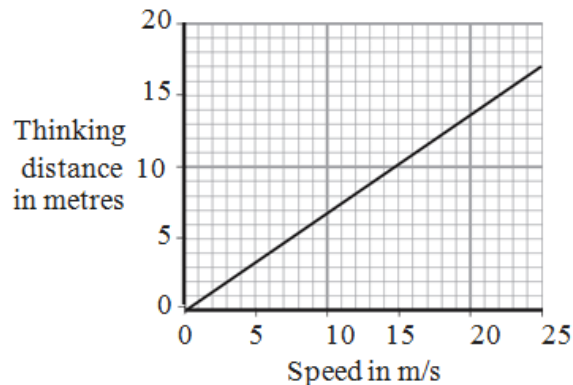


# Stopping Distance And Reaction Time 1

**Q:1** (a) A car driver takes a short time to react to an emergency before applying the brakes. The distance the car will travel during this time is called the 'thinking distance'. The graph shows how the thinking distance of a driver depends on the speed of the car.



(a)(i) What is the connection between thinking distance and speed?

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(1 mark)

(a)(ii) Many people drive while they are tired.

Draw a new line on the graph to show how thinking distance changes with speed for a tired driver.

(1 mark)

(a)(iii) The graph was drawn using data given in the Highway Code.

Do you think that the data given in the Highway Code is likely to be reliable?

Draw a ring around your answer.

Yes    No                    Maybe

Give a reason for your answer.

\_\_\_\_\_ (1 mark)

(b) The distance a car travels once the brakes are applied is called the 'braking distance'.

(b)(i) What is the relationship between thinking distance, braking distance and stopping distance?  
\_\_\_\_\_

(1 mark)

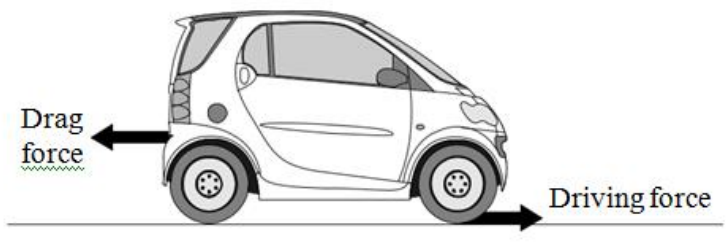
(b)(ii) State two factors that could increase the braking distance of a car at a speed of 15 m/s.

1 \_\_\_\_\_

2 \_\_\_\_\_

(2 marks)

**Q:2** 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 constant .

decreasing
Increasing

(1 mark)

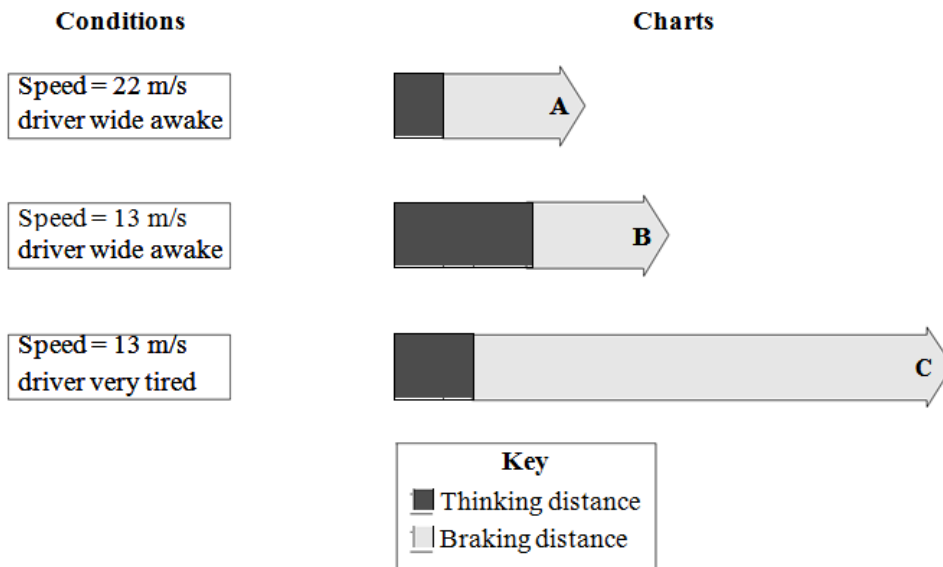
(ii) Putting the brakes on transforms the car's kinetic energy mainly into

- heat
- light
- sound

(1 mark)

(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.



