculate the resultant force causing the car to decelerate.

Use the equation:

$$\text{resultant force} = \text{mass} \times \text{deceleration}$$

[2 marks]

Resultant force = _____ N

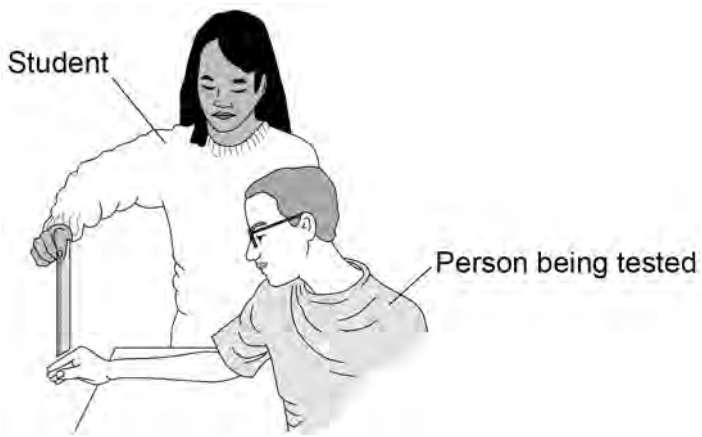
4.5.6.3.4 Factors affecting braking distance 2

Question 13 · continued

Thinking distance is affected by the reaction time of the driver.

Figure 4 shows how a student tested a person's reaction time.

Figure 4



The student held a ruler and then released it.

The person being tested closed his hand to catch the ruler as quickly as possible.

The further the ruler fell the greater the person's reaction time.

0 2 . 6 The student wanted to test the reaction time of the people in her class.

Which of the following could have been a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

- Distance fallen by the ruler before being caught ☐
- Initial height of the ruler above the person's hand ☐
- Reaction time of the person being tested ☐

4.5.6.3.4 Factors affecting braking distance 2

Question 13 · continued

0 2 . 7 The student tested three people in her class.

The mean distance that the ruler fell before being caught was 18.2 cm.

If all of the people in her class were tested, the mean distance may not be 18.2 cm.

Suggest why.

[1 mark]

0 2 . 8 Describe how this investigation could be changed to find out how listening to music affects reaction time.

[2 marks]

13

4.5.6.3.4 Factors affecting braking distance 2

Question 14

0 4 Car **X** and car **Y** have engines that produce the same maximum forward force.

The cars are the same shape, but car **X** has a greater mass than car **Y**.

0 4 . 1 How does the maximum acceleration of car **X** and car **Y** compare?

[1 mark]

Tick (✓) **one** box.

Car **X** has a greater maximum acceleration. ☐

Car **X** and car **Y** have the same maximum acceleration. ☐

Car **X** has a smaller maximum acceleration. ☐

0 4 . 2 Car **Y** has a mass of 900 kg.

Car **Y** accelerates at 2.5 m/s^2.

Calculate the resultant force on car **Y**.

Use the equation:

resultant force = mass × acceleration

[2 marks]

Resultant force = _____ N

Question 4 continues on the next page

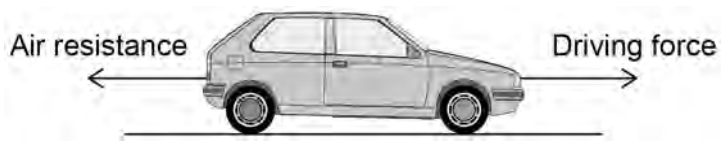
4.5.6.3.4 Factors affecting braking distance 2

Question 14 · continued

0 4 . 3 A car moves at a constant speed on a level road.

Figure 4 shows the horizontal forces on the car.

Figure 4



The driver makes the car accelerate until the car reaches its maximum speed.

Explain how the horizontal forces on the car change as the car accelerates to its maximum speed.

[4 marks]

4.5.6.3.4 Factors affecting braking distance 2

Question 14 · continued

To pass a driving test, drivers need to understand the difference between thinking distance and braking distance.

