

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**B721/02**

**GATEWAY SCIENCE**  
**ADDITIONAL SCIENCE B**

**Additional Science modules B3, C3, P3**  
**(Higher Tier)**

**TUESDAY 22 JANUARY 2013: Morning**

**DURATION: 1 hour 15 minutes**  
**plus your additional time allowance**

**MODIFIED ENLARGED 18pt**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.**  
**A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**Periodic Table (inserted)**

**OTHER MATERIALS REQUIRED:**

**Pencil**


**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer ALL the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

## **INFORMATION FOR CANDIDATES**

- Your quality of written communication is assessed in questions marked with a pencil ()
- A list of equations can be found on pages 4–5.
- An enlarged copy of the Periodic Table is inserted.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 75.

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## **EQUATIONS**

$$\text{energy} = \text{mass} \times \frac{\text{specific heat capacity}}{\text{}} \times \frac{\text{temperature change}}{\text{}}$$

$$\text{energy} = \text{mass} \times \text{specific latent heat}$$

$$\text{efficiency} = \frac{\text{useful energy output} (\times 100\%)}{\text{total energy input}}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{energy supplied} = \text{power} \times \text{time}$$

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

$$\text{distance} = \text{average speed} \times \text{time}$$

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

$$\text{power} = \text{force} \times \text{speed}$$

$$\text{KE} = \frac{1}{2}mv^2$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

$$\text{GPE} = mgh$$

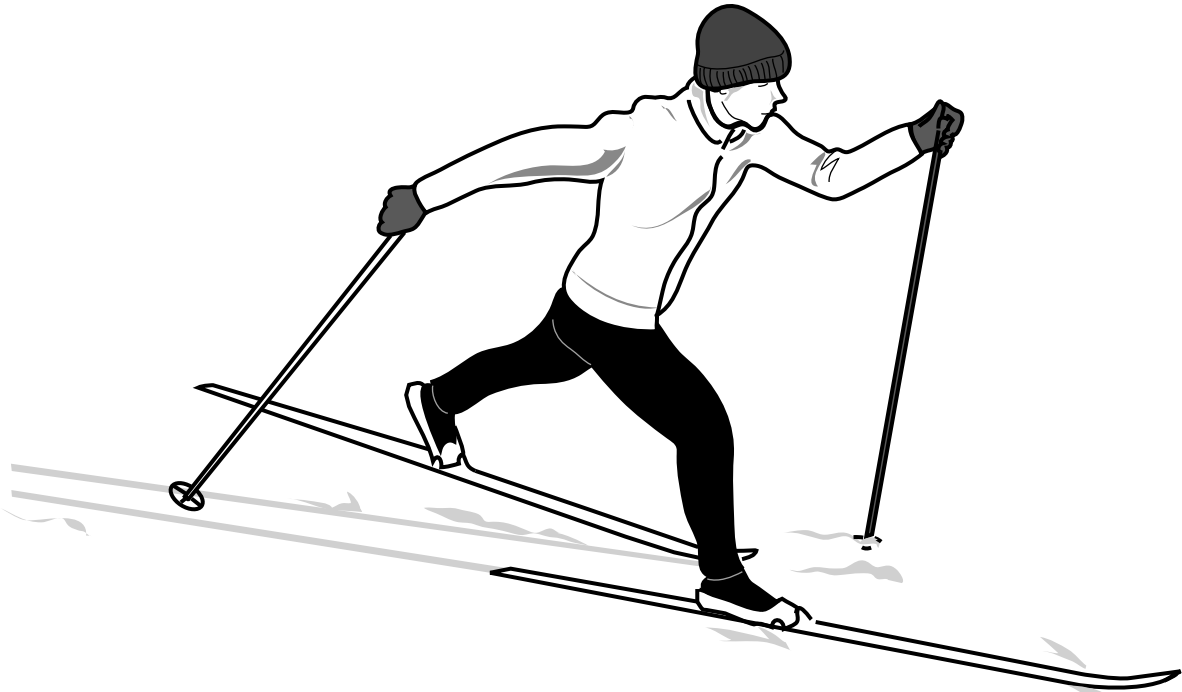
$$mgh = \frac{1}{2}mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

**Answer ALL the questions.**

**SECTION A – MODULE B3**

**1 Cross-country skiers have to be very fit.**



- (a) Cross-country skiers have high numbers of mitochondria in the muscles of their arms and legs.**

**Runners only have increased numbers in their leg muscles.**

**Explain this difference.**

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**[2]**

- (b) One way of measuring the fitness of a person is to measure the maximum rate that they can use oxygen.

This is called their  $\text{VO}_2\text{MAX}$ .

The table shows typical ranges of  $\text{VO}_2\text{Max}$  for different men.

	Range of $\text{VO}_2\text{Max}$
non-sportsman	43–52
cross-country skier	65–94
runner	60–85
weightlifter	43–52

- (i) Weightlifters only take several seconds to lift weights.

Their muscles respire anaerobically.

Explain why their  $\text{VO}_2\text{Max}$  is the same as a non-sportsman.

\_\_\_\_\_ [1]

(ii) It is hard to measure  $\text{VO}_2$  Max.

It can be estimated using the formula below.

