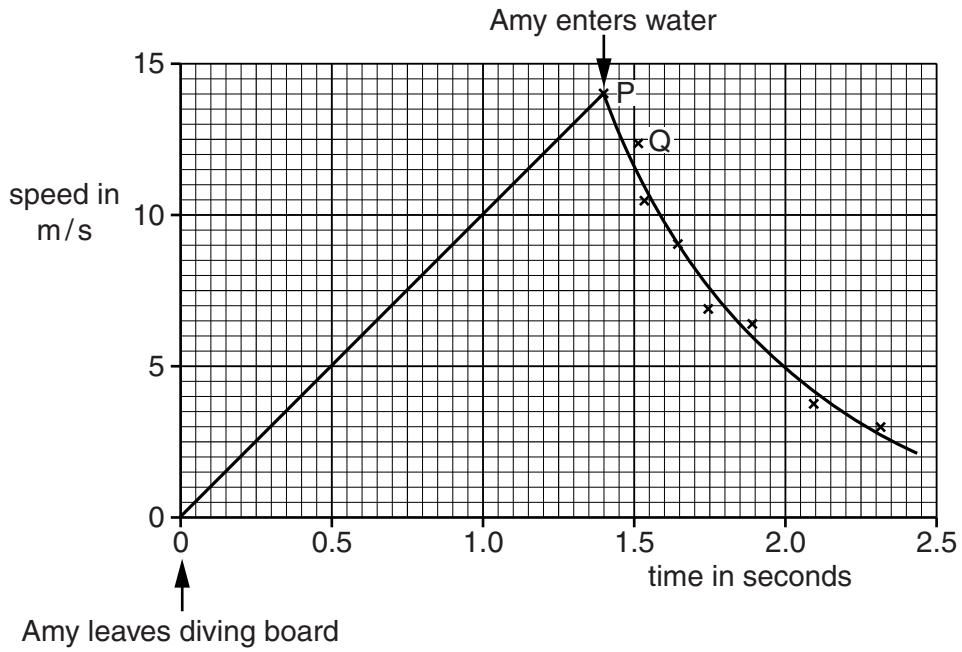
1 Amy dives from the high diving board at a swimming pool.

Look at the graph of her motion.



(a) Calculate the height of the diving board above the water.

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answer ..... m **[2]**

(b) (i) John thinks that he can find Amy's deceleration just after she enters the water by using points **P** and **Q** on the graph.

Elaine thinks it is better to find Amy's deceleration just after she enters the water by using the gradient of the graph at point P.

Explain why Elaine's method is better than John's to find the deceleration.

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..... **[2]**

(ii) Amy has a mass of 60 kg.
Amy's deceleration as she enters the water is 20 m/s^2.
Calculate the decelerating force on Amy just as she enters the water.

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answer ..... N **[1]**

2 Artificial satellites are put into space for scientific research.

The satellites are carried into space by rockets.

(a) A rocket accelerates steadily from rest and reaches 8000 m / s after travelling 1 680 000 m. Calculate the time, in minutes, it takes the rocket to reach this speed.

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answer ..... minutes **[3]**

(b) **(i)** The rocket is now in a stable orbit.
To keep the rocket in this orbit its speed needs to stay at 8000 m / s.
Suggest, by using ideas about gravitational and centripetal forces, why this speed needs to be maintained to keep it in this stable orbit.

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..... **[3]**

(ii) The rocket re-enters the Earth's atmosphere safely.

In the final part of the descent its speed reduces steadily from 2000 m/s to 120 m/s just before touchdown. This takes place over a distance of 5×10^5 m.

Calculate the average **deceleration** over this distance.

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answer .....m/s^2 **[3]**

(c) The International Space Station (ISS) is an artificial satellite.
The astronauts on the ISS do scientific research.
These astronauts are from different countries that work in teams and publish their results.

(i) Suggest why using teams of scientists on the ISS may be beneficial.

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..... **[1]**

(ii) Suggest why it is important for the scientists on the ISS to publish their results.

