Wales in a global context: enhancing learners' skills

Stopping distances

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Joint Education Service

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Stopping distances: Introduction

This question is from the domain of mathematics and requires students to:

- make sense of the context
- make decisions, select and apply appropriate mathematics
- interpret answers sensibly

The question is suitable for students in both a formative and summative manner.

Level of mathematical reasoning

- Question 1: *
- Question 2: **
- Question 3: ***
- Question 4: ***
- Question 5: ***
- Question 6: ***
- Question 7: ****

Skills and knowledge

Mathematics

- Interpret an infographic
- Estimate distance from information in an infographic
- Find a general rule
- Use ratio and proportion to find a conversion rule
- Read and interpret a line graph
- Carry out a trial and improvement method
- Use a rule to estimate and predict

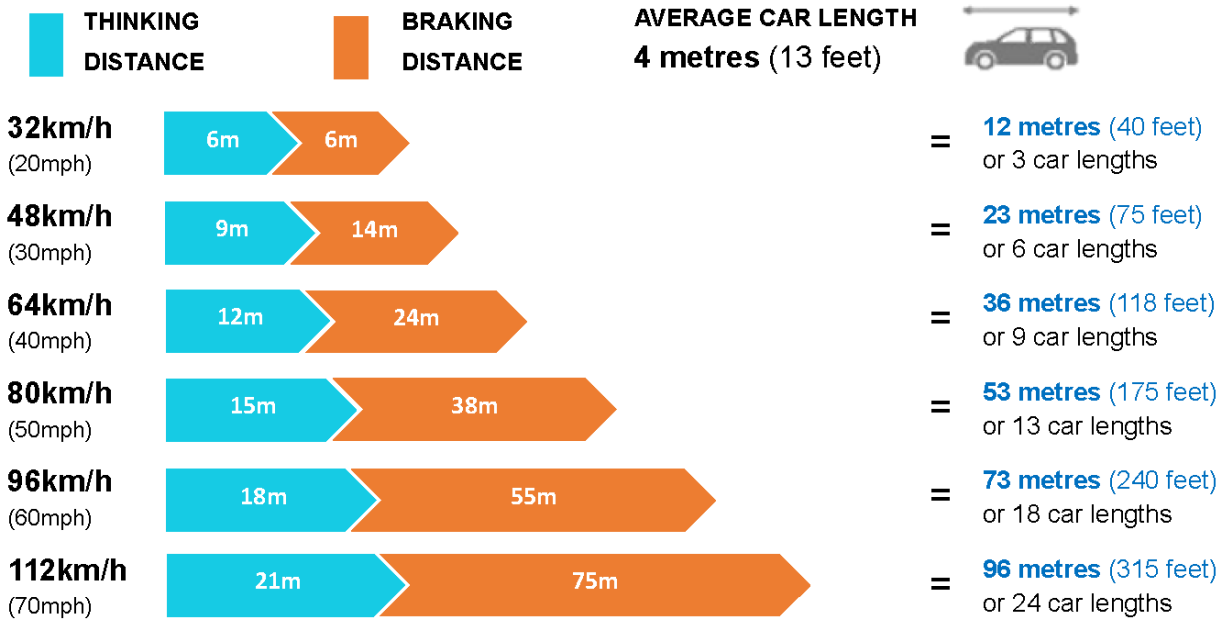
Stopping distances: Question 1

Question 1

You are travelling in a car at 30mph and have to brake suddenly. Using the information on the right, how far do you travel while you think about braking (thinking time)?

- ○ 9m
- ○ 12m
- ○ 14m
- ○ 6m

Look at the following information about stopping distances.



Source: http://1.bp.blogspot.com/-1eAqRqAXGsE/TmpyVmGBtvI/AAAAAAAACCs/vdGoCV8-bb0/s1600/TypicalStoppingDistances.png

