AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.5.6.3 FORCES AND BRAKING (PACK 1)

SCORE	PERCENTAGE
/124	%

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Q1.

The image below shows a lorry.



(a) The brakes of the lorry are in a poor condition.

What effect will the condition of the brakes have on thinking distance and the braking distance of the lorry?

Thinking distance _____

_____

Braking distance _____

_____

(2)

(b) Using a hand-held mobile phone while driving is illegal in the United Kingdom.

The table below shows the effect of using a mobile phone on thinking distance.

	Thinking distance
Not using a mobile phone	19 m
Using a mobile phone with hands-free kit	23 m
Using a hand-held mobile phone	27 m

Explain why driving while using a hand-held mobile phone is more dangerous than using a mobile phone with a hands-free kit.

Use data from the table above.

_____

_____

_____

_____

_____

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_____

_____

_____

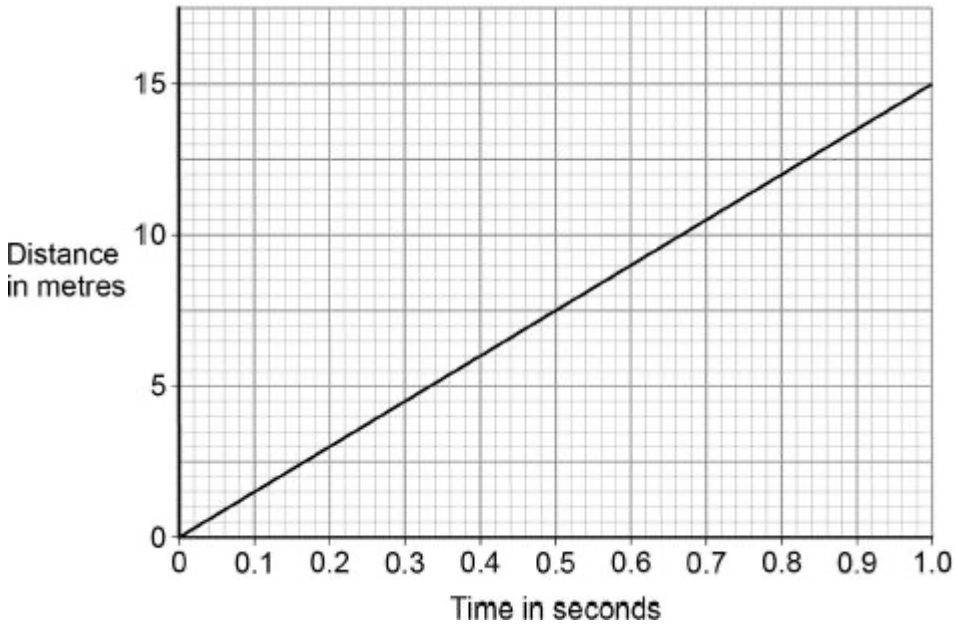
(4)

(Total 6 marks)

Q2.

(a) **Figure 1** shows the distance-time graph for a car travelling at 15 m/s

Figure 1



When the driver is tired, his reaction time increases from 0.50 seconds to 0.82 seconds.

Determine the **extra** distance the car would travel before the driver starts braking.

_____

_____

_____

Distance = _____ m

(2)

(b) When the brakes are used, the temperature of the brakes increases.

Explain why. Use ideas about energy in your explanation.

_____

_____

_____

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(2)

(c) A lorry travels 84 m with a constant acceleration of 2.0 m/s^2 to reach a velocity of 19 m/s

Calculate the initial velocity of the lorry.

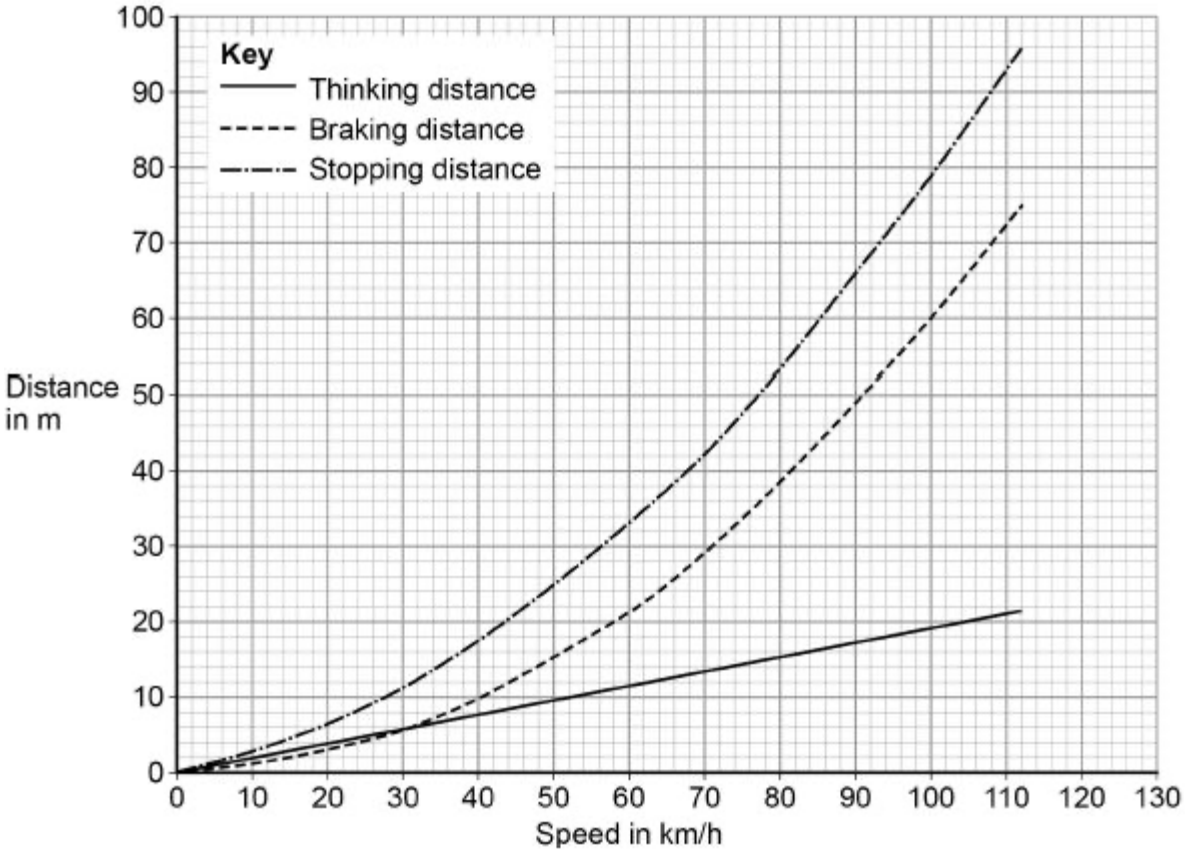
Use the Physics Equations Sheet.

