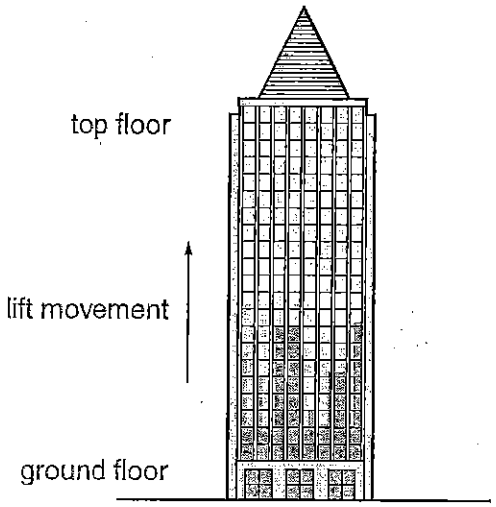
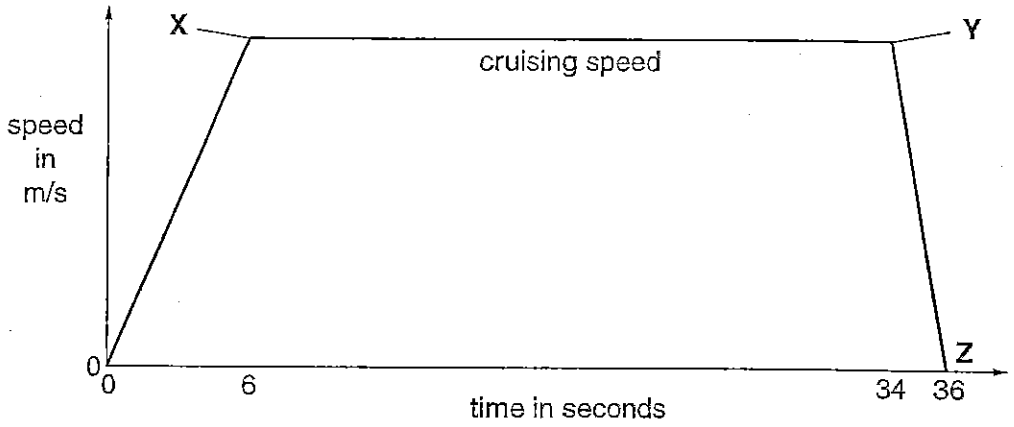
SECTION C – Module P3

10 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 .....

.....

.....

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]

11 Look at the extract from a newspaper article promoting electric cars.

> *Will electric cars take over our roads?*
>
> - *no need for fuel*
> - *no emissions*
> - *silent*
> - *economic to purchase*
> - *easy to charge batteries*

Electric cars could become more popular than petrol and diesel cars.

Use the points raised in the extract to identify the arguments **for** and **against** increasing the use of electric cars.


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

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

[Total: 6]

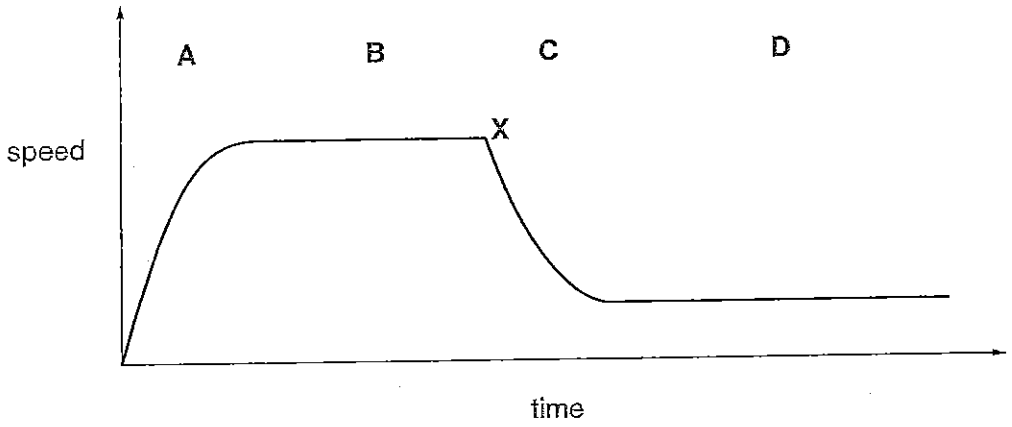
12 Susie is a skydiver.