The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

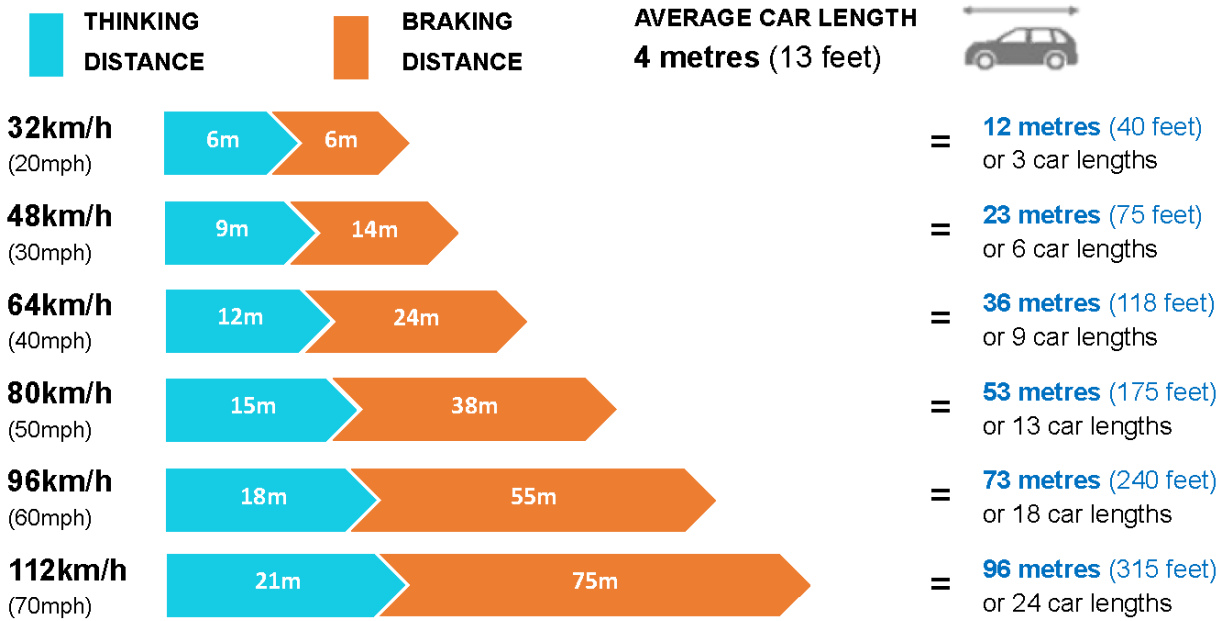
Stopping distances: Question 1

Question 1: Feedback

- ☑ **9m**
- ○ 12m
- ○ 14m
- ○ 6m

The blue part of the table represents thinking time. At 30mph the blue part is 9m therefore the answer is **9m**.

Look at the following information about stopping distances.



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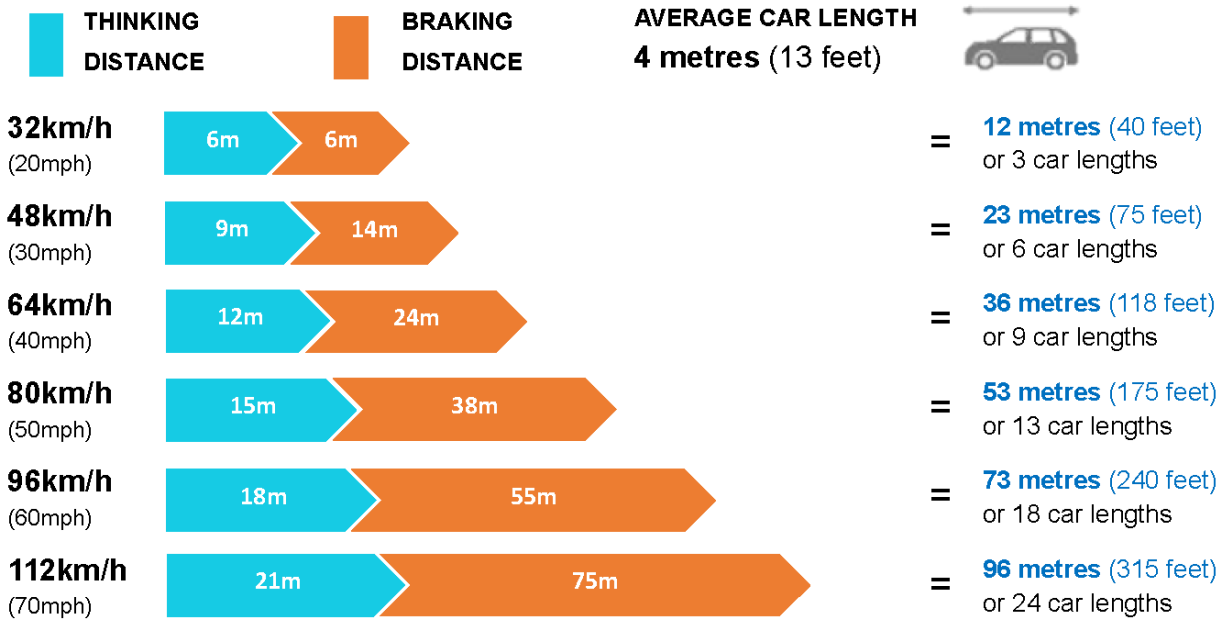
Stopping distances: Question 2

Question 2

Using the information on the right, estimate the braking distance for a car travelling at 45mph.

Look at the following information about stopping distances.