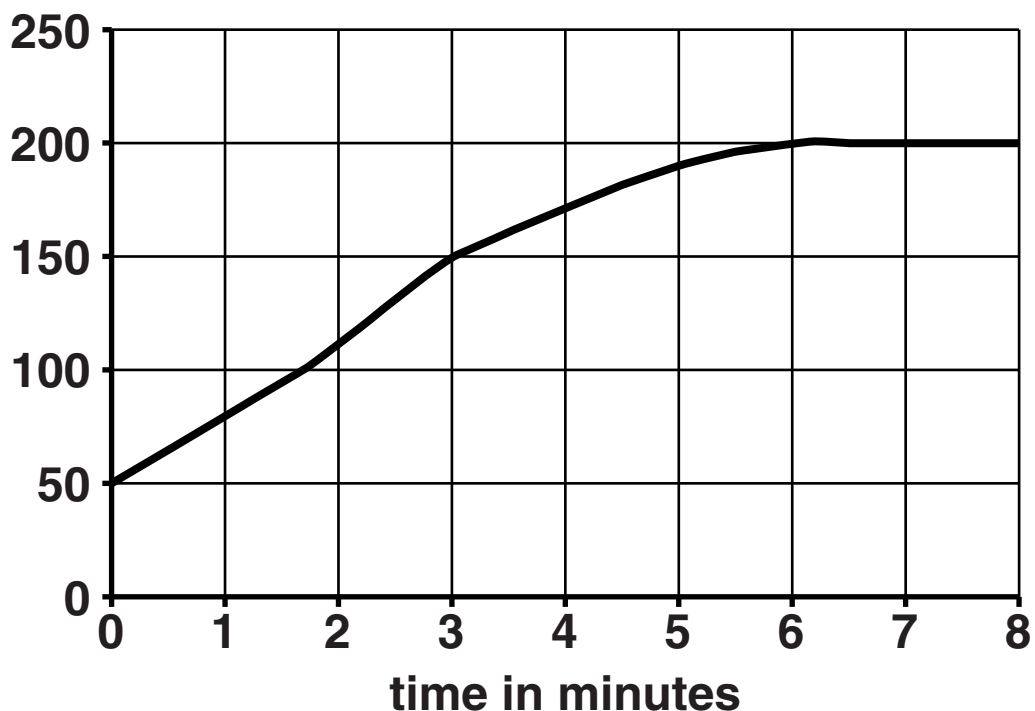
$$\text{VO}_2 \text{ MAX} = \frac{15 \times \text{MAXIMUM HEART RATE}}{\text{RESTING HEART RATE}}$$

Toby is training to become a cross-country skier.

He starts from rest and exercises as hard as he can for 8 minutes.

The graph shows his heart rate as he exercises.

heart rate  
in beats  
per minute





**Work out Toby's  $\text{VO}_2$  Max.**

**answer = \_\_\_\_\_ [2]**

**(iii) Is Toby fit enough yet to be a successful cross-country skier?**

**Justify your answer.**

\_\_\_\_\_  
\_\_\_\_\_ **[1]**

**(c) Read the article.**

### **HEART FEAR FOR CROSS-COUNTRY SKIERS**

**It has long been known that cross-country skiers have bigger hearts than average. This helps them compete.**

**However, this might cause problems.**

**The top two chambers of the heart may start to beat in an unusual way. This is called fibrillation.**

**A study looked at 78 retired skiers; 13 of them had fibrillation.**

**About 15 percent of 75 year-old men in the whole population have fibrillation.**

**However, the skiers developed the condition at an earlier age than most men.**

- (i) What is the name of the chambers that are developing fibrillation?**

\_\_\_\_\_ **[1]**

- (ii) Explain how the results of the study could be used to show that there is NO link between skiing and fibrillation.**

\_\_\_\_\_  
\_\_\_\_\_ **[1]**

**[TOTAL: 8]**

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**TURN OVER FOR QUESTION 2**

**2 Look at the advertisement about storing stem cells from umbilical cords.**

**STORE YOUR BABY'S STEM CELLS**

**Now for a single payment you can have your baby's stem cells stored.**

**There are stem cells in the baby's umbilical cord.**

**These stem cells are NOT embryonic stem cells but are similar to adult stem cells.**

**They could still prove lifesaving to your child later in life.**

**The stem cells can be frozen and stored in case they are needed.**

**Write about why people might want to have their baby's stem cells stored and why embryonic stem cells might be more useful.**



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

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**[6]**

**[TOTAL: 6]**

**3 Haemoglobin is found in blood.**

**(a) Explain how haemoglobin supplies the tissues of the body with oxygen.**

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**[3]**

**(b) Cyril has a disorder called sickle cell anaemia.**

**The haemoglobin in his blood has a different structure to normal haemoglobin.**

**This is due to a mutation.**

**Explain how a mutation can result in a change in the haemoglobin molecule.**

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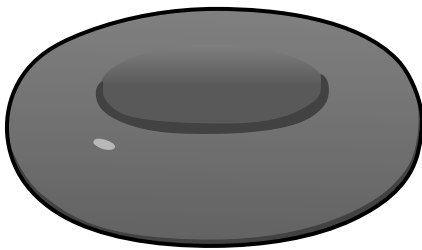
**[2]**