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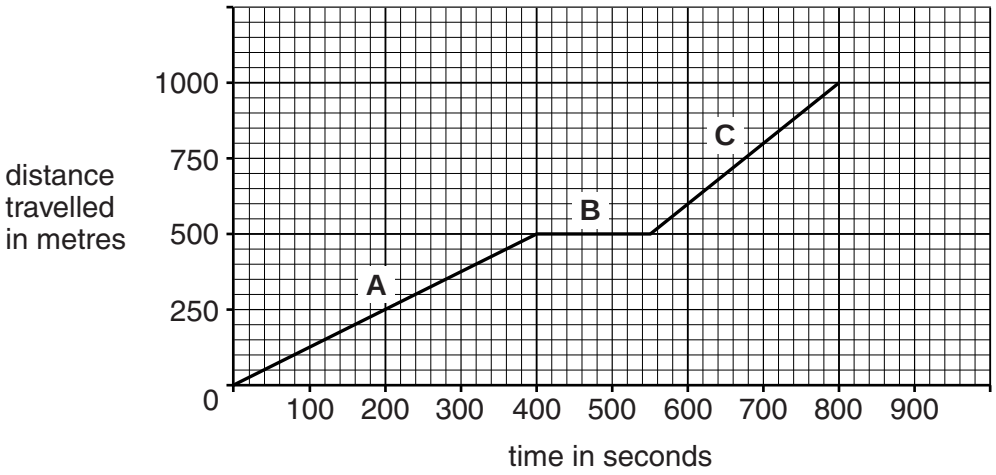
..... **[1]**

3 Colin walks to school.

Look at the graph representing his journey.



(a) Use the graph to calculate Colin's **average** speed for the total journey to school.

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answer .....m/s **[2]**

(b) Use the graph to calculate his speed in **part C** of the journey.

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answer .....m/s **[2]**

[Total: 4]

4 Emma drops a rock from the top of a cliff.

(a) The rock has a mass of 0.5 kg.

As the rock falls it loses potential energy and gains kinetic energy.

The rock is travelling at a speed of 15 m/s just before it hits the ground.

Calculate the distance the rock falls.

Take the value of g to be 10 N/kg.

Ignore the effect of air resistance.

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answer ..... metres **[3]**

(b) Emma drops another rock.

This rock has a mass of 1.0 kg.

The rock hits the ground at the same speed.

Explain why.

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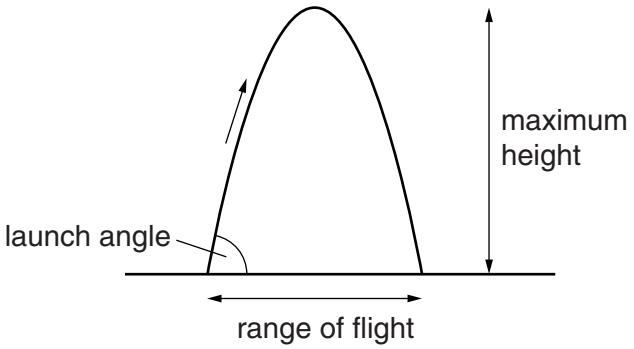
..... **[1]**

[Total: 4]

5 Jia makes a model air rocket in school.

She measures the maximum height and the range of flight for different launch angles.

Look at the diagram.



Look at Jia's results.

Launch angle in degrees	Maximum height reached in m	Range of flight in m
30	1.2	8.7
45	2.5	10.0
60	3.7	8.7
75	4.7	5.0

(a) Use the data to describe how the launch angle affects the range of flight of the rocket.

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..... **[2]**

(b) Jia tests one more launch angle.

This angle gives the rocket its greatest maximum height.

Suggest the launch angle she used in this test.

..... degrees **[1]**

(c) Jia's rocket is a projectile and it follows a path.

If there is very little air resistance, the projectile path is very predictable.

(i) Name the **shape** of the path followed by Jia's rocket.

..... **[1]**

(ii) How does the force of gravity affect the vertical velocity **and** vertical acceleration as the rocket rises?