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Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

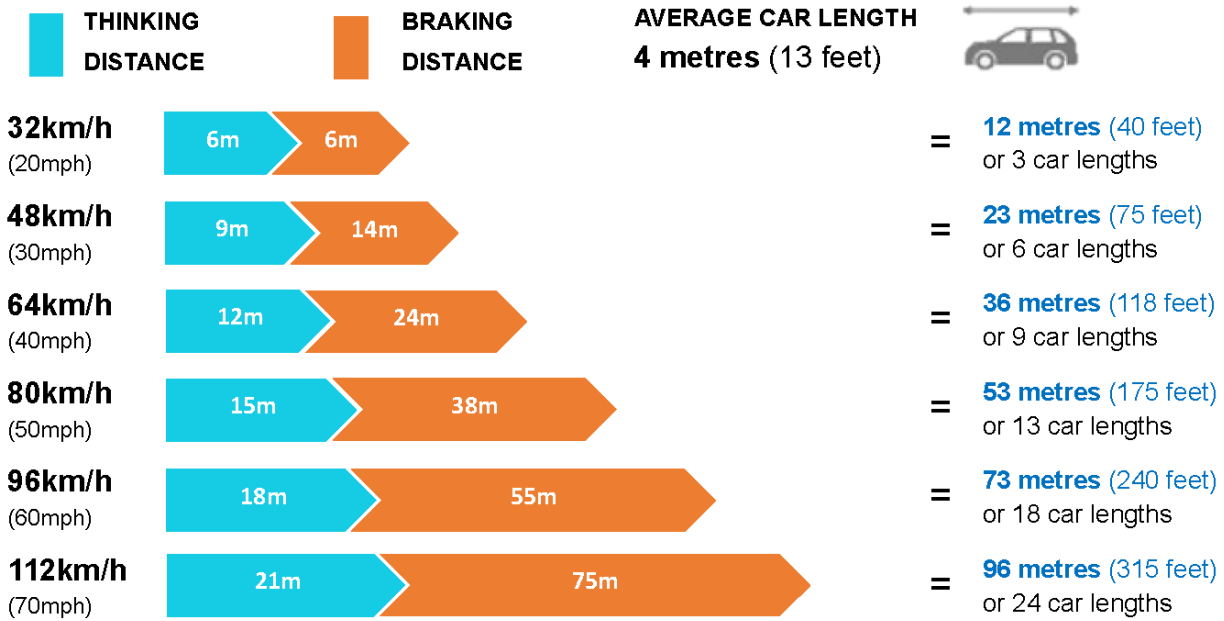
Stopping distances: Question 2

Question 2: Feedback

The table indicates that a car travelling at 40mph has a braking distance of 24m and a car travelling at 50mph has a braking distance of 38m.

45mph is in the middle of these two given values so an estimate for the braking distance would be **31m** as this is halfway between 24m and 38m.

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

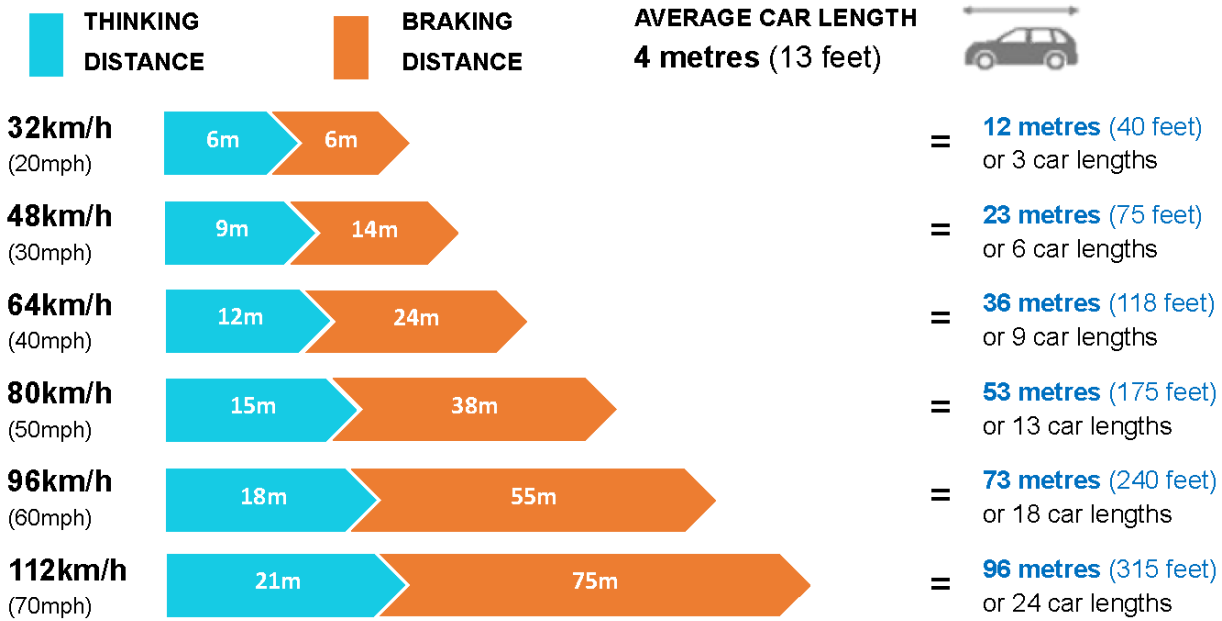
Stopping distances: Question 3

Question 3

What is the rule that links the speed in mph to the thinking time?