**(c) Haemoglobin is found in red blood cells.**

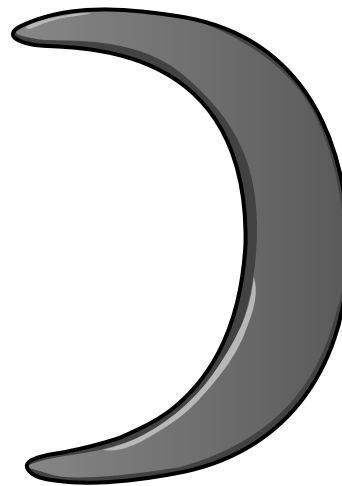
**During exercise the blood flowing through Cyril's muscles becomes more acidic.**

**This affects Cyril's haemoglobin and makes his red blood cells change shape.**

**normal red blood cell**



**sickled red blood cell**



**Explain why Cyril's red blood cells do NOT work so well after they change shape.**

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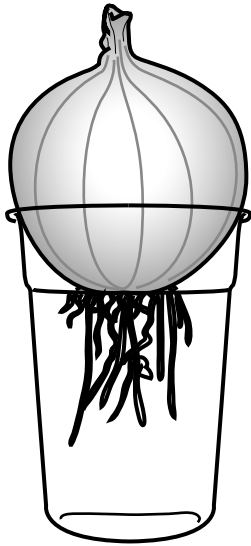
**[2]**

**[TOTAL: 7]**

**4 Noel investigates the growth of onions.**

**He puts an onion bulb in a jar of water.**

**The bulb starts to grow roots.**



**(a) Cell division is happening in the tips of the roots to make new cells for growth.**

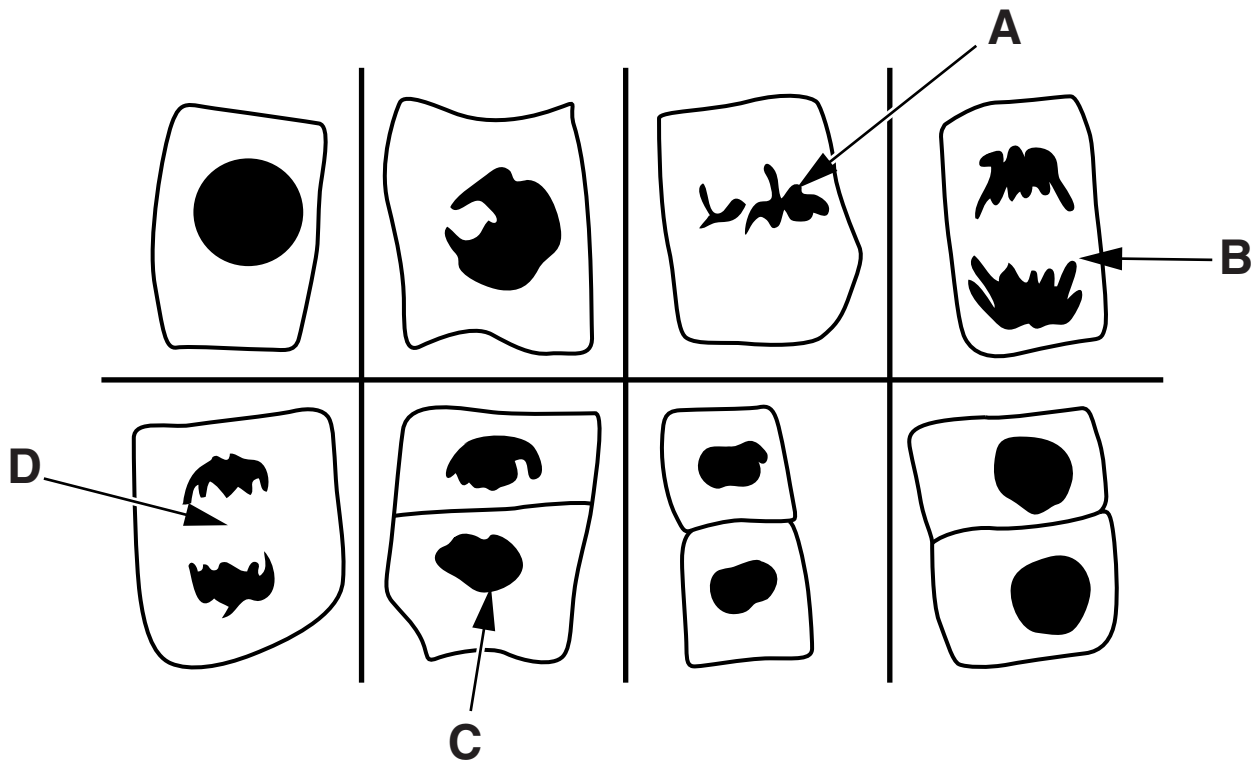
**What is the name of this type of cell division?**

\_\_\_\_\_ [1]



(b) Noel then makes a slide of the onion root and looks at it with a light microscope.

He sees chromosomes inside dividing cells.



(i) Cells A, B, C and D are in different stages of cell division.

Put the stages in order.

One has been done for you.

		D	
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[2]

(ii) Noel cannot see ribosomes in the onion cells.