Initial velocity = _____ m/s

(3)

(d) **Figure 2** shows how the thinking distance, braking distance and stopping distance for a car vary with the speed of the car.

Figure 2



Describe the relationships shown in **Figure 2**

You should include factors that would affect the gradient of the lines.

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(6)

(Total 13 marks)

Q3.

The stopping distance of a car depends on the thinking distance and the braking distance.

(a) Thinking distance depends on the driver's reaction time.

Give **two** factors that can affect reaction time.

1. _____

2. _____

(2)

(b) Give **one** factor that can affect the braking distance.

_____

_____

(1)

(c) The thinking distance is the distance travelled during the driver's reaction time.

A car was travelling at 13 m/s

The driver's reaction time was 0.6 s

Calculate the thinking distance.

Use the equation:

distance travelled = speed × time

_____

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_____

_____

Thinking distance = _____ m

(2)

(d) The braking distance of the car was 14.0 m

What was the stopping distance of the car?

_____

_____

Stopping distance = _____ m

(1)

(e) What is the link between speed and braking distance?

Complete the sentence.

The greater the speed, the _____

(1)

(f) If a large braking force is applied, the car decelerates and stops in a very short distance.

Give **two** disadvantages of applying a large braking force.

1. _____

_____

2. _____

_____

(2)

(Total 9 marks)

Q4.

Figure 1 shows a cyclist with a trailer attached to his bike.

Figure 1



(a) Describe how Newton's Third Law applies to the forces between the bike and the

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trailer.

_____

_____

_____

_____

(2)

(b) A student investigated how the stopping distance of the bike was affected by the mass of the load.

The same person rode the same bike throughout the investigation.

Give **two** other variables which the student should have controlled.