- ○ Thinking distance = 3 x speed (mph)
- ○ Thinking distance = 30 x speed (mph)
- ○ Thinking distance = 0.03 x speed (mph)
- ○ Thinking distance = 0.3 x speed (mph)

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

Stopping distances: Question 3

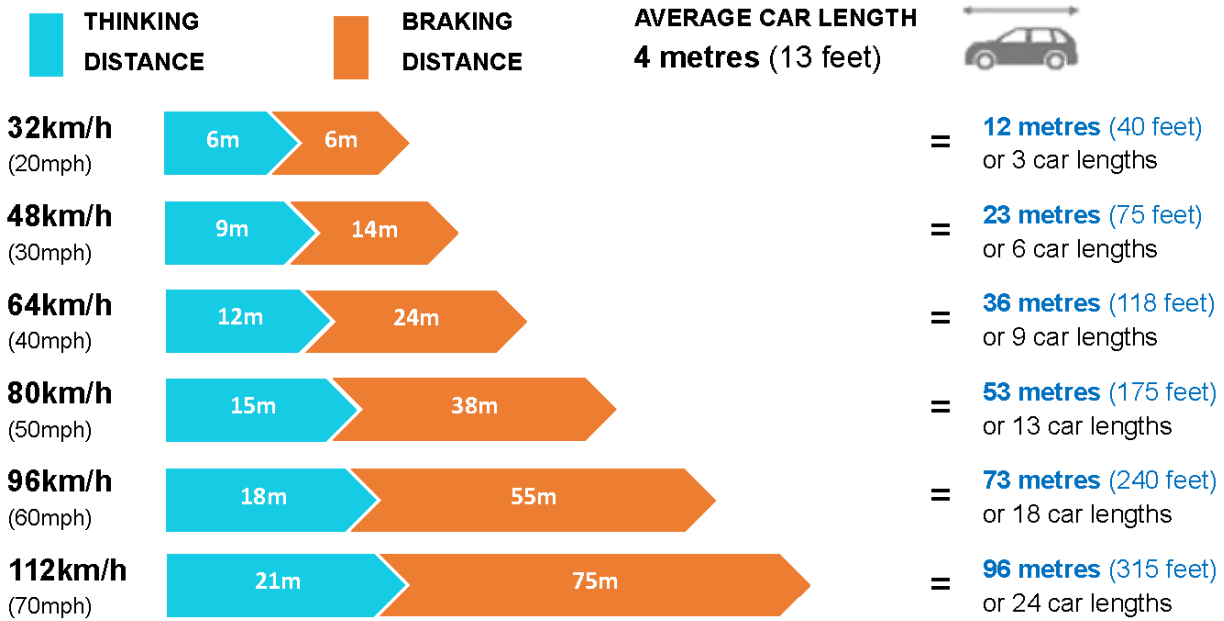
Question 3: Feedback

- ○ Thinking distance = 3 x speed (mph)
- ○ Thinking distance = 30 x speed (mph)
- ○ Thinking distance = 0.03 x speed (mph)
- ☑ **Thinking distance = 0.3 x speed (mph)**

The thinking distance increases by 3m for every 10mph increase, i.e. for every 1mph increase the thinking distance increases by 0.3m

Therefore, the rule is: **Thinking distance = 0.3 × speed (mph)**

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

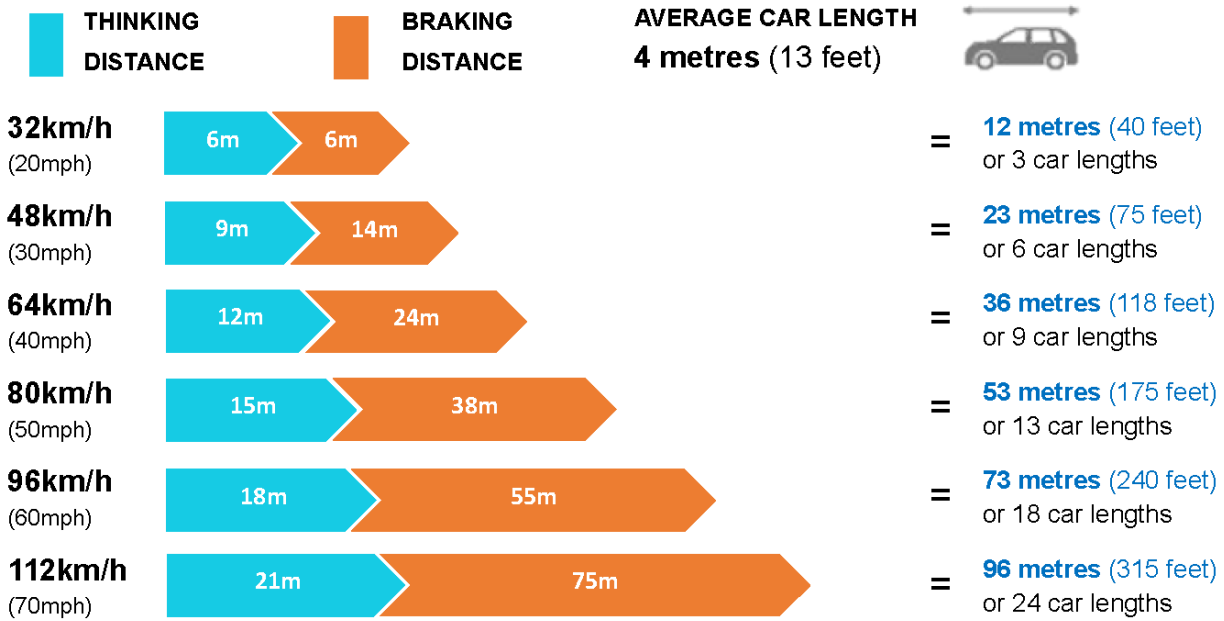
Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