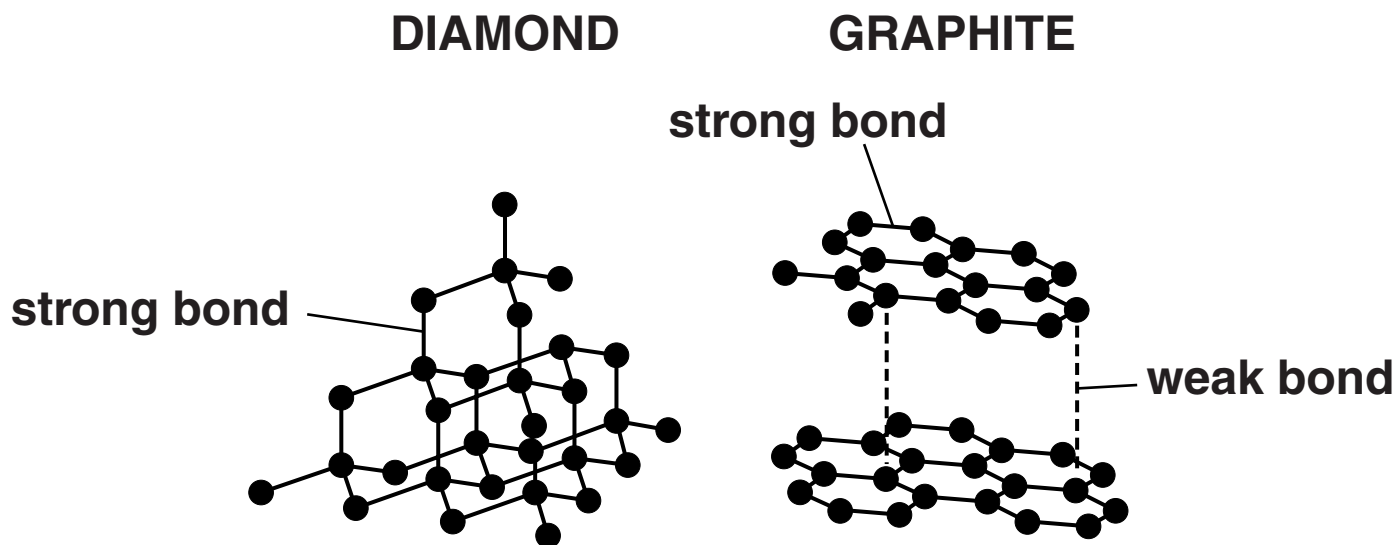
What is the most likely reason for this?

\_\_\_\_\_ [1]

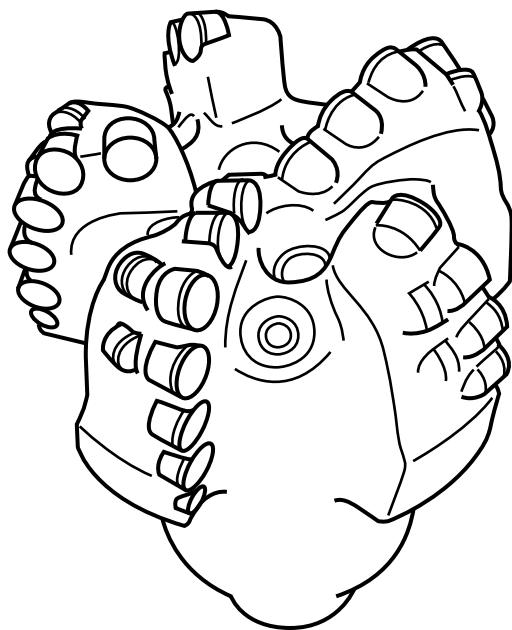
[TOTAL: 4]

## SECTION B – MODULE C3

- 5 Look at the diagrams. They show the structures of diamond and graphite.



- (a) Diamond is used in cutting tools.



**Explain why.**

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[2]

**(b) Graphite is slippery.**

**Explain why.**

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**[1]**

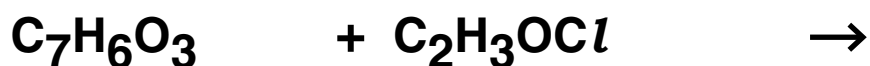
**[TOTAL: 3]**

**6 Aspirin is a medicine used to control pain.**

**Look at the equations. They show how aspirin can be made.**

**salicylic acid + ethanoyl chloride →**

**aspirin + hydrogen chloride**



**Look at the table. It shows some information about the compounds involved in making aspirin.**

<b>Compound</b>	<b>Formula</b>	<b>Relative formula mass</b>
<b>salicylic acid</b>	<b>C<sub>7</sub>H<sub>6</sub>O<sub>3</sub></b>	<b>138</b>
<b>ethanoyl chloride</b>	<b>C<sub>2</sub>H<sub>3</sub>OCl</b>	<b>78.5</b>
<b>aspirin</b>	<b>C<sub>9</sub>H<sub>8</sub>O<sub>4</sub></b>	<b>180</b>
<b>hydrogen chloride</b>	<b>HCl</b>	<b>36.5</b>

**(a) Calculate the ATOM ECONOMY of this reaction.**

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**answer = \_\_\_\_\_ % [2]**

**(b) A company is making a new medicine.**

**They want the atom economy to be as high as possible.**

**Explain why.**

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[2]