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..... **[2]**

(iii) How does the force of gravity affect the horizontal velocity of the rocket?

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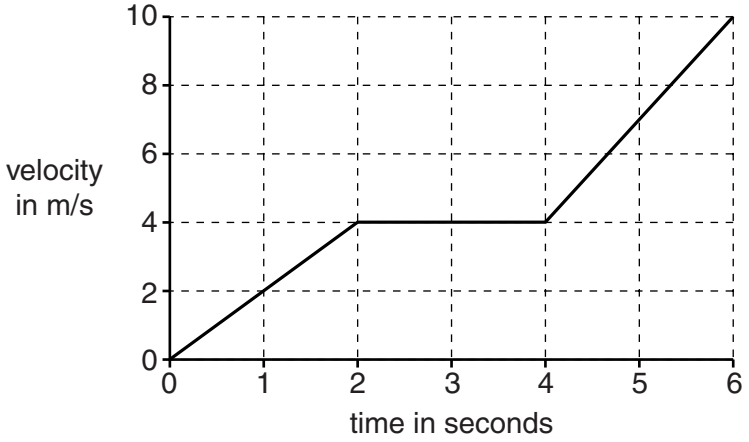
..... **[1]**

[Total: 7]

6 Daisy uses her remote controlled model car.

Look at the simple velocity-time graph for this car.



Describe and compare, in detail, the accelerations, and distances travelled by her car during the three parts of the 6-second journey.

The quality of written communication will be assessed in your answer to this question.

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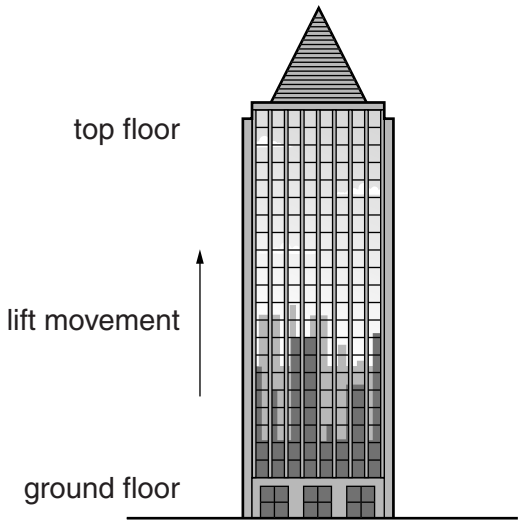
..... **[6]**

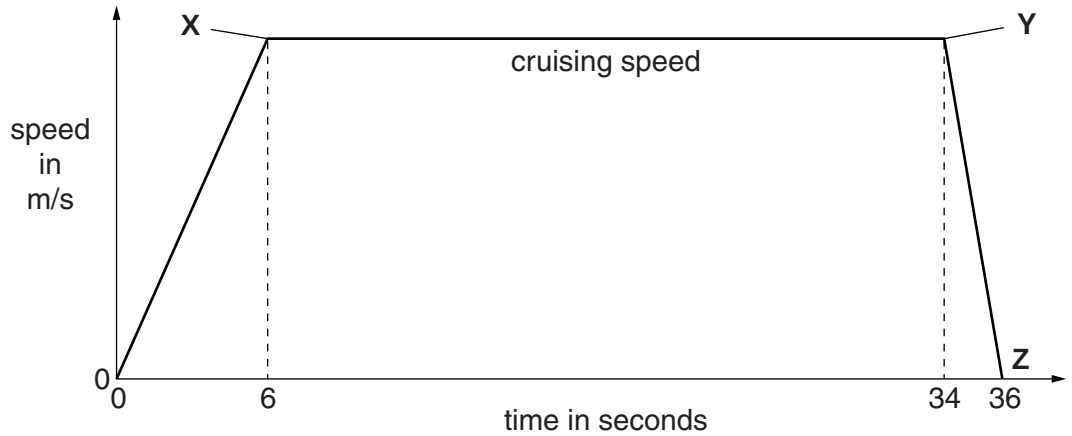
[Total: 6]

7 Samuel is investigating the movement and forces in tall buildings (skyscrapers).

Skyscrapers have lifts or elevators to transport people up and down.