Stopping distances: Question 4

Question 4

Using the information in the table on the right, convert 1 metre into feet. Give your answer correct to 1 decimal place.

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

Stopping distances: Question 4

Question 4: Feedback

To find the conversion for metres into feet, use one of the pieces of information in the table on the right where there is a comparison between metres and feet.

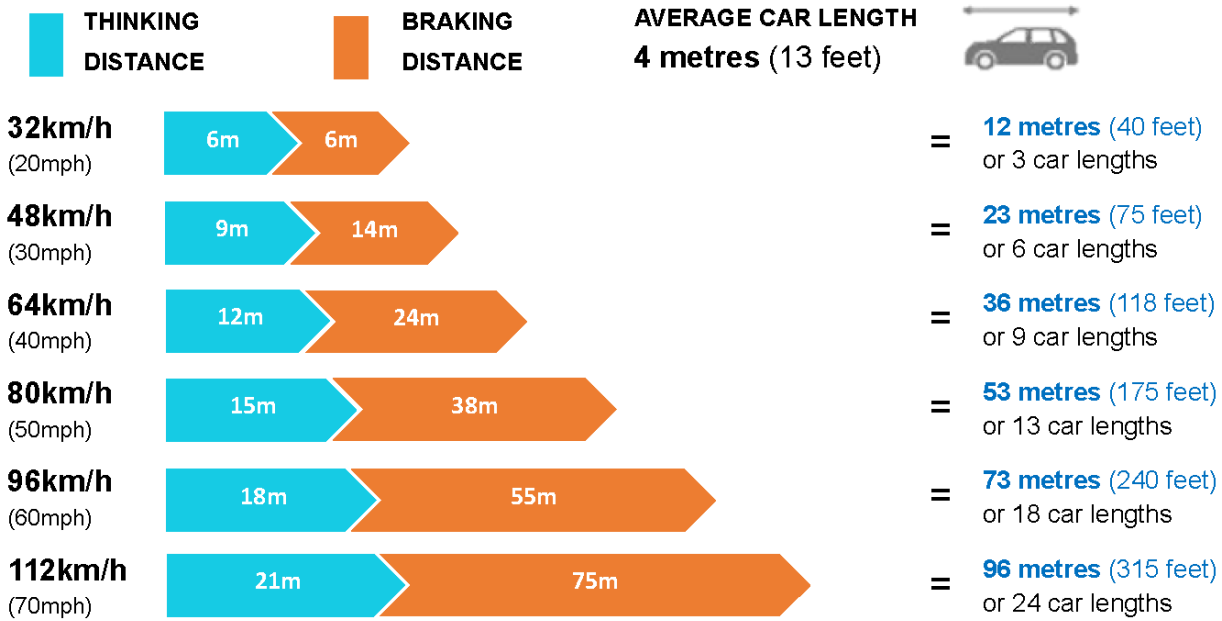
For 20mph, total stopping distance is 12 metres or 40 feet.
12 metres is equivalent to 40 feet.

1 metre = $\frac{40}{12}$ = **3.3 feet**

The table below shows all of the possible values.

Speed	Calculation	Answer (to 1 decimal place)
20mph	$\frac{40}{12} = 3.3333$ feet	1m = 3.3 feet
30mph	$\frac{75}{23} = 3.2609$ feet	1m = 3.3 feet
40mph	$\frac{118}{36} = 3.2778$ feet	1m = 3.3 feet
50mph	$\frac{175}{53} = 3.3019$ feet	1m = 3.3 feet
60mph	$\frac{240}{73} = 3.2877$ feet	1m = 3.3 feet
70mph	$\frac{315}{96} = 3.2813$ feet	1m = 3.3 feet
Car length	$\frac{13}{4} = 3.25$ feet	1m = 3.3 feet

Look at the following information about stopping distances.