**(c) It is difficult to develop and test new medicines so that they are safe to use.**

**Explain why.**

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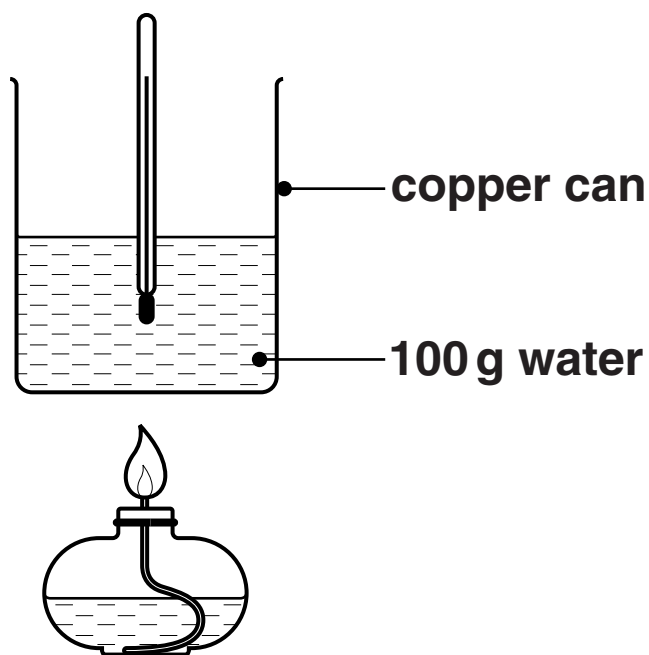
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[2]

**[TOTAL: 6]**

- 7 Nick and Lesley are comparing the energy content of three fuels.

Look at the diagram. It shows the apparatus they use.



Look at their results.

Fuel	Temperature at start in °C	Temperature at end in °C	Mass of fuel burned in g	Energy transferred per gram in J
A	20	30	0.5	8400
B	18	43	0.8	
C	22	42	0.4	

**Write about how Nick and Lesley do the experiment. Calculate the energy transferred per gram for fuels B and C to show which fuel gives out the most energy per gram.**

**The specific heat capacity of water is  $4.2 \text{ J/g } ^\circ\text{C}$ .**



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

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**[6]**

**[TOTAL: 6]**

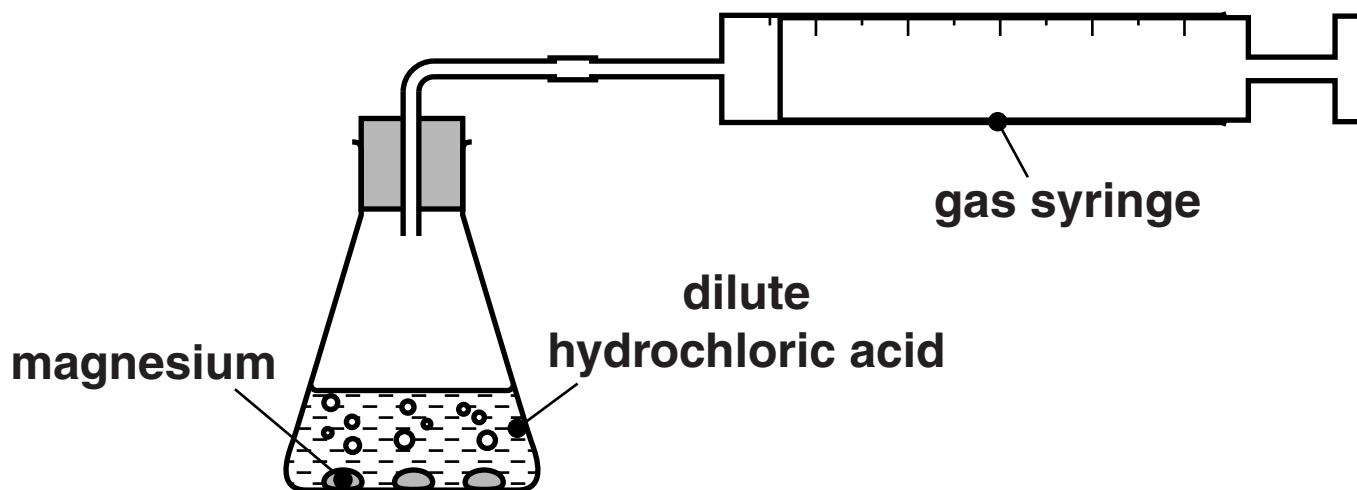
- 8 Jan and Mike investigate the reaction between magnesium lumps and hydrochloric acid,  $\text{HCl}$ .

Magnesium chloride solution,  $\text{MgCl}_2$ , and hydrogen gas,  $\text{H}_2$ , are made.

- (a) Write a **BALANCED SYMBOL** equation for this reaction.

\_\_\_\_\_ [2]