1. _____

_____

2. _____

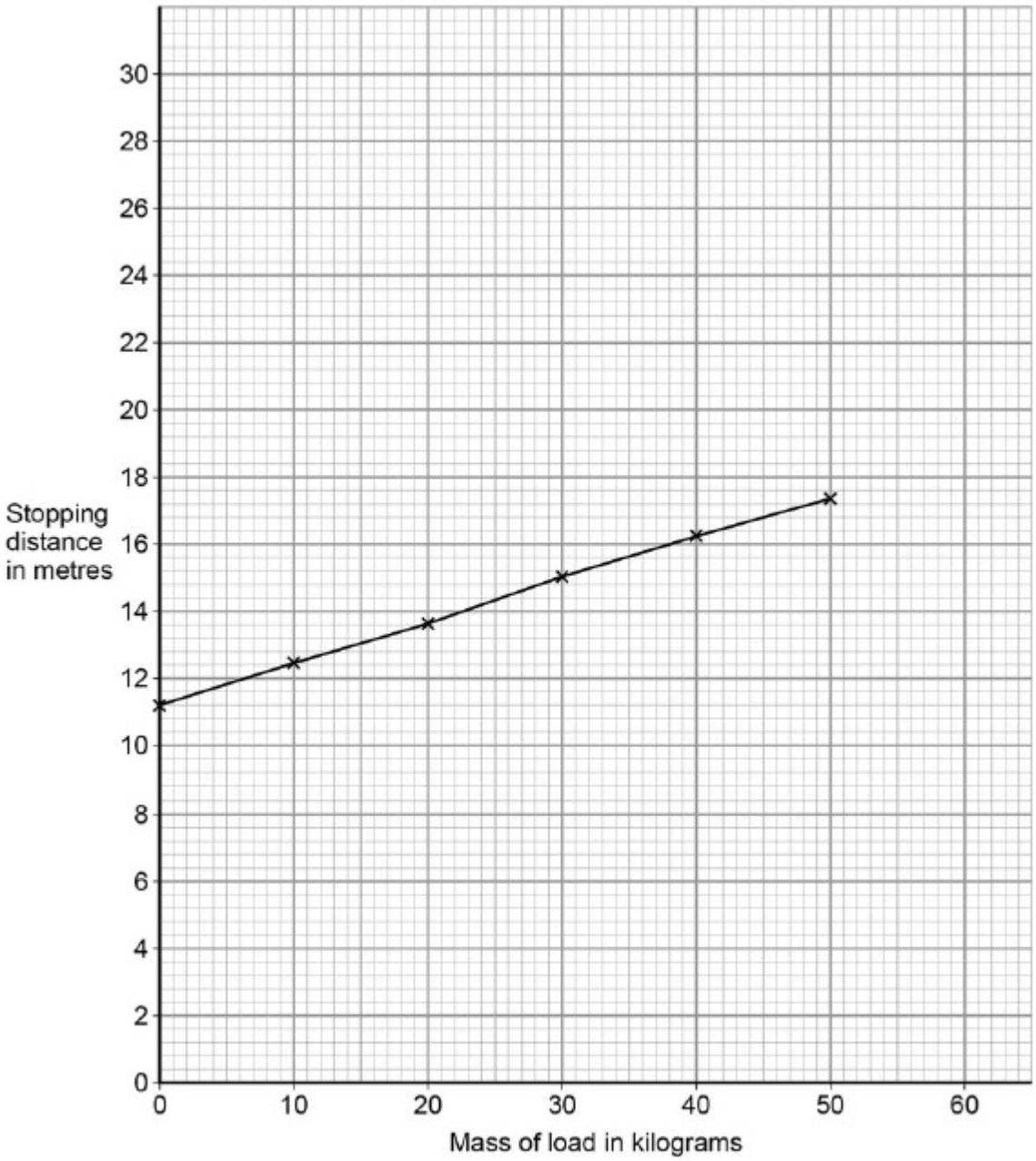
_____

(2)

(c) **Figure 2** shows the results of the investigation.

Figure 2

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Draw a line on **Figure 2** to show how the stopping distance would be different if a heavier cyclist rode the bike.

(1)

(d) At one time in the investigation the cyclist was distracted.

The distraction increased the stopping distance of the bike but did **not** affect the braking distance.

Explain why the stopping distance increased.

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_____

_____

(3)

(Total 8 marks)

Q5.

Speed and velocity are different quantities.

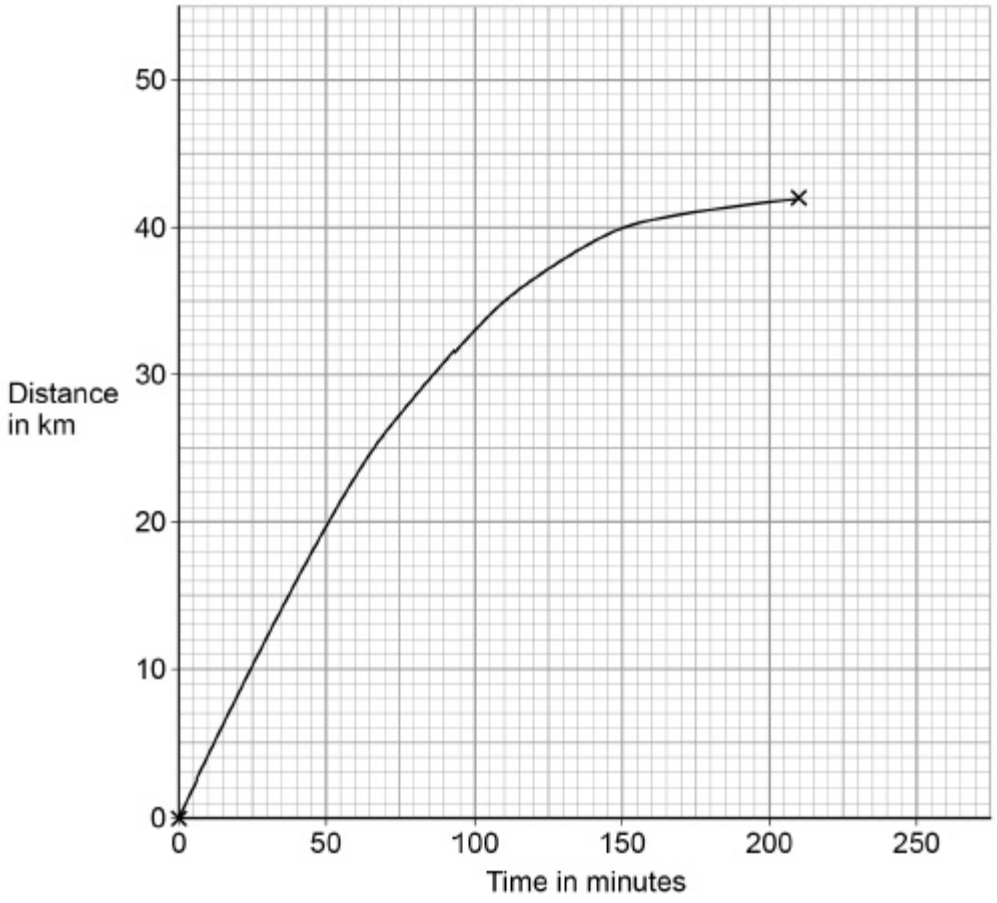
(a) Complete the sentences.

Velocity is a _____ quantity.

The velocity of an object is its speed in a given _____.

(2)

The graph shows a distance-time graph for an athlete in a race.



(b) Determine the distance of the race and the time taken for the athlete to complete the race.

Use the graph.

_____

_____

Distance = _____

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Time = _____

(1)

(c) Describe how you can use the graph to determine the velocity of the athlete 20 minutes after the start of the race.

_____

_____

_____

_____

_____

_____

(3)

A car following the race accelerates at a constant rate in a straight line.

The velocity of the car increases from 4.9 m/s to 6.4 m/s in 3.00 minutes.