(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?

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(1 mark)

**Q:3** a) The total stopping distance of a car has two parts. One part is the distance the car travels during the driver's reaction time. This distance is often called the 'thinking distance'.

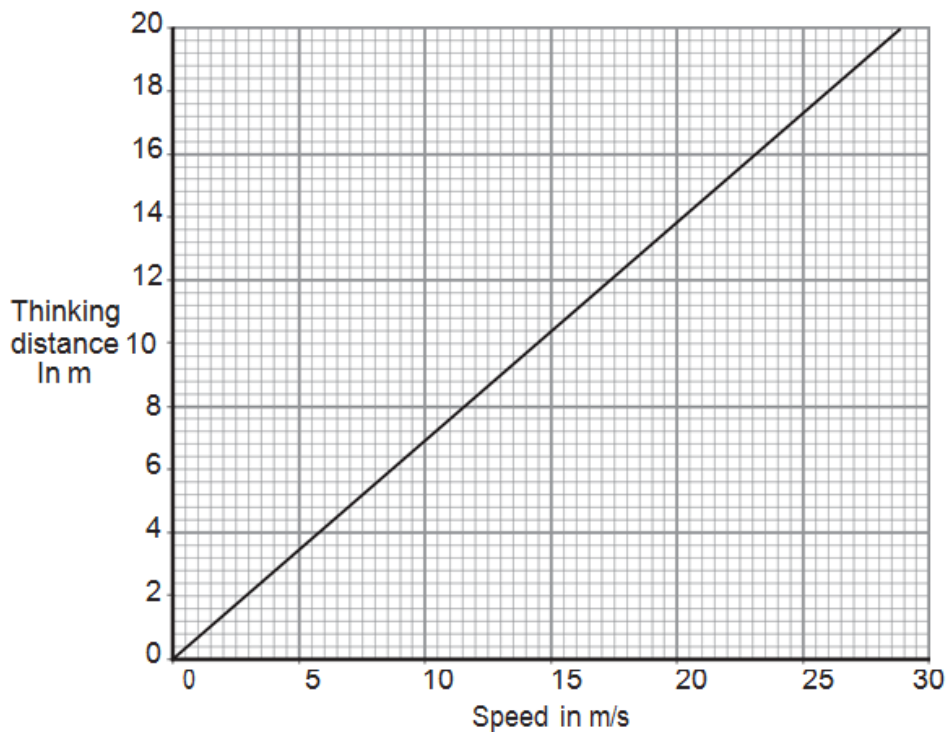
What distance is added to the 'thinking distance' to give the total stopping distance

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(1 mark)

(b) The graph shows the relationship between the speed of a car and the thinking distance.



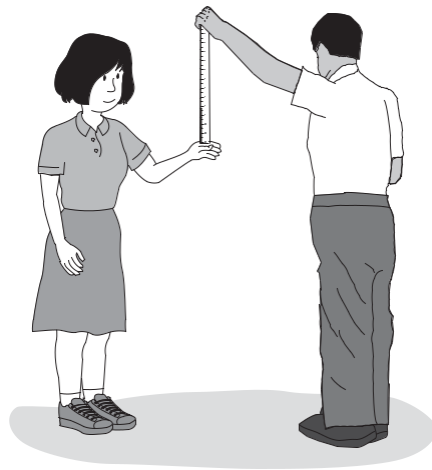
Describe the relationship between speed and thinking distance.

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(2 marks)

(c) The diagram shows two students investigating reaction time.



One student holds a 30 cm ruler, then lets go. As soon as the second student sees the ruler fall, she closes her hand, stopping the ruler. The further the ruler falls before being stopped, the slower her reaction time.

(c) (i) One student always holds the ruler the same distance above the other student's hand. In this experiment, what type of variable is this?

Put a tick (☑) in the box next to your answer.

independent variable

dependent variable

control variable

(1 mark)

(c) (ii) Describe how this experiment could be used to find out whether listening to music affects reaction time.