Look at the graph.

It shows her speed after she has jumped from an aeroplane.

There are four sections of the graph, labelled **A**, **B**, **C** and **D**.

Susie opened her parachute at point **X** shown on the graph.



(a) Write about the forces acting on Susie during her descent to explain the different speeds she travels at.

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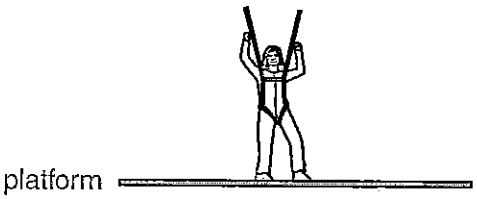
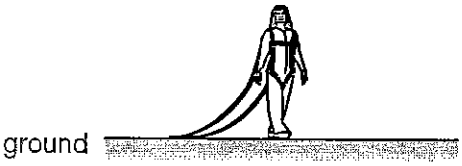
..... [4]

Turn over for the remainder of question 12

(b) Susie practises her landings by jumping from a low platform.

She is attached to straps which act like a parachute.





A Susie **standing still** on platform.

B Susie is **exactly half way** down.

C Susie is **on** the ground.

Look at the statements about Susie's energy as she does her practice fall.

Put a tick (✓) in the box beside any correct statement and a cross (✗) beside any incorrect statement.

The first one has been done for you.

At **A** all of Susie's energy is GPE.	✓
Between **A** and **B** Susie gains **both** GPE and KE.	
Between **A** and **B** Susie gains **only** KE.	
At **B** her KE is **exactly** half her GPE at **A**.	
Just before touching the ground at **C** Susie has her maximum KE.	
On the ground at **C** Susie has zero KE.	
On the ground at **C** Susie has her maximum GPE.	

[3]

[Total: 7]

Question 13 begins on page 24

13 Rufus is driving to work in his car.

In the first part of his journey he drives at a speed of 10 m/s on a dry road.

In the second part of his journey he drives at a speed of 20 m/s and it starts to rain.

Explain how the higher speed and the wet road affect:

- Rufus' thinking distance
- the car's braking distance.

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..... [3]

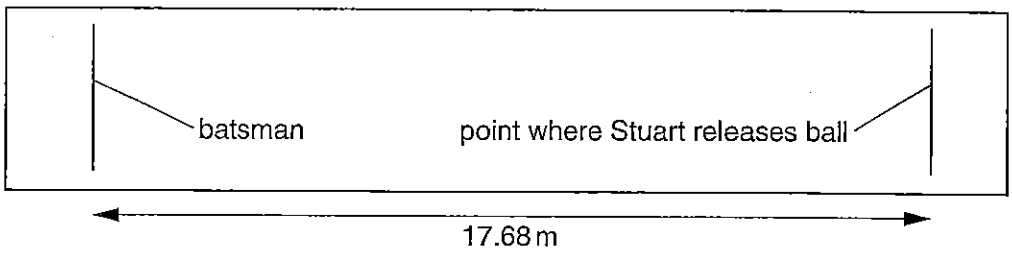
[Total: 3]

END OF QUESTION PAPER

Section C – Module P3

9 Stuart is a keen cricketer.

In a match he bowls a cricket ball at a batsman.



(a) The ball's speed was measured.

The ball left Stuart's hand at a speed of 41 m/s.

It reached the batsman at a speed of 37 m/s.

Calculate the time taken for the cricket ball to reach the batsman.

Give your answer to **two** decimal places.

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answer ..... seconds **[3]**

(b) The batsman needs 0.48 seconds to react and hit the cricket ball.