Look at the speed-time graph for **part** of the journey of a lift up a skyscraper.



(a) The lift travels 30 m before it reaches its cruising speed (at point **X**).

Samuel thinks that the cruising speed is 5 m/s. Use a calculation to explain if he is correct.

calculation .....

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.....

answer ..... m/s

How does this compare to what Samuel thinks?

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.....

[3]

(b) The lift begins to slow down at point **Y** on the graph.

Compare the acceleration between points **0** and **X** with the acceleration between points **Y** and **Z**.

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..... **[2]**

(c) **(i)** When the lift is moving at its **cruising speed** work is done by the motor pulling the lift.

There are 8 people in the lift. The average weight of **each** person is 600 N.

The weight of the lift is 6000 N.

Calculate the power needed to move the lift and the 8 people at cruising speed.

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..... W **[2]**

(ii) Calculate the total **mass** of the lift and the people in it.

The value of gravitational field strength = 9.8 N/kg.

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Give your answer to **2** significant figures.

answer ..... kg **[2]**

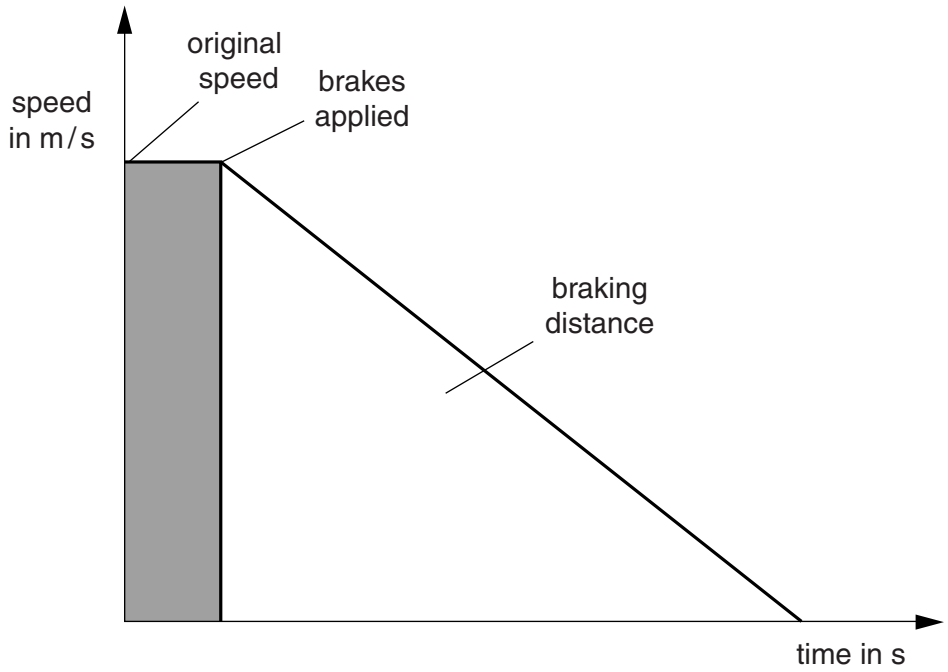
[Total: 9]

8 The police take measurements after some road accidents.

They can measure the braking distance by measuring the length of the skid marks on the road.

This can give them an estimate of the original speed of the vehicles.

Look at the graph of a car stopping.



The car takes 5 s to brake and the skid mark is 75 m long.

(a) Calculate the **original** speed of the vehicle using this distance.

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answer ..... m/s **[2]**

(b) The speed limit is 32 m/s.

The police are not sure if the driver was travelling at a higher speed than the speed limit.

Suggest why the skid mark may **not** give an accurate estimate of the original speed of the driver.

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..... **[2]**

(c) Police know that braking distances are related to speed.

This is because kinetic energy is transferred in braking.

Look at the diagram.

(i) Car **A** and car **B** are travelling at the same speed.