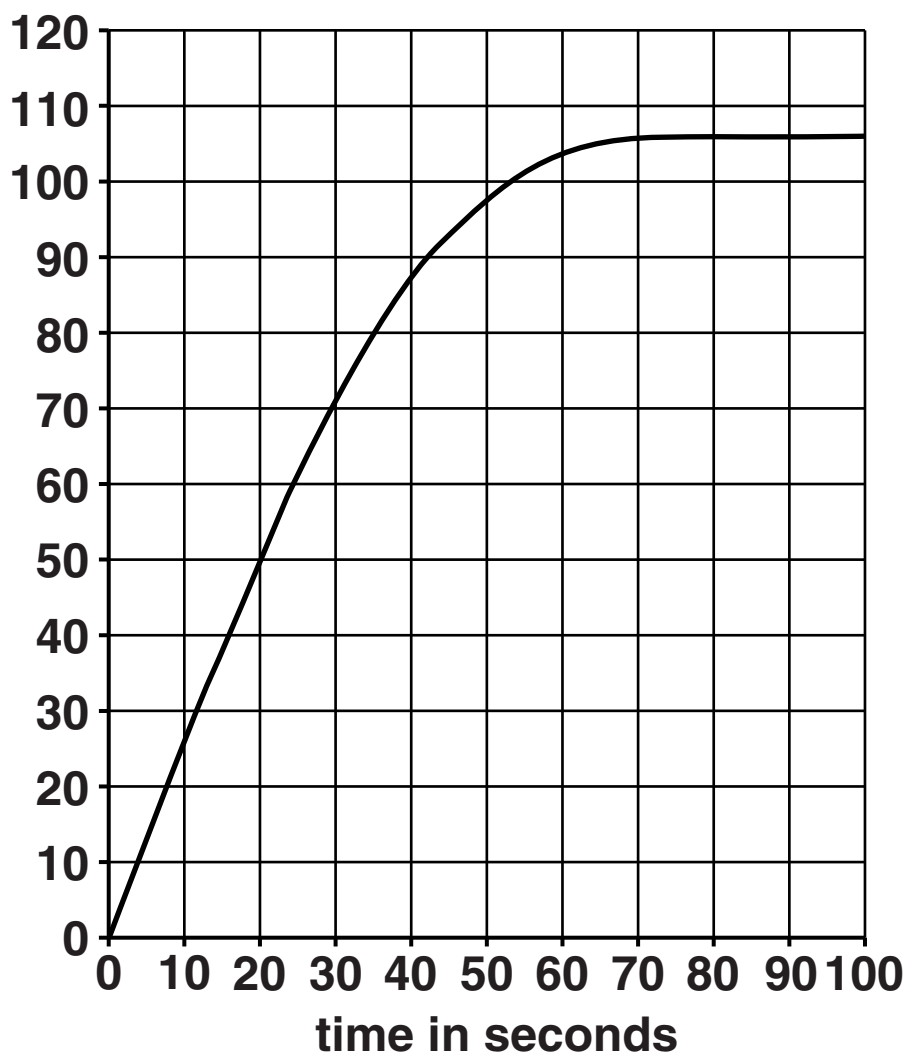
- (b) Look at the diagram. It shows the apparatus they use.





Look at the graph of their results

volume of  
hydrogen  
given off  
in  $\text{cm}^3$



(i) What volume of gas is made when the reaction has finished?

\_\_\_\_\_  $\text{cm}^3$

[1]

- (ii) Calculate the rate of reaction during the first 20 seconds.

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rate of reaction = \_\_\_\_\_ [2]

- (c) Increasing the temperature of the hydrochloric acid increases the rate of the reaction.

Use the reacting particle model to explain why.

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- (d) Breaking the lumps of magnesium into a POWDER increases the rate of the reaction.

Use the reacting particle model to explain why.

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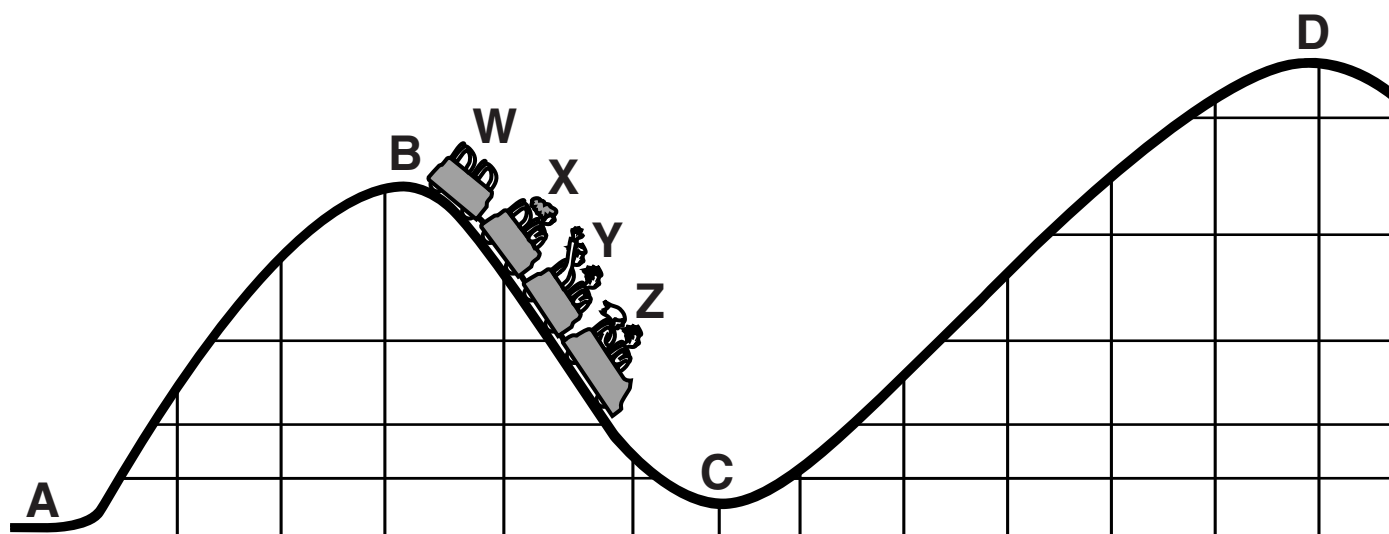
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[TOTAL: 10]