Was the batsman able to hit the cricket ball?

answer .....

explanation

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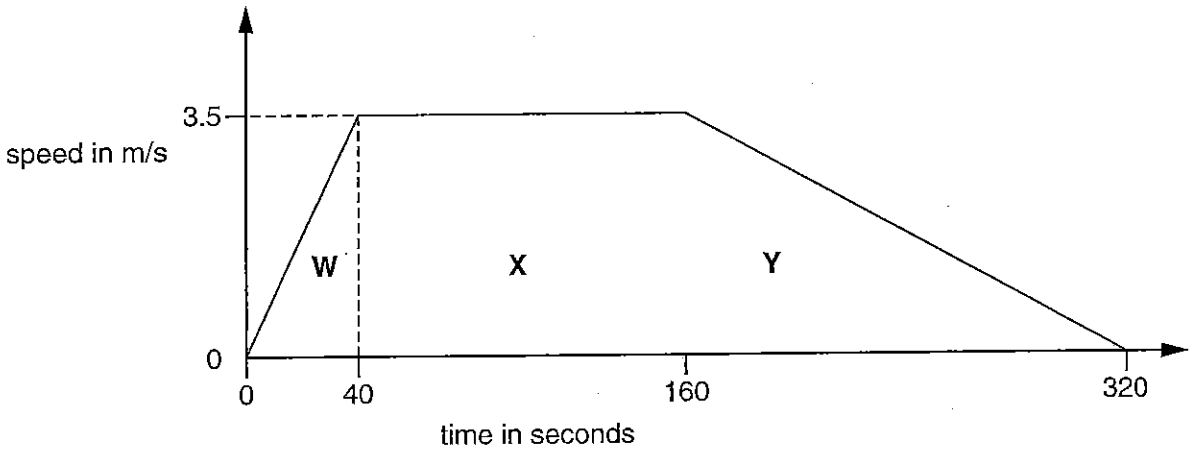
..... **[1]**

[Total: 4]

10 Jessica is an athlete.

The graph shows the speed of Jessica during a training run.



(a) Jessica travels 70 m in part **W** of the graph.

Describe how this can be found from the graph.

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

(b) Compare the distance in part **W** with the distance travelled in the other two parts of the graph.

Use calculations in your answer.

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

[Total: 4]

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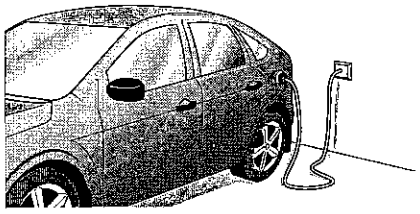
11 Look at the diagram of an electric car being charged.



In the future, electric cars will increasingly be used instead of cars that run on petrol or diesel.

Write about the arguments for and against the use of electric cars **and** how scientists can determine if the use of electric cars is a benefit to the environment.

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

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

[Total: 6]