Car **A** has double the mass of car **B**.

Compare the amount of kinetic energy of car **A** and car **B**.

..... **[1]**

(ii) What happens to the kinetic energy of car **A** when its **speed** is doubled?

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..... **[1]**

(iii) What happens to the braking distance when the speed is doubled?

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..... **[1]**

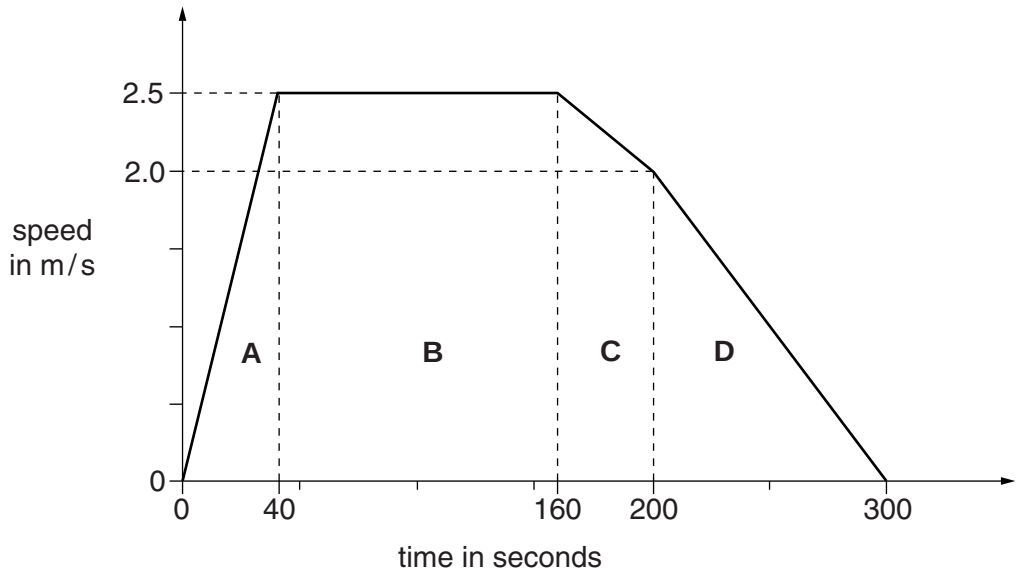
[Total: 7]

9 Laura and Paul are learning about speed and distance in a science lesson.

Paul walks around the school sports field.

Laura calculates the speed for different parts of his walk.

She draws a speed-time graph.



(a) Laura thinks that Paul **accelerates** in part **A** but **decelerates** in part **C**, then decelerates **more rapidly** in part **D**.

Is Laura correct?

answer .....

Explain your answer using information from the graph.

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..... **[2]**

(b) (i) Calculate the **distance** travelled while Paul's speed is **increasing**.

Put a (ring) around the correct answer.

10 m **50 m** **80 m** **90 m** **100 m** **300 m**

[1]

(ii) Paul walks a **total** distance of 540 m.

His **average** speed for the whole walk is 1.8 m/s.

He does a **longer** walk of 1.2 km at the **same** average speed.

Calculate the time for his longer walk.

Give your answer to **3** significant figures.