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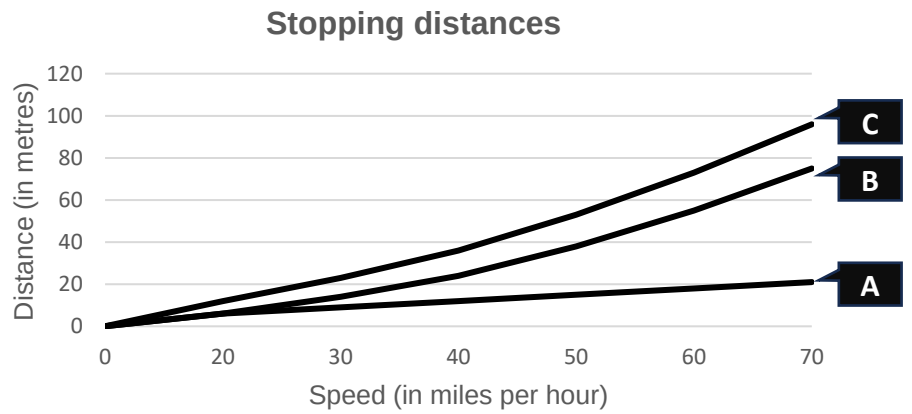
The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table 'mph' means miles per hour and 'km/h' means kilometres per hour.

Stopping distances: Question 5

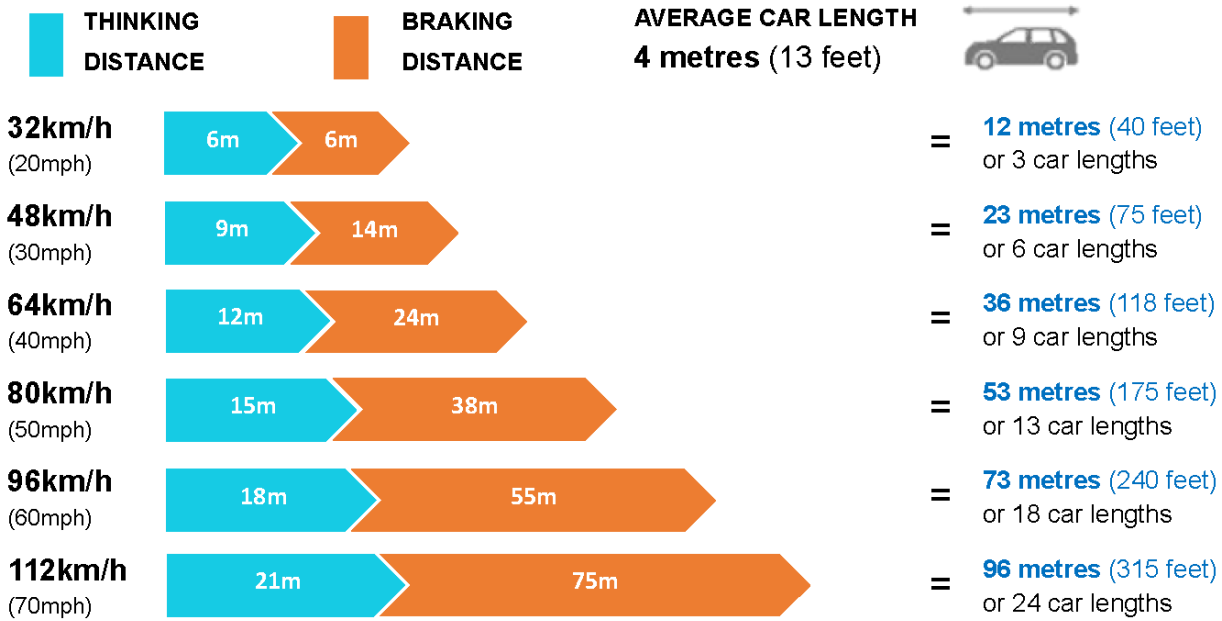
Question 5

Choose the correct label for each line on the graph (A, B and C) below:
'Thinking distance', 'Braking distance' or 'Total stopping distance'.



- ○ Line A: …….
- ○ Line B: …….
- ○ Line C: …….

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table 'mph' means miles per hour and 'km/h' means kilometres per hour.