## 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:

$$\text{GPE} = mgh$$

\_\_\_\_\_

\_\_\_\_\_ [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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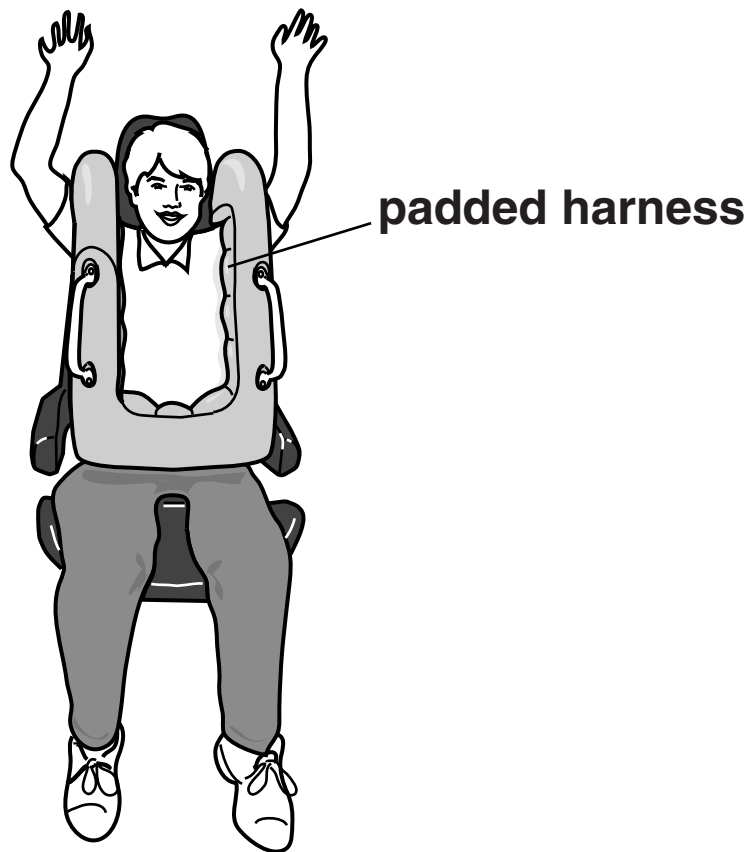
**Explain your answer.**

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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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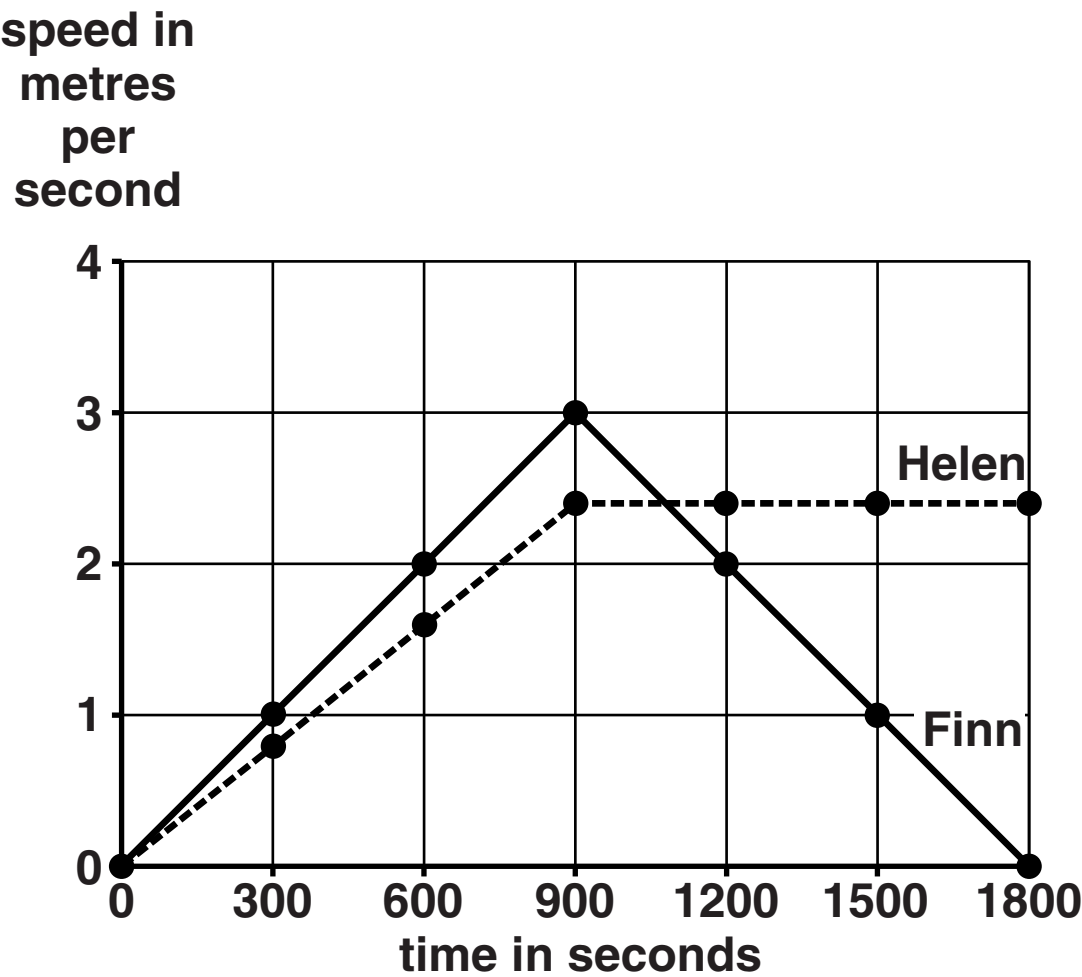
[2]