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(2 marks)

(d) The following information is written on the label of some cough medicine.

WARNING: Causes drowsiness.  
Do not drive or operate machinery.

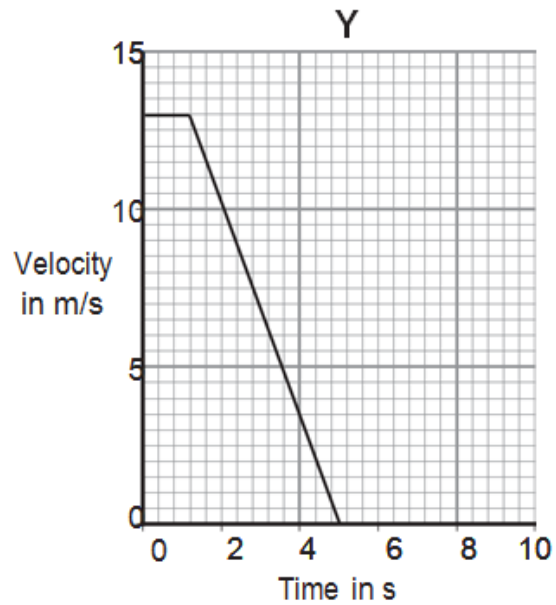
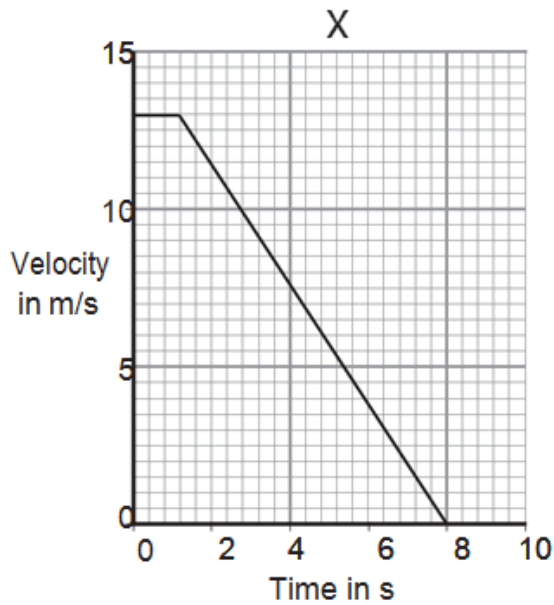
How is feeling drowsy (sleepy) likely to affect a driver's reaction time?

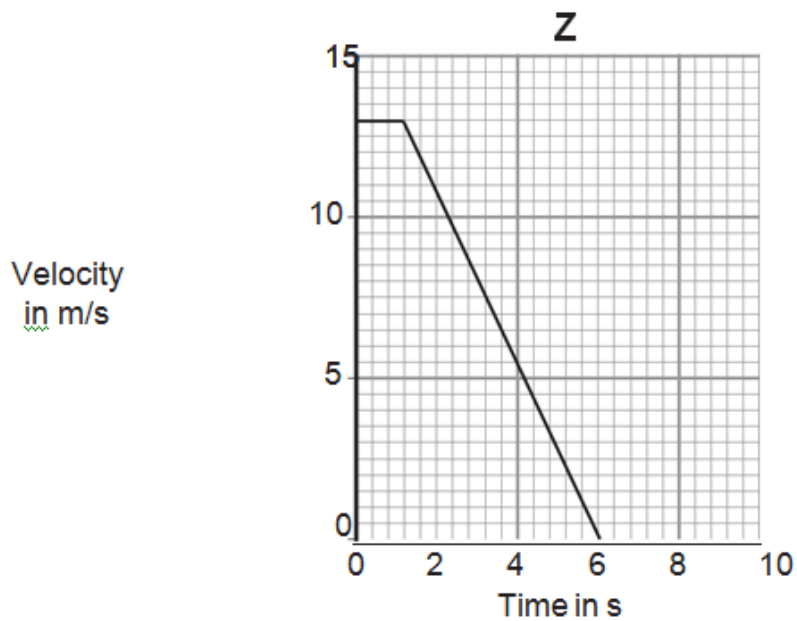
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(1 mark)

(e) Three cars, X, Y and Z, are being driven along a straight road towards a set of traffic lights. The graphs show how the velocity of each car changes once the driver sees that the traffic light has turned to red.