(d) Calculate the acceleration of the car.

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

_____

Acceleration = _____ m/s^2

(4)

(e) Sketch a velocity-time graph to represent the acceleration of the car in part (d).



(2)

(f) At the end of the race the car is travelling at 5.2 m/s

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The brakes are applied causing the car to slow down and stop.

The brakes apply a constant force of 855 N in the opposite direction to the car's motion.

The mass of the car is 950 kg

Calculate the braking distance travelled by the car.

Braking distance = _____ m

(6)

(Total 18 marks)

Q6.

Figure 1 shows the forces acting on a car while it is moving.

Figure 1



(a) What is the resultant force acting on the car when it is travelling at constant velocity?

Resultant force = _____ N

(1)

(b) The car accelerates at 0.8 m/s^2

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The mass of the car is 850 kg

Calculate the resultant force acting on the car while it is accelerating.

Use the equation:

resultant force = mass × acceleration

Resultant force = _____ N

(2)

(c) The driver notices a hazard and applies the brakes.

The car is travelling at 12 m/s

The driver's reaction time is 0.180 s

Calculate the distance travelled during the driver's reaction time.

Use the equation:

distance travelled = speed × time

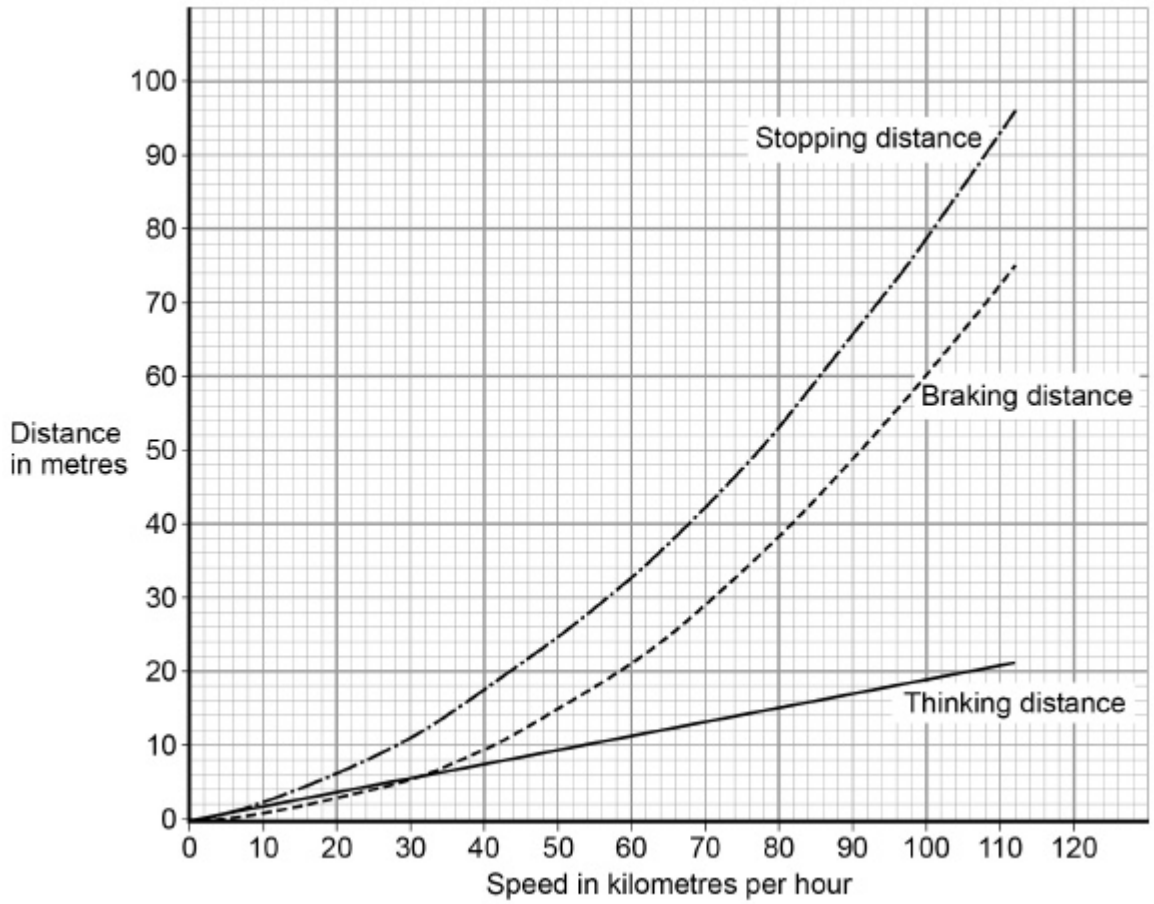
Distance travelled = _____ m

(2)

(d) **Figure 2** shows how the thinking distance, braking distance and stopping distance of a car change with speed.

Figure 2

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Describe the trends in the data in **Figure 2**.