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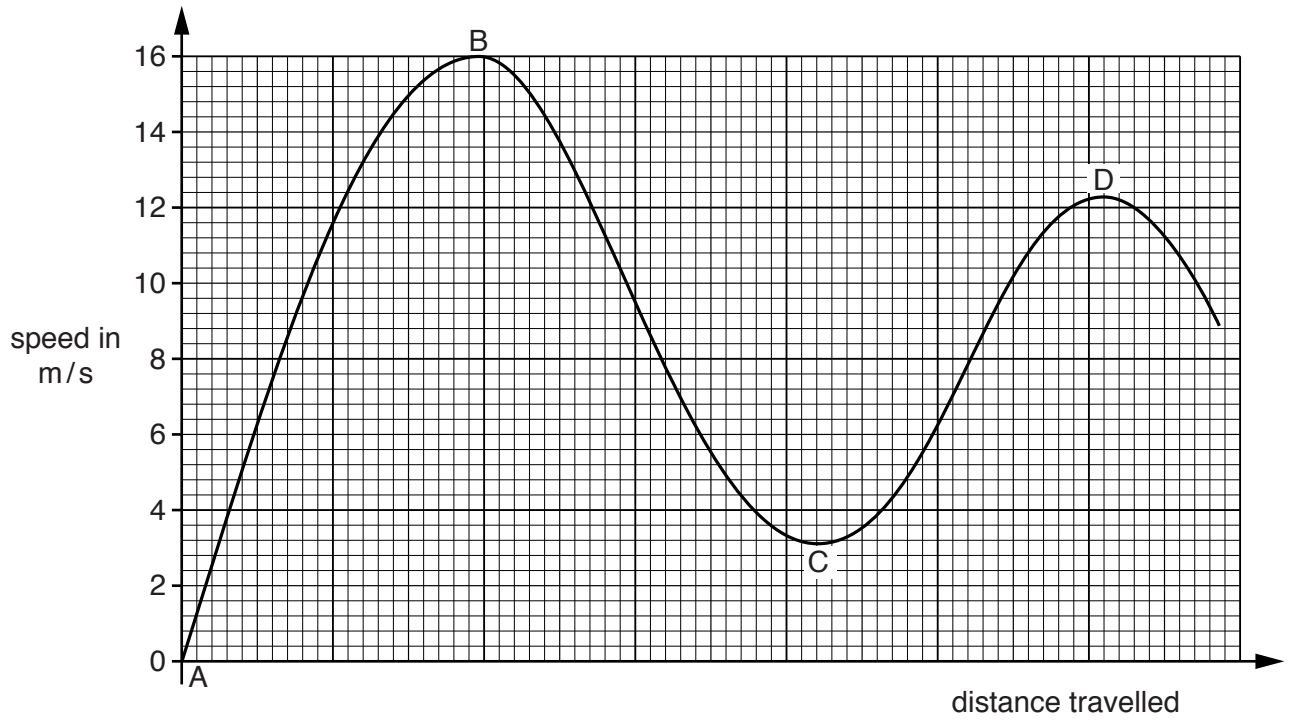
answer ..... s **[2]**

[Total: 5]

10 This question is about kinetic and gravitational potential energy.

Look at the graph.

It shows how the speed of a roller coaster car changes with the distance travelled along part of the track.
The roller coaster car starts from rest at the top of the track at **A**.
The car and its passengers have a total mass of 400 kg.



Describe how the kinetic energy and the gravitational potential energy of the car change in sections AB and BC of the journey, and calculate the difference in height of the roller coaster between A and B assuming no energy is lost.

The acceleration due to gravity is 10 m/s^2.

The quality of written communication will be assessed in your answer to this question.

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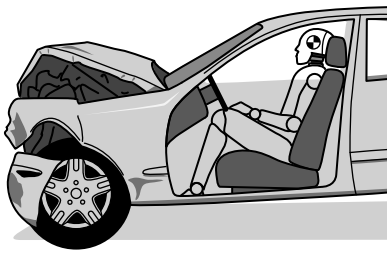
..... **[6]**

11 Scientists investigate the safety of seat belts.

They use two cars. Each car has an identical dummy in the driver's seat.

Both cars are crashed, at the same speed, into identical barriers.

In one car, the dummy is wearing a seat belt. In the other car, the dummy is not wearing a seat belt and hits the windscreen in the collision.



Look at the results.

	Crash with seat belt	**Crash without seat belt**
Mass of dummy	60 kg	60 kg
Distance travelled by dummy whilst stopping	60 cm after seat belt locked	20 cm after hitting windscreen
Time taken for dummy to stop moving	0.08 sec	0.03 sec
Deceleration	175 m / s^2	467 m / s^2
Stopping force	10500 N	

Calculate the missing data and use the information in the table to explain how seat belts reduce injury in a crash.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]