Stopping distances: Question 5

Question 5: Feedback

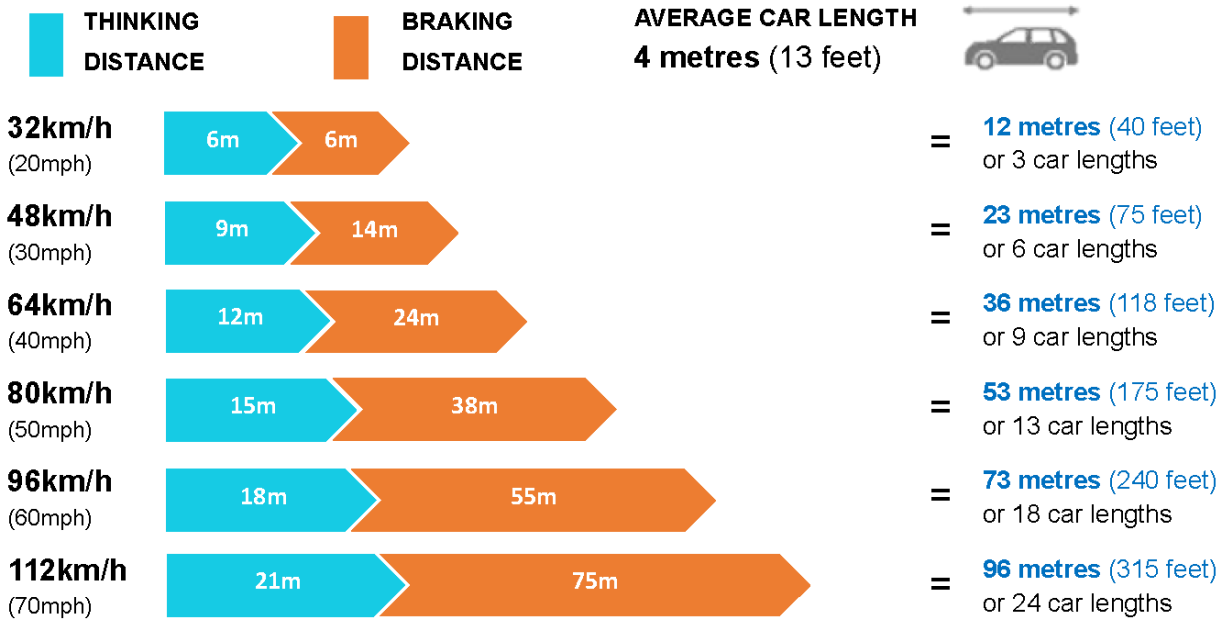
- ◯ Line A: **Thinking distance**
- ◯ Line B: **Braking distance**
- ◯ Line C: **Total stopping distance**

The bottom line is thinking distance. Comparing the bottom line to the figures in the table on the right, you can see that from 20mph to 70mph the thinking distance increases from 6 metres to 21 metres.

The middle line is braking distance. Comparing the middle line to the figures in the table on the right, you can see that from 20mph to 70mph the braking distance increases from 6 metres to 75 metres.

The top line is overall stopping distance. This shows the combined thinking and braking distances. Comparing the top line to the figures in the table on the right, you can see that from 20mph to 70mph the total stopping distance increases from 12 metres to 96 metres.

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table ‘mph’ means miles per hour and ‘km/h’ means kilometres per hour.

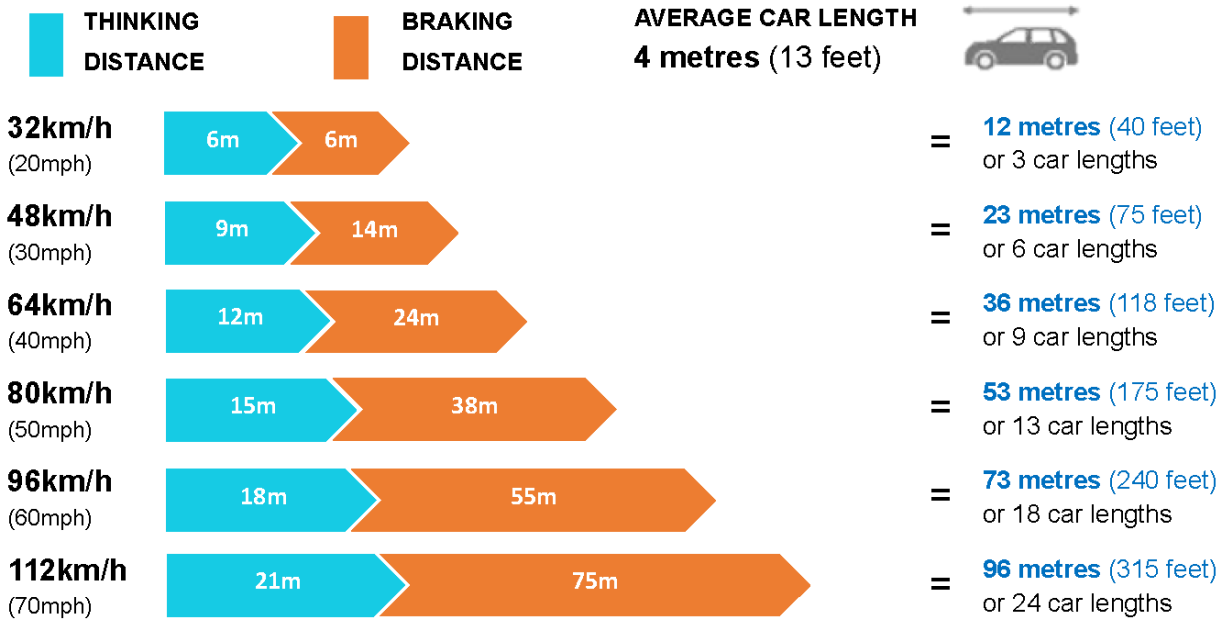
Stopping distances: Question 6

Question 6

For 40mph, the stopping distance is 118 feet. Changing the stopping distance to 120 feet, what is the rule that links the speed in mph to the stopping distance in feet?

- ○ Stopping distance = speed x 2.5
- ○ Stopping distance = 0.5 x $(\text{speed})^2$ + speed
- ○ Stopping distance = 0.05 x $(\text{speed})^2$ + speed
- ○ Stopping distance = 0.1 x $(\text{speed})^2$ + speed

Look at the following information about stopping distances.