(3)

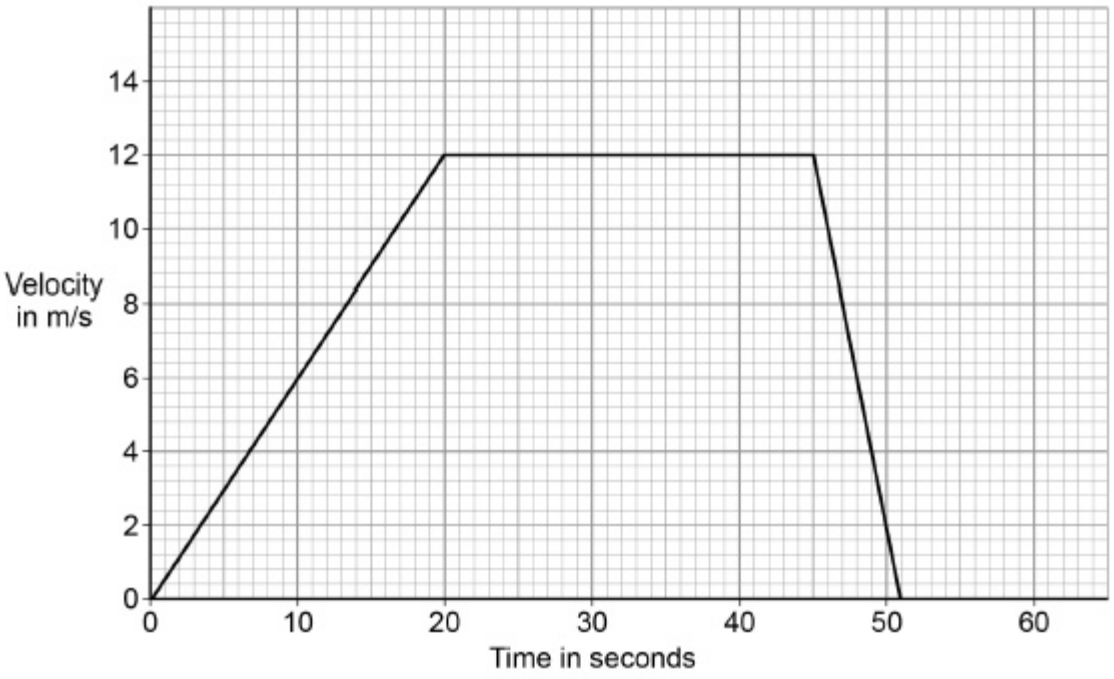
(Total 8 marks)

Q7.

Figure 1 shows a velocity–time graph for a short car journey.

Figure 1

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(a) Determine the acceleration of the car in the first 20 seconds of the journey.

Give the unit.

Acceleration = _____ Unit _____

(3)

(b) Determine the total distance travelled by the car during the journey shown in **Figure 1**.

Total distance travelled = _____ m

(4)

(c) The driver had to stop suddenly.

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The car's shock absorbers are springs.

At one point while the car was braking, one shock absorber had an elastic potential energy of 258 J

The spring constant of the shock absorber is 45 300 N/m

Calculate the extension of the shock absorber.

Use the Physics Equations Sheet.

Extension = _____ m

(3)

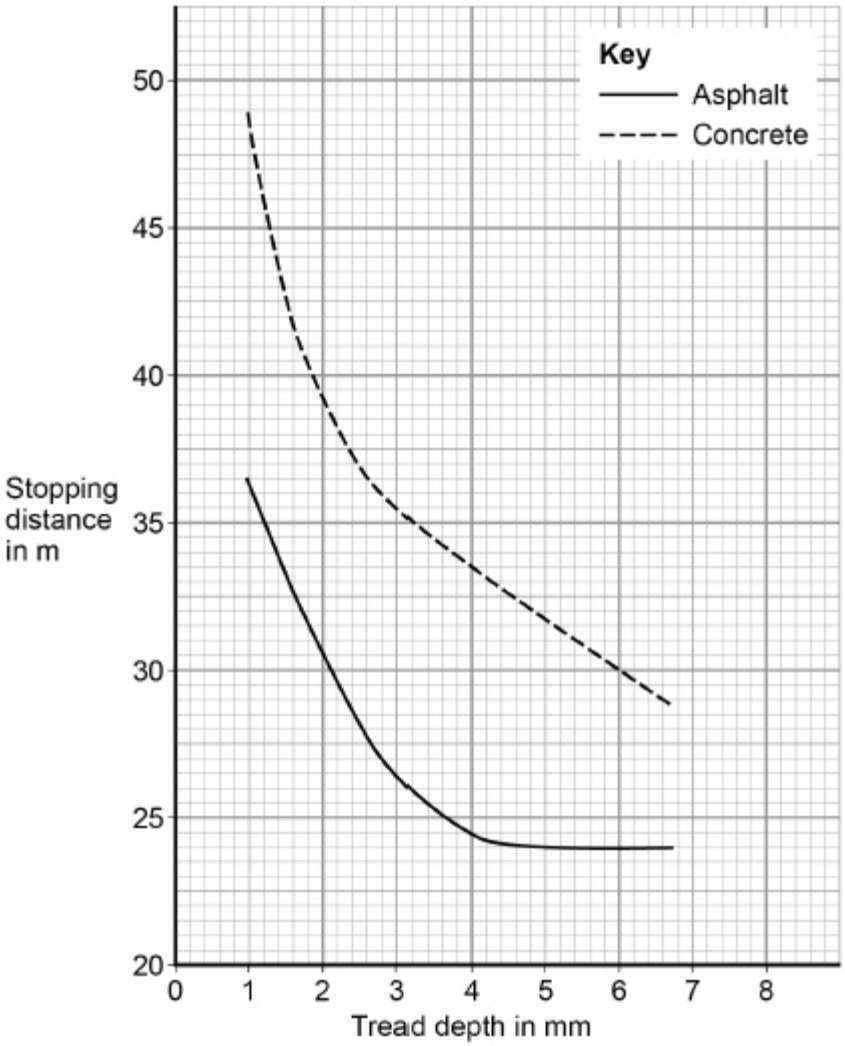
The stopping distance of a car can be affected by the condition of both the tyres and the road.