Which one of the cars, X, Y or Z, stops in the shortest distance?

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(1 mark)

**Q:4** A car has an oil leak. Every 5 seconds an oil drop falls from the bottom of the car onto the road.

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

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(1 mark)

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.

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Explain the reason for your answer.

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(3 marks)

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

(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.

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(1 mark)

(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.

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Work done = \_\_\_\_\_

(3 marks)

**Q:5** (a) The stopping distance of a vehicle is made up of two parts, the thinking distance and the braking distance.

(a) (i) What is meant by thinking distance?

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(1 mark)

(a) (ii) State two factors that affect thinking distance.

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

(2 marks)

(b) A car is travelling at a speed of 20 m/s when the driver applies the brakes. The car decelerates at a constant rate and stops.

(b) (i) The mass of the car and driver is 1600 kg.

Calculate the kinetic energy of the car and driver before the brakes are applied.

Use the correct equation from the Physics Equations Sheet.

\_\_\_\_\_  
\_\_\_\_\_

Kinetic energy = \_\_\_\_\_ J

(2 marks)

(b) (ii) How much work is done by the braking force to stop the car and driver?

Work done = \_\_\_\_\_ J

(1 mark)

(b) (iii) The braking force used to stop the car and driver was 8000 N. Calculate the braking distance of the car.

Use the correct equation from the Physics Equations Sheet.

\_\_\_\_\_  
\_\_\_\_\_

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Braking distance = \_\_\_\_\_ m

(2 marks)

(b) (iv) The braking distance of a car depends on the speed of the car and the braking force applied.

State one other factor that affects braking distance.

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(1 mark)

(b) (v) Applying the brakes of the car causes the temperature of the brakes to increase. Explain why.

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(2 marks)

(c) Hybrid cars have an electric engine and a petrol engine. This type of car is often fitted with a regenerative braking system. A regenerative braking system not only slows a car down but at the same time causes a generator to charge the car's battery.

State and explain the benefit of a hybrid car being fitted with a regenerative braking system.

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(3 marks)

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

$$\begin{array}{ccccccc} \text{Thinking} & + & \text{Braking} & = & \text{Stopping} \\ \text{distance} & & \text{distance} & & \text{distance} \end{array}$$

(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)

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

Tick (☑) one box.

The car driver being tired.

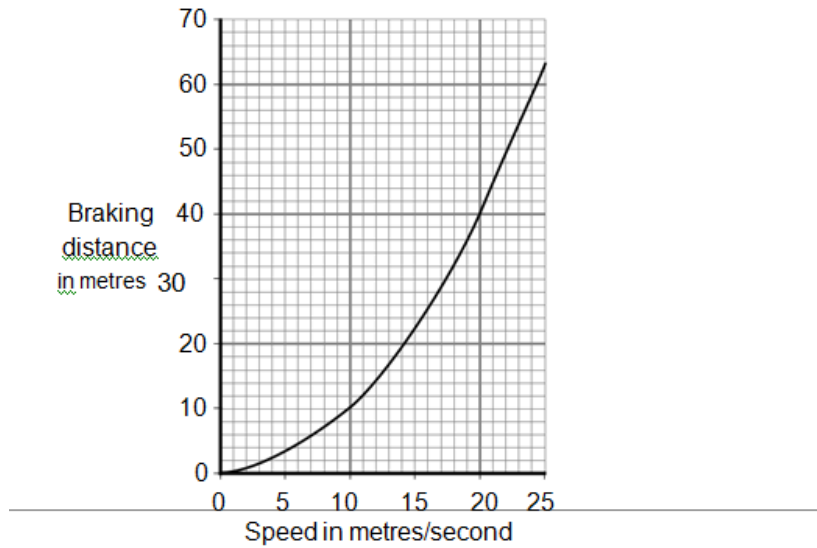
The car tyres being badly worn

The car being driven fast

(1 mark)

(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.



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

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(2 marks)

(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)

(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.

(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?

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(1 mark)

(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?

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(2 marks)

**TOTAL MARKS=49**