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The table shows the thinking and braking times to give the total stopping distances according to the Highway Code.

Note: In the table 'mph' means miles per hour and 'km/h' means kilometres per hour.

Stopping distances: Question 6

Question 6: Feedback

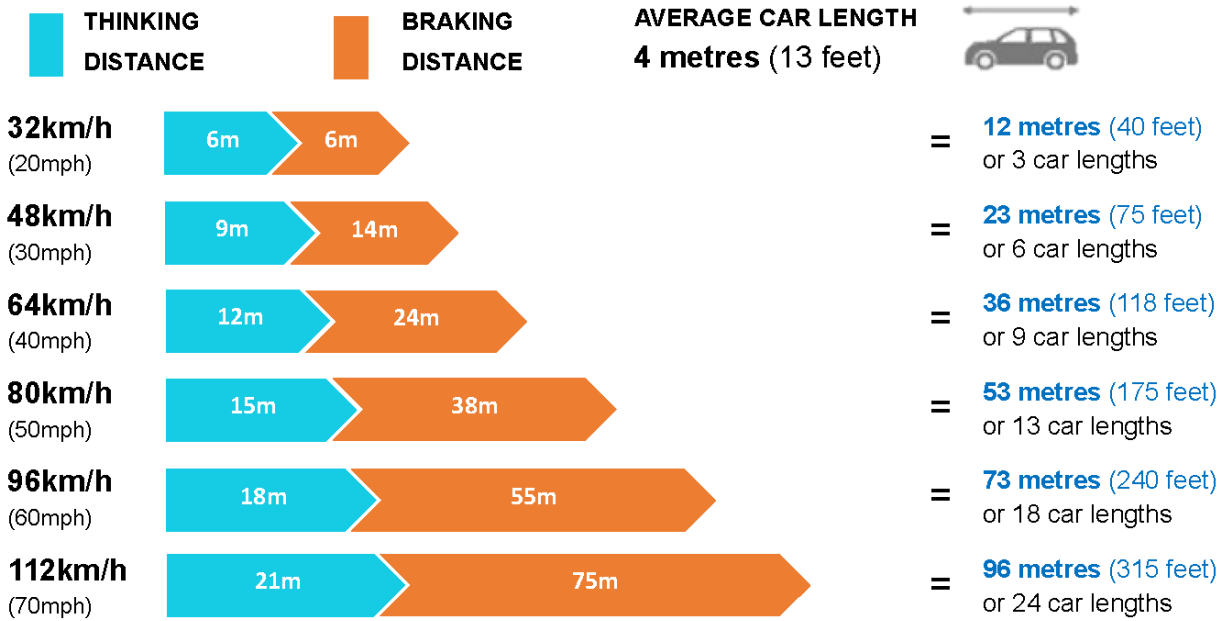
- ○ Stopping distance = speed x 2.5
- ○ Stopping distance = 0.5 x (speed)^2 + speed
- ☑ **Stopping distance = 0.05 x (speed)^2 + speed**
- ○ Stopping distance = 0.1 x (speed)^2 + speed

Substituting any of the speed values will give you the distance in feet.

Substituting 70mph for 'speed' gives the following:
Stopping distance = 0.05 x 70^2 + 70
= 315 feet

The rule is: **Stopping distance = 0.05 x (speed)^2 + (speed)**

Look at the following information about stopping distances.



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Note: In the table 'mph' means miles per hour and 'km/h' means kilometres per hour.

Stopping distances: Question 7

Question 7

A Bugatti Veyron has been recorded travelling at 267.856mph.

Estimate the total stopping distance when travelling at this speed.

- ○ 4,590 feet
- ○ 3,915 feet
- ○ 4,995 feet
- ○ 6,075 feet

Look at the following information about stopping distances.

One way of estimating the total stopping distance in feet is to use this pattern:

- 20mph x 2 = 40 feet
- 30mph x 2.5 = 75 feet
- 40mph x 3 = 120 feet
- 50mph x 3.5 = 175 feet
- 60mph x 4 = 240 feet
- 70mph x 4.5 = 315 feet

Stopping distances: Question 7

Question 7: Feedback

- ◯ 4,590 feet
- ☑ **3,915 feet**
- ◯ 4,995 feet
- ◯ 6,075 feet

Start by rounding the given speed up to 270mph.

Then look at the pattern. For every increase of 10mph the multiplier increases by 0.5

The speed increases by 200mph from 70mph in the information on the right.

This leads to a multiplier of 14.5 which gives:
270mph x 14.5 = **3,915 feet**

(This is approximately $\frac{3}{4}$ of a mile.)

Look at the following information about stopping distances.

One way of estimating the total stopping distance in feet is to use this pattern:

- 20mph x 2 = 40 feet
- 30mph x 2.5 = 75 feet
- 40mph x 3 = 120 feet
- 50mph x 3.5 = 175 feet
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