- The 'tread depth' of a tyre is the depth of the grooves in the tyre.
- Most roads have surfaces made of asphalt.
- Some roads have surfaces made of concrete.

Figure 2 shows how these factors affect the stopping distance for a car travelling at a certain speed.

Figure 2

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(d) Give **three** conclusions about the factors affecting stopping distance that can be made from **Figure 2**.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(e) The lowest stopping distance shown on **Figure 2** is 24 m

Explain why the stopping distance does not go below 24 m

_____

_____

_____

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_____

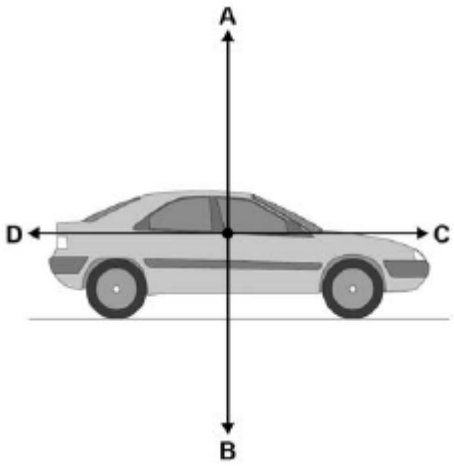
(2)

(Total 15 marks)

Q8.

Figure 1 shows the forces acting on a car moving at a constant speed.

Figure 1



(a) Which force would have to increase to make the car accelerate?

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(b) The car travels a distance of 2040 metres in 2 minutes.

Use the following equation to calculate the mean speed of the car.

$$\text{mean speed} = \frac{\text{distance}}{\text{time}}$$

_____

_____

Mean speed = _____ m / s

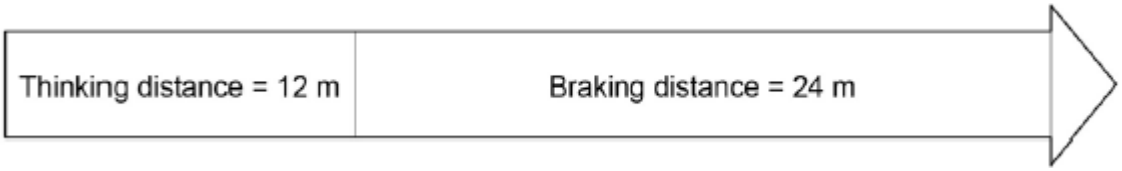
(2)

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(c) The car makes an emergency stop.

Figure 2 shows the thinking distance and braking distance of the car.

Figure 2



What is the stopping distance?

_____

(1)

(d) The person driving the car is tired.

What effect will this have on the thinking distance and braking distance?

Tick **one** box for thinking distance.

Tick **one** box for braking distance.

	decreases	increases	stays the same
thinking distance	☐	☐	☐
braking distance	☐	☐	☐

(2)

(Total 6 marks)

Q9.

Four students tested their reaction times using a computer program.

When a green light appeared on the screen the students had to press a key.

Table 1 shows their results.

Table 1

Student	Reaction time in s			Mean reaction time in s
	Test 1	Test 2	Test 3	
Boy 1	0.28	0.27	0.26	0.27
Boy 2	0.28	0.47	0.22	0.29
Girl 1	0.31	0.29	0.27	0.29

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Girl 2	0.32	0.30	0.29	0.30

(a) What is meant by 'reaction time' in this experiment?

_____

_____

(1)

(b) Boy 2 had an anomalous result in **Test 2**.

Suggest a reason why.

_____

_____

(1)

(c) Give **one** conclusion that can be made from the results in **Table 1**.

_____

_____

(1)

(d) Suggest further evidence that you could collect to support your conclusion.

_____

_____

(1)

(e) Reaction time is important at the start of a race.

Table 2 shows the time taken by a boy to run different distances.

Table 2

Distance in m	Time in s
100	12.74
200	25.63
800	139.46

Reaction time is more important in a 100 m race than in an 800 m race.

Explain why.