0 4 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

force	length	time

The thinking distance is affected by the driver's reaction _____.

0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

force	length	time

The braking distance is the distance travelled by the car under the braking _____.

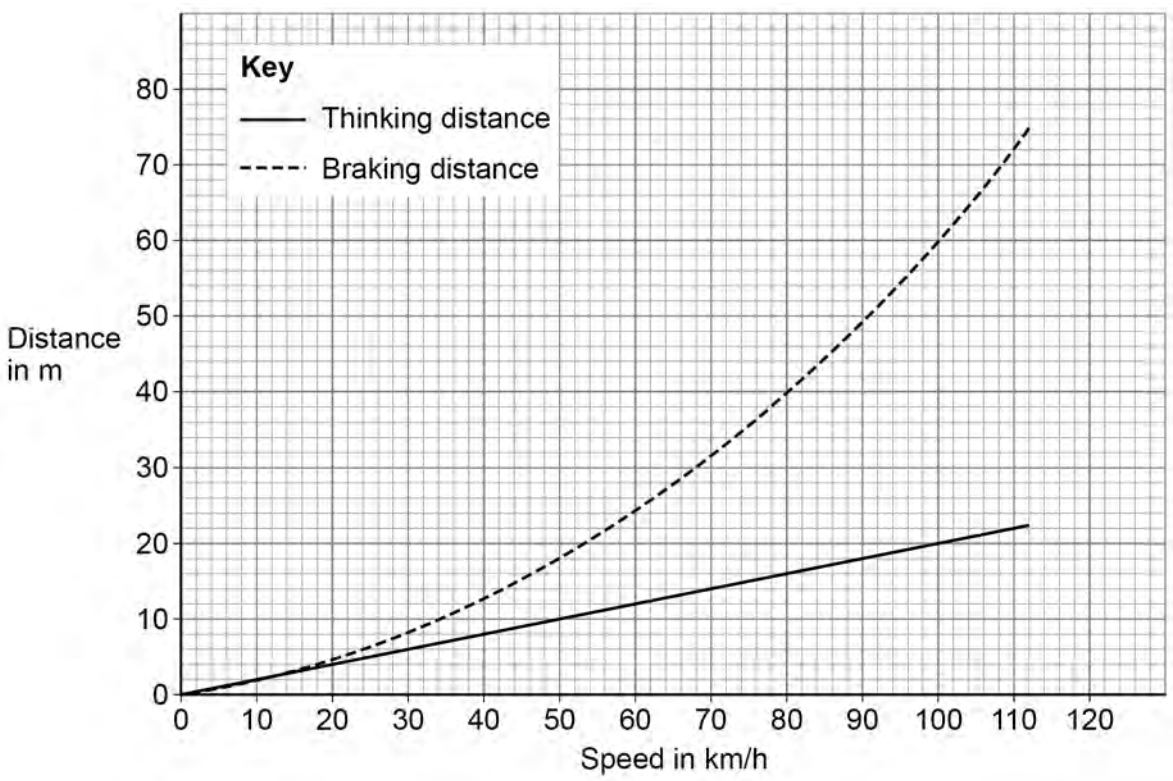
Question 4 continues on the next page

4.5.6.3.4 Factors affecting braking distance 2

Question 14 · continued

0 4 . 6 **Figure 5** shows how speed affects the thinking distance and braking distance of a car.

Figure 5



The car is moving at a speed of 100 km/h.

Calculate the stopping distance of the car.

Use **Figure 5**.

[3 marks]

Stopping distance = _____ m

4.5.6.3.4 Factors affecting braking distance 2

Question 14 · continued

0 4 . 7 Which **two** of the following would **increase** the stopping distance of a car?

[2 marks]

Tick (✓) **two** boxes.

- Fitting new brakes to the car ☐
- Fitting new tyres to the car ☐
- The driver becoming tired ☐
- Driving uphill ☐
- Driving on a wet road ☐

14

Turn over for the next question