12 This question is about cars, speed and road safety.

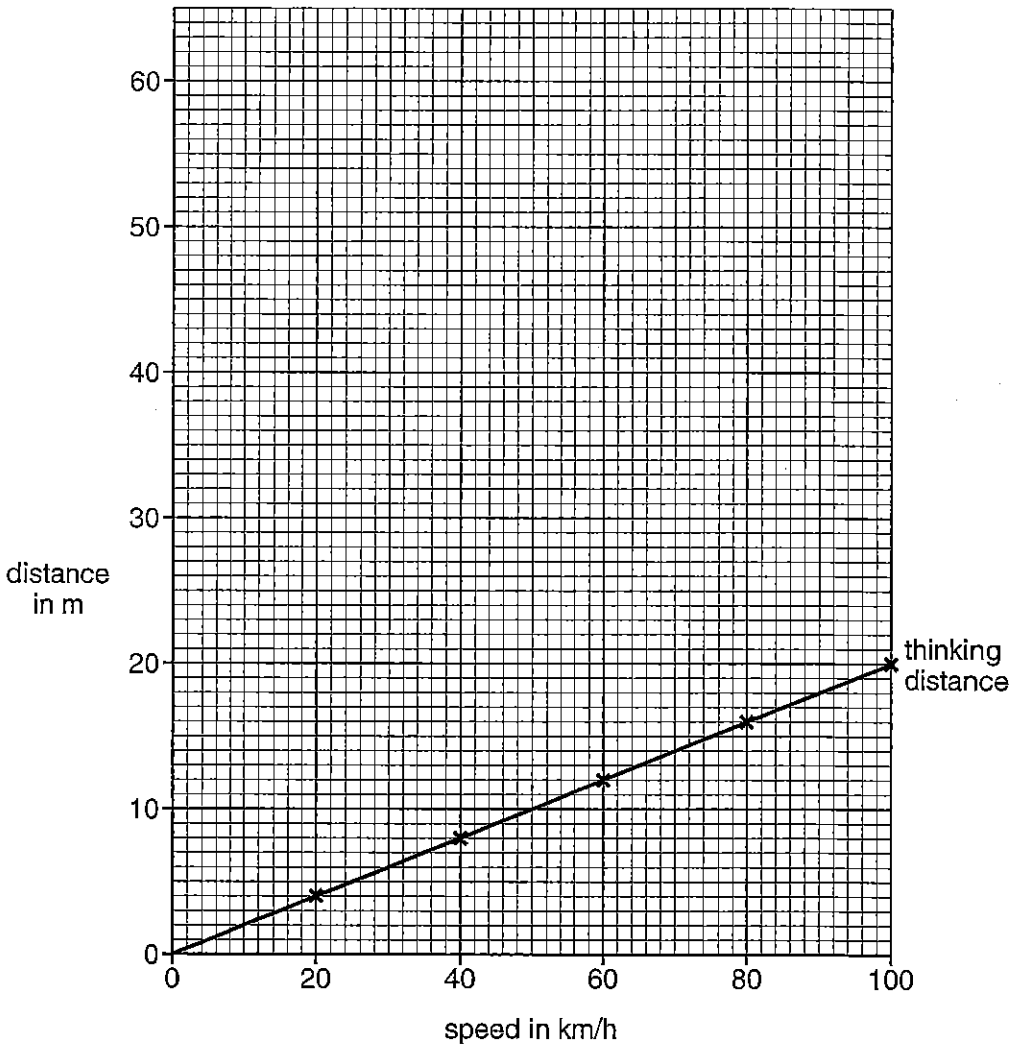
(a) Look at the table.

It shows speeds and distances for a car travelling on a dry road.

speed in km/h	thinking distance in m	braking distance in m	stopping distance in m
20	4	2.5	6.5
40	8	10.0	18.0
60	12	22.5	34.5
80	16	40.0	56.0
100	20	62.5	82.5

Plot the points and draw the graph for the **braking distance** on the axes below.

The graph of thinking distance has been done for you.



[2]

(b) Use the information in part **(a)** to explain which quantity has the greatest effect on stopping distance as speed increases.

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..... [2]

(c) Scientists obtained the figures for braking and stopping distance on a dry road by doing test runs with cars.

This information is used to inform drivers about safe driving.

(i) How do these scientists ensure that they can be confident about their conclusions about safe driving?

.....

..... [1]

(ii) What would scientists need to do to make further predictions about braking distance for different driving conditions?

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..... [1]

(d) Crumple zones on cars can reduce injury to drivers and passengers.

The crumple zones reduce the forces on these people in a crash.

Explain how.

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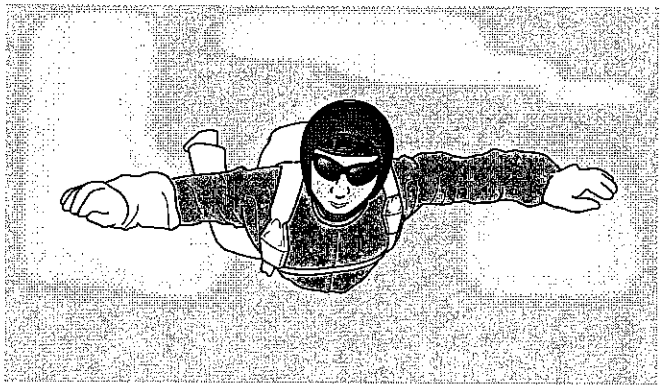
..... [2]

[Total: 8]