_____

_____

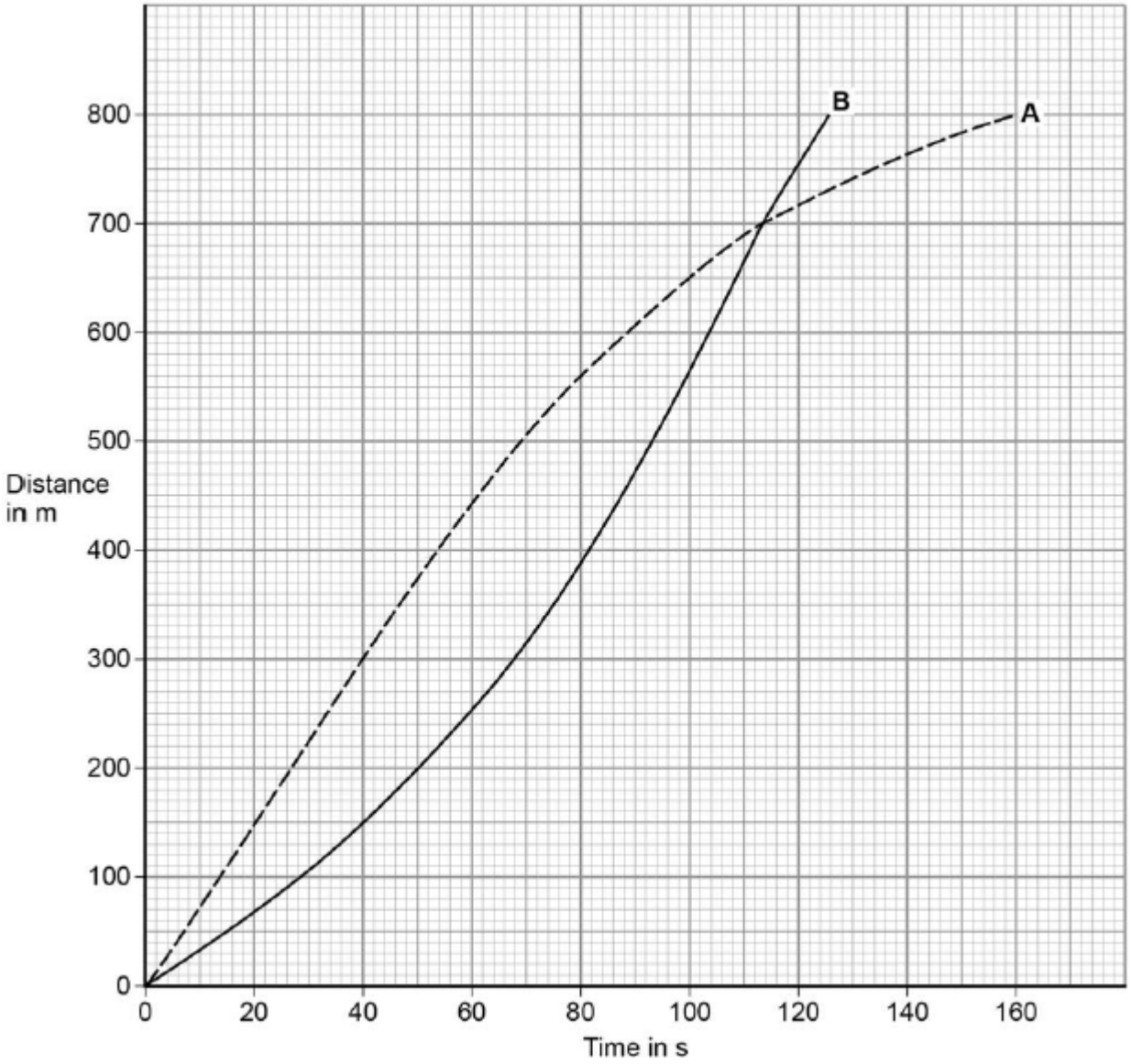
_____

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(2)

(f) Two girls, **A** and **B**, ran an 800 m race.

The figure below shows how the distance changed with time.



Compare the motion of runners **A** and **B**.

Include data from the figure above.

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(6)
(Total 12 marks)

Q10.

Four students tested their reaction times using a computer program.

When a green light appeared on the screen the students had to press a key.

Table 1 shows their results.

Table 1

Student	Reaction time in s			Mean reaction time in s
	Test 1	Test 2	Test 3	
Boy 1	0.28	0.27	0.26	0.27
Boy 2	0.28	0.47	0.22	0.29
Girl 1	0.31	0.29	0.27	0.29
Girl 2	0.32	0.30	0.29	0.30

(a) What is meant by 'reaction time' in this experiment?

(1)

(b) Boy 2 had an anomalous result in **Test 2**.

Suggest a reason why.

(1)

(c) Give **one** conclusion that can be made from the results in **Table 1**.

(1)

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(d) Suggest further evidence that you could collect to support your conclusion.

_____

_____

(1)

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Table 2 shows the time taken by a boy to run different distances.

Table 2

Distance in m	Time in s
100	12.74
200	25.63
800	139.46

Reaction time is more important in a 100 m race than in an 800 m race.

Explain why.