[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]**

## **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 <sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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]**

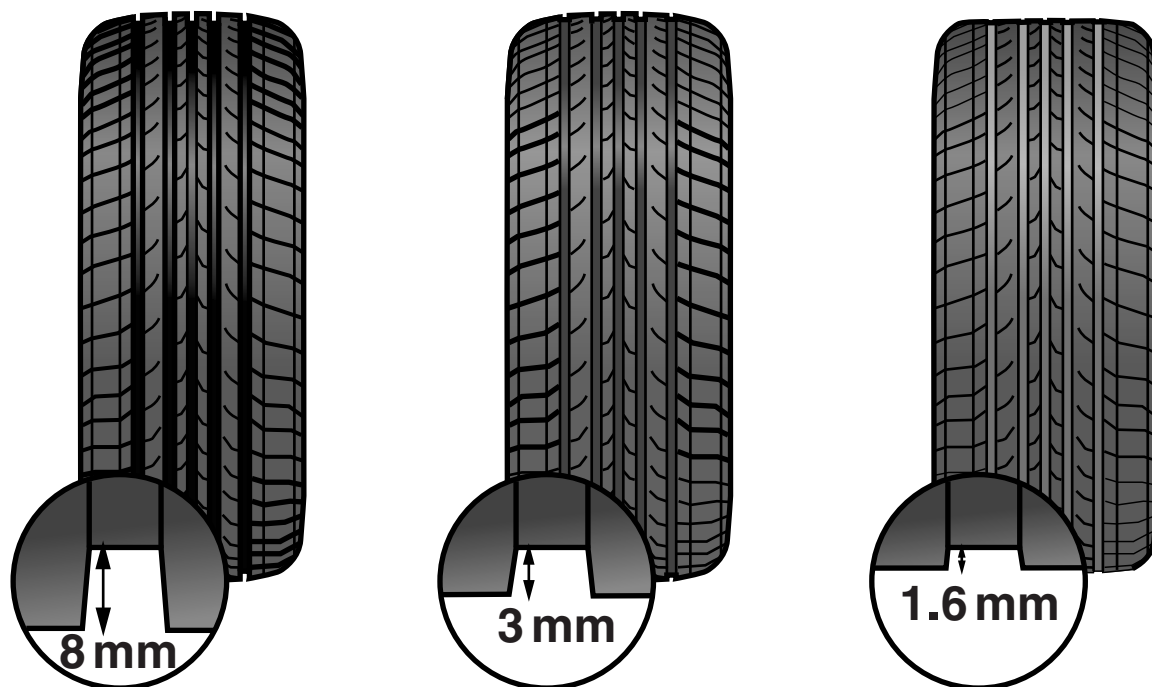
**[TOTAL: 7]**

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**TURN OVER FOR QUESTION 12**

## 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	braking distance
8 mm	25.9 m
3 mm	31.7 m
1.6 mm	39.5 m

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

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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.

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[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]

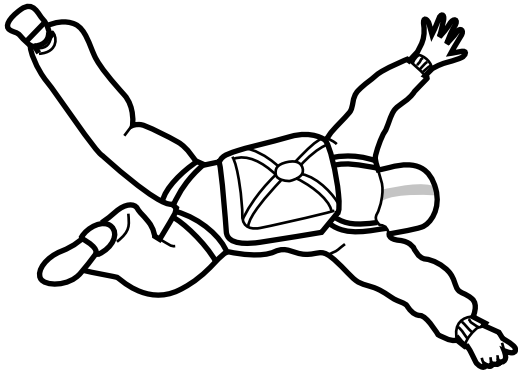
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**TURN OVER FOR QUESTION 13**

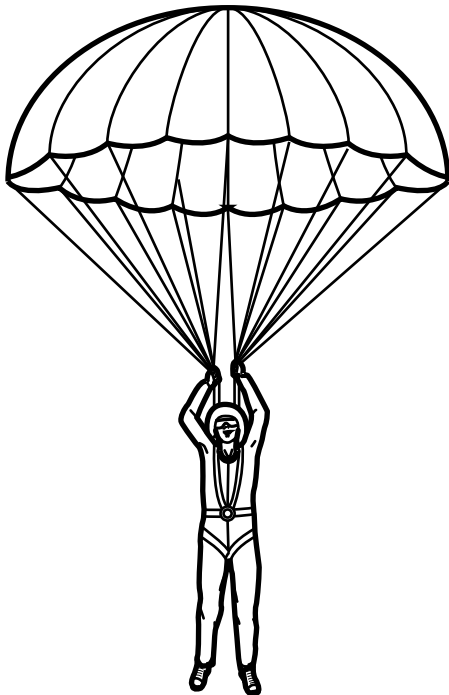
**13 David is a parachutist.**

**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**

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