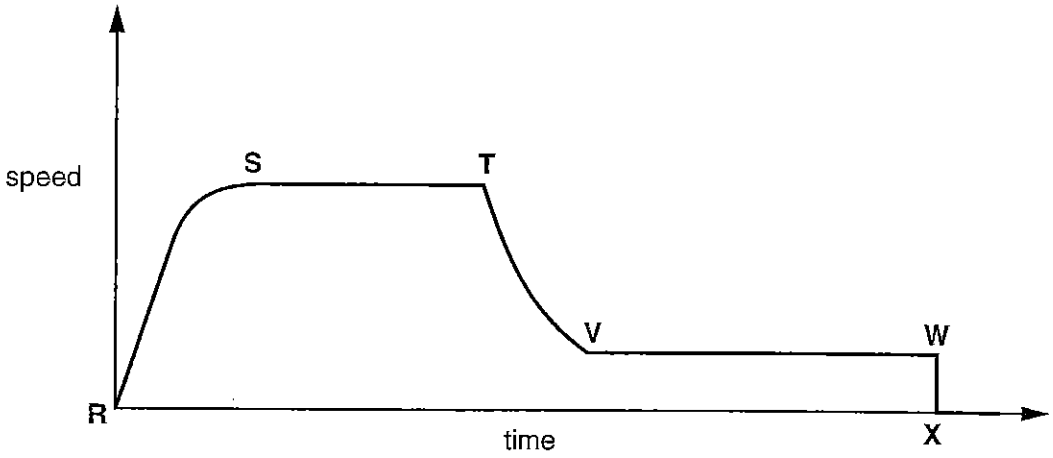
13 Haroon is a skydiver.



He jumps from a plane.

At some point during his fall he opens his parachute.

Look at the graph that shows his speed during his descent.



Use the letters **R**, **S**, **T**, **V**, **W** and **X**.

(a) What two parts of the graph show when Haroon was moving with the forces of drag and weight balanced?

answer between ..... and ..... **and** between ..... and ..... **[1]**

(b) Where was there a big increase in drag force on Haroon due to an increased surface area?

answer between ..... and ..... **[1]**

(c) When did Haroon experience an increasing drag force due to him accelerating?

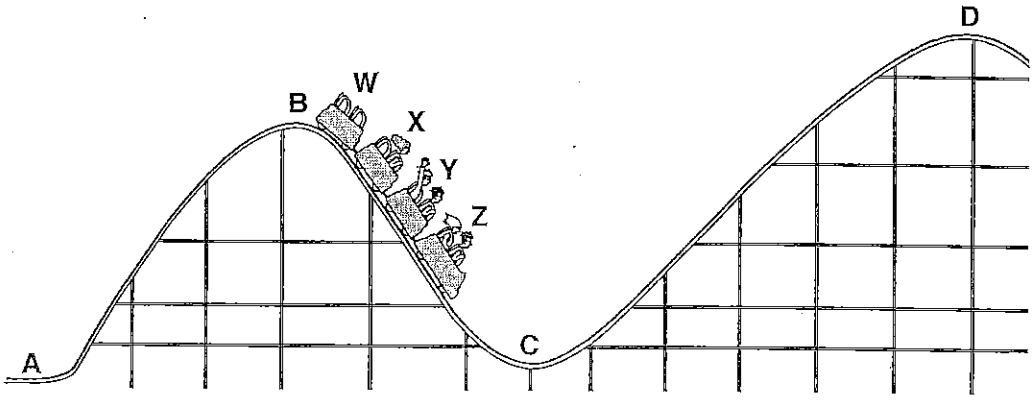
answer between ..... and ..... **[1]**

[Total: 3]

END OF QUESTION PAPER

SECTION C – Module P3

9 Five people ride on a roller coaster.



(a) At position **D**, the roller coaster has the greatest **gravitational potential energy** (GPE).

Explain why, using the equation:

$$GPE = mgh$$

.....

..... [1]

(b) Roller coaster car **W** is empty.

Josef thinks that the roller coaster car **W** has **no** momentum as it moves down the slope.

Is he correct?

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Explain your answer.

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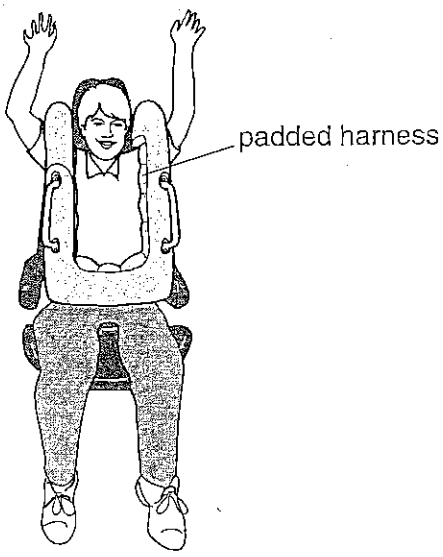
..... [1]

(c) All the people in the roller coaster cars wear a padded harness.



If the roller coaster comes to a sudden stop the **padded** harness reduces the likelihood of an injury.

Explain why.

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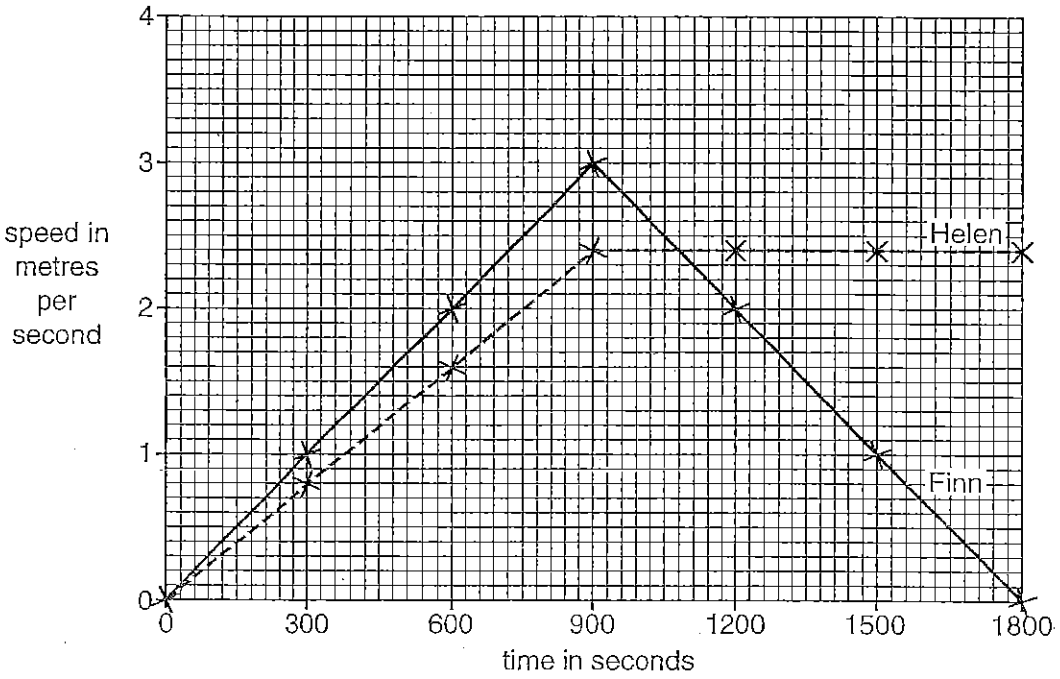
..... [2]

[Total: 4]

10 Helen and Finn take part in a cross-country run.

Look at the information about their run.

Their speeds have been plotted on a graph.



Use the graphs to compare Helen's and Finn's **acceleration** over the whole run.

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

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

[Total: 6]

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Question 11 begins on page 22

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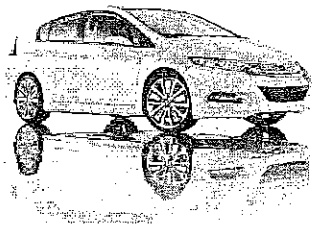
11 There are many different types of cars available.



Look at the information.

Conventional cars use fossil fuels.

Bio-fuel hybrid electric cars use bio-fuels and an electric motor.
They can be plugged in to a power supply to recharge the battery.

Plug-in hybrid electric cars use fossil fuels and an electric motor.
They can be plugged in to recharge the battery.

Electric cars only use a battery.
They can be plugged in to recharge the battery.

Type of car	CO_2 emissions in kg per 160 km
conventional	39.5
bio-fuel hybrid electric	25.9
plug-in hybrid electric	28.2
electric	24.5

(a) The CO_2 emissions could come from a power station as well as directly from the fuel in the car.

Use this information to explain the differences in CO_2 emissions for the four different types of car.

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..... [4]

(b) Fuel consumption figures for the four different types of car increase when road conditions are poor.

Explain what factors, other than road conditions, need to be considered when comparing fuel consumption figures.

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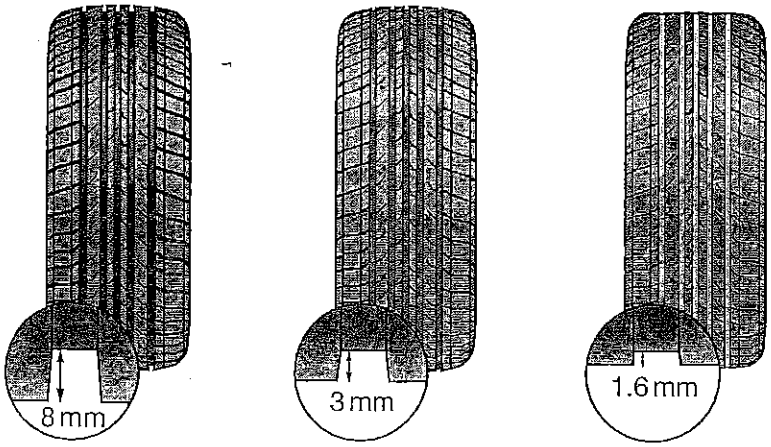
..... [3]

[Total: 7]

Question 12 begins on page 24

12 Car tyres have tread.

As tyres become worn the amount of tyre tread decreases.



magnified view of tyre tread showing depth

(a) Look at the braking distance chart for the **same** car with different tyre tread depths.

tyre tread depth in mm	braking distance in m
8	25.9
3	31.7
1.6	39.5

(i) What is the braking distance for the car with a tyre tread depth of **8 mm** when the speed is **doubled**?

.....

.....

braking distance ..... m **[1]**

(ii) Speed affects **braking distance**.

Doubling the speed of the car with a tyre depth **below** 1.6 mm is a significant concern in terms of road safety.

Explain why.

.....

.....

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

(b) The data in the table shows the advice about depth of tyre tread.

Depth of tyre tread in mm	Advice
8	tyre is legal
4	tyre is legal
3	consider replacing
1.6	legal limit

Due to technological advances a new tyre has been made.

The tread on the new tyre is more resistant to wear **but** once it reaches 4 mm tread depth the rate of wear rapidly increases.

Describe a benefit of using this new tyre, and suggest a way of limiting the **risks** of using it.

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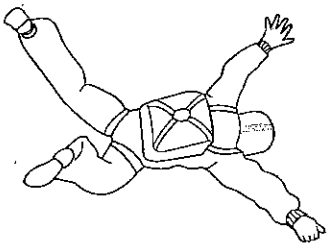
..... [2]

[Total: 5]

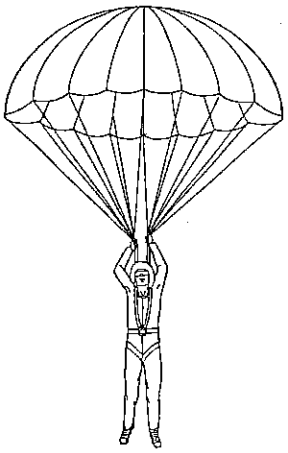
13 David is a parachutist.

He jumps out of an aeroplane.



(a) David's terminal speed is 60 m/s **before** he opens the parachute.

David opens the parachute.



Explain, in terms of balanced forces acting on David, why his terminal speed is different before **and** after he opens his parachute.

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..... [2]

(b) The acceleration due to gravity is given the symbol **g**.

Describe what happens to the value of **g** as David jumps out from the aeroplane at very high altitude and falls all the way to Earth.

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..... [1]

[Total: 3]

END OF QUESTION PAPER