_____

_____

_____

_____

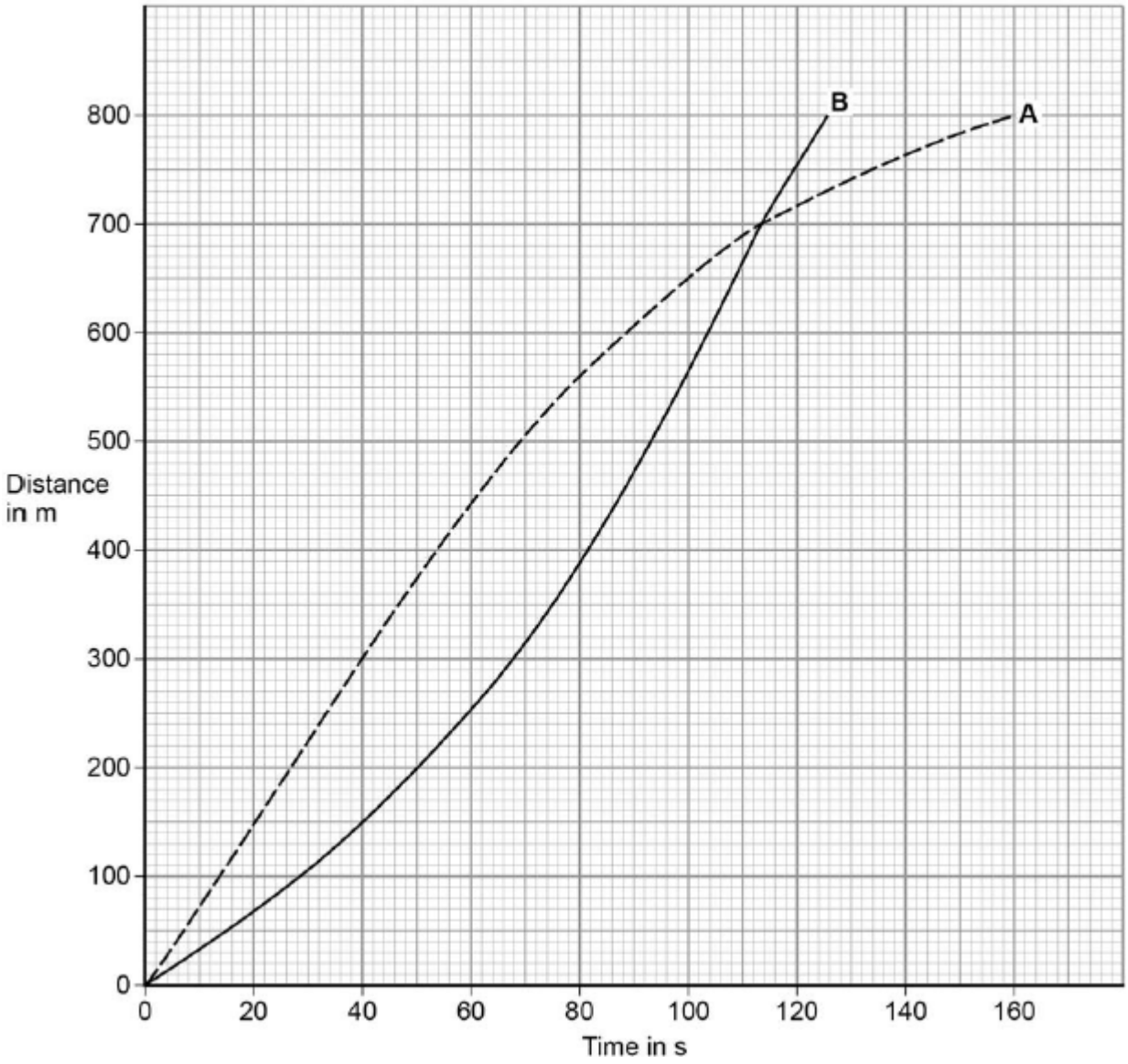
_____

(2)

(f) Two girls, **A** and **B**, ran an 800 m race.

The figure below shows how the distance changed with time.

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Compare the motion of runners **A** and **B**.

Include data from the figure above.

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_____

(6)

(g) Use above **Figure** to determine Girl **B**'s speed at 60 s.

Show how you use the graph to obtain your answer.

_____

_____

_____

Speed = _____ m / s

(3)

(Total 15 marks)

Q11.

This question is about speed.

(a) What is a typical value for the speed of sound?

Tick **one** box.

3.3 m / s ☐

3.3×10^2 m / s ☐

3.3×10^3 m / s ☐

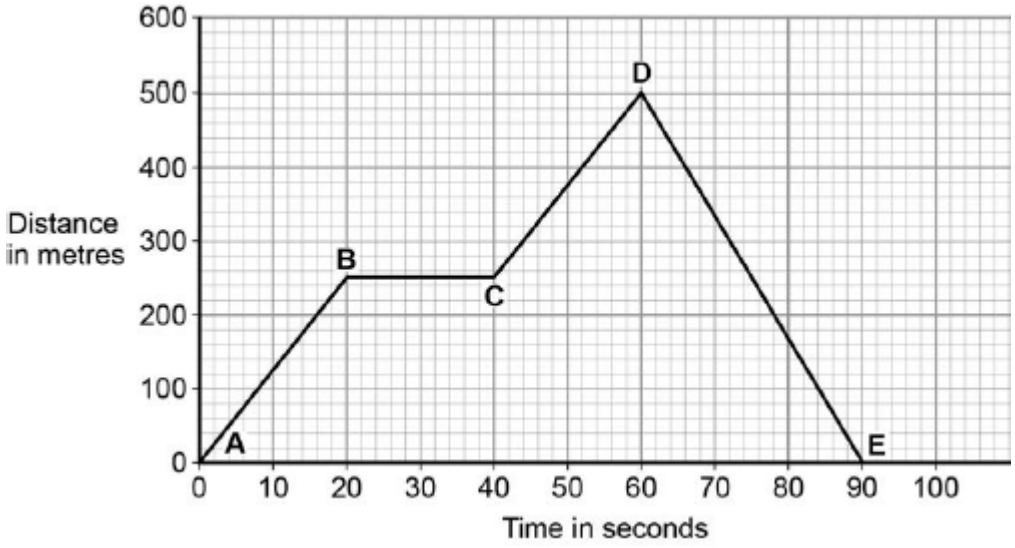
3.3×10^6 m / s ☐

(1)

(b) **Figure 1** shows a distance–time graph of a car.

Figure 1

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Explain what **Figure 1** shows about the motion of the car between point **A** and point **E**.

You should use values from **Figure 1** in your answer.

(4)

(c) The kinetic energy of a moving car depends on the car's mass and speed.

Write down the equation that links kinetic energy, mass and speed.

(1)

(d) A car has a mass of 1 650 kg.

The table below shows the kinetic energy of the car moving at 11 m / s.

Mass of car in kg	Speed in m / s	Kinetic energy in J
1 650	11	99 825
1 650	30	

Calculate the missing value in the table above.

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Give your answer in kilojoules (kJ).

Kinetic energy = _____ kJ

(2)

(e) A man is driving his car at a constant speed on a wet road.

He sees a fallen tree on the wet road and tries to stop quickly to prevent an accident.

Figure 2



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Explain why the man may not be able to stop in time.

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_____

_____

_____

_____

(6)

(Total 14